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Resident perceptions of the short- and long-term impacts of Hurricane Harvey

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Abstract

Severe storms and flooding events are expected to increase in frequency and severity, with lasting economic, social, and psychological impacts on communities in post-disaster recovery.

In the first mixed methods study to focus on the experiences of Houstonians during Hurricane Harvey, which resulted in unprecedented and widespread flooding and billions of dollars in damage, we conducted five focus groups from four neighborhoods almost two years after Harvey made landfall. Our purpose was to understand how residents withstood and recovered from flooding-related stressors, what the major sources of support were and what long-term issues they were still dealing with. Residents relied on their families, friends, and neighborhood networks offline and online to seek important information about the storm and coordinate rescue efforts. They turned to their friends and neighbors for help with cleaning their homes and received support and donations from church and volunteer groups, while in one neighborhood residents organized themselves and coordinated aid and clean-up activities. Contrasting with this initial surge of social support that was perceived as overwhelmingly positive, the process of applying for federal aid was confusing, and residents reported continued stress and mental health strain. The experiences of Houston residents echo those of Hurricanes Katrina and Sandy survivors, particularly when seeking federal assistance, an experience that continued to exacerbate post-disaster stress. Enhanced state and local disaster response mechanisms, as well engaged partnerships between community stakeholders, academics and policy makers have the potential to improve community resilience, particularly in the natural and industrial disaster-prone greater Houston area.

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Declaration of competing interest

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Keywords

Disaster; Flooding; Hurricane Harvey; Social support; Federal aid; Mental health

1. Introduction

Severe storms and flooding events remain the most frequent disasters occurring due to natural hazards globally [1]. In 2017, floods impacted approximately 55 million people worldwide [2]. The severity of climate-related stressors is expected to increase with climate change [3], with significant and lasting public health impacts. Flooding disasters may have direct effects on health outcomes, for example, through the spread of water-borne illnesses, exacerbation of chronic illnesses, or through injuries and deaths (e.g., those caused by falling debris or drowning), as well as indirect health effects, such as adverse birth outcomes [4-6]. There is also a growing recognition of the impact of flooding disasters on mental health; post-traumatic stress disorder (PTSD), depression and anxiety following traumatic exposure to flood events have been the most commonly reported mental health outcomes in several systematic reviews [4,6-8].

In the post-disaster recovery period, secondary psychosocial stressors, such as dealing with losses and financial strains or rebuilding and adjusting to new environments, can impact recovery for survivors [7,8]. The degree of social cohesion and availability of social support play a critical role in the vulnerability of individuals and communities to the traumatic impact of flooding disasters, as well as in their ability to deal with stressors in their aftermath [9]. Unfortunately, flooding disasters often cause social upheaval, loss and breakdown in social networks, leading to a deterioration of support and potentially exacerbating the long-term impact of flood exposures [10].

In addition to individual sociodemographic characteristics and health status, factors influencing a community's vulnerability to the health impacts of floods differ across geographies, cultures and disasters [11]. In Houston, Texas, the area's shallow floodplains, as well as its location along the Gulf Coast and the associated occurrence of tropical cyclones and intense rainfall events, make it particularly vulnerable to flooding [12], and Houstonians have uniquely endured a series of floods, with one occurring approximately every two years [13]. Second, as the fourth largest city in the United States (U.S.), Houston is home to a large ethnically, culturally and socioeconomically diverse population and experiences during and in the aftermath of floods may differ from one community to another.

Hurricane Harvey made landfall in Texas on August 25, 2017, with torrential rainfalls over several days causing catastrophic flooding along the Gulf Coast, 68 direct fatalities [14] and an estimated \$125 billion in damages [15]. An estimated 36–48 inches of rain were recorded in the Houston metro area [15]. In what was to be Houston's third 500-year flood in three years ([16], many parts of the city saw unprecedented flooding and consequent damage to approximately 80,000 structures [17]. Controlled releases afterwards from the Addicks and Barker reservoirs west of the city caused further flooding and displacement. In contrast to the postdisaster literature of the past two decades, particularly on Hurricane Katrina (2005) and to a lesser extent, on Hurricane Sandy (2012), there have been fewer studies on effects

of Hurricane Harvey among Texas Gulf Coast residents and the investigations so far have focused on disparate flooding exposures [18,19], mental health impact [20-22], social media use [23,24], disaster preparedness [25], assistance [26] and resilience [27,28]. Additionally, a few studies have focused on the experiences of specific groups, such as public servants, first responders and college students [29-31]. However, apart from a single report by the Kaiser Family Foundation and Episcopal Health Foundation, who conducted surveys and focus groups in 24 counties along the Texas coast (including Harris County, where Houston is located) [32], ours is the first study to examine the unique experiences of Houston residents during Harvey as well their recovery over the long term.

