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**The Capstone Committee for Joseph J. Shearer Certifies that this is the approved
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**Petrogenic Polycyclic Aromatic Hydrocarbon Levels and Health of Gulf
Coast Communities Following the Deepwater Horizon Oil Spill**

Committee:

Sharon A. Croisant, MS, PhD

Christine M. Arcari, PhD, MPH

John D. Prochaska, DrPH, MPH

Dean, Graduate School

**Petrogenic Polycyclic Aromatic Hydrocarbon Levels and Health of Gulf
Coast Communities Following the Deepwater Horizon Oil Spill**

by

Joseph J. Shearer, B.A.

Capstone

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Dedication

To my Family and Friends,

This would have been possible without your love and support.

Above all to my Mother for her unwavering support and endless encouragement
throughout my entire academic journey.

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I would like to acknowledge Sharon Croisant for being nothing less than an exceptional mentor. A constant source of support and encouragement driving me to follow my passions. I would also like to thank my PhD mentor Marxa Figueiredo for allowing me to opportunity to pursue multiple academic passions throughout my graduate studies while providing unending support and encouragement.

Petrogenic Polycyclic Aromatic Hydrocarbon Levels and Health of Gulf Coast Communities Following the Deepwater Horizon Oil Spill

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Joseph J. Shearer, MPH

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Supervisor: Sharon A. Croisant

The 2010 Deepwater Horizon oil spill was responsible for the release of over five million barrels of crude oil, containing petrogenic polycyclic aromatic hydrocarbons (PAHs), into the Gulf of Mexico. Few studies have described the effects that the Deepwater Horizon oil spill has had on human health. Utilizing an ongoing longitudinal cohort study we set out to investigate the relationship between health status and exposure to petrogenic PAHs following the oil spill. Our results show differences in cardiovascular, skin, and musculoskeletal health based on community residence. Relatively higher median plasma PAH levels were also observed in multiple communities following the oil spill compared to the reference community. However, no association between overall clinical status and plasma PAH levels for any of the clinical categories assessed was observed. Communities did indicate an increased likelihood of associating the spill with the development of their symptoms based on location. Overall, health outcomes analyzed were not associated with plasma PAH levels. These data provide a baseline in which to compare the results with subsequent waves of data collected in order to investigate potential long-term health effects following the Deepwater Horizon oil spill.

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List of Abbreviations

CARDIO	Cardiovascular
CEEJ	Center for Environmental and Economic Justice
GC-HARMS	Gulf Coast Health Alliance: health Risks related to the Macondo Spill
GC-MS	Gas Chromatography-Mass Spectrometry
GI	Gastrointestinal
HEENMT	Head, Eyes, Ears, Nose, Mouth and Throat
LSU	Louisiana State University
MUSC	Musculoskeletal
MVC	Mississippi Vietnamese Fishing Community
NA	Not Applicable
NEURO	Neurological
ng/mL	nanogram per milliliter
PAHs	Polycyclic Aromatic Hydrocarbons
RESP	Respiratory
UHN	United Houma Nation
UPenn	University of Pennsylvania
UTMB	University of Texas Medical Branch

Chapter 1 Introduction

RESEARCH QUESTION

In recent history, residents surrounding the Gulf of Mexico have been subjected to a variety of natural and manmade disasters which have greatly impacted the region. These disasters have included hurricanes Katrina and Ike and most recently the 2010 Deepwater Horizon oil spill. Unfortunately with regards to the latter, the at-risk population not only included those that came in direct contact with the oil spill during the clean-up effort but also the nearly 14 million people that reside in counties directly adjacent to the Gulf of Mexico (Willson & Rishetti, 2010). This is particularly concerning considering the well documented health concerns associated with human exposure to oil spills (Solomon & Janssen, 2010).

One major question that is yet to be answered regarding the Deepwater Horizon oil spill is the potential long-term health ramifications associated with an oil spill exposure. Of particular concern is the potential for bioaccumulation of pollutants released from the oil spill into the local seafood supply and how that may impact the health of an at-risk population. This concern is not without precedence. For example, following a previous oil spill (i.e. the Erika) petrogenic polycyclic aromatic hydrocarbons (PAHs) were shown to accumulate in certain types of invertebrate species at high enough concentrations to cause deleterious effects in a mammalian experimental model (Lemiere et al., 2004).

It is well-known that exposure to elevated levels of PAHs can have a wide spectrum of adverse effects on human health (ATSDR, 2013). This potentially dangerous notion led us to our overall hypothesis that **exposure to petrogenic PAHs levels may be associated with adverse health outcomes in Gulf Coast communities following the Deepwater Horizon oil spill.**

SPECIFIC AIMS

In order to address the question of whether exposure to petrogenic PAHs following the Deepwater Horizon oil spill was associated with adverse health outcomes of residents residing in nearby Gulf Coast communities, we proposed to investigate the following aims:

(1) *Identify health differences between cohorts of Gulf Coast communities.* To address this we utilized two metrics for each respondent: a personalized health examination by a medical professional and a questionnaire given to identify self-reported adverse health symptoms following the oil spill. The examination addressed a wide spectrum of population-based concerns including a range of health symptoms pertaining to respiratory, skin, eye, gastrointestinal, bleeding problems, immune, neurological, and emotional health, while the questionnaire ascertained the presence of more specific self-reported skin symptoms.

(2) *Identify whether health outcomes were associated with plasma PAH levels.* Summed plasma petrogenic PAH levels from ~42 species of PAHs were utilized as a surrogate marker for exposure to the oil spill for each respondent. Petrogenic PAHs have already been shown to be increased in the seafood following the Deepwater Horizon oil spill. Using this information we investigated whether or not detected health differences were associated with petrogenic PAH levels and potentially seafood consumption.

(3) *Identify whether the respondents attributed adverse health outcomes to exposures stemming from the Deepwater Horizon oil spill.* Using the same questionnaire form (1) respondents were asked to pose the likelihood in which the self-reported health (measured utilizing a range of questions related to symptoms of disease and illness) were a result of exposure to the oil spill. Using this information we attempted to identify the perception of risk following the oil spill and propensity to self-report symptoms based on the community in which the respondents resided.

SIGNIFICANCE

Extensive research has been conducted looking at the ecological and economic impact that oil spills can cause (Aguilera, Méndez, Pásaro, & Laffon, 2010). However, there are far fewer studies that aim to elucidate the effects that these manmade catastrophes can have on the health of populations that live in the vicinity of the oil spill. Unfortunately, many of the studies that have looked at the effects on human health have focused on acute changes *in lieu* of long-term health consequences. In response to the lack of conclusive evidence, the Gulf Coast Health Alliance: health Risks related to the Macondo Spill (GC-HARMS) was established. Their purpose was to work in concert with Gulf Coast community leaders in order to investigate whether or not exposure to petrogenic PAHs, presumably through bioaccumulation in the seafood following the Deepwater Horizon oil spill, affects human health in the Gulf Coast region over an extended period of time. Additionally, this group is dedicated to helping community coalitions locate appropriate medical facilities and educational opportunities in order to combat any health differences that are identified. This particular study aims to establish the initial health effects of four Gulf Coast communities directly following the spill, which will be essential for monitoring the health status of community members over time and how that relates to detected levels of petrogenic PAHs.

Petrogenic PAHs have already been detected in the seafood within the exposed regions suggesting bioaccumulation has already occurred (unpublished data). However, little direct evidence has been presented to fully elucidate whether or not consumption of seafood containing petrogenic PAHs from the spill are directly linked to the adverse health effects. This makes our study extremely significant in identifying potential adverse health outcomes stemming from long-term exposure of bioaccumulated contaminants released during the oil spill. This is especially important considering that one of the major concerns of the communities represented in this study is determining the

safety of the seafood supply in regards to the potential long-term health effects stemming from the Deepwater Horizon oil spill.

Ascertaining an association between PAH levels and health, can help community leaders better educate their members on the potential threat of exposure. In addition, assessing health differences between diverse Gulf Coast communities will assist in identifying potential risk factors in which future interventions can be implemented, regardless if there is an association with petrogenic PAH exposure or not. Ultimately, our investigation will provide evidence on whether or not the levels of plasma petrogenic PAHs are associated with adverse health outcomes of Gulf Coast communities affected by the Deepwater Horizon oil spill, which can be used in subsequent analyses to determine the long-term health ramifications.

Chapter 2 Background

Comprised of nearly 1,600 coastal miles, five states, and 14 million residents, the Gulf of Mexico plays a pivotal role in a variety of activities ranging from tourism and fishing to offshore oil drilling operations. These major activities equate to roughly 200 billion dollars of revenue annually to the surrounding Gulf of Mexico region (Hargreaves, 2010). In 2009 alone, commercial fishing was responsible for the harvest of nearly 1.4 billion pounds of finfish and shellfish from the Gulf, contributing an estimated 629 million dollars to the local economy (National Marine Fisheries Service, 2011). Even today the fishing industry continues to represent a vital source for economic growth and food supply for residents of the Gulf Coast region.

In 2010 the Deepwater Horizon oil spill was responsible for the release of nearly five million barrels of oil into the Gulf of Mexico (McNutt et al., 2012). This makes it one of the largest offshore oil spills in recorded history (Robertson & Krauss, 2010). In the aftermath, a variety of studies have been conducted in order to measure the ecological (Barron, 2012) and economic (Posadas, 2015) burdens resulting from the spill. To date, the health consequences for Gulf Coast residents following oil spill has yet to be fully elucidated. This is in spite of the fact that prolonged risk of exposure to genotoxic agents following the oil spill could be a legitimate concern (Singleton et al., 2016).

Many of the studies that have investigated the effects on human health following the spill have largely focused on factors associated with mental health and resiliency (Drescher, Schulenberg, & Smith, 2014; Morris, Grattan, Mayer, & Blackburn, 2013; Rung et al., 2015). These same studies have indicated a possible association between exposure to the spill and adverse mental health outcomes. These data led us to investigate other clinical endpoints in order to determine if any other adverse health effects were occurring following the spill.

This investigation was driven partly due to concerns of many Gulf Coast residents regarding the potential for adverse health outcomes as a result of exposure to oil through consumption of contaminated seafood. Contaminated seafood has been shown to be a valid concern in previous oil spills including the Erika, where polycyclic aromatic hydrocarbons (PAHs) were revealed to have the propensity to accumulate in mussels at high enough concentrations to cause genotoxic effects in an experimental mammalian model (Lemiere et al., 2004). Unfortunately, the long-term health effects of exposure to petrogenic PAHs are not fully understood. One recent study performed a probabilistic risk assessment for a range of unsubstituted and alkylated PAHs in order to ascertain if consumption of locally harvested shrimp increased the risk of acute health issues or cancer in a high risk population following the Deepwater Horizon oil spill (Wilson et al., 2015). Their results showed no acute health effects associated with consumption of locally harvested shrimp based on the PAH levels detected in those shrimp. However, this study varied from our own as they were focused on one particular community rather than incorporating a range of communities throughout the Gulf of Mexico. Our study also varied from the Wilson study as we measured PAH levels in human subjects.

