Clinical Social Work Journal
https://doi.org/10.1007/s10615-024-00926-1

ORIGINAL PAPER

'Recovering from Tornado Brain': A Qualitative Analysis of Long-Term Needs after One of the Deadliest Tornadoes in U.S. History

Jennifer M. First[1] · Megan Carnahan[2] · Mansoo Yu[2] · Sangwon Lee[1] · J. Brian Houston[3]

Accepted: 7 February 2024

Abstract
This study examined qualitative open-ended responses from 359 residents in Joplin, Missouri who provided text comments about unmet needs they were facing 2.5 years following the May 22, 2011 EF-5 tornado. Strategies of content analysis were used to code the open-ended responses and identify the main themes of long-term needs. Four main themes were identified: (1) mental health needs, (2) affordable homes and safe shelters, (3) community rebuilding, and (4) household financial needs. These findings provide an understanding of individual experiences, perceptions, and challenges during long-term recovery. This data can be used to inform future long-term recovery interventions, policies, and programs.

Keywords Disaster · Recovery · Unmet needs · Mental health

Background

Tornadoes are considered to be one of the most violent phenomena of all atmospheric storms in nature (National Weather Service, n.d.). With an average of 1,200 tornadoes per year, the United States experiences the most tornadoes among all countries worldwide (NOAA National Severe Storms Laboratory, n.d.)). Tornadoes can have far-reaching consequences, causing widespread injury, property loss, and displacement while disrupting access to basic human needs such as food, water, and housing. Beyond the physical impacts, tornadoes can have significant psychological impacts, leading to various mental health disorders such as depression, anxiety, and post-traumatic stress disorder (Lee & First, 2022). The psychological and emotional consequences resulting from the stressors associated with a tornado can deplete individuals' coping resources, disrupt their social connections, and challenge their beliefs regarding the safety and predictability of the world (Hobfoll et al., 2007).

On May 22, 2011, a supercell thunderstorm produced an EF-5 tornado that struck the U.S. city of Joplin, Missouri, causing 161 fatalities, the deadliest tornado in U.S. history since the National Weather Service began keeping records in 1947 (National Weather Service, 2011). Additionally, over 1,000 individuals sustained injuries from the tornado, with many experiencing injuries from debris impacts. The tornado touched down around 5:30 PM CDT on May 22, 2011, and carved a path of destruction over six miles long and one mile wide (National Weather Service, 2011). As an EF-5 tornado on the Enhanced Fujita Scale, winds were estimated to be between 200 and 250 miles per hour. The tornado affected an estimated 7,500 homes and 500 businesses, resulting in $3 billion of property damage, the highest ever for a U.S. tornado (Kuligowski & Omori, 2014). It directly impacted 41% of Joplin's population, approximately 20,820 out of an estimated 50,175 residents (Kuligowski et al., 2014).

Recovery from large-scale disasters, such as the Joplin EF-5 tornado, can be extensive and long-lasting. Disaster recovery has been defined in multiple ways; most definitions emphasize that the overarching objective is to return to normalcy and includes both short and long-term phases (Chen et al., 2013; Goenjian et al., 2018). Short-term recovery typically overlaps with the disaster response phase and is focused on clearing debris, restoring critical infrastructure,

✉ Jennifer M. First
jfirst@utk.edu

[1] College of Social Work, University of Tennessee, 420 Henson Hall, Knoxville, TN, USA

[2] School of Social Work, University of Missouri, Columbia MO 65201, USA

[3] Public Health, University of Missouri, Columbia MO 65203, USA

Published online: 19 February 2024

repairing buildings and other damaged property, and providing mental health and emotional support to individuals and communities affected by the disaster (FEMA, 2016; Institute of Medicine, 2015). After the short-term disaster recovery phase concludes, the focus shifts towards the long-term recovery process. While short-term recovery primarily concentrates on restoring critical infrastructure, repairing property damage, and providing mental health support; long-term recovery encompasses addressing ongoing physical, economic, and psychosocial needs, as well as fostering strategies for disaster risk reduction and resilience-building, which may span several years or even decades (FEMA, 2016; Institute of Medicine, 2015).

