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"Allergic to the region": A population-based study of the diversity of health experiences in the industrial zone of Marseille, France

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Abstract

This article analyzes the qualitative data collected as part of a 2015 community-based participatory cross-sectional health study conducted in two towns in a heavily polluted industrial zone on the port of Marseille, France. In addition to quantitative measures of residents' health outcomes, the open-ended question about health experiences provide important depth and a lived dimension of the possible harms inflicted on, and endured by, the population. The qualitative responses (n=497) give voice to the diversity of health experiences and struggles of people living in industrial areas. It reveals local tacit ways that people make sense of their health issues and hypothesize their conditions beyond epidemiological statistics. We argue that including qualitative questions in statistical environmental health studies captures important embodied knowledge as survey questions can never anticipate the variety of health issues experienced. Open-ended survey responses can point to new avenues of public health research given both the social vulnerabilities of the population and the environmental health complexities of dealing with a cocktail of pollutants in industrial areas.

Keywords: community-based participatory research; environmental health; environmental justice; health inequities; local knowledge; France; industrial pollution

Introduction

In 1972, New York Times correspondent Henry Kammer wrote about a small, idyllic town perched on a hillside beside the Mediterranean in the south of France. [4] He named the piece "Adieu Quiet." The village, Fos-sur-Mer, had existed for over 700 years, but its relative obscurity allowed residents to enjoy peaceful respite from the bustle of nearby Marseille. Since the late 1960s, the plans to construct one of Europe's largest ports and erect a 16,000 acre industrial zone, to which steel factories and petrochemical plants would call home, would quickly disrupt residents' lives and transform the local environment.

Due to its location on a strategic deep water port, this region had been a key petro-chemical and industrial growth area since rebuilding France after World War II.[5] To understand the unusual dynamics of environmental power, and thus injustice in the region, one only needs to examine who has ultimate authority over the land, the air, and the water. In 1965, the state designated this region as the Autonomous Port of Marseille, now the Grand Maritime Port of Marseille (GPMM), the largest port in France.[6] Its reach encompasses not only the actual port of Marseille, but includes the ports and adjacent land extending through Fos-sur-Mer and Port-St-Louis-du-Rhone. This legal designation effectively removed all decision-making authority from the citizens and their elected officials and transferred it to the state—specifically, the public-private partnership that comprises the GPMM. In the last two decades, several siting decisions occurred, regarding a large incinerator to burn all the garbage of Marseille and an enormous depot for France's largest gas company. Both instances were very public controversies, opposed by the local population and their elected leaders but to no avail due to the GPPM designation of the region. Their protests were all but invisible to the state, and procedurally unjust, as they had no rights over their environment per the law.[7] [8]

Today, the beachside town houses some of Europe's most polluting factories.[9] The air in the region is monitored through AirPACA, the regional air quality agency for the Bouche de Rhone region. They have air monitoring equipment in various locations, including a monitor in each of the two towns. The monitors readings are communicated to the local population via a flag system. Air quality is flagged as green for "good" and "red" for very bad with some intermediate flags in between. According to the regulations, the red flag is not raised until there are 30 consecutive days of air pollution content exceeding regulatory levels. Thus, residents can be left uninformed about poor air quality for weeks. In 2013, for example, there was only one day the red flag was raised even though there had been many days of the air pollution content exceeding regulatory standards. Water and soil are less consistently measured for pollutants and typically only when a special study is done by the state.

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The industrial zone was seen as a remedy to an "under-industrialized" southern France and to address concerns about potential future increases in unemployment.[10] Nearly half a century after Kammer's report, New York Times journalist Adam Nossiter documented the town's stark evolution, noting: "Residents of Fos-sur-Mer accepted a trade-off for decades: good jobs for foul air. But when the health costs became impossible to ignore, they went to court, a groundbreaking move in France." In 2019, a collection of citizen groups, workers' unions, and residents filed a legal complaint of criminal endangerment against the state's allowance of decades of industrial pollution, introducing a landmark case to the French courts.[11]