Much like pyrogenic PAHs, petrogenic PAHs are a diverse class of environmental contaminants that are the result of incomplete combustion reactions. Unlike the more general pyrogenic PAHs which can come from a range of sources including charred food, smoking, or exhaust emissions, petrogenic PAHs come from petroleum-based combustion reactions involving sources such as oil, kerosene, and diesel fuels. However, much less is known about the effects that exposure to these oil-based carcinogens may have on human health long-term. One common mechanism of action of PAHs is their ability to cause cellular dysfunction through the creation of DNA adducts (Baird, Hooven, & Mahadevan, 2005). These adducts can go on to create permanent mutations to the DNA with a range of deleterious effects. However, the pharmacokinetic and dynamic properties of PAH compounds are largely dependent upon their speciation, which is driven through

activation of parent compounds into active metabolites during metabolism by a diverse class of proteins called cytochrome P450's (Shimada & Fujii-Kuriyama, 2004). To complicate things further, the function of cytochrome P450's can vary widely depending on factors such as ethnicity, which may put certain populations at greater risk following PAH exposure (Zanger & Schwab, 2013).

As an academic partner in the GC-HARMS one of our major objectives is to ascertain any potential risks to human health stemming from seafood consumption following the Deepwater Horizon oil spill. Working with community leaders, GC-HARMS has developed a community-based participatory research partnership with four Gulf Coast communities, three of which were located in close proximity to the oil spill and one that was largely unexposed to direct contact with the oil spill. The ultimate goal of GC-HARMS is to investigate and disseminate information to community partners regarding the risk to community health following the oil spill over an extended period of time.

Using a retrospective analysis of data stemming from an ongoing longitudinal cohort study, we aimed to identify any health differences following the aftermath of the Deepwater Horizon oil spill that may reflect exposure to petrogenic PAHs in the oil. We set to accomplish this by addressing three major questions: are there any adverse clinical outcomes associated with detected plasma PAH levels, do communities that were in close proximity to the oil spill show differences in their levels of plasma PAHs compared to a reference community, and what is the perception of risk associated with the spill as ascertained by a survey of self-reported symptoms compared to plasma PAH levels.

Chapter 3 Methods and Materials

STUDY DESIGN

We performed a retrospective analysis of data collected from an ongoing longitudinal cohort study comprised of four Gulf Coast communities following the Deepwater Horizon oil spill (Illustration 1). This study in partnership with GC-HARMS and community leaders has followed the same individuals through three waves of data collection (one per year) in order to track the changes in health and PAH levels following the Deepwater Horizon oil spill. To date only the PAH levels from the initial Wave 1, which was taken <2 years following the oil spill, have been analyzed and are the subject of this study.

Communities were selected following an extensive selection process that involved multiple meetings, the establishment of community leadership, and input from each community member. Communities were also selected based on diversity regarding ethnicity, professional background, and exposure risk in attempts of capturing the diverse range of Gulf residents that may be affected by the aftermath of the oil spill. Communities involved in the study, as described by their affiliations with community partnerships, included the Center for Environmental and Economic Justice (CEEJ; Biloxi, MS), the Mississippi Vietnamese Fishing Community (MVC; Gulfport, MS) and the United Houma Nation (UHN; Houma, LA). These three communities were compared to our reference community that was largely unaffected by the oil spill, i.e., Galveston (Galveston, TX). A demographic description of the total study population is summarized in Table 1.

Prior to the initiation of the study, Institutional Review Board approval for the study and protocols was obtained from each participating academic institutions (UTMB, UPenn and LSU). During the recruitment phase, one hundred participants from each

community, with roughly the same number of male and females, including 25 adolescents (5-19 years of age), 50 adults (20-50 years of age), and 25 elderly (>50 years of age) residents were recruited into the study with the help of community partners. These community leaders randomly selected members for inclusion into the study utilizing registries associated with their associations. However, prior to enrollment, expressed written consent (as well as assent for juvenile participants) was acquired from each participant that outlined the study protocols and purpose.

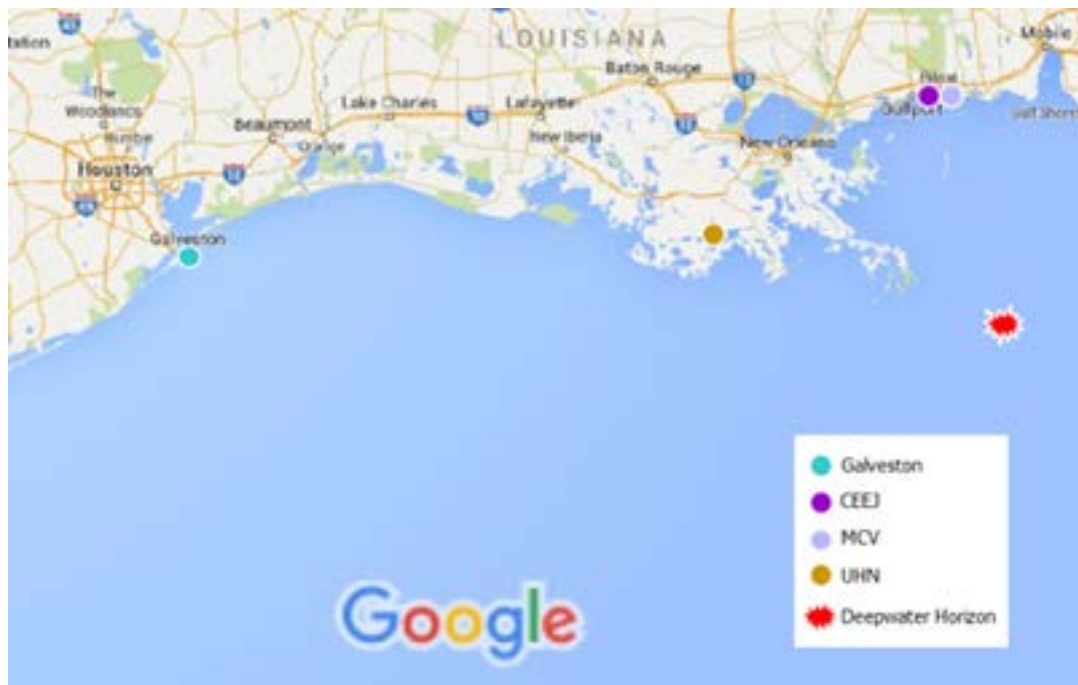


Illustration 1: Study Population Map.

HEALTH SCREEN AND STUDY QUESTIONNAIRE

Enrolled study participants were given a full health screen assessment. The same physician performed the physical examination at each community site to avoid interpersonal variability with regards to diagnoses. Seven clinical categories related to head, eyes, ears, nose, mouth, and throat (HEENMT), cardiovascular, respiratory, gastrointestinal, skin, musculoskeletal, and neurological health were assessed for any abnormalities. If any adverse clinical outcomes were detected regardless of severity, following the health screen the participant's chart was flagged "abnormal" for that category.

Additionally, each participant was then asked to complete a questionnaire aimed at exposure history and self-reported health status. A copy of the baseline questionnaire given to each participant can be seen in Appendix A. Questionnaires were provided in the respondent's native language which included English, Spanish, or Vietnamese. If a participant requested, the survey could be read to them. With regards to this particular study and based on the initial health screen assessments, each respondent was asked to report whether or not they had developed a range of self-reported skin symptoms since the oil spill. If they answered "yes" they were asked a follow-up question to assess the likelihood they believed that those symptoms were directly related to exposure from the oil spill. In addition to self-reported symptom data, general health and exposure were assessed by the questionnaire including seafood consumption metrics, previous work history, and self-reported health status.

PLASMA PAH DETERMINATION

In collaboration with the laboratory of Dr. Shakeel Ansari (UTMB), summed plasma PAH levels were determined from ~42 unique PAHs by gas chromatography-mass spectrometry (GC-MS). Briefly, blood from each participant was collected during the physical examination, centrifuged, and shipped to UTMB for storage until PAH

analysis could be conducted. To analyze PAH levels 1.5 mL of plasma was spiked with 5 μ L (5 μ g/mL) of deuterated phenanthrene to serve as a recovery standard. After vortexing, 3 mL of hexane (reagent plus grade, Sigma) was added to the mixture and vortexed using a multi tube shaker. The resulting sample was centrifuged to separate the organic and aqueous layers. 2.0 mL of the hexane layer was obtained and dried under a stream of nitrogen. The dried sample was reconstituted with 100 μ L of acetonitrile (Fisher Scientific) and running standards (deuterated naphthalene, acenaphthene and perylene; Cambridge Isotope Laboratories) were added to each sample. 2 μ L of each extracted sample was injected to an Agilent 6890N/5975C GC-MS equipped with a DB-5MS (30 m x 0.25 mm x 0.10 μ m) (Agilent p/n 122-5531) column. The data were analyzed using the retention times and the pattern recognition of the parent and alkylated PAHs. All summed plasma PAH values are presented as ng/mL.

STATISTICAL ANALYSIS

For the overall study demographics Chi-Square tests were used to ascertain whether there was a significant difference across communities based on age and gender. For ethnicity and language, a Fisher's exact test was used to ascertain whether there was a significant relationship between frequencies of a particular first primary language spoken across communities due to the small sample numbers. CEEJ and MVC each had one subject with an insufficient plasma sample for PAH determination, therefore two out of the 400 subjects originally enrolled in the study were excluded from the further analysis within this study.

Normality of the PAH data distribution was assessed and shown to be highly skewed. An example of a Q-Q plot demonstrating the data distribution as a function of plasma PAH concentration can be seen in Appendix B. An attempt to log-transform the data failed to yield normally distributed data, thus nonparametric tests were employed for any associations with plasma PAH levels. The non-normal distribution of the plasma

PAH data was likely due to the fact that many respondents had low or undetectable levels of plasma PAHs as determined by GC-MS.

Associations between demographic data and plasma PAH levels were examined for statistical significance using either the Wilcoxon rank-sum test (Gender, Smoking Status, and Smoker in Household) or the Kruskal-Wallis test (Organization, Age Group, and Ethnicity) comparing median PAH values across the four communities. The Wilcoxon rank-sum test was also used when comparing the median plasma PAH levels for clinical status as well as self-reported symptoms across the four communities. For frequency data comparing the number of respondents with abnormal and normal clinical outcome status the Fisher exact test with a Monte Carlo estimation was used to assess if there was a significant difference in median PAH levels across the four communities. This test was also utilized when comparing the self-ascribed likelihood of the spill causing the development of particular skin-related symptoms. A P-value of < 0.05 was considered to be statistically significant for all tests. Analysis was conducted using SAS, Version 9.4 software.

Chapter 4 Results

OVERALL STUDY DEMOGRAPHICS

The overall demographics of the study population (n=400) were assessed (Table 1). Of the 400 originally enrolled individuals for the Wave 1 analysis there was no statistical difference between communities based on age or gender. However ethnicity ($P < 0.001$) and language ($P < 0.001$) were statistically significant when comparing the frequency of each across the four communities. For instance, Black respondents made up the majority of the total study population with Galveston (55%) and CEEJ (87%) having over half of their population identify as Black. Also, important to note MVC was of 100% Asian composition. UHN was the most ethnically diverse community comprised of 42% Native American, 28% Black, 27%, White, and 3% Other. While English was the predominant language for the majority of the study population (Galveston, CEEJ, and UHN), for MVC 99% of the community spoke Vietnamese as their primary language. For the remainder of the analysis the two individuals who did not have available PAH values were censored from the analysis as described in the methods section.