Within a month of Hurricane Harvey making landfall, we launched the Houston Hurricane Harvey Health (Houston-3H) study, a mixed-methods study, which sought to examine flood-related exposures on health among Houston residents who were impacted by Hurricane Harvey [33]. Using quantitative methods, participants self-administered a questionnaire, were asked to wear a wristband for seven days to assess chemical exposures and provided biological samples for microbiome analyses both immediately after Harvey and roughly 12 months after the storm. In addition, we conducted focus groups in 2019 to add a more granular understanding of the complex issues faced by residents in different Houston communities, how they responded and recovered from the challenges they faced, what the major sources of support and aid were, and what long-term issues remained almost two years after the storm. Previously, based on the questionnaire data, we observed that flood-related exposures were associated with high stress both immediately after Harvey and 12 months later [33]. Here we report on learnings from the focus group discussions with Houston-3H study participants.

2. Methods

2.1. Houston-3H study population

The sampling frame and recruitment procedures for the Houston-3H Study are described elsewhere [33]. Briefly, participants came from four different neighborhoods across Harris County, chosen for having high counts of damaged properties, based on Federal Emergency Management Agency (FEMA) preliminary damage assessment (PDA) maps: the Houston neighborhoods of Addicks, East Houston, and Meyerland, as well as the city of Baytown. In Addicks, home to predominantly affluent residents, more than 9,000 homes and businesses were affected by flooding from overflow following the controlled releases of the Addicks and Barker reservoirs. Within days after Harvey, homeowners upstream and downstream of the two reservoirs filed lawsuits against the U.S. Army Corp of Engineers for flood damage [34,35]. East Houston, which is located northeast of the city with primarily low-income Black and Hispanic/Latinx residents [36], also saw unprecedented flooding, with the Houston fire department recording 943 rescue calls for help from residents in the area [37]. We also recruited Baylor College of Medicine (BCM) employees who largely lived in the Meyerland area, located in southwestern Houston, with a diverse and mostly affluent population. Surrounding the Brays Bayou, Meyerland lies in a 100-year flood plain and has seen repeated flooding prior to and during Harvey. Baytown, 30 miles east of Houston on Galveston Bay, is home to petrochemical and chemical manufacturing complexes and

downstream of two Superfund sites. The city of Baytown estimated that about 4,300 homes sustained flood damage [38].

Sociodemographic characteristics and flooding experiences of the study population by neighborhood are shown in Table 1. Most Houston-3H study participants had their homes flooded (85%) and damaged (76%). In Baytown, participants had a mean (SD) age of 50.0 (20.9) years, were mostly non-Hispanic Black (74%), and approximately 28% had a high school education or less. Twenty-eight percent of Baytown participants reported being rescued during the flood by a friend, neighbor, or emergency worker. East Houston participants were predominantly Hispanic/Latinx (49%) or Black (47%) and younger, with a mean (SD) age of 40.8 (19.7) years; 65% had a high school education or less and 40.9% of them reported being rescued during the flood. Addicks and Meyerland participants were largely non-Hispanic White (78% and 66%, respectively), with at least an undergraduate degree (84% and 92%, respectively). Mean (SD) age was 62.6 (22.3) years in Addicks and 50.0 (14.3) years in Meyerland. Over 81% of Addicks residents were rescued, compared to 21% of Meyerland residents.

2.2. Focus groups

Houston-3H participants (adults ≥ 18 years) whose homes flooded during Hurricane Harvey were invited to participate in focus groups. We limited participation to one person from each household. During screening, participants were asked which language they preferred (English or Spanish), and we followed up to confirm attendance and coordinate transportation where needed. This study was approved by the institutional review boards at The University of Texas Health Science Center at Houston (UTHealth) and Baylor College of Medicine.

Between May and August 2019, we conducted five focus groups in total: one in English at each of the four locations, with an additional focus group in Spanish in East Houston facilitated by a bilingual researcher. All sessions were held at community centers, except for the Meyerland group, which was held in a conference room on the BCM campus. After obtaining consent and explaining procedures, sessions were audio recorded and lasted between an hour and an hour and a half. Lunch was provided after each session and participants received US\$ 20 in cash. The facilitator used open-ended questions and probes to ask participants to comment on the major issues they experienced during and immediately after the four days of the storm, how they were able to recover from them and any long-term issues that remained.

Audio files were transcribed verbatim, and the Spanish transcript was translated into English by a professional agency. We analyzed the transcripts in the database management program ATLAS.ti (version 8). In this thematic analysis, two researchers (A.R. and S.M.) used inductive and deductive codes as they coded two transcripts and developed a coding scheme. Disagreements were discussed until consensus was reached. The final coding scheme and code definitions were used by A.R, who analyzed the remaining three transcripts and grouped the codes into themes with feedback from S.M.

3. Findings

A total of 43 participants attended five focus groups. The Baytown group included three men between 45 and 68 years of age, two of them non-Hispanic Black and one non-Hispanic White. In East Houston, one group was comprised of 17 participants, approximately half (47%) of whom were men and the majority (60%) were non-Hispanic Black. Ages in this group ranged between 36 and 81 years. The other East Houston group, conducted in Spanish, included three women who identified as Hispanic/Latinx and were between 37 and 52 years of age. The Addicks group was comprised of three non-Hispanic White women and one non-Hispanic White man, whose ages ranged between 59 and 76 years. The Meyerland group included 16 participants (two of whom were men), between the ages of 38 and 67 and the majority (75%) were non-Hispanic White. Three themes emerged: friends, neighbors, and outsider support; perceived inefficient, unproductive, and insufficient official ‘assistance’; and mental health strains. Overall, cooperation and support from the ground level contrasted with the burdens and frustrations experienced at the federal level. Tangible support provided some relief, but emotional stress continued almost two years later.