Research on post-disaster recovery, despite its immense importance, remains one of the least explored areas within the field of natural hazards and disasters (Alipour et al., 2015; Chang & Rose, 2012). Disaster recovery can be a complex and demanding endeavor, as it involves interdependent tasks that must be undertaken simultaneously (e.g., restoration of infrastructure, housing, public services; Abramson et al., 2015). Successful recovery involves identifying and addressing barriers and unmet needs during the process of recovery (Bame et al., 2012). Unmet disaster needs refer to specific requirements and challenges faced by individuals and communities affected by a disaster that have not been adequately fulfilled or addressed during recovery (Bame et al., 2012). These needs often persist in the long term, extending beyond the immediate response and short-term recovery phases, and these needs disproportionately impact marginalized populations, exacerbating existing social, economic, and health disparities (Cutter et al., 2003; Enarson, 2012; Reid, 2013; Tierney, 2014). However, in the United States, existing disaster recovery policy frameworks primarily support the immediate aftermath and short-term recovery of disasters, typically emphasizing support for the initial 36 months following a disaster (Ghosh et al., 2022). While these policies are vital to quickly restore access to emergency healthcare services and tackle the direct health impacts of natural disasters, such as injuries, infections due to compromised water sources, and urgent medication requirements, this focus often overlooks the sustained and evolving needs that emerge in the long-term recovery phases (Finucane et al., 2020).

Furthermore, when it comes to disaster recovery data, quantitative studies have provided valuable insights into the magnitude and distribution of various recovery indicators, such as economic losses (Deryugina et al., 2018), infrastructure damage (Finucane et al., 2020), and the identification of vulnerable populations (Cutter et al., 2003). However, quantitative studies sometimes lack important context, history, and local knowledge of the recovery process (Merry, 2016). Qualitative research can complement and extend the identification and quantification of human needs and provide a deeper understanding of complex and multifaceted challenges (Palinkas, 2006; Terzis et al., 2022; Raven et al., 2018). However, few studies have captured the subjective experiences, perspectives, and nuance contexts of individuals and communities affected by disasters over the long term (Coffman & Noy, 2012; Nomura et al., 2016; Oloruntoba et al., 2018). Therefore, the intent of the current study is to provide an understanding and description of Joplin residents' experiences and perceptions of long-term disaster-related needs. To this end, we utilized qualitative content analysis methods to analyze 359 open-ended responses about long-term unmet needs from a cross-sectional survey administered to Joplin residents 2.5 years after the May 22, 2011 tornado. Our research question was as follows:

RQ1 What are Joplin residents' experiences and perceptions of unmet needs 2.5 years following the May 22, 2022 tornado?

Methods

Participants and Procedures

This qualitative descriptive study is part of a larger mix-method study that includes both quantitative and qualitative assessment and focused on post-disaster topics such as depression, social support, PTSD, mental health service utilization, and long-term effects of the May 22, 2011 tornado in Joplin, Missouri (Houston et al., 2015). Data were collected for the study using an online survey that was conducted approximately 2.5 years after the May 22, 2011 tornado (September 30 to December 13, 2013). The consent processes and all study procedures for the survey was reviewed and approved by University of Missouri Institutional Review Board. Participants were eligible for the study if they were at least 18 years old and were residents of Joplin, Missouri at the time of the 2011 tornado. In person recruitment for the study involved flyers posted and distributed in public locations in Joplin, Missouri (e.g., medical facilities and public libraries). Online recruitment for the study included flyers posted on Facebook pages about recovery from the Joplin tornado. All study recruitment materials included the Internet address that participants could use to access and complete the survey, designed in and hosted by Qualtrics online survey software (Qualtrics, 2023). When participants visited the online survey, they first read an informed consent form and were required to click the button "I agree" to indicate their consent to participate in the study. For the qualitative method, participants were

invited to provide detailed text responses to two questions using Qualtric's data collection platform that enables "Text Entry" responses. This functionality allowed respondents to provide text responses to the following questions: "*What, if any, current unmet does your community face following the Joplin tornado? What, if any, current unmet needs do you or your family face following the Joplin tornado?*" In this study, only the open-ended responses that participants provided in their own words were included from the survey items.