CLINICAL ABNORMALITIES ACROSS COMMUNITY COHORTS

As previously described, a clinical assessment was performed for each individual participant in order to ascertain if any abnormalities in health status relating to seven major categories could be detected across communities. Table 2 summarizes those results indicating that three clinical categories had statistically significant differences when comparing the frequency of participants diagnosed with an abnormal clinical status across communities. Those significant results included clinical outcomes related to cardiovascular ($P = 0.011$), skin ($P = 0.010$), and musculoskeletal ($P = 0.003$) health. In each of these categories CEEJ had the highest percentage of participants with an

abnormal clinical outcome ranging from 8-14% depending on category. On the other hand, MVC had the lowest percentage of community members diagnosed with abnormal clinical outcomes for both cardiovascular and musculoskeletal health status ranging from 0-1% and second lowest for skin at 7%. The reference community (Galveston) showed 4-12% for the same three clinical outcomes.

DEMOGRAPHICAL CHARACTERISTICS OF PLASMA PAH LEVELS BETWEEN COHORTS

Demographic data pertaining to plasma PAH levels from our four cohort communities is summarized in Table 3. Of those PAHs analyzed, the major PAH species detected were naphthalene and C1 and C2 alkylated naphthalenes. Results suggest a statistically significant relationship relating to plasma PAH levels ($P < 0.001$) when assessing across the four communities. CEEJ (0.77 ng/mL) and UHN (0.86 ng/mL) had higher median plasma PAH levels compared to the reference community, Galveston (0.59 ng/mL). MVC on the other hand had the lowest median PAH level of 0.46 ng/mL. No statistically significant associations were detected in regards to other non-modifiable characteristics analyzed including gender, age group, and ethnicity when comparing plasma PAH levels across the cohorts. The relationship between the modifiable risk factors of either personal or household exposure to smoking was assessed for differences in plasma PAH levels results, albeit with no statistical significance.

Table 1: Total Study Populations Demographics

Demographics	Overall	Galveston	CEEJ	MVC	UHN	<i>P value</i> [#]
Age Group (years)						
5-19	93	24	26	25	18	0.78 ^a
20-55	207	52	53	49	53	
>55	100	24	21	26	29	
Gender						
Female	224	53	63	53	55	0.43 ^a
Male	176	47	37	47	45	
Ethnicity						
Asian	103	1	2	100	0	< 0.01 ^b
Black	170	55	87	0	28	
Native American	42	0	0	0	42	
White	71	35	9	0	27	
Other	14	9	2	0	3	
Language						
English	297	96	100	1	100	< 0.01 ^b
Vietnamese	99	0	0	99	0	
Spanish	4	4	0	0	0	

Abbreviations: CEEJ, Center for Environmental and Economic Justice; MVC, Mississippi Vietnamese Fishing Community; UHN, United Houma Nation.

^a Chi-squared.

^b Fisher's exact test.

Table 2: Abnormal Clinical Status Respondents in Each Communities

Health Category	Galveston	CEEJ	MVC	UHN	<i>P value</i> ^a
HEENMT	10	10	3	5	0.117
Cardiovascular	4	8	0	2	0.011
Respiratory	3	8	1	5	0.079
Gastrointestinal	3	2	0	1	0.461
Skin	12	13	7	2	0.010
Musculoskeletal	10	14	1	9	0.003
Neurological	5	7	1	3	0.139

Abbreviations: CEEJ, Center for Environmental and Economic Justice; HEENMT, Head, eyes, ears, nose, and throat; MVC, Mississippi Vietnamese Fishing Community; UHN, United Houma Nation.

^a Fisher exact test with Monte Carlo estimation comparing clinical status across communities with.

Absolute values are reported for each community.

Table 3: Plasma PAH Demographics

Characteristic	N	Plasma PAH ^a		<i>P value</i>
		Mean(SD)	Median	
Organization				
Galveston	100	0.65 (0.63)	0.59	<0.001 ^b
CEEJ	99	1.09 (1.04)	0.77	
MVC	99	1.00 (1.53)	0.46	
UHN	100	1.04 (1.35)	0.85	
Gender				
Male	174	0.90 (1.10)	0.64	0.610 ^c
Female	224	0.98 (1.26)	0.70	
Age Group (years)				
5-19	92	0.99 (1.14)	0.70	0.574 ^b
20-55	207	0.92 (1.24)	0.62	
55+	99	0.96 (1.16)	0.71	
Ethnicity				
Asian	102	1.02 (1.53)	0.47	0.213 ^b
Black	169	0.92 (0.91)	0.71	
Native American	42	1.00 (1.22)	0.87	
Other	14	0.89 (0.71)	0.68	
White	71	0.87 (1.34)	0.66	
Smoking Status				
Smoker	84	1.00 (1.53)	0.67	0.823 ^c
Non Smoker	270	0.89 (1.06)	0.66	
Smoker in Household				
Yes	105	0.87 (1.19)	0.70	0.883 ^c
No	262	0.98 (1.24)	0.67	

Abbreviations: CEEJ, Center for Environmental and Economic Justice; MVC, Mississippi Vietnamese Fishing Community; UHN, United Houma Nation.

^a ng/mL.

^b Kruskal-Wallis test.

^c Wilcoxon rank-sum test.

ASSOCIATION OF PLASMA PAH LEVELS AND CLINICAL ABNORMALITIES

We next investigated whether there was an association between being diagnosed with a clinical abnormality and plasma PAH levels. Figure 1 summarizes those results for each of the seven clinical categories. Our results suggest that there are no statistically significant differences in median plasma PAH levels based on overall clinical diagnoses when comparing the entire study population of “abnormal” and “normal” diagnosed participants as assessed using the Wilcoxon rank-sum test. Further intracommunity analysis pertaining to plasma PAH and clinical status was carried out (See Appendix C). Only CEEJ in regards to clinical skin status ($P = 0.043$) appeared to have a statistically significant association with elevated levels of plasma PAH and abnormal clinical status with a median plasma PAH for “normal” and “abnormal” clinical outcome equal to 0.74 and 1.34 ng/mL, respectively. Two other intracommunity associations suggested that those with higher plasma PAH levels may be more likely to have a “normal” clinical status. These included CEEJ and HEENMT whose median plasma PAH levels were 0.80 and 0.33 ng/mL ($P = 0.013$) for “normal” and “abnormal” respectively. Galveston also had a similar pattern for neurological status with 0.59 and 0 ng/mL ($P = 0.039$) for “normal” and “abnormal” respectively. However, Galveston only had a single abnormal respondent for neurological health making definitive associations difficult to assess due to its low prevalence.

PERCEIVED RISK AND SELF-REPORTED SKIN SYMPTOMS

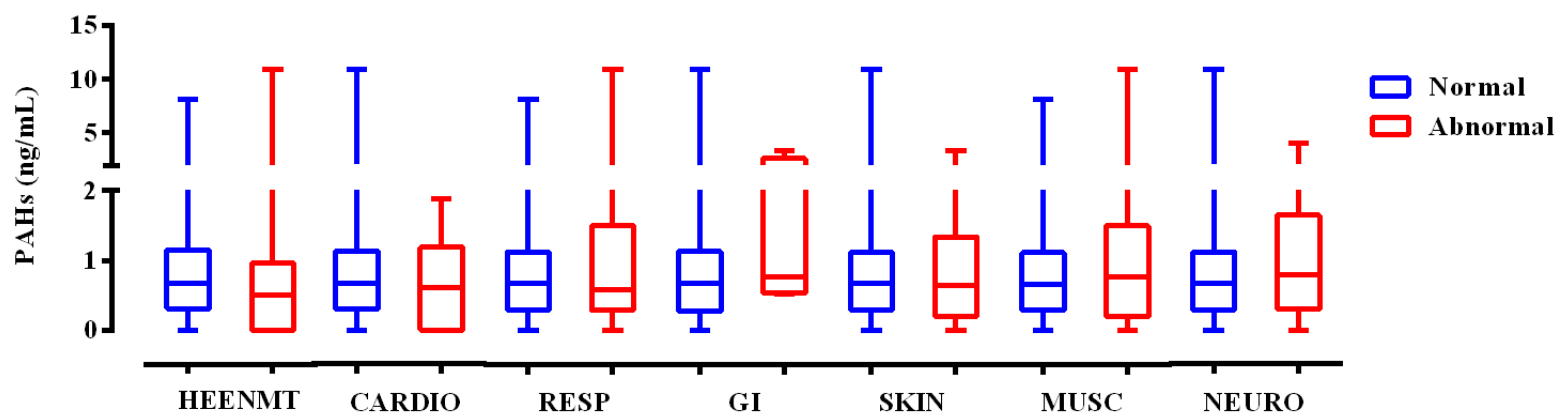
The perception of risk associated with the oil spill was investigated by asking participants who self-reported specific skin ailments the likelihood that they attributed the spill as the reason for the development of those symptoms. Each person was asked to

indicate whether it was not likely, not sure, or likely that the oil spill was the cause of their symptoms. Table 4 summarizes these results and suggests that symptoms related to itching ($P = 0.024$) and sores ($P = 0.010$) had statistically significant differences in the likelihood to associate symptom development with the oil spill. For itching symptoms, communities attributed the spill as the likely reason for the symptom 40-74% of the time compared to 30% for the reference community. For sores, the communities ranged from 33-83% while the reference community had 0% of respondents attribute the spill as the likely cause of the symptom. For both of these symptoms the frequency of reporting symptomatic development was greatest for MVC with 47 and 42 total respondents for itching and sores compared to an average of 11.7 and 4.3 respondents for the other three communities.

ASSOCIATION OF SELF-REPORTED SKIN SYMPTOMS AND PLASMA PAH LEVELS

Because overall skin health was previously determined to be statistically significant when comparing across the four communities, we further investigated specific self-reported skin symptoms to ascertain their association with plasma PAH levels. Participants were asked whether or not they had developed specific skin symptoms following the oil spill. These symptoms are summarized in Figure 2 including changes in skin, hair, nails, itching, rashes, sores, lumps, moles, or irritation. A single self-reported skin symptom, change in nails ($P = 0.001$), suggested an overall statistically significant relationship between those that had reported the symptom and those that did not with plasma PAH level. Interestingly, the data would suggest that those who report symptoms involving their nails following the spill had lower plasma PAH levels than those that did not, with median plasma PAH levels of 0.20 and 0.69 ng/mL, respectively. While the

change may be statistically significant it is only a modest increase in magnitude which makes its biological relevance undetermined at this point.