While the industrial zone was supposed to increase the wealth of the population, a significant proportion of residents today remain low-income. In Fos-sur-Mer, 10% of the population live in poverty and 16% reside in public housing; these numbers climb to 20% and 44%, respectively, for the population of the neighboring town of Port-Saint-Louis-du-Rhône.[12] Even though, unlike in the U.S., many fenceline residents work in the industrial facilities nearby,[13] the wealth generated is concentrated in corporations: ArcelorMittal, an international steel company whose factory neighbors Fos-sur-Mer and Port-Saint-Louis-du-Rhône has annual revenue of more than 70 billion USD.[14] (A 1978 law banned collecting race or ethnicity data in France, so we have no racial/ethnic data available about the participants.[15] Given these social norms, we also did not ask about immigrant status, but the Marseille region has been a hub for immigrants for centuries as the main port of France, including immigrants from across the Mediterranean in northern Africa.)

Though residents voiced concerns about environmental health, government- and industry-sponsored studies in the region did not engage residents in the process and led to incomplete and inconclusive studies that residents did not trust.[16] [17] Community-based participatory epidemiologic research can be one way to build up trust in health research.[18] In 2015, the Etude Participative de Santé Environnement Ancrée Localement (EPSEAL) (Locally-Anchored Participatory Study of Environmental Health) sought to change this by engaging residents of Fos-sur-Mer and the neighboring town of Port-Saint-Louis-du-Rhône throughout the research

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[11] Nossiter, A. "One of Europe's Most Polluted Towns Stages a Noisy Revolt," *New York Times*, 1 April 2020. Date accessed: May 14th, 2020. https://www.nytimes.com/2020/04/01/world/europe/france-pollution-fos-sur-mer.html

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[13] Allen, Barbara L., Alison K. Cohen, Yolaine Ferrier, Johanna Lees, and Travis Richards. "Redesigning a participatory health study for a French industrial context." *New Solutions: A Journal of Environmental and Occupational Health Policy* 26, no. 3 (2016): 458-474.

[14] https://www.macrotrends.net/stocks/charts/MT/arcelormittal/net-worth

[15] https://www.brookings.edu/articles/race-policy-in-france/

[16] Allen, et al. "Redesigning a participatory health study for a French industrial context." *New Solutions: A Journal of Environmental and Occupational Health Policy* 26, no. 3 (2016): 458-474.

[17] Allen, Barbara L., Yolaine Ferrier, and Alison K. Cohen. "Through a maze of studies: health questions and 'undone science' in a French industrial region." *Environmental Sociology* 3, no. 2 (2017): 134-144.

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process, from the questions asked to the analysis of the data generated.[19] [20] [21] The study found elevated prevalences of asthma, cancer, and other chronic illnesses which aligned with the local citizens' experiences.[22] Given the cocktail of diverse chemical exposures (e.g. heavy metals including antimony, arsenic, and mercury and volatile organic compounds, such as polycyclic aromatic hydrocarbons and benzene, and organochlorines, like PCBs[23]) and routes of exposures (e.g., air, water, soil), which others have attempted to partially characterize,[24] there are many possible pathways by which the environmental pollution in this region could contribute to this disproportionate health burden. Qualitative research can shed insights on how complex exposures can intersect to affect health.[25]

This paper analyzes the qualitative data collected from the 2015 EPSEAL study on local illness experiences, in which participants' voices contribute to a small-scale embodied health movement in the industrial region of Marseille. In many embodied health movements, fenceline residents take initiative on linking their adverse health outcomes to their lived experiences in an environment contaminated by pollution.[26] Their tacit health experiences expand upon the incomplete information on the health effects of the industrial pollution from state- and industry-sponsored studies that did not seek their input on mapping connections between environmental pollution and possible adverse health outcomes. The diversity of health issues discussed and experienced by participants reveals the depth and dimension of possible harm inflicted by exposure to industrial pollution — truths that can be more completely revealed by documenting the voices of those who experience it.[27] [28] [29]

Methods

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Study sample and measures

As detailed elsewhere,[30] we conducted a community-based participatory cross-sectional health survey in two towns in the industrial zone of Marseille, France: Fos-sur-Mer and Port-Saint-Louis-du-Rhône. Participants were systematically randomly sampled via door-knocking between July and December 2015. Participation was high: we had 816 study participants in the random sample, which represents 22% of all doors knocked and 45% of all doors knocked when someone was home to answer the door.[31] People could also volunteer to participate in our study's volunteer sample.[32] This study was approved by the Virginia Tech Institutional Review Board.