In total, 565 individuals consented to participate and started the survey. However, 127 participants discontinued the survey without completing more than half of the questions and 79 participants did not provide responses to the open-ended questions related to unmet needs. Participants who exited the online survey before completing more than half the questions and participants who did not answer the open-ended responses were not included in the current study's analysis. The final sample for the current study included 359 respondents who provided responses to questions on current unmet needs. Of the total sample size, 71.1% were female and 28.9% were male. The age distribution was relatively evenly distributed, with the majority falling in the 26–45 age range. Most of the sample identified as white, not of Hispanic origin, while other ethnicities were represented in much smaller numbers. The education level varied, with the largest group having some college education but no degree, followed closely by those with a college degree. Regarding income, the largest group fell in the $15,000 to $29,999 range. See Table 1 for demographic information of participants.

Table 1 Descriptive statistics of participants ($N = 359$)

	N	%
Gender		
Female	253	71.1
Male	103	28.9
Age		
18–25	31	8.6
26–35	76	21.2
36–45	86	24.0
46–55	95	26.5
56–65	58	16.2
Over 65	13	3.6
Race / Ethnicity		
American Indian / Alaska Native	10	2.8
Asian / Asian American	4	1.1
Black / African American / Afro-Caribbean	3	0.8
Hispanic / Latino / Latina / Latinx	3	0.8
White, not of Hispanic origin	336	91.3
Other	3	0.8
Education		
Grade school	2	0.5
Some high school	4	1.1
High School / GED	37	10.1
Some college, but no degree	122	33.2
College degree (A.A., B.A., BS, etc.)	114	31.0
Graduate degree (M.A., PhD, J.D., etc.)	79	21.5
Income		
Less than $15,000	27	7.6
$15,000 to $29,999	70	19.8
$30,000 to $44,999	49	13.8
$45,000 to $59,999	38	10.7
$60,000 to $74,999	44	12.4
$75,000 to $89,999	43	12.1
$90,000 to $104,999	25	7.1
$105,000 to $119,999	6	1.7
$120,000 to $134,999	10	2.8
$135,000 or more	24	6.8
Don't Know	18	5.1

Analysis

Participants submitted written comments about unmet needs they were facing related to the Joplin tornado resulting in 12,046 words and 46 pages of text. The length of the typed responses varied from three to four words to 723 words. Most of the open-ended responses ranged from 50 words to 100 words. Text from the open-ended responses was entered into NVivo 10 (Lumivero, 2023), a qualitative analysis software. We utilized a content analysis method that included multiple coding stages to identify the data's main themes. Content analysis is a qualitative analysis method that enables researchers to organize extensive textual information into manageable categories by identifying patterns, themes, and frequencies into participants' perspectives, experiences, and the significance they attach to them (Graneheim & Lundman, 2004; Patton, 1990). Our analysis began with first reading the written responses multiple times to familiarize ourselves with the data. This step helped develop a deep understanding of the content and context of the data. Next, we began the coding process, which involved systematically labeling data segments relevant to our research question. After generating initial codes, we collapsed the codes into broader categories (e.g., patterns, ideas, or concepts that emerge from the data) to identify overall themes to capture the overarching experiences of needs reported.

We undertook numerous techniques to ensure the credibility of our findings (Lincoln & Guba, 1985). Two of the authors conducted multiple rounds of coding. Throughout each coding stage, we wrote analytical notes and generated a codebook that included code names, operational definitions, instructions for when to apply codes, and data to illustrate the meaning of each code. We also met weekly to discuss and compare our coding themes and when discrepancies in coding occurred, we discussed our interpretations until we reached an overall consensus. The first and

second author ultimately conducted 10 weeks of intensive coding and refining of the 359 written responses, and then reviewed and discussed all the findings and themes with the five-person research team. Throughout the analysis process, we were committed to remaining attentive to potential biases and engaged in reflective practices to ensure the rigor and credibility of the analysis. The final themes of needs that emerged were: (1) mental health needs, (2) affordable homes and safe shelters, (3) community rebuilding, and (4) household financial needs.

Results

Content analysis of the qualitative open-ended responses identified four main overarching themes: (1) mental health needs, (2) affordable housing and safe shelters, (3) community rebuilding, and (4) household financial needs. A summary description of each of the themes and frequencies is provided in Table 2. Below we highlight each theme in more detail. All participant names provided are pseudonyms.