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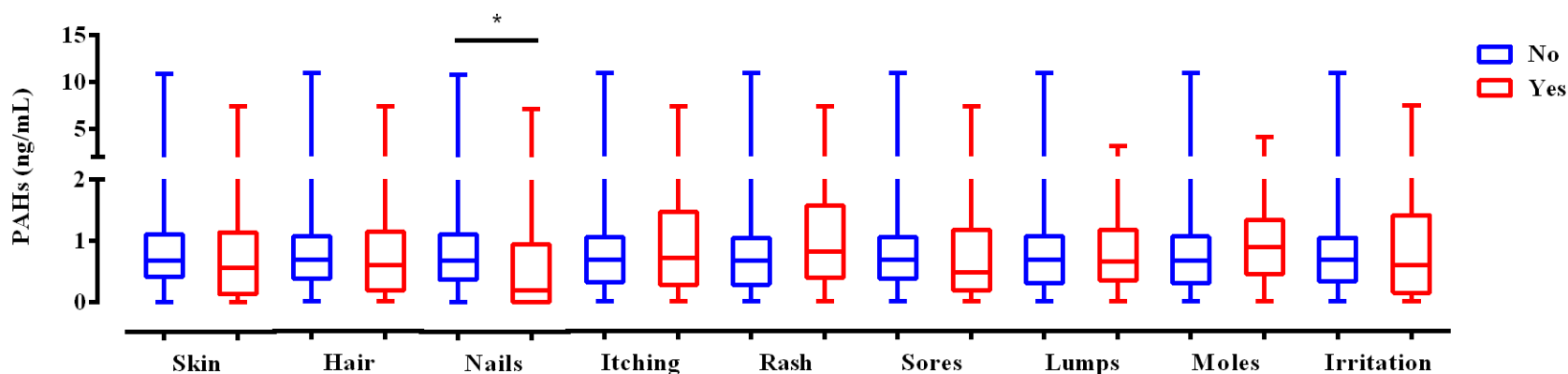
Figure 1: Clinical Status and Plasma PAH levels. Summed plasma PAH levels (ng/mL) were determined for 398 total participants. These results compare the plasma PAH levels of normal (blue bars) and abnormal (red bars) clinical status for the entire study population as determined by a physician regarding any deviation from normal health for seven major categories including head, eyes, ears, nose, and throat (HEENMT), cardiovascular (CARDIO), respiratory (RESP), gastrointestinal (GI), skin, musculoskeletal (MUSC), and neurological (NEURO) health. These results are represented as a box plot which shows the median value with the 25 and 75 percentile as the top and bottom of the box and the maximum and minimum values shown as the T-bars. Comparisons between normal and abnormal status and their median plasma PAH levels were assessed using the Wilcoxon rank-sum test with a cutoff of $P < 0.05$ for significance. No significant differences were found by comparing clinical status with plasma PAH levels for any of the seven categories.

Table 4: Risk Perception of Self-Reported Symptoms Following Oil Spill

		N (column %)				<i>P value</i> ^a
		Galveston	CEEJ	MVC	UHN	
Skin						
	Not likely	4 (50.00)	1 (14.29)	7 (15.91)	2 (16.67)	0.189
	Not Sure	3 (37.50)	2 (28.57)	11 (25.00)	5 (41.67)	
	Likely	1 (12.50)	4 (57.14)	26 (59.09)	5 (41.67)	
Hair						
	Not likely	2 (66.67)	0 (0.00)	5 (12.50)	0 (0.00)	0.077
	Not Sure	1 (33.33)	1 (20.00)	6 (15.00)	2 (33.33)	
	Likely	0 (0.00)	4 (80.00)	29 (72.50)	4 (66.67)	
Nails						
	Not likely	2 (66.67)	0 (0.00)	5 (23.81)	0 (0.00)	0.253
	Not Sure	1 (33.33)	2 (50.00)	10 (47.62)	2 (33.33)	
	Likely	0 (0.00)	2 (50.00)	6 (28.57)	4 (66.67)	
Itching						
	Not likely	3 (33.33)	2 (13.33)	6 (12.77)	3 (27.27)	0.024
	Not Sure	3 (33.33)	7 (46.67)	6 (12.77)	3 (27.27)	
	Likely	3 (33.33)	6 (40.00)	35 (74.47)	5 (45.45)	
Rashes						
	Not likely	6 (50.00)	0 (0.00)	6 (20.00)	2 (28.57)	0.060
	Not Sure	3 (25.00)	5 (71.43)	7 (23.33)	1 (14.29)	
	Likely	3 (25.00)	2 (28.57)	17 (56.67)	4 (57.14)	
Sores						
	Not likely	2 (50.00)	0 (0.00)	4 (9.52)	0 (0.00)	0.010
	Not Sure	2 (50.00)	2 (66.67)	6 (14.29)	1 (16.67)	
	Likely	0 (0.00)	1 (33.33)	32 (76.19)	5 (83.33)	
Lumps						
	Not likely	0 (0.00)	0 (0.00)	7 (53.85)	0 (0.00)	0.138
	Not Sure	0 (0.00)	1 (100.00)	4 (30.77)	2 (50.00)	
	Likely	0 (0.00)	0 (0.00)	2 (15.38)	2 (50.00)	
Moles						
	Not likely	0 (0.00)	0 (0.00)	4 (57.14)	1 (20.00)	0.256
	Not Sure	0 (0.00)	0 (0.00)	1 (14.29)	3 (60.00)	
	Likely	0 (0.00)	2 (100.00)	2 (28.57)	1 (20.00)	
Irritation						
	Not likely	1 (50.00)	0 (0.00)	5 (19.23)	4 (36.36)	0.157
	Not Sure	1 (50.00)	2 (66.67)	4 (15.38)	2 (18.18)	
	Likely	0 (0.00)	1 (33.33)	17 (65.38)	5 (45.45)	

The total number of subject for each question can be different because not all respondents answered all questions.

^a Fisher exact test with Monte Carlo estimation.



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Figure 2: Self-Reported Skin Symptoms Following Oil Spill. Summed plasma PAH levels (ng/mL) were determined for 398 total participants encompassing the entire study population with PAH data. These results compare the plasma PAH levels of those who did not report a specific symptom (blue bars) and those that did (red bars) for nine skin specific symptoms. These results are represented as a box plot which shows the median value with the 25 and 75 percentile as the top and bottom of the box and the maximum and minimum values shown as the T-bars. Comparisons between those with and without self-reported symptoms and their plasma PAH levels were assessed using the Wilcoxon rank-sum test with a cutoff of $P < 0.05$ for significance (*). Total N varied based on symptom as not every respondent answered every question. However, the biological significance is unknown.

Chapter 5 Discussion

DISCUSSION SUMMARY

The ecological and economic impact of the Deepwater Horizon oil spill has already become quite evident (Barron, 2012; Posadas, 2015). Studies have been conducted suggesting the potential for deleterious health effects to Gulf residents following the oil spill, through direct or indirect routes of exposure (Solomon & Janssen, 2010). Unfortunately, the ultimate toll that the Deepwater Horizon incident may have on human health may not be fully realized for many years to come. Between the psychological and environmental exposure risks associated with traumatic events such as an oil spill, it is important to establish a baseline of health directly following the Deepwater Horizon oil spill in order to track the long-term health effects.

To do this we set out to establish how each community's health compared to one another following the oil spill. Three of these communities were located in close proximity to the oil spill while one was relatively unaffected. Our results revealed that three major clinical categories including cardiovascular, skin, and musculoskeletal health possessed differences in the frequency of "abnormal" clinical diagnoses following physical examination. One important point to address is that our communities are made up of both ethnically and racially diverse populations which can play a role in the risk of developing many health effects. For instance, Black non-Hispanics have been shown to have nearly a 30% higher chance of cardiovascular-related mortality compared to White non-Hispanics (Mozaffarian et al., 2016) which may be a confounding factor for the increased prevalence of cardiovascular health issues found in CEEJ compared to the other communities. Due to the modest changes in PAH levels the role of other non-modifiable characteristics may be playing a much larger role in the frequency of health issues seen in some of these communities.

One of the main concerns of Gulf Coast residents is the safety of their seafood following the oil spill. This is an unfortunate reality residents are faced with, considering that accumulation of toxic contaminants in seafood (mussels) following oil spills has been observed in the past (Lemiere et al., 2004). The strong connection that Gulf communities have with the local seafood supply necessitated the investigation of the effects of such a possibility in order to elucidate whether increased exposure to the oil spill was associated with adverse health outcomes. Our results suggest that multiple communities, who reside nearly four times as close to the origin of the oil spill compared to our reference community, Galveston, had relatively elevated levels of petrogenic PAHs in their plasma. Perplexing was the fact that another community, MVC, who is also located closer to the epicenter of the spill compared to our reference community showed reduced median levels of plasma PAHs. These results suggest that proximity to the spill may not be the major driver of the differences in PAH levels.

However, for those communities that did have relatively higher PAH levels, it remains uncertain whether these relatively modest levels of PAHs are significant enough to eventually cause adverse health effects in these communities. This is even further complicated due to the incomplete knowledge of how individual PAH metabolites can affect human health let alone the cumulative effects of a complex mixture of PAHs such as found following oil spills. Because we are reporting a summed plasma PAH value for each respondent we are unable to address whether or not certain PAH metabolites, which may possess drastically different toxicity levels, are related to certain health outcomes.

Regardless, monitoring of summed plasma PAH levels over time and human health may be helpful in establishing whether or not there are any potential links between changes in health status following the oil spill. This is particularly important to monitor over time if we take into account what we have learned from non petrogenic PAHs, which have been linked to more chronic issues rather than acute toxicity (ATSDR, 2013).

Our results indicated that whenever we compared the entire study population of “abnormal” and “normal” respondents combined from the four communities, there was no association between clinical status and plasma PAH levels. Because of the aforementioned reasons associated with the diverse make-up of each community we investigated further whether or not at an intracommunity level there were any associations with increased levels of PAHs and abnormal clinical status. The only outcome that suggested a statistically significant association with increased plasma PAH levels and abnormal clinical outcomes was within CEEJ relating to skin health. This was an interesting finding considering reports have been published suggesting a correlation between increased skin lesions and PAH levels of aquatic life following the Deepwater Horizon spill (Murawski, Hogarth, Peebles, & Barbeiri, 2014). However, skin issues are more frequently associated with dermal exposures rather than ingestion associated with eating contaminated seafood, so further work needs to be done to pinpoint the exact sources of petrogenic PAHs community members are being exposed to.

In order to further investigate specific skin-related symptoms that may be related to PAH level, each respondent was asked to self-report the development of a range of skin-associated symptoms since the spill. Because clinical manifestation of disease may be preceded by earlier symptoms we thought it was important to investigate. We found exposure to PAHs do not directly relate to the development of such symptoms.

Even though the association of self-reported symptoms or clinical manifestation of disease does not appear to be linked to plasma levels of petrogenic PAHs for the initial sampling following the oil spill, an intriguing observation emerged pertaining to the community’s response to these events with regards to whether they blame the spill for the development of health issues. What we observed was that even though plasma PAH levels did not correlate to self-reporting of specific skin related symptoms following the spill, there were differences related to the frequency in which community residents who reported symptoms attributed the likelihood of those symptoms to the oil spill.