3.1. Friends, neighbors, and outsider support

In the days preceding Hurricane Harvey and during the storm, residents received information from different sources on the potential for flooding, how to prepare and whether and how they needed to evacuate mostly through their support networks in-person and online. In addition to following the news on the television and radio, residents discussed preparations with their families and friends over the phone and learned where to evacuate by word of mouth from others in their neighborhoods. For support with evacuation, residents used social media as they turned to their families, friends, neighbors, coworkers, and volunteers from Houston and elsewhere, such as the Cajun Navy. Houstonians and far-flung family and friends organized at the neighborhood level to rescue extended family, elderly neighbors, and people's abandoned pets, using their phones and online resources, such as social media. Some residents described their communications with their neighbors and rescue teams without naming a specific social media platform, describing it only as “the internet”. A Baytown resident, who also arranged evacuation for his elderly neighbors, explained that his granddaughter sought help on the internet from out-of-state volunteers who rescued the family and their neighbors:

We did have cell service. And actually my granddaughter got out on the Internet and got in contact with people through the Internet. And they had local people and people from out of state who were very helpful –the Cajun Army or somebody –I mean, they got identification and everything and somebody got in touch with the people that were doing the rescuing in the area. And they got us out about 9:30 that night.

(Baytown, Participant 2).

Neighbor to neighbor communication continued as the flood waters started to recede and residents needed to check up on their homes. A Meyerland participant also communicated with their neighbors online, an activity they called “interneting”: “*And sometimes just interneting [sic], because since our whole neighborhood flooded, neighbors were*

communicating with each other and what they found and letting each other know.” (Meyerland, Participant 4). The following quote by an Addicks resident pointed directly to Facebook:

All of the Facebook pages became the source of information that directly affected us and was helpful. You could listen to radio and the news, but it was the local communications in the neighborhoods that really, you knew how to get ahold of, you know who had boats, how to get in touch with the airboats, and that was the source of communication. I mean, that was one vital use for Facebook, heh! That really was how most of the information was being communicated.

(Addicks, Participant 1)

As residents were getting back into their homes, they shared supplies and assisted each other with muck and gut (debris removal) activities. As one participant from the Meyerland focus group put it: *“Mostly it was friends and family that came and helped us, but they were tireless, and once we finished with our house, we just went door-to-door, up and down our street, helping other people to get theirs out. So it was more friends helping friends, family helping family, for us.”* (Meyerland, Participant 1).

In all four neighborhoods, residents received donations from groups passing through the flooded neighborhoods as they worked on their homes – *“... when the water was gone 18-wheelers were coming in and dropping water and toilet paper and stuff like that.”* (Baytown, Participant 3). For Baytown, East Houston and Meyerland residents, this form of unofficial support appeared to be mostly from church groups. A Meyerland participant said that they were *“... inundated with church groups. I mean, they were showing up, they were bringing food, they were bringing water, they were helping people pull out drywall.”* (Meyerland, Participant 4). Similarly, in East Houston, these supplies came in on a regular basis and from several different churches. An East Houston resident, speaking in Spanish, described how these groups were the most helpful while she was cleaning out her house:

Yes, there were people from the church I go to who, helped me, in addition to family, organizations, the city, although I believe that the city did not help much. More than anything organizations, churches, Catholics, Baptist, Pentecost, Jehovah's Witnesses, any denomination, they all contributed. Economically, FEMA [helped the most], but many church groups entered the neighborhood where I live. They came in with their trailers attached in the back and arrived with everything so you could enter your house. I was cleaning my house and there was no shortage of people who would give food, milk ...

(East Houston, Participant 1, translated from Spanish)

There were differences between neighborhoods in the source and method of organizing the support they received. For example, though volunteers and church groups also visited Addicks with donated supplies and volunteered to help with muck and gut activities, efforts there were more in the form of organized mutual aid among residents than any of the other neighborhoods. As one resident put it, *“people just stepped up”* (Addicks, Participant 1). Residents spoke with pride about how, during the shutdown week after Hurricane Harvey when the city was at a virtual standstill, their community organized supplies via Amazon

shopping lists that people donated to, as well as muck and gut activities so those in the neighborhood who didn't flood were able to help others:

In my neighborhood, the entire neighborhood didn't flood, and so the neighbors in the streets that had not flooded, they organized as well. And, they would make contacts, and make lists of people. "Do you need help? Who's coming to help you?" People were coming in to supply help or just to help us. And so, we had, like, neighbors who took that role on, because they hadn't flooded. I mean, they opened up a neighborhood store by getting, you know, people were contacting neighbor [sic] ... "What can we do to help?" They set up an Amazon account, where people just send money, and they would buy the supplies needed as the recovery process started and they kinda, man I knew, very effective at doing that [sic]. They had not flooded, and so they would, you know, "What kind of help do you need? Do you need help gutting out your house? [...] we can get people there", and they would come down and do some of it themselves, but remember, the city was sorta shut down for that first week ...