Mental Health Needs

This category was the largest category and contained the most description with almost half (42%) of the responses describing unmet mental health needs after the tornado. Many participants noted the lingering impact of the tornado experience on their daily life and the need for resources and support to help them regain a sense of normalcy. Terri described her symptoms as 'tornado brain':

> I need help concentrating and recovering from what we call 'tornado brain' in Joplin. Every time we hear the rumble of the storm, we think and hear the tornado happening. Two and half years later, it hasn't changed. People that did not experience the tornado personally, do not understand how much it has changed us. I would be thrilled to move on and quit thinking about it, but mentally, it hasn't happened yet.

Another participant, Shelly, also wrote about how severe weather and storms heightens her anxiety and impact daily activities like going to the store and driving:

> I need emotional help and getting all the terrible memories out of my head to be stronger for my kids. I'm still very frightened and on edge. I've taken on a lot of anxiety and now I fear everyday activities like going to the store and driving my car. I need help coping with the panic when the bad weather threatens and the fear and panic creep in. I am scared to death to be on the road or outside if the weather is sketchy because I am afraid to get run over if the sirens ever went off. I don't know if there's a way to counsel your nervous system, because regardless of your brain's take on things when sirens go off, those of us who were in danger shake on the inside.

Another respondent, Tina shared that she still experiences anxiety, sadness, and anger related to the tornado, "My greatest need is coping with my anxieties, sadness, and anger. I am angry that a town I grew up in has changed forever due to this event, and I am sad that I had to experience this event and that so many people suffered or lost their lives." Additional responses highlighted that many children and youth in the community also still struggled with anxiety and mental health needs. For example, Carol stated:

> We need more sensitivity in the schools that kids are still scared of storms - even in secondary schools. I have had to get my child from school on stormy days because he was so anxious. Do not just tell the kids to suck it up and get over it. There are so many children, teenagers that need counseling. They talk about it [tornado] a lot.

Additional participants detailed how many residents of Joplin were still facing psychological issues, including post-traumatic stress, depression, anxiety, and negative emotions related to the tornado that had gone untreated. Mike shared how he could receive mental health treatment but many others did not: "I sought psychological treatment after the tornado. I was completely broken. However, there are lots of people in Joplin with untreated PTSD." Another participant, Tom, described how he struggled with sleep issues,

Table 2 Main themes frequencies and codebook description

Unmet Need Domain		Codebook Description
Mental Health	$n = 149$ 42%	Needs related to psychological issues, including post-traumatic stress, depression, anxiety, and negative emotions related to the tornado experience.
Housing and Shelter	$n = 117$ 33%	Needs pertaining to temporary shelter, permanent housing, and attaining safe shelter during future severe storms and tornados.
Community Rebuilding	$n = 104$ 29%	Needs pertaining to rebuilding the community infrastructure (e.g., business, schools, hospitals, tree canopy) following the tornado experience.
Financial	$n = 73$ 20%	Needs related to finances, employment, insurance, transportation, food, and personal belongings following the tornado experience.

depression, and anxiety and how his neighbor also experiences anxiety:

> I currently live in an area that was completely flattened by the tornado. It is a community of duplexes. I had a lot of trouble after the tornado with lack of sleep, depression, and anxiety due to losing loved ones and doing search and rescue for two weeks afterward. Though I have received a lot of counseling and care… my neighbors do not seem to be recovering well… but they cope in their ways. One neighbor makes hundreds of beaded bracelets each week to help him with his anxiety

In terms of barriers to accessing mental health treatment, various participants described encountering financial barriers. Martin shared:

> I do not think many of us were financially able to seek the counseling we needed to deal with what happened to us and around us. Losing everything and experiencing what we went through was extremely tough. We need affordable therapy. I was diagnosed with PTSD 15 months after the tornado and with a $50 copayment, I stopped therapy before I really should have because I could not afford the sessions.