Perception of risk following oil spills has already been shown to have the potential to have indirect health effects and thus impact more people than by physical exposure alone (Gallacher, Bronstering, Palmer, Fone, & Lyons, 2007). This suggests that the psychological burden associated with the spill may be playing a role in the etiology of adverse health symptoms more than direct exposure or at least in concert with one another.

LIMITATIONS

While our study does highlight findings regarding differences in health within Gulf communities, it is not without its limitations. A range of considerations need to be taken into account regarding the collection, analysis, and interpretation of the PAH data. First, we do not know what the true baseline plasma PAH levels in the communities was prior the oil spill. It is conceivable that our communities already possessed differences in PAH levels prior to the spill, which may explain why there was a lack of correlation with symptom development after the spill and plasma PAH levels. This tends to be a common issue with response to ecological disasters due to the fact that very few examples exist where a depository of biological samples or overall health status for an at-risk population is readily available prior to the occurrence of a disaster. However, the eventual goal of analyzing subsequent waves of data over time should alleviate the issue of not knowing the baseline, because relative changes in PAHs can be monitored.

Participant enrollment based upon association with a certain community group rather than a geographical region as a whole may limit the generalizability of the study to some degree due to the fact there may be a degree of selection bias associated with our study population. Additionally, inclusion of a single reference community may not provide a perfect comparison due to the diversity associated with the different communities. For instance MVC has a widely different ethnic background than that of our reference community Galveston. These ethnic differences associated with these

communities may be much more important to the observed differences in health than PAH levels.

Our choice to measure PAH in the plasma versus urine could be problematic as well due to the fact we are measuring largely unmetabolized PAH parent compounds compared to urine which may have given insight into the individual PAH metabolites individuals were exposed to. This is largely due to the fact that the majority of metabolism occurs in the liver where Cytochrome P450's are most prevalent. That coupled with the fact we have reported summed PAH levels rather than individual PAH metabolite levels could cause an issue. As previously mentioned, speciation of PAHs plays a major role in their toxicity thus without metabolite-specific data it is hard to determine whether or not a particular PAH may be more responsible for health issues than another. Also, the relative magnitude of detected plasma PAH levels are very low with medians in the sub-ppb range. While we do have some significant findings pertaining to differential expression of PAHs, caution should be taken when determining the biological consequences of such levels until more evidence is gathered. Considering the average consumption of PAHs in a human's diet is < 2 ppb (ATSDR, 1995) a sub-ppb change may not have much biological significance.

Also, although our hypothesis was that consumption of petrogenic PAHs may have been through contaminated seafood following the Deepwater Horizon oil spill it is entirely possible that other routes of exposure (e.g. through the air) that were related to oil spill or other sources are also being detected. This makes identification of Deepwater Horizon oil spill associated PAHs somewhat difficult, especially coupled with the modest increase. However, the advantage of our ongoing study design is that we will be able to continually monitor these minute changes in plasma PAH levels as they relate to human health over time in order to elucidate whether or not there is a significant biological relevance.

Regarding the clinical aspect of the analysis, we have to also consider that an abnormal clinical diagnosis is comprised of a range of different phenotypes and etiologies that may or may not be related to the oil spill in varying degrees. Because any chart comment resulted in an “abnormal” designation it is hard to disseminate whether or not particular health abnormalities are associated with PAH levels compared to others. Recall bias is another issue we need to consider when analyzing the self-reporting of symptoms. The subjectivity of what constitutes the development of a symptom rather than a normal baseline physiology can vary from person to person. Also based on cultural differences, the willingness and convenience of pointing to the spill as a major contributor to the development of adverse health effects may be greater for some communities than others. Cultural differences have been shown in the past to play a role in the resiliency of communities following oil spills (Palinkas, Russell, Downs, & Petterson, 1992), which could help explain why some cultures are more apt to place blame on the spill. The fact remains that the potential effects of environmental exposure to the oil spill may not manifest associated symptoms for many years. However, we believe that we have done due diligence to create a proper portrayal of these communities in order to investigate the potential health effects following the oil spill for years to come.

CONCLUSIONS AND FUTURE DIRECTIONS

In conclusion, we have demonstrated that there are significant differences in the cardiovascular, skin, and musculoskeletal health in some communities following the Deepwater Horizon oil spill. The etiology of these health differences unknown at this point, however our analysis suggests that there is no association between these health differences and plasma PAH levels as originally hypothesized. Particularly our hypothesis that proximity to the Deepwater Horizon oil spill would result in relatively higher plasma PAH levels appears to be unsubstantiated at the moment considering MVC

had the lowest median plasma PAH concentration, even though without a known baseline we cannot know for sure.

Interestingly, our results do indicate differences in the way communities view the spill as a likely causal agent for the development of their symptoms. This is an important finding moving forward to consider whenever analyzing self-reported symptom data, i.e., there may be a propensity of certain populations to attribute a disaster to health woes. The ultimate consequences of this on the health of these communities would be an interesting follow up question as wave 2 and 3 are analyzed in this study. Additionally, as we move farther away from the Deepwater Horizon oil spill the question remains whether frequency in which community members attribute symptoms to the disaster will remain as prevalent in some communities?

Moving forward, subsequent waves will help show whether there is a temporal relationship with these health issues following the oil spill. Additionally, further PAH analysis will help to tease out whether these PAH levels are stable or changing as a course of time. Also, a more in depth analysis of particular PAH metabolites would be critical in order to ascertain whether there is a particular species of PAH that is more associated with adverse health than another rather than simply summing the values.

Ultimately, this study establishes an initial assessment of the relationship between health and petrogenic PAH levels following the Deepwater Horizon oil spill, which will serve as an important finding when assessing health over the course of this longitudinal study in order to determine if sustained plasma PAH levels have any association with chronic health issues. In addition, this study highlights potential health disparities associated with communities within the Gulf which can be monitored overtime with the ultimate goal of providing information that can be utilized for potential intervention strategies aimed at diminishing those health issues.

Appendix A Baseline Questionnaire

Baseline GC-HARMS Questionnaire

Respiratory

1. Have you developed any of the following symptoms since the spill?

- ☐ Shortness of breath
- ☐ Wheezing
- ☐ Cough
- ☐ Sputum
- ☐ Coughing up blood
- ☐ Pneumonia
- ☐ New onset asthma
- ☐ Bronchitis
- ☐ Emphysema
- ☐ Tuberculosis
- ☐ None of the above
- ☐ Don't know
- ☐ Refused

2. If yes how likely are they related to the oil spill?

	Not (0%)	Not likely (25%)	Not sure (50%)	Likely (75%)	Highly likely (100%)	Don't know	Refuse d
Shortness of breath	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wheezing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cough	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sputum	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coughing up blood	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pneumonia	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
New onset asthma	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bronchitis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Emphysema	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tuberculosis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Skin

3. Have you developed any of the following symptoms since the spill?

- ☐ Skin
- ☐ Hair
- ☐ Nail changes
- ☐ Itching
- ☐ Rashes
- ☐ Sores
- ☐ Lumps
- ☐ Moles
- ☐ Irritation
- ☐ None of the above
- ☐ Don't know
- ☐ Refused

4. If yes how likely are they related to the oil spill?

	Not (0%)	Not likely (25%)	Not sure (50%)	Likely (75%)	Highly likely (100%)	Don't know	Refused
Skin	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hair	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nail changes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Itching	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rashes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sores	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lumps	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Moles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Irritation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Eye

5. Have you developed any of the following symptoms since the spill?

- ☐ Blurriness
- ☐ Tearing
- ☐ Itching
- ☐ Acute Vision Changes
- ☐ None of the above
- ☐ Don't know
- ☐ Refused

6. If yes how likely are they related to the oil spill?

	Not (0%)	Not likely (25%)	Not sure (50%)	Likely (75%)	Highly likely (100%)
Blurriness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tearing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Itching	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Acute Vision Changes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Gastrointestinal

7. Have you developed any of the following symptoms since the spill?

- ☐ Change in appetite
- ☐ Nausea
- ☐ Vomiting
- ☐ Indigestion
- ☐ Difficulty swallowing
- ☐ Change in bowel movements
- ☐ Diarrhea
- ☐ Constipation
- ☐ Bleeding
- ☐ Abdominal pain
- ☐ Jaundice
- ☐ Hepatitis
- ☐ Liver disease
- ☐ None of the above
- ☐ Don't know
- ☐ Refused

8. If yes how likely are they related to the oil spill?

	Not (0%)	Not likely (25%)	Not sure (50%)	Likely (75%)	Highly likely (100%)	Don't know	Refuse d
Change in appetite	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nausea	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vomiting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Indigestion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Difficulty swallowing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Change in bowel movements	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Diarrhea	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Constipation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bleeding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Abdominal pain	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jaundice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hepatitis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Liver disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Bleeding Problems

9. Have you developed any of the following symptoms since the spill?

- ☐ Nosebleeds
- ☐ Bleeding gums
- ☐ Blood in stool
- ☐ Blood in vomit
- ☐ Free bleeding
- ☐ Easy bruising
- ☐ None of the above
- ☐ Don't know
- ☐ Refused

10. If yes how likely are they related to the oil spill?

	Not (0%)	Not likely (25%)	Not sure (50%)	Likely (75%)	Highly likely (100%)	Don't know	Refuse d
Nosebleeds	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bleeding gums	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Blood in stool	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Blood in vomit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Free bleeding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy bruising	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Immune

11. Have you developed any of the following symptoms since the spill?

- ☐ Frequent colds or flu
- ☐ Recurrent infections
- ☐ None of the above
- ☐ Don't know
- ☐ Refused

12. If yes how likely are they related to the oil spill?

	Not (0%)	Not likely (25%)	Not sure (50%)	Likely (75%)	Highly likely (100%)	Don't know	Refuse d
Frequent colds or flu	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recurrent Infections	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Neurological

13. Have you developed any of the following symptoms since the spill?

- ☐ Loss of sensations
- ☐ Numbness
- ☐ Tingling
- ☐ Tremors
- ☐ Weakness
- ☐ Paralysis
- ☐ Fainting
- ☐ Blackouts
- ☐ Seizures
- ☐ None of the above
- ☐ Don't know
- ☐ Refused

14. If yes how likely are they related to the oil spill?

	Not (0%)	Not likely (25%)	Not sure (50%)	Likely (75%)	Highly likely (100%)	Don't know	Refuse d
Loss of sensations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Numbness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tingling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tremors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Weakness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Paralysis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fainting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Blackouts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Seizures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Mental or Emotional

15. Have you developed any of the following symptoms since the spill?

- ☐ Mood swings
- ☐ Anxiety
- ☐ Depression
- ☐ Tension
- ☐ Memory problems
- ☐ Do you think you have any other health problem that are related to the Gulf oil spill?
- ☐ None of the above
- ☐ Don't know
- ☐ Refused

16. If yes how likely are they related to the oil spill?

	Not (0%)	Not likely (25%)	Not sure (50%)	Likely (75%)	Highly likely (100%)
Mood swings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Anxiety	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Depression	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tension	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Memory Problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you think you have any other health problem that are related to the Gulf oil spill?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

17. Indicators of General Health

	Very Good	Good	Fair	Poor	Very Poor
How would you rate your general health state prior to the oil spill?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How would you rate your general health since the oil spill?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18.a Respiratory Symptoms