(Addicks, Participant 1)

Another Addicks resident shared similar stories of his neighbors distributing cleaning supplies provided by the city for everyone in the neighborhood who needed them, as this discussion reveals:

Well, our neighbors did it. They set up, like, what they called the beach. So, we had a couple guys that were just [...] these guys stayed there 14–15 hours a day. They were the organizers, you know? They were eight men. Anything anything you wanted. Anything you wanted. You had a problem, you went to them, and then they would get somebody else and do it.

(Addicks, Participant 2)

That's really what the neighbors were doing. They volunteered their garages as, like, the store, you know? And just bring in the supplies that were needed.

(Addicks, Participant 1)

This on-the-ground support provided critical relief in the early days following Hurricane Harvey, but residents commented that it diminished past Labor Day:

But then it was, I think it was, like, Labor Day was Monday, and then, people had to go back [to work], and that's when other groups started coming in. So, the neighbors –you know, the neighbors just doing the work—they had to go back to their lives if they hadn't flooded, that's when the other groups would start coming in

(Addicks, Participant 1)

3.2. Perceived inefficient, unproductive and insufficient official 'assistance'

The week after the hurricane—when most businesses and schools were shut down and families and neighbors helped one another— was followed by weeks of frustration when people turned to more formal assistance post-Labor Day. In East Houston in particular, while there were generally positive experiences with neighbors, volunteers and aid groups, some

Black residents were frustrated and felt let down by charitable organizations and agencies offering financial assistance. They thought the application process was too invasive, an experience that was not reported in any of the other focus groups. One resident was wary of having her photograph taken when applying for assistance. She commented that she was being asked too many details, only to be rejected later despite her need:

In trying to get assistance and help, I ran across a lot of the agencies in the area, and [...] I don't understand why you have to give them your whole history. They already know that you've been flooded. If you're in a home, they want your deed, they want your last year income tax statements. They want your last three check stubs. Why so much information that you have to give, and then they come and say, "Well, I'm sorry, but you don't qualify for assistance"? [...] And that's one thing until the next [...]. I can't remember the next agency. Then when they started asking for the same thing, we just refused to give out all our personal information, and we're still right now today just going bit by bit, just trying to complete our damages.

(East Houston, Participant 10)

Her frustration with this process was echoed by other Black East Houston residents, one of whom was concerned how his personal information might be used by different organizations, as opposed to donations from a nearby church that did not require documentation:

What they did -the church- they'd give out cards, you know, some of them were like \$400 on a card. They helped a lot. But a lot of organizations, you give them all your information, they wouldn't help you. They were helping themselves, because they needed that information to turn in, in order for them to get the money. And then you didn't see a dime. So, you know, that was a stressful situation because you didn't know what the deal was. You didn't know how they were going to use your information.

(East Houston, Participant 11).

Because of their negative experiences, these residents did not seek further financial assistance, which ultimately slowed their home repair progress and return to normalcy. Similar frustrations with formal sources of assistance, such as FEMA, were echoed by other residents in all four neighborhoods. While those who had private flood insurance reported a smooth process and did not have to wait long for compensation, most residents faced a confusing application process, long waiting periods and insufficient federal assistance, which further exacerbated their financial burdens and stress. The sharp contrast between the informal channels of support in the immediate aftermath and formal channels over the next several months can be summed up in the following words from one Addicks resident, who received help from her friends and church but was frustrated with FEMA's process: "*my experience in terms of humanity was awesome. In terms of government assistance, not so awesome.*" (Addicks, Participant 3).

Whether they applied for aid from FEMA online, on the phone or in person at their church or shelter, participants were frustrated with the confusing process, often complicated by inexperienced FEMA agents:

Yeah, like number two said, FEMA and insurance company [sic], the process was super confusing because when you only have your phone to interact with their website, it's almost impossible to know what you're supposed to do and, you know, which order to do things, who to contact. It was very hard to get through to people. And the people that you talk to, don't know what you're supposed to do.

(Meyerland, Participant 8)

In Baytown, one resident stood in line on a daily basis, both at the shelter where he was initially staying and later at his church, to ask about his FEMA application and, as reflected in the following quote, had to wait several months without basic needs before eventually receiving assistance: “*And it takes so much time and line, and line, and line, and like, okay, you have my information. You have my paperwork. But I've got to wait four months, six months, eight months? [...] I don't have a bed, I don't have a sofa, I don't have a microwave, I don't have any food in my refrigerator.* (Baytown, Participant 1).

In most cases, the funds available through FEMA were insufficient. In East Houston, one resident received cleaning support from volunteers, but not enough money from FEMA to rebuild her house. She relied eventually on donated building supplies. She questioned the process through which the agency determined how much each household receives:

That was a challenge, trying to get FEMA to help us, you know, with the rest of it. I don't know how they go about deciding how much money your house they can help you with [sic], when it seemed like they didn't help us with anything. You know, didn't pay for much [...] your house is a total loss, but they think that \$7,000 is gonna help you That's not gonna help you, that's not. That didn't. So after that it was, like, the goodness of other people that knew us, that helped us [...] like one person would give us some sheet rock, and somebody else would give us some insulation.