The survey asked a wide variety of questions related to the health of the participant and their household members. In addition to asking closed-ended questions in a questionnaire about specific health issues and diagnoses (reported elsewhere[33]), we asked an open-ended question at the end of the section with closed-ended health questions to provide participants with an opportunity to offer any additional insights: "Êtes-vous affecté(e) par d'autres problèmes de santé dont vous aimeriez nous parler?" ("are you affected by any other health problems about which you would like to tell us?"). For the 497 participants who provided a more than one-word response to this question (i.e., "no"), 478 were from the random sample, and 19 were part of the volunteer sample. It is well known that the collection of qualitative data through the addition of open-ended questions is a critical method to documenting the unpredictable diversity of health experiences, especially in a setting of "contested illness," where the experience or existence of a disease has yet to be recognized or understood, in this case by state and industry.[34]

Data analysis

All data were in French and coded in French. Author 1, in consultation with Author 3, created 31 generalized codes to categorize the health issues listed by the survey participants (n = 497), as well as if the health issue(s) mentioned pertained to the participant, their partner, their child, or another relative. (Author 1 and Author 3 are fluent in French.) The number of participants, children, partners, and relatives were counted by hand three times to ensure accuracy. The codes assigned to each correspondent were counted once by hand and once by a filtered search to confirm accuracy.

Illustrative quotes were selected based on clarity and relevance. Where most respondents simply listed their medical conditions, many described their experience with a health issue in more detail, sometimes provided individual and clinical explanatory models for their health issue. Author 1 translated all quotes from the original French in consultation with Author 3. (Author 1 is a certified French-English translator.)

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[30] Cohen, et al. "Health issues in the industrial port zone of Marseille, France: the Fos EPSEAL community-based cross-sectional survey." *Journal of Public Health* 26, no. 2 (2018): 235-243.

[31] Cohen, et al. "Health issues in the industrial port zone of Marseille, France: the Fos EPSEAL community-based cross-sectional survey." *Journal of Public Health* 26, no. 2 (2018): 235-243.

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[33] Cohen, et al. "Health issues in the industrial port zone of Marseille, France: the Fos EPSEAL community-based cross-sectional survey." *Journal of Public Health* 26, no. 2 (2018): 235-243.

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Results

Most participants were women, and the median age of participants was 56 (Table 1). Compared to our full sample,[35] those who responded to this question had a slightly lower income and more were retired or unemployed. At least 68% had at least one chronic illness, which was relatively similar to the proportion in our full sample (63%). At least 41% discussed having one or more comorbidity in their response.

Although this open-ended question focused on other health issues that had not already been discussed, some participants took the opportunity to share further details about their previously mentioned health issues, including respiratory illness, diabetes, endocrine diseases, and fatigue. Many others spoke to the depths and variety of the health complications they had been facing throughout their lives.

Health issues

We focused primarily on what health issues the participant shared about their own health (Table 2). However, sometimes participants also talked about their partner (n=48), their children (n=20), or other relatives (n=8).

As with many environmental health issues in contested arenas,[36] [37] [38] residents did not have isolated experiences but rather often experienced symptoms in relation to each other. One resident, for example, cited their hyperthyroid condition as the reason for the exhaustion episodes that they have experienced for years. Another resident speculated that the burning throat they'd been experiencing for two months was likely in relation to the headaches they'd been experiencing. A third participant speculated that the "emission of pollutants" could have provoked an onslaught of acute pain, including an intense, recurring urinary infection and severe chest pain that appeared over the course of a month.

Participants discussed a wide variety of health issues (Table 2), and very few discussed only one health issue. While most individuals described experiencing many health issues over their lives, some described experiencing various, recurring health issues and symptoms simultaneously. One respondent noted, "Between 2008-2009, [I experienced] long episodes of unexplainable fatigue, despite having stopped occupational fishing, [and] had a carcinoma that had grown and needed treatment at that time as well. Intestinal and digestive problems, [I] had a lot of issues at the same time." This quote illustrates the complexity of co-morbidities and the importance of documenting the full health experiences of residents. Even though a particular health issue may make up a small part of health issues experienced by the population, accounting for the combination of diseases experienced at the same time is important. For example, the participant is not only part of the 7.9% of respondents who discussed their gastrointestinal issues, but also among the 15.1% of participants who discussed fatigue and the 1.8% of participants who discussed cancers.