	Yes	No	Don't Know	Refused	NA
Do you usually have a cough? (Count a cough with first smoke or on first going out-of doors. Exclude clearing of throat.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you usually cough as much as 4 to 6 times a day, 4 or more days out of the week?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you usually cough at all on getting up or first thing in the morning?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you usually cough at all during the rest of the day or at night?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If yes to any of the above questions, do you cough like this on most days for 3 consecutive months or more during the year?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
For how many years have you had this cough?	<input type="text"/> year(s)				

19.a Respiratory Symptoms

	Yes	No	Don't Know	Refused	NA
Do you usually bring up phlegm from your chest?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you usually bring up phlegm as much as twice a day, four or more days out of the week?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you usually bring up phlegm at all on getting up, or first thing in the morning?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you usually bring up phlegm at all during the rest of the day or night?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If yes to any of the above questions, do you bring up phlegm like this on most days for 3 consecutive months or more during the year?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

For how many years have you had trouble with phlegm?

year(s)

20.a Respiratory Symptoms

	Yes	No	Don't Know	Refused	NA
Have you had periods or episodes of increased cough and phlegm lasting for 3 weeks or more each year? If yes to any of the above questions, do you bring up phlegm like this on most days for 3 consecutive months or more during the year?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How long have you had at least one such episode per year?					
<input type="text"/> year(s)					
Have you ever been told by a doctor, nurse, or other health professional that you have asthma anytime in your lifetime?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have you been told by a doctor, nurse, or other health professional since the spill that you have asthma?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you currently have asthma? (Either currently on an asthma medication or have had an attack in the past 12 months)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Symptoms of asthma include cough, whistling or wheezing in the chest, shortness of breath, chest tightness, and phlegm production when you do not have a cold or respiratory infection. Since the spill, have you had these symptoms?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have you had coughing, wheezing, or shortness of breath with exercise or activity and had to stop because of these symptoms at any time since the spill?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When you have a cold, does it usually last more than 10 days?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you have a doctor who typically follows your asthma?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Did you miss work since the spill because of your asthma?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How many times?					
<input type="text"/> times					

21.a

Respiratory Symptoms

	Yes	No	Don't Know	Refused	NA
Since the spill, did you have to stay overnight in the hospital because of your asthma?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Since the spill, did you have to visit an emergency room or urgent care center because of your asthma?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How many times?					
<input type="text" value=""/> times					
Did you have lung trouble before the age of 16?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have you ever been diagnosed with bronchitis by a doctor?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have you been diagnosed with bronchitis since the spill?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have you ever been diagnosed with pneumonia by a doctor?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have you been diagnosed with pneumonia since the spill?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you have allergies including hay fever; watery, itchy eyes; a stuffy, itchy, or runny nose in the absence of a cold?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

22.a Respiratory Symptoms

Since the spill, have you had sinusitis or sinus infection? ☐ Yes ☐ No ☐ Don't Know ☐ Refused ☐ NA

If yes, how many times?

times

Are you disabled from walking by any condition other than heart or lung disease? ☐ Yes ☐ No ☐ Don't Know ☐ Refused ☐ NA

Are you troubled by shortness of breath when hurrying on the level or walking up a slight hill? ☐ Yes ☐ No ☐ Don't Know ☐ Refused ☐ NA

If you are troubled by shortness of breath when hurrying on the level or walking up a slight hill, do you have to walk slower than people of your own age on the level because of breathlessness? ☐ Yes ☐ No ☐ Don't Know ☐ Refused ☐ NA

If you are troubled by shortness of breath when hurrying on the level or walking up a slight hill, do you ever have to stop for breath when walking at your own pace on the level? ☐ Yes ☐ No ☐ Don't Know ☐ Refused ☐ NA

If you are troubled by shortness of breath when hurrying on the level or walking up a slight hill, do you ever have to stop for breath after walking about 100 yards (or after a few minutes) on the level? ☐ Yes ☐ No ☐ Don't Know ☐ Refused ☐ NA

If you are troubled by shortness of breath when hurrying on the level or walking up a slight hill, are you too breathless to leave the house or breathless on dressing or undressing? ☐ Yes ☐ No ☐ Don't Know ☐ Refused ☐ NA

23.a Respiratory Symptoms

If you get a cold, does it usually go to your chest (usually means more than 1/2 the time)? ☐ Yes ☐ No ☐ Don't Know ☐ Refused ☐ NA

During the past 3 years, have you had any chest illnesses that have kept you off work, indoors at home, or in bed? ☐ Yes ☐ No ☐ Don't Know ☐ Refused ☐ NA

If during the past 3 years you have had any chest illnesses that have kept you off work, indoors at home, or in bed, did you produce phlegm with any of these chest illnesses? ☐ Yes ☐ No ☐ Don't Know ☐ Refused ☐ NA

If during the past 3 years you have had any chest illnesses that have kept you off work, indoors at home, or in bed, how many such illnesses with increased phlegm did you have which lasted a week or more?

(number of illnesses)

Did you have any lung trouble before the age of 16? ☐ Yes ☐ No ☐ Don't Know ☐ Refused ☐ NA

24.a

Respiratory Symptoms

	Yes	No	Don't Know	Refused	NA
Have you ever had attacks of bronchitis that were confirmed by a doctor?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

At what age did you have your first attack?

years old

Have you ever had pneumonia that was confirmed by a doctor?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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At what age did you first have it?

years old

Have you ever had hay fever that was confirmed by a doctor?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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At what age did it start?

years old

Have you ever had chronic bronchitis that was confirmed by a doctor?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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At what age did it start?

years old

Have you ever had emphysema that was confirmed by a doctor?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
---	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

At what age did it start?

years old

25.a Chronic Health Problems					
	Yes	No	Don't Know	Refused	NA
Have you ever been told by a doctor, nurse, or other health professional that you have high blood pressure or hypertension?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have you been treated for high blood pressure or hypertension in the last 10 years?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have you ever been told by a doctor, nurse, or other health professional that you have high blood sugar or diabetes?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have you been treated for high blood sugar or diabetes in the last 10 years?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have you ever been diagnosed with cancer?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
What type and when?	<input type="text"/>				
Have you ever been told by a doctor, nurse or other health professional that you have heart trouble?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have you ever had treatment for heart trouble in the past 10 years?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have you ever had a stroke, cerebral hemorrhage, or brain attacks?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have you had treatment for a stroke, cerebral hemorrhage, or brain attacks in the past 10 years?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have you been hospitalized for any other health problems since the spill?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Are you pregnant?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26.a Access to Medical and Mental Health Resources					
	Yes	No	Don't Know	Refused	NA
Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicaid, TRICARE, and Veterans Benefits, or a state health care plan?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Does your health care plan include mental health coverage?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you feel you have access to any health care professional to help with and treat your problems?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you feel there is a physician who understands the health issues you have?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do you know of a clinic or health care provider where you can go to get medical care?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mental Health					

27.

Anxiety

Over the past two weeks, how many days have you been nervous, anxious, or on edge?

--Click Here-- ▼

0 days
1 day
2 days
3 days
4 days
5 days
6 days
7 days
8 days
9 days
10 days
11 days
12 days
13 days
14 days
Don't Know
Refused
NA

28.

Over the past two weeks, how many days have you not been able to stop or control worrying?

--Click Here-- ▼

0 days
1 day
2 days
3 days
4 days
5 days
6 days
7 days
8 days
9 days
10 days
11 days
12 days
13 days
14 days
Don't Know
Refused
NA

29. Over the past two weeks, how many days have you worried too much about different things?

--Click Here-- ▼

- 0 days
- 1 day
- 2 days
- 3 days
- 4 days
- 5 days
- 6 days
- 7 days
- 8 days
- 9 days
- 10 days
- 11 days
- 12 days
- 13 days
- 14 days
- Don't Know
- Refused
- NA

30. Over the past two weeks, how many days have you had trouble relaxing?

--Click Here-- ▼

- 0 days
- 1 day
- 2 days
- 3 days
- 4 days
- 5 days
- 6 days
- 7 days
- 8 days
- 9 days
- 10 days
- 11 days
- 12 days
- 13 days
- 14 days
- Don't Know
- Refused
- NA

31. Over the past two weeks, how many days have you been so restless that it was hard to sit still?

--Click Here-- ▼

- 0 days
- 1 day
- 2 days
- 3 days
- 4 days
- 5 days
- 6 days
- 7 days
- 8 days
- 9 days
- 10 days
- 11 days
- 12 days
- 13 days
- 14 days
- Don't Know
- Refused
- NA

32. Over the past two weeks, how many days have you been easily annoyed or irritable?

--Click Here-- ▼

- 0 days
- 1 day
- 2 days
- 3 days
- 4 days
- 5 days
- 6 days
- 7 days
- 8 days
- 9 days
- 10 days
- 11 days
- 12 days
- 13 days
- 14 days
- Don't Know
- Refused
- NA

33. Over the past two weeks, how many days have you felt afraid as if something awful might happen?

--Click Here-- ▼

0 days
1 day
2 days
3 days
4 days
5 days
6 days
7 days
8 days
9 days
10 days
11 days
12 days
13 days
14 days
Don't Know
Refused
NA

34. **Depression**
Over the past two weeks, how many days have you had little interest or pleasure in doing things?

--Click Here-- ▼

0 days
1 day
2 days
3 days
4 days
5 days
6 days
7 days
8 days
9 days
10 days
11 days
12 days
13 days
14 days

35.	Over the past two weeks, how many days have you felt down, depressed, or hopeless?	--Click Here-- ▼
		0 days
		1 day
		2 days
		3 days
		4 days
		5 days
		6 days
		7 days
		8 days
		9 days
		10 days
		11 days
		12 days
		13 days
	14 days	
36.	Over the past two weeks, how many days have you had trouble falling asleep or staying asleep or sleeping too much?	--Click Here-- ▼
		0 days
		1 day
		2 days
		3 days
		4 days
		5 days
		6 days
		7 days
		8 days
		9 days
		10 days
		11 days
		12 days
		13 days
	14 days	
37.	Over the past two weeks, how many days have you felt tired or had little energy?	--Click Here-- ▼
		0 days
		1 day
		2 days
		3 days
		4 days
		5 days
		6 days
		7 days
		8 days
		9 days
		10 days
		11 days
		12 days
		13 days
	14 days	

38. Over the past two weeks, how many days have you had a poor appetite or eaten too much?
- Click Here-- ▼
- 0 days
 - 1 day
 - 2 days
 - 3 days
 - 4 days
 - 5 days
 - 6 days
 - 7 days
 - 8 days
 - 9 days
 - 10 days
 - 11 days
 - 12 days
 - 13 days
 - 14 days
39. Over the past two weeks, how many days have you felt bad about yourself or that you were a failure or had let yourself or your family down?
- Click Here-- ▼
- 0 days
 - 1 day
 - 2 days
 - 3 days
 - 4 days
 - 5 days
 - 6 days
 - 7 days
 - 8 days
 - 9 days
 - 10 days
 - 11 days
 - 12 days
 - 13 days
 - 14 days
40. Over the past two weeks, how many days have you had trouble concentrating on things, such as reading the newspaper or watching TV?
- Click Here-- ▼
- 0 days
 - 1 day
 - 2 days
 - 3 days
 - 4 days
 - 5 days
 - 6 days
 - 7 days
 - 8 days
 - 9 days
 - 10 days
 - 11 days
 - 12 days
 - 13 days
 - 14 days

41. Over the past two weeks, how many days have you moved or spoken so slowly that other people could have noticed? Or the opposite-being so fidgety or restless that you were moving around a lot more than usual?