Affordable Housing and Safe Shelter

In this category, over a third of respondents (33%) expressed the importance of more affordable housing and safe shelter for residents following the tornado. The tornado destroyed close to one-third of the housing stock in the city and there was significant demand for housing in the affected areas. While many respondents noted that the community had increased housing options, including temporary housing, rental units, and new construction, they also noted that the availability of affordable housing remained a significant concern for many low-income families. One participant, Jerry stated:

> Housing has been majorly affected. Granted we have a lot of nice new housing but many people cannot afford this housing now, to find a home to rent in a reasonable ($500-$700) range is almost impossible. A lot of low-income housing was destroyed and those people cannot afford to build back their homes or leave with no options for a place to live. Right now, we need to find a way to provide housing for low-income families because we have a shortage of low-cost housing, especially for the long-term or permanently disabled.

Furthermore, participants noted the housing needs faced by low-income homeowners who did not have adequate insurance. While insurance can help mitigate some of the financial losses incurred by disaster survivors, not everyone had adequate coverage or could afford insurance premiums. Tim noted:

> Many people are still living in temporary homes because the tornado took their homes away from them and most homes were uninsured. So many people still need ongoing assistance after losing their homes and not having adequate insurance.

In addition to affordable housing needs, respondents also discussed the need for safe storm shelters in the event of future tornadoes. Phil wrote, "My first concern is designated shelters around the community because not everyone has a basement and they need someplace to go in a tornado. We absolutely need safer places to be built to have somewhere to go in future storms." Another participant, Cindy, highlighted the need for greater accessibility and affordability of storm shelters along with more information about where to find shelter during storms.

> We need to have more information out there about where to go for shelter during storms. Also, we need to have shelters or storm shelters cheaper for people without money to buy them. I think there should be a government grant that can help homes here have a storm shelter for each home. Because of the cost of building a shelter, it is hard for everyone to have it. I am always in fear that the tornado season is coming and my new house still does not have a shelter (lost my home in the tornado) it should be a top priority for this city for all houses to have a storm shelter.

Community Rebuilding

Over a quarter of respondents (29%) described the need for rebuilding the community's infrastructure (e.g., businesses, schools, hospitals, tree canopy) following the tornado. For example, Jin wrote about the need for building more businesses: "To continue to rebuild and especially bring in new businesses to the Joplin area so it does not seem so empty and such reminders." Many responses also emphasized that the community rebuilding process also contributed to addressing some of the psychological impacts of the tornado. They acknowledged that the ongoing exposure to the destruction was a daily reminder of the losses endured during the tornado, further emphasizing the need for comprehensive rebuilding efforts. Another participant said: "Even

after two years, areas still need to be rebuilt. Some areas still have no electricity supply of materials and there are areas that still have no street lighting and it's eerie & uncomfortable for people living there." One participant, Lee shared about the need for rebuilding businesses, houses, and trees:

> We have needs with returning businesses and rebuilding in the community as we still need major cleanup with so many destroyed buildings that are left. I live on a street with no houses or trees, which is a constant reminder of the many dead bodies I saw that day.

Other respondents also emphasized the need for replanting trees and restoring a healthy tree canopy in the community as important. Fay wrote:

> We need to rebuild and restore Joplin to the beauty it was before—especially the trees. We lack mature trees. The neighborhoods are so barren of tree height that it looks as though the tornado could have happened just yesterday. We need to wipe away the look of destruction.

Household Financial Needs

Close to a quarter of responses (20%) detailed needs related to finances, employment, insurance, transportation, food, and personal belongings. increased financial burdens. For example, Mel stated: "The tornado financially changed my life, I struggle every day to make ends meet for my family!" Responses also highlighted that there were many tornado-related costs incurred by individuals and families that insurance would not cover. For example, participants reported that insurance did not cover roof damage and cracks. Mark stated:

> Because my house was not totally destroyed, I didn't get any help at all. I have issues with cracks in my ceilings and then my walls due to my foundation being moved. I also have a lot of air and drafts coming into my house. Insurance will not cover this or fix the roof damage.

Other participants shared about insurance not covering their cars and vehicles. Mary reported, "We lost our only vehicle, our insurance didn't cover it. And we have been driving beat up, wrecked, cheap/free nobody wants any more cars. We still need a reliable working vehicle."

Furthermore, many families faced new financial needs due to the cost of higher home insurance premiums placing an additional financial strain on them. For example, John wrote:

> We have so many financial needs – we never got any help from the government though we complied with all requests for details. We were told we met the requirements but then never heard back. And our family now has new financial needs because we are paying higher