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[35] Cohen, et al. "Health issues in the industrial port zone of Marseille, France: the Fos EPSEAL community-based cross-sectional survey." *Journal of Public Health* 26, no. 2 (2018): 235-243.

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The most prevalent health issue mentioned by respondents were cardiovascular issues (25.4%). Of the respondents that reported a cardiovascular issue (n=126), 40% reported hypertension. While most respondents who reported a cardiovascular issue did not provide extensive detail, many mentioned that it was chronic, and shared by other household members. Upon reporting their hypertension, one respondent reflects, "I've had hypertension for approximately eight years. I find that on some days in Fos, when the factories like Sollac flare or de-gas, it's difficult because the [released gases] get inside the house when we open the windows to aerate...leaving behind black particulate matter in the patio tiles." It was typical for respondents to provide reflections on their place of residence and perceptions of pollution alongside their health conditions, demonstrating the extent to which the surrounding environment was at the forefront of many respondents' health concerns.

As visible in the quantitative data,[39] many participants discussed allergies and respiratory issues. While participants reported allergies in the closed-ended quantitative questions, 10.4% respondents expanded upon their experience with allergies, many relating their experiences to the environment. Participants also mentioned experiencing allergies when they talked about others' health experiences: for 25% of the children mentioned and 10.4% of the partners referenced. For some, allergies were a new development: "Since I've moved to Port-Saint-Louis, I have asthma and allergies that I didn't have before." Another reported their allergies appeared upon moving to Fos-sur-Mer: "Since moving to Fos, I developed a series of cutaneous and inflammatory allergies. This prevented me from being able to practice my profession as a hairdresser, I had to close my salon." For this participant, the sudden onset of health issues, seemingly provoked by new residency in the region, had both adverse health and economic effects. Participants often expressed puzzlement at the onset of their allergies, indicating that this was a health issue they were unaccustomed to and associated strongly with their environment. Upon seeking medical advice for chronic allergy symptoms of an unknown source, one participant recounted their ear nose and throat doctor's explanation that they are simply, "allergic to the region!"

It was not uncommon for participants to reference their doctors, especially when discussing pollution in the region. One participant who suffered from conjunctivitis, experiencing burning and itching eyes, noted that their doctor "tells me it's related to the pollution." Similarly, a participant who also suffered from chronic conjunctivitis explains their affliction as being "without a doubt in connection with the pollution." While referencing a problematic immune system, another participant explained how their doctor suggested that their "weak immune defense...could be in connection with the pollution." Across the board, participants considered their health problems relative to their exterior environment, and explanations from health professionals were shown to be a source for these reflections.

Some participants focused on rarer, more severe health outcomes, like pregnancy or birth abnormalities (3.6%). The majority of abnormalities consisted of premature births, in some cases resulting in premature death of the child. As one participant explained, it was due to a malformation of their uterus that their "babies were born prematurely at five and a half months and did not live more than one day." Other participants reported miscarriages, and some (1.4%) reported fertility issues or diagnosed infertility.

Links to environment

[39] Cohen, et al. "Health issues in the industrial port zone of Marseille, France: the Fos EPSEAL community-based cross-sectional survey." *Journal of Public Health* 26, no. 2 (2018): 235-243.

While we did not prompt study participants to identify potential determinants of their health issues, thirty-seven individuals (7.5%) reported their personal health issues in connection to living in Port-Saint-Louis and Fos-sur-Mer and/or the greater Etang de Berre region as a whole (for those who offered hypotheses about causes, this was the predominant explanation). This does not account for participants' references to others' health problems related to the regional pollution. One parent, for example, notes that their "oldest daughter was born with a single malformed kidney. [Our] doctor says that there are more and more children in the region who have deformities, [they] say it's connected to the pollution." This quote illustrates a persistent local belief that local pollution is a primary determinant of diverse health issues. Moreover, this illustrates what additional, qualitative information participants wanted to include at the end of the health survey about their health experiences. As this was an open-ended, optional question, it is likely that not all respondents captured the extent of their health perceptions or thought to mention their perceptions about their environment in their response.