--Click Here--
0 days
1 day
2 days
3 days
4 days
5 days
6 days
7 days
8 days
9 days
10 days
11 days
12 days
13 days
14 days

42.a
PTSD (Post-traumatic Stress Disorder)

	Yes	No	Don't Know	Refused	NA
During the past 30 days, have you had nightmares about the oil spill or any clean-up efforts you engaged in or thought about it when you did not want to?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During the past 30 days, have you tried hard not to think about the oil spill or any clean-up efforts you engaged in or went out of your way to avoid situations that remind you of it?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During the past 30 days, have you been constantly on guard, watchful, or easily startled?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During the past 30 days, have you felt numb or detached from others, activities, or your surroundings?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

43.a
Resiliency/Coping

	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Refused
I am in control of my future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can do just about anything I really set my mind to do.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident in my ability to handle unexpected problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I need suggestions about how to deal with a personal problem, I know there is someone I can turn to.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dealing with past hurricanes and other disruptive events provided our community with experiences to help us recover from the oil spill.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local individuals with specific knowledge of environmental and social conditions within my community are better suited to guiding recovery efforts than state or federal officials.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

44.a Social Support

	Always	Usually	Sometimes	Rarely	Never	Refused
Since the spill, have you had someone willing to listen to you when you need to talk? It need not always be the same person.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Since the spill, have you had contact with people who are in a similar situation?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Since the spill, did you receive practical help, for example financial help, help with household repairs, or meals provided by others?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When recovering from an event like the oil spill, I first turn to family and neighbors for assistance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When recovering from an event like the oil spill, I first turn to government organizations for assistance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

45.a Receipt of Care

	Yes	No	Don't Know	Refused	NA
Before the spill, did you receive any sort of counseling for problems with your emotions, nerves, or mental health?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Since the spill, have you received any sort of counseling for problems with your emotions, nerves, or mental health?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Before the spill, were you prescribed medication for problems with your emotions, nerves, or mental health?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Since the spill, have you been prescribed medication for problems with your emotions, nerves, or mental health?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the past 30 days, have you gotten angry about the clean up effort or oil spill?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

46. Economic Stress

	Yes	No	Don't Know	Refused	NA
Were you at any time unemployed due to the oil spill?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
For how long were you unemployed?					
Has your family's income been impacted negatively by the spill?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Has your living situation changed as a result of the spill? (e.g., moved in with other family members)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

47.a Habits and Lifestyle		Yes	No	Don't Know	Refused	NA
	Do you engage in specific physical activity for exercise for a minimum of 10-20 minutes at least 3 days/week?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Do you drink alcohol?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Has your alcohol consumption increased since the spill?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Since the oil spill, do you believe there has been more domestic violence in your community?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

48.a Habits and Lifestyle		Yes	No	Don't Know	Refused	NA
	Does anyone who lives in your home smoke cigars, cigarettes, or pipes indoors?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
48.b	How many per day? <input type="text"/> per day					
48.c	At your job or business, does anyone smoke cigars, cigarettes, or pipes indoors?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
48.d	How many hours per day are you exposed? <input type="text"/> hours per day					
48.e	Do you NOW smoke cigarettes?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
48.f	How many cigarettes per day on average do you smoke? <input type="text"/> cigarettes per day					
48.g	Have you EVER smoked cigarettes?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
48.h	How old were you when you first started regularly smoking cigarettes? <input type="text"/> years old					
48.i	If you have stopped smoking cigarettes completely, how old were you when you stopped? <input type="text"/> years old					
48.j	On average during the time you smoked, how many cigarettes did you smoke per day? <input type="text"/> cigarettes per day					
48.k	Do you or did you inhale the cigarette smoke?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

49.a Habits and Lifestyle

	Yes	No	Don't Know	Refused	NA
Have you ever smoked a pipe regularly?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

49.b *How old were you when you started to smoke a pipe regularly?*
years old**49.c** *On the average over the entire time you smoked a pipe, how much pipe tobacco did you smoke per week?*
oz. per week**49.d** *How much pipe tobacco are you smoking now?*
oz. per week

49.e Do you or did you inhale the pipe smoke?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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49.f Have you ever smoked cigars regularly?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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49.g *How old were you when you started smoking cigars regularly?*
years old**49.h** *If you have stopped smoking cigars completely, how old were you when you stopped?*
years old**49.i** *On the average, over the entire time you smoked cigars, how many cigars did you smoke per week?*
cigars**49.j** *How many cigars are you smoking per week now?*
cigars per week

49.k Do you or did you inhale the cigar smoke?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Family History

50.a Have any of the following relatives had the following health conditions?

	Self	Father	Mother	Siblings	Children	Other	Not sure
Asthma	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chronic lung condition (e.g., COPD, bronchitis, emphysema)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cardiovascular disease	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stroke, cerebral hemorrhage, or brain attack	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hypertension or high blood pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
High blood sugar or diabetes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cancer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please specify type of cancer:

51.a Have any of the following relatives had the following health conditions?

	Self	Father	Mother	Siblings	Children	Other	Not sure
Neurological disease	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Epilepsy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ALS (amyotrophic lateral sclerosis), motor neuron disease, or Lou Gehrig's disease	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parkinson's	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Alzheimer's	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lupus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rheumatoid Arthritis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Graves disease or other thyroid disease	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chronic skin problems (skin cancers, psoriasis, eczema, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Liver disease	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mental or emotional problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

52. Occupational History

	Yes	No	Don't Know	Refused	NA
Were you exposed directly to the oil spill?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If so, please describe

	Yes	No	Don't Know	Refused	NA
Were you exposed directly to dispersants?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If so, please describe

Have you ever worked full time (30 hours per week or more) for 6 months or more?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Have you ever worked for a year or more in any dusty job?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Have you ever been exposed to gas or chemical fumes in your work?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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53.

	Mild	Moderate	Severe	Refused	NA
If you did work for a year or more in a dusty job, how extensive was your exposure?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If you worked in a job where you were exposed to gases or chemical fumes, how extensive was your exposure?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Specify the job you did where you were exposed to dust.

Specify the job you did where you were exposed to gases or chemical fumes.

What has been your usual occupation or job - the one you have worked at the longest?

Number of years employed in this occupation:

Position title:

Business, field, or industry:

54. Occupational History Related to Spill

	FT Year Round	PT Year Round	FT Seasonally	PT Seasonally	No	Refused
Have you ever worked as a commercial fisherman, full-time, part-time, or seasonally?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
54. Were you working as a commercial fisherman, full-time, part-time, or seasonally prior to the spill?	Yes <input type="radio"/>	No <input type="radio"/>				
Have you worked as a commercial fisherman, full-time, part-time, or seasonally since the spill?	<input type="radio"/>	<input type="radio"/>				
Since the spill, have you fished commercially in waters previously closed due to the spill?	<input type="radio"/>	<input type="radio"/>				

55. Fishing Income

From the list below, please indicate how you perceive your catch has been impacted

	More	Less	About the same	Don't Know	Refused	NA
Compared to prior to the spill, would you say that your income from fishing since the spill is more, less, or about the same?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Compared to prior to the spill, would you say that your typical catch in the last year has been more, less, or about the same?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

56. Fishery Description

	More	Less	About the same	Don't Know	Refused	NA
Gulf of Mexico large fish that live in the water column as opposed to bottom dwellers (pelagics) longline	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico gillnet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico shrimp trawl	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Atlantic mixed species trap/pot	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico menhaden purse seine	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico butterfish trawl	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico mixed species trawl	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
FL West Coast sardine purse seine	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico snapper-grouper and other reef fish bottom longline/hook-and-line	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico shark bottom longline/hook-and-line	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico large fish that live in the water column as opposed to bottom dwellers (pelagics) hook-and-line/harpoon	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

57. Fishery Description

	More	Less	About the same	Don't Know	Refused	NA
Gulf of Mexico trotline	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
FL spiny lobster trap/pot	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico blue crab trap/pot	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico mixed species trap/pot	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico gold crab trap/pot	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico stone crab trap/pot	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico oyster dredge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico haul/beach seine	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Southeastern U.S. Atlantic haul / beach seine	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico shellfish dive, hand / mechanical collection	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico cast net	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gulf of Mexico commercial vessel for recreational fishing (party boat)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

60. Please rank your concerns regarding the effect of the Gulf oil spill on local seafood quality and consumption on a scale of one to five. Do you feel the effects on your seafood and seafood quality are:

	1	2	3	4	5
Are mild or severe	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Are short-term or long-term	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Affect few people or affect many people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Are not understood by scientists or are understood by scientists	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Are not understood by you or are understood by you	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Are not understood by fisherfolk or are understood by fisherfolk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Are not understood by public health officials or are understood by public health officials	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pose little or no health risk or pose a great health risk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Are something you can control or are something you cannot control	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have recovered or will never recover	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Sources of Seafood

61. Please rank the following sources of your seafood:

	Grocery store	Seafood market	Restaurant	Catch your own	Neighbor, friend, family member	Other
BEFORE the Gulf Oil Spill which was preferred or used most?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
DURING the Gulf Oil Spill which was preferred or used the most?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AFTER the Gulf Oil Spill which is preferred or used the most?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

62. Please describe the seafood you typically ate BEFORE the Gulf Oil Spill.

	Fish	Oysters	Crabs	Shrimp
What type(s) of seafood did you eat for one or more meals per week (in or out of season)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What type(s) of seafood did you eat for one or more meals per month but less than one meal per week?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What type(s) of seafood did you eat less than once per month?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What type(s) of seafood did you never eat?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

63. Please describe the seafood you typically ate DURING the Gulf Oil Spill.

	Fish	Oysters	Crabs	Shrimp
What type(s) of seafood did you eat for one or more meals per week (in or out of season)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What type(s) of seafood did you eat for one or more meals per month but less than one meal per week?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What type(s) of seafood did you eat less than once per month?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What type(s) of seafood did you never eat?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What type(s) of seafood did you stop eating?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

64. Please describe the seafood you typically eat SINCE the Gulf Oil Spill.

	Fish	Oysters	Crabs	Shrimp
What type(s) of seafood do you eat for one or more meals per week (in or out of season)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What type(s) of seafood do you eat for one or more meals per month but less than one meal per week?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What type(s) of seafood do you eat less than once per month?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What type(s) of seafood do you never eat?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What type(s) of seafood did you stop eating?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

65. Seafood Quality

	Unsafe	Poor	Good	Excellent
Please rate the quality of your seafood BEFORE the Gulf oil spill.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Please rate the quality of your seafood DURING the Gulf oil spill.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Please rate the quality of your seafood AFTER the Gulf oil spill.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

66.