(East Houston, Participant 9).

Her comments echoed similar experiences of participants from the other three neighborhoods. Notable exceptions, however, were two Spanish-speaking women who, despite not having flood insurance, did not report any significant challenges with FEMA because their relatives helped them apply for financial aid, and one of them was able to stay in a FEMA-supplied hotel room for several months. The other woman found out about potential aid from FEMA on television and had help from her sister, who had already been flooded and knew who to call:

On television, they started giving information about all those affected, those who had lost their home or were in that situation to call such a number [sic]. But my sister had already given me that. She called me and she said, “I called this number, they will help you, I will give you the phone from FEMA.” Thank God we had a place to sleep because the hotels could accommodate all people. But me, on TV and my sister [sic], who had already been through the flooding.

(East Houston, Participant 3, Translated from Spanish).

Another resident in Baytown, who already had flood insurance, also mentioned that though the process was slow, he ultimately received assistance from FEMA in the form of a trailer, which he suspected was because his granddaughter and her six month old infant were living with the family at the time and they were evacuated together: “*it was slow coming, but I did get some help. And I think the reason I did is because of the little one.*” (Baytown, Participant 2). Overall, however, the majority of residents across the four neighborhoods were confused by the application process, felt that the agents assigned to assist them were also confused or inexperienced, and that the aid they ultimately received was slow in coming and not enough to rebuild, leading to a slow recovery period and additional financial strain and distress.

3.3. Mental health strains

The lasting mental health impact of experiencing Hurricane Harvey and the damage that ensued was a recurring theme in all focus groups, whether in the recollection of traumatic events and scenes, in the processing of and grieving over losses or in describing continued and present difficulties. In reflecting on their losses in the immediate aftermath of the flood, one resident described it as “*mentally straining, sitting there wondering what you have left.*” (Baytown, Participant 1). Expressions of regret and grief were also common—some grieved over the loss of family memorabilia and others over the death of their pets or farm animals. A woman from Addicks described her grieving process and the additional mental toll of having to get back to work immediately after the storm:

There were the emotions, the gamut of emotions that you experience after that. Yeah, it was a grieving process. I kept thinking, “Why didn't I have flood insurance? That was stupid of me.” So, you know, a lot of tearing myself down for not making those decisions, and there was a lot of stuff that went on that way. That’s one of the things that I think, if I were organizing helping after a natural disaster like this, one of the things I would really think needs to be attended to, besides people’s physical needs, is the mental, emotional, spiritual sideofit, because, you know, you can rebuild or not rebuild your house. Those are just factual, dragnet kind of things you do, but walking around all day, and having to, having to go back to work. Having to figure out how you’re going to go back to work. How are you gonna drive when you don’t have a car? You need to find a car. How are you gonna get to work? What are you gonna do? All of those things just take a toll, a real toll.

(Addicks, Participant 3)

Some residents mentioned feeling traumatized by their experiences and seeking therapy to recover. Others also mentioned that they or their family members dreamt about water: “*And I’m still dreaming, I’m still dreaming about it,*” (East Houston, Participant 5); “*He had a lot of dreams, he dreamt of water.*” (East Houston, Participant 1, translated from Spanish).

Anxiety and fear every time it rained were common experiences and widely acknowledged in each of the focus groups, by way of nods and echoes of agreement and sympathy. In Baytown, one resident, the father of an infant at the time, describes the effect of storms on his family:

"My wife -and the baby is older now- yeah, when it rains, and thunder, and lightening, they get anxiety. I don't get much anxiety from it. What's going to happen is going to happen, you know. But, yeah, you think about it. And now it's hurricane season, you really start, I start thinking about it now. Hey, here we go again.

"(Baytown, Participant 2).

The triggering experience of rainfall is described by one woman from East Houston who refers to a storm that had passed through the area the week prior to the focus group:

Another thing is that after you've been through Harvey, as you go through the months, the days and all, any rain traumatizes you psychologically. Why? Because you're like: "is it going to happen again?" even now, last week, I felt chills, I felt the fear and that's because what you lived is nothing to do with this past week, which was a storm, you could say. But you're automatically traumatized. Psychologically it affects you, you say: "it's going to happen again.

"(East Houston, Participant 1, translated from Spanish).

Similar experiences were discussed in all groups, and people used different terms, such as obsessive thinking, flashbacks or "freaking out" to describe them. One man in East Houston said he hadn't realized he was traumatized until he heard the rain and wind from the previous week:

I didn't know I was freaking out, you know, that when I heard it rain, and heard all the wind, the thought of it would just flash before my eyes, you know, when I saw the ditches and streets filling up. Cars backing up, people [...] walking in the rain, you know. I didn't know I was traumatized.