In October 2015, Sylvia Pietri, a researcher from the French National Center for Scientific Research (CNRS in French), held a conference in Fos-sur-Mer to present her research on mice who, for one hour each day for six months, were exposed to an air quality similar to that in Fos-sur-Mer. At the conclusion of the study, 80% of mice had contracted a cardiovascular illness or diabetes. One participant who attended this conference referenced the findings in relation to their own health: "[I've been] obese since adolescence...and, well, I feel like this mouse that became obese after inhaling non-toxic fine particulate matter—except at the conference it was explained that for people like me, it was *toxic* fine particulate matter that I had inhaled!"

Discussion

This study expands our understanding of the diversity of health issues affecting residents of the industrial zone of Marseille, providing qualitative insights that complement quantitative analyses reported previously. These findings deepen our understanding of the range of health issues residents experience, and how they perceive and make sense of their health issues. This disproportionate, diverse health burden exists parallel to industries generating wealth for people outside of the region as they generate pollution within the region. The experiences of residents in relation to their polluting industrial neighbors demonstrate the classic environmental injustice: an enormous advantage to industry comes at a devastating disadvantage to their laborers and surrounding environment.

This study relied on qualitative data collected from residents of Fos-sur-Mer and Port-Saint-Louis-du-Rhône in the industrial zone of Marseille. Given the optional, open-ended nature of the prompt, the proportion of participants who discussed each health issue (table 2) does not necessarily reflect the proportion of individuals who had this health issue in the entire study population, but it did allow us to collect data on many more health outcomes than we had included in the closed-ended part of the survey. Our findings document the diversity of health issues experienced, from diagnosed chronic diseases to burdensome symptoms, among residents in this industrial zone.

Participants' insights, including reflections on local tacit knowledge about the prevalence of industrial pollution and perceived health effects from their exposure, shows the importance of

local public participation in the conduct of health studies.[40] [41] The local, embodied knowledge of inhabiting a space is instrumental to understanding the diverse effects of environmental pollution on health and wellbeing.[42] Incorporating qualitative accounts of resident health experiences provides contextual insight to the statistical information collected.

The qualitative data set reveals that participants experienced a wide range of health issues (e.g., cardiovascular issues, gastrointestinal issues) beyond ones measured more commonly in environmental health studies (e.g., cancer, respiratory health). We encourage future researchers to study a broad array of potential health effects of living within an environmentally polluted zone, using both quantitative and qualitative questions. Environmental pollution's impacts (including exposures to different types of pollutants in combination with each other) can manifest in nuanced ways that can range the gamut of health conditions, from minor chronic symptoms to serious lifelong conditions. All adverse health outcomes can contribute to a diminished quality of life in the area. For example, exposure to antimony, a heavy metal found to be emitted by the industrial zone, has shown to lead to a diversity of health effects, including skin conditions like eczema (which was widely cited by participants) and gastrointestinal issues (also oft-cited).[43]

Notably, the diverse constellation of health issues experienced by residents of the industrial zone can increase susceptibility for other health issues, including COVID-19. For example, residents in the industrial zone have higher prevalences of respiratory illness and diabetes,[44] each of which increases the risk for more severe COVID-19 outcomes.[45] [46]

When examining the co-occurrence of local pollution and health issues in disproportionately burdened communities, inclusion of local knowledge (via citizen science or participatory research approaches) is critical. The inclusion of local knowledge and participatory research, which includes consulting participants' insights throughout the conduct of the study, not only allows for more thorough and novel public health research, but participatory research is a critical component of enacting procedural justice, when participants have access to the data and analysis that they took part in so that they may advocate a larger stake in the decision-making processes about their environment and livelihoods.[47] To include local knowledge, we recommend using open-ended questions to complement closed-ended survey questions to provide a space for residents to discuss the health issues of greatest importance to them and/or health issues that traditional epidemiology questions may have missed. Local experience can guide public health

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research, pointing toward issues that may have been historically or statistically overlooked.[48] We strongly recommend public health researchers take a multi-method approach to documenting health issues in environmental justice communities. As we retrieve these issues from obscurity, through collaboration between researchers and local residents, and prioritize the voices of those who experience the harm of environmental degradation, we can create larger pathways that lead us toward a more just and livable society.