Decreased
availability

Health
Concerns

Both

Other

No

Don't
Know

Refused

Did you or have you changed what
types of local seafood you eat
because of the Gulf oil spill?

☐☐☐☐☐☐☐

Please specify

Have you changed how often you eat
seafood because of the Gulf oil spill?

☐☐☐☐☐☐☐

Please specify

Have you changed the
amounts/portions of seafood you
typically eat because of the Gulf oil
spill?

☐☐☐☐☐☐☐

Please specify

When I prepare seafood, I typically cook it by the following methods

67.

Fish

	Never	Not very often	Sometimes	Half of the time	Most of the time	Always	Don't Know	Refused
Deep frying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pan Fry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smoking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Baking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grilling over an open flame	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Blackening	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boiling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Raw	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

When I prepare seafood, I typically cook it by the following methods

68.

Oysters

	Never	Not very often	Sometimes	Half of the time	Most of the time	Always	Don't Know	Refused
Deep frying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pan Fry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smoking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Baking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grilling over an open flame	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Blackening	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boiling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Raw	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

When I prepare seafood, I typically cook it by the following methods

69.

Crab

	Never	Not very often	Sometimes	Half of the time	Most of the time	Always	Don't Know	Refused
Deep frying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pan Fry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smoking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Baking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grilling over an open flame	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Blackening	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boiling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Raw	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

When I prepare seafood, I typically cook it by the following methods

70. Shrimp

	Never	Not very often	Sometimes	Half of the time	Most of the time	Always	Don't Know	Refused
Deep frying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pan Fry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smoking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Baking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grilling over an open flame	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Blackening	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boiling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Raw	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

71. Residential History

	Yes	No	Don't Know	Refused	NA
I lived on a farm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I had city water supply.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I had water supplied from a private well.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I lived within ¼ miles of a farm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I lived within ¼ mile of fields or orchards.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Before age 18, I lived at least half of my life on a farm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I lived near a pipeline compression station.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I lived near a hazmat (or RCRA exempt) waste pit or injection well.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I lived near a marine painting operation (ship building & fabrication).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

72. Residential History related to Hurricanes

	Katrina	Rita	Gustav	Ike	NA
I lived on the Gulf Coast during the following storms.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was forced to leave my residence during the storm.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I returned to a prior or different residence due to damage to my residence.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was forced at least temporarily to reside in a different neighborhood.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was unable to return to my residence for > (greater than) 3 weeks.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was unable to return to my residence for >3 months.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was unable to return to my residence for >1 year.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was never able to return to my previous residence.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I lost my job as a result of the hurricane.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was unable to return to my job for >3 weeks.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was unable to return to my job for >3 months.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was unable to return to my job for >1 year.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was never able to return to my previous job.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I experienced the death of an immediate family member as a result of the storm and/or its aftermath.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
An immediate family member was severely injured as a result of the storm and/or its aftermath.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Trust in Social Institutions/Politics

73. How much trust do you have in the information coming from?

	Very much	Fairly much	Not that much	Not at all	No opinion
Family, friends, neighbors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Medical experts in general (doctors/nurses)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My personal doctor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other medical professionals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Public health departments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Education system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Police	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Social services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Employment services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Small Businesses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Large Corporations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Insurance services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

74. How much trust do you have in the information coming from?

	Very much	Fairly much	Not that much	Not at all	No opinion
Courts of law	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
National government	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
State government	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local government	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Trade or professional unions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My pastor or local church	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Universities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
National or public radio	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
National or public TV	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
National newspapers or print media	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local radio	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local TV	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local newspapers or print media	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Petroleum industry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The internet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Visual images (e.g., videos from YouTube)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Appendix B Q-Q Plot for Plasma PAH Data Distribution

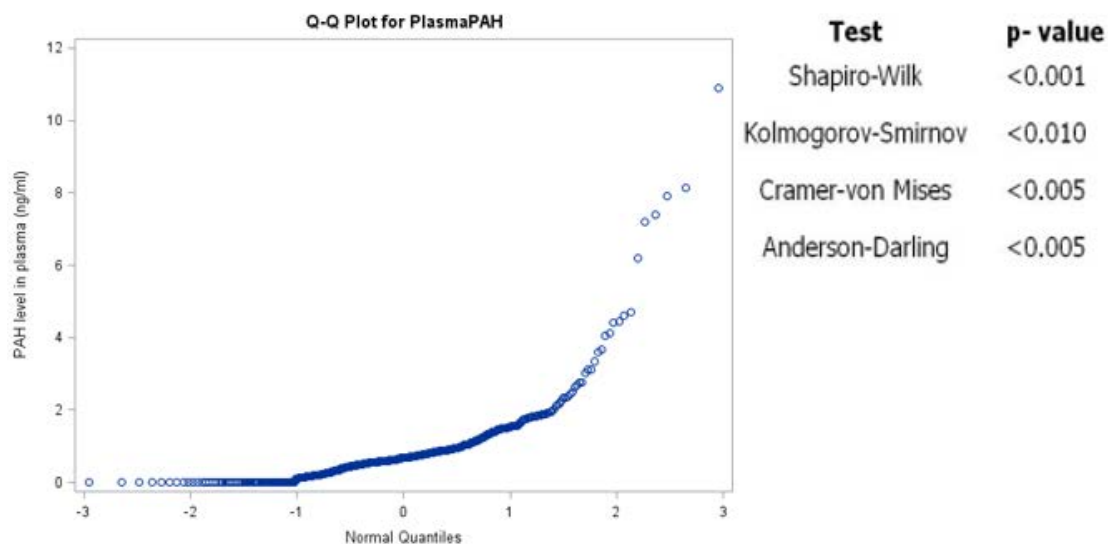


Figure S1: Q-Q Plot for Plasma PAH. Plot shows the distribution of Plasma PAH data in total study population, which appears to be distributed in a non-normal fashion. In addition to the plot normality was assessed by a range of normality tests including the Shapiro-Wilk and Komogorov-Smirnov tests that both had significant ($P < 0.05$) results suggesting the data was distributed in a non-normal manner.

Appendix C Supplemental Table S1: Intracommunity Clinical Status

Table S1: Intracommunity Clinical Status

	<i>Normal Plasma PAHs</i>			<i>Abnormal Plasma PAHs</i>			P-Value
	N	Mean(SD) ^a	Median	N	Mean(SD) ^a	Median	
HEENMT	370	0.94 (1.11)	0.68	28	0.05 (2.03)	0.50	0.109
Galveston	90	0.66 (0.64)	0.59	10	0.49 (0.50)	0.54	0.397
CEEJ	89	1.16 (1.06)	0.80	10	0.51 (0.63)	0.33	0.013
MVC	96	1.01 (1.55)	0.47	3	0.63 (0.82)	0.34	0.719
UHN	95	0.95 (0.94)	0.84	5	2.92 (4.47)	0.87	0.384
Cardiovascular	384	0.95 (1.21)	0.68	14	0.70 (0.66)	0.61	0.508
Galveston	96	0.66 (0.63)	0.59	4	0.35 (0.57)	0.10	0.207
CEEJ	91	1.13 (1.06)	0.78	8	0.72 (0.65)	0.61	0.250
MVC	99	1.00 (1.53)	0.46	0	NA	NA	NA
UHN	98	1.04 (1.37)	0.83	2	1.34 (0.67)	1.34	0.273
Respiratory	381	0.92 (1.08)	0.68	17	1.58 (2.68)	0.59	0.907
Galveston	97	0.62 (0.50)	0.59	3	1.56 (2.47)	0.26	0.715
CEEJ	91	1.11 (1.04)	0.78	8	0.87 (1.05)	0.61	0.264
MVC	98	1.00 (1.54)	0.45	1	0.59 (NA)	0.59	0.846
UHN	95	0.95 (0.94)	0.84	5	2.93 (4.49)	1.50	0.402
Gastrointestinal	392	0.94 (1.20)	0.67	6	1.44 (1.24)	0.78	0.257
Galveston	97	0.63 (0.60)	0.59	3	1.24 (1.22)	0.54	0.543
CEEJ	97	1.07 (1.02)	0.77	2	2.02 (1.89)	2.02	0.391
MVC	99	1.00 (1.53)	0.46	0	NA	NA	NA
UHN	99	1.05 (1.36)	0.84	1	0.87 (NA)	0.87	0.917
Skin	364	0.95 (1.22)	0.68	34	0.92 (0.90)	0.65	0.967
Galveston	88	0.65 (0.64)	0.59	12	0.58 (0.52)	0.59	0.811
CEEJ	86	1.03 (1.03)	0.74	13	1.54 (1.05)	1.34	0.043
MVC	92	1.03 (1.57)	0.47	7	0.54 (0.63)	0.37	0.497
UHN	98	1.06 (1.36)	0.86	2	0.25 (0.35)	0.25	0.091
Musculoskeletal	364	0.92 (1.10)	0.67	34	1.24 (1.95)	0.76	0.591
Galveston	90	0.67 (0.64)	0.59	10	0.46 (0.46)	0.37	0.342
CEEJ	85	1.07 (1.01)	0.77	14	1.22 (1.26)	0.76	0.888
MVC	98	0.99 (1.53)	0.45	1	1.79 (NA)	1.79	0.267
UHN	91	0.94 (0.95)	0.85	9	2.08 (3.35)	0.80	0.379
Neurological	382	0.94 (1.20)	0.67	16	1.14 (1.18)	0.79	0.509
Galveston	95	0.67 (0.63)	0.59	5	0.19 (0.34)	0.00	0.039
CEEJ	92	1.05 (1.00)	0.77	7	1.62 (1.48)	0.80	0.393
MVC	98	0.99 (1.53)	0.45	1	1.79 (NA)	1.79	0.267
UHN	97	1.03 (1.37)	0.84	3	1.36 (0.51)	1.50	0.196

Abbreviations: CEEJ, Center for Environmental and Economic Justice; HEENMT, head eyes, ears, nose, and throat; MVC, Mississippi Vietnamese Fishing Community; NA, Not Applicable; UHN, United Houma Nation.

^a ng/mL.

^b Wilcoxon rank-sum test.

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Vita

Joseph (Joe) Shearer was born in Fridley, MN on April 28th, 1989. He lived with his Mother, Jolynn Shearer in Atwater, MN where he graduated from New London-Spicer High School in 2007. After high school he attended and graduated from Macalester College (Saint Paul, MN) in 2011 with a B.A. in Chemistry with an emphasis in Biochemistry. Following a year of working at Saint Jude Medical Inc. as an analytical chemist, Joe enrolled at the University of Texas Medical Branch in 2012 as a PhD student in the Department of Pharmacology and Toxicology. In 2015 he began the pursuit of his MPH degree in the Department of Preventative Medicine and Community Health at UTMB under the direction of Dr. Sharon Croisant. During his graduate career Joe has published numerous manuscripts and book chapters. After graduation Joe is planning on doing a postdoctoral experience aimed at the interface of basic science and epidemiology.

Permanent address: 16623 Sperry Lake Road, Atwater, MN 56209

This dissertation was typed by Joseph J. Shearer.