(East Houston, Participant 3)

Another aspect of the long-term mental health strains that emerged in the Addicks group, though not in others, was the isolating impact of prolonged Harvey-related stress for residents who had been unable to move on as quickly as the rest of the city. One woman referred to the group as "floodies", who were set apart from their friends and neighbors who had not flooded:

... I also feel like, after a certain amount of time went by, it became almost a little more difficult, eh, it was almost like, you can only talk to floodies about certain topics at some point, because everybody else is thinking, "you're still being held back by that? It's been six months." Well, after six months, most people weren't even close to returning to their homes. Maybe even making a decision about what they're going to do with their home. So, maybe it was just me, but it seemed to, at one point, become almost a little bit of an isolation because of that, like, well, if they didn't flood, they didn't understand, and you just get to the point, or I got to the point, where I didn't want to, you know, if a person hadn't flooded, you almost, wanna stay away from them a little bit, because you didn't want to once again answer the question: "how are you doing since the flood? Are you back in your house?" You know, that kinda stuff. It's like, no.

(Addicks, Participant 1)

There was general agreement among the participants that these experiences made them not want to talk about it – “*You don't wanna answer it honestly.*” (Addicks, Participant 3). The group also spoke in sarcastic tones about how quickly the rest of the city seemed to have moved on while they and their neighbors were still struggling to return to normal:

I can remember my wife yelling at the TV when the mayor came on and says [sic],
"well, we're past this."

[Laughter]

“Houston is open for business!”

Yeah, ha!

[Laughter]

Not on the west end, mayor. Not on the west end.

(Addicks, Participants 1 and 2).

In addition to their other trauma, Addicks residents experienced stigmatization as others failed to appreciate their ongoing recovery struggles and judged them negatively.

4. Discussion

Participants shared similar experiences during and after Hurricane Harvey, though there were some notable differences by neighborhood. Overall, residents emphasized their reliance on their friends and neighbors to seek information about preparedness and help with evacuations and rescues. Friends and neighbors also lent support during muck and gut activities in the immediate aftermath of the storm, and most of the material support and donations during this time came from churches and other volunteer groups that visited the affected neighborhoods. Aid efforts in Addicks were more formally organized than in other neighborhoods, as residents coordinated their supplies and clean-up activities to support their neighbors whose homes had flooded. These volunteer efforts and support networks provided significant relief during the first week after Hurricane Harvey. Yet, this was followed by a confusing period of applying and waiting for assistance, especially from federal sources, which was a common source of stress in all four neighborhoods. Participants also reported continued mental strain following the storm, and Addicks residents in particular expressed feelings of isolation and stigmatization and felt they hadn't moved on as quickly as the rest of the city had.

In their review of the literature on social support following disasters due to natural hazards, Kaniasty and Norris [10] distinguish between the types of social support in a post-disaster community: received support (in the form of tangible support), perceived support (belief that support is available), and social embeddedness (relationships with other people). They also report on the different dynamics of social support, where there is heavy mobilization in the immediate aftermath of a disaster and an eventual waning as time goes by, as well as a deterioration of perceived support and social embeddedness [10]. We observed a similar pattern in the four communities in Houston, i.e., the initial community mobilization

and on-the-ground tangible support that residents received in the early days from family, neighbors, churches and volunteer groups allowed them to get back into their homes to start the cleaning process and possibly had a protective impact on their well-being [39], similar to findings from previous investigations of the buffering effect of social support on mental health following disasters [40-43]. Further, compared to the other three neighborhoods, Addicks residents appeared to have greater community capital in their quick mobilization of resources (e.g., access to Amazon lists to purchase and distribute supplies) and the leveraging of social networks through which they could organize themselves and solicit donations, as well as a sense of community pride in how they came together to support one another, all of which are important contributors to community disaster resilience [44,45]. Ultimately, however, as these informal channels of social support eventually dried up, residents in all four neighborhoods faced difficulties securing financial support from more official sources, which added to their distress.

In the weeks following the arrival of Hurricane Harvey, some Black East Houston residents, who were overwhelmed with the documentation required by organizations offering financial assistance and had some privacy concerns about sharing their information, ultimately did not receive any additional aid, which prolonged their recovery period. Though in a different domain, these experiences are in line with the well-documented lack of trust among Black communities in the medical mistrust literature, given the legacy of unethical practices and structural racism in the U.S [46]. They also point to the general frustrations residents across Houston had with the aid structures in place that led many of them to giving up and feeling let down. The lengthy wait times with applying for federal assistance echo post-Harvey news reports of the area [47], as well reports from focus groups conducted among survivors, where assistance with navigating systems for receiving aid was identified as an area of need one year after the flooding [32]. The post-Katrina (2005) and Sandy (2012) literature that examined residents' experiences with FEMA reported similar findings. Hurricane Katrina survivors reported long wait times while navigating an unclear and confusing process and the negative experiences of Black impoverished survivors contrasted with the more positive perspective of White middle-class survivors [48]. Despite documented racial and economic disparities in the extent of Hurricane Harvey flooding [18,19], the negative experience of applying for federal aid was reported by almost all participants in our study and residents were in agreement about the difficulties involved and the insufficient sums they received. A study that examined the association between social vulnerability and the receipt of post-disaster assistance following Hurricane Harvey found that the distribution of federal assistance was generally equitable with regard to race/ethnicity; that households with children were more likely to receive assistance (including from the federal government); and that Hispanic/Latinx households were more likely to receive assistance compared to non-Hispanic White households, suggesting that the latter was probably due to resource sharing among family and friends [26]. These findings may explain the relatively positive experience with FEMA as reported by the three residents who were either Hispanic/Latinx and received help from family members in their FEMA application process or had a child in the house during Harvey.