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Table 1. Demographic characteristics of interview sample.

	Interview sample (n=497) Percent or mean	Full random sample (n=818) (Cohen et al., 2018) Percent or mean
How participant was sampled		
Random sample	96.2%	100%
Volunteer sample	3.8%	0%
Gender		
Male	39.4%	41.5%
Female	59.6%	57.7%
Did not answer	1.0%	0.8%
Respondent age	Mean: 56.0 (SD: 17.4) Median: 58 (interquartile range: 42-69)	Mean: 52.7 Median: 54
How long lived at address	Mean: 17.0 (SD: 15.5) Median: 14 (interquartile range: 4-25)	Mean: 15.2 Median: 10
Town of current residence		
Fos-sur-Mer	62.4%	66%
Port-Saint-Louis-du-Rhône	37.2%	34%
Did not answer	0.4%	0%
Current employment status		
Full-time	27.7%	46.1%
Part-time	7.7%	10..8%
Unemployed or retired	62.8%	41.8%
Don’t know or did not answer	1.8%	1.3%
Current annual income		

Less than 11,500 euros	15.6%	12.8%
11,501-13,800 euros	13.7%	13.3%
13,801-23,000 euros	24.3%	25.6%
More than 23,000 euros	31.3%	32.8%
Don’t know	6.6%	
Refused to answer	8.5%	
Highest level of education attained		
Brevet des colleges (equivalent to 10th grade or GED)	10.1%	11.2%
CAP/BEP (vocational or technical education/degree)	35.8%	35.3%
Baccalaureat (equivalent to high school diploma)	17.1%	19.9%
Bac + 2 (DEUG, BTS, DUT) (equivalent to associates degree)	9.2%	20.8% (any higher education degree)
Bachelor’s Degree	5.6%	
Bac +4 (Maitrise, grandes ecoles) (equivalent to some graduate school)	3.0%	
Masters or doctorate degree	2.1%	
Other	14.8%	12.8%
Don’t know or refused	1.4%	
Had any chronic illness	68.2%	63%

Table 2. Health issues discussed by participants.

	Proportion of sample who mentioned this health issue (n=497)	Prevalence in full sample (n=818)
Health issue discussed in closed-ended survey		
Abnormality during pregnancy or birth	3.6%	15.5% miscarriage, 2% stillbirth (Cohen et al., 2018)
Cancer	1.8%	10.5% (Cohen et al., 2018)
Ear, nose, and throat issues	4.2%	39.0% experienced nose and throat problems unrelated to hay fever (Cohen et al., 2018)
Fatigue-related health issues	15.1%	33.2% (Jeanjean, Cohen, Allen, & Lees, under review)
Respiratory issues	9.3%	25.9% (Cohen et al., 2018)
Health issue first discussed in open-ended question		
Allergies	10.4%	(n/a)
Cardiovascular issues	25.4%	(n/a)
Diabetes	4.8%	(n/a)
Concern about environmental exposures' implications for health	7.5%	(n/a)
Eye issues	8.3%	(n/a)
Gastrointestinal issues	7.9%	(n/a)
Hernia	3.0%	(n/a)
Infectious diseases	3.8%	(n/a)
Joint and tendon issues	10.4%	(n/a)
Kidney issues	2.6%	(n/a)
Liver issues	0.8%	(n/a)
Mental health condition or hardship	6.7%	(n/a)
Other health issues	10.9%	(n/a)
Muscular issues	2.0%	(n/a)
Nervous system issues	1.2%	(n/a)
Neurological condition	4.4%	(n/a)
Pain	10.0%	(n/a)
Reproductive organ issues	5.6%	(n/a)
Skin conditions	9.1%	(n/a)
Unusual symptoms	5.4%	(n/a)
Urinary issues	3.4%	(n/a)
Comorbidities		
Participants who discussed having one or more comorbidity	41.2%	(n/a)