Similar to the complaints of a confusing application process that were common in this study, Greer and Trainor reported frustrations among Hurricane Sandy survivors, for whom the

most common complaint was the confusing and redundant paperwork [49]. Hurricane Sandy survivors suggested a lack of coordination at the agency as a possible reason for the difficult process, which was also echoed in comments that residents in our study made about the apparent confusion and lack of experience among FEMA agents. As reported in the two previous studies, these negative experiences increased Houston residents' waiting time and stress. One Addicks participant mentioned that FEMA's inability to help her added to her anxiety and this she attributed to the incompetence of the agent she was dealing with.

Participants also shared their experiences of traumatic events during the flooding, as well as their grief and regret over their losses, and described feelings of anxiety and depression and fear every time it rained. Reports of symptoms of PTSD, depression and anxiety are in line with the literature on Hurricanes Katrina [50,51], Ike [52], Sandy [53,54] and Maria [55,56], as well as preliminary assessments of survivors three weeks [22] and five months [20] after Harvey that reported symptoms of PTSD and depression associated with flood exposures and displacement.

A 2015 systematic review of 54 quantitative and qualitative studies on the mental health impact of flooding found consistent evidence of mental health disorders, including post-traumatic stress disorder, depression and anxiety [8], and the prevalence of these problems was associated with higher levels of threat during the flood or the extent of loss and damage experienced. This is consistent with what residents reported across different groups –their distress corresponded with their traumatic rescue or loss (of family members, pets, farm animals and family memorabilia) as well as the extent of damage they sustained from the flood and the concern they felt about starting over or losing it all again in another flood. Though reviews of the mental health impact of disasters have been primarily focused on the acute effects of exposure to flooding disasters and displacement, several investigations conducted among survivors of Hurricanes Katrina and Sandy reported a lasting impact on mental health and findings of PTSD and depression months and years after exposure [57-60]. Our findings suggest a similar lasting impact almost two years after Harvey: residents described persistent symptoms of depression and anxiety, as well as negative feelings triggered by rainfall. Furthermore, due to their inability to move past their flooding experience like their neighbors and the rest of city had after Harvey, Addicks residents felt isolated and stigmatized as “floodies”, perhaps because so many of these residents were evacuated from their homes during the storm. This is consistent with previous evidence of social isolation and the fracturing of social networks following disasters [61], as well as with self-reported social isolation among adolescents in New Orleans after hurricane Katrina [62].

Our study has several strengths and limitations. First, we recruited participants of diverse racial, ethnic, cultural, and socioeconomic backgrounds from Houston's highly impacted neighborhoods, which allowed us to capture experiences across groups who differed in their demographic profiles. Also, we examined a myriad of issues Houstonians faced, related to flooding, rescue, support, and financial assistance in the immediate aftermath of Hurricane Harvey, as well as the lingering impacts of this disaster that persisted almost two years later. However, we did not examine how language or language barriers might have shaped the experiences of monolingual (Spanish-speaking) residents or of undocumented Houstonians,

nor did we probe perceptions about racial or ethnic injustice in interactions with neighbors, volunteers, and aid agencies. It is possible that social desirability, a tendency to provide answers to questions that are consistent with dominant or prevailing views, may have led some who had good experiences with FEMA to remain quiet. The purpose of doing four focus groups was to act as a check for what may surface when conducting only one [63,64]. In addition to conducting multiple focus groups, we sought to minimize bias using recommended fieldwork strategies [65], including providing assurances that responses would remain confidential; using neutral questions that were prefaced with sufficient context; and following up with additional probes to seek clarification and allow for an expanded discussion. Another strength is the timing of this study almost two years after the event; we were able to characterize the long-term mental health strain and emotional distress residents faced, thereby addressing an important knowledge gap in the literature on chronic mental health effects of flooding disasters, particularly in the post-Harvey literature. Nonetheless, we recognize that participants may have exaggerated events occurring 20–22 months earlier, yet their memories of too much red tape, too little financial aid that arrived too late remained intact. Triangulating results with other data collection methods is a complementary approach to interpreting focus group data [66]. Findings from the parent study, news associations, and social media boost the reliability of the reports of our focus groups' participants. In lieu of possible biases in participants' responses, these results can be considered formative research that future investigators using multiple methods, including in-depth individual interviews, can build on.

5. Conclusion

Our findings underscore the importance of pre- and post-disaster interventions that engage community members in the assessment, planning and implementation stages. Residents relied on support networks as well as volunteers and church groups to organize rescue, relief, and clean-up efforts. This points to the need for disaster preparedness and response programs that leverage social support networks and other informal channels (such as neighborhood organizations and church groups), all of which were integral to gathering information and organizing different kinds of assistance during Harvey. Further, the continued mental strain associated with the short- and long-term stressors of experiencing Harvey points to the importance of post-disaster mental health assistance that addresses immediate needs after the event as well as alleviates stressors and supports survivors' recovery in the long-term.

Ensuring expedient and sufficient financial assistance should also be a primary focus in the post-disaster recovery period. The challenges residents faced in applying for federal aid are consistent with those faced by survivors of hurricanes Katrina and Sandy, suggesting missed opportunities for applying lessons learned from these previous disasters to Harvey which, despite the distinctly different characteristics of each event, may have lightened the burden on survivors during recovery. A report on the disproportionate impact of disasters due to natural hazards pointed to FEMA's organizational failures (in planning, staffing and training), which led to inadequate delays in supplies and financial assistance in all three hurricanes as well as Hurricane Maria in Puerto Rico [67].

Finally, in light of the increasing frequency and severity of disasters worldwide, as well as the certainty that Houston will experience another major disaster [68], investment in and commitment to building community resilience is essential for mitigating the impact of disasters, which is especially important for residents living in disadvantaged neighborhoods who typically bear the greatest burden of disasters [18,19,69]. As previously recommended by Maltz [67] and Dunning [70]; emergency preparedness and response policies and systems at the state and local government level might be better equipped for disaster preparedness and quick disaster response. Previous studies on coastal counties affected by Harvey also demonstrate that a community's perception of resilience is heavily dependent on the local context [27], and suggest that local policy-makers leverage community-based solutions and capacities for disaster resilience [28]. Further, the 2012 National Research Council report on disaster resilience emphasized the shared responsibility of all sections of the community in building resilience [71]. This requires engaged partnerships between community stakeholders, academics and policy makers to organize community resources and capital. In highlighting the unique experiences and needs of Houstonians during and after Hurricane Harvey, our study points to opportunities and lessons that may be prioritized in this respect.

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Data availability

The data that has been used is confidential.

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Table 1

Selected sociodemographic characteristics and information on flood damage and rescue during Hurricane Harvey among Houston-3H Study participants, Houston, TX, 2017–2019.

	Addicks		Baytown		East Houston		Meyerland	
	N = 64		N = 89		N = 110		N = 84	
	n	%	n	%	n	%	n	%
Age (years)								
Mean (SD)	62.6 (11.3)		50.0 (20.9)		40.8 (19.7)		50.1 (14.3)	
<18	1	1.6	10	11.2	21	19.1	0	0.0
18 to 34	0	0.0	12	13.5	19	17.3	10	11.9
35 to 44	2	3.1	5	5.6	20	18.2	23	27.4
45 to 64	34	53.1	33	37.1	32	29.1	38	45.2
65	26	40.6	28	31.5	16	14.5	12	14.3
Missing	1	1.6	1	1.1	2	1.8	1	1.2
Gender								
Male	25	39.1	27	30.3	37	33.6	27	32.1
Female	39	60.9	62	69.7	73	66.4	57	67.9
Race/ethnicity								
non-Hispanic Black	4	6.3	66	74.2	52	47.3	3	3.6
non-Hispanic White	51	79.7	11	12.4	3	2.7	55	65.5
Hispanic/Latinx	6	9.4	3	3.4	54	49.1	8	9.5
Other	3	4.7	8	9.0	1	0.9	18	21.4
Missing			1	1.1				
Education								
High School or Less	1	1.6	25	28.1	71	64.5	5	6.0
Some College	8	12.5	18	20.2	19	17.3	2	2.4
Undergraduate	26	40.6	32	36.0	10	9.1	26	31.0
Advanced Degree	28	43.8	11	12.4	3	2.7	51	60.7
Missing	1	1.6	3	3.4	7	6.4		
Employed								
Yes	24	37.5	48	53.9	27	24.5	68	81.0
No	39	60.9	39	43.8	73	66.4	16	19.0
Missing	1	1.6	2	2.2	10	9.1	0	0.0
Flooded home								
Yes	63	98.4	52	58.4	105	95.5	76	90.5
No	1	1.6	36	40.4	5	4.5	8	9.5
Missing			1	1.1				
Rescued								
Yes, by friend or neighbor	25	39.1	8	9.0	23	20.9	12	14.3
Yes, by emergency workers	27	42.2	17	19.1	22	20.0	6	7.1
No	11	17.2	58	65.2	54	49.1	63	75.0
Missing	1	1.6	6	6.7	11	10.0	3	3.6

	Addicks		Baytown		East Houston		Meyerland	
	N = 64		N = 89		N = 110		N = 84	
	n	%	n	%	n	%	n	%
Home damage								
Destroyed	2	3.2	2	3.8	7	6.7	4	5.3
Damaged, uninhabitable	53	84.1	20	38.5	32	30.5	36	47.4
Damaged, habitable	8	12.7	25	48.1	54	51.4	35	46.1
None or minimal			4	7.7	6	5.7	1	1.3
Missing			1	1.9	6	5.7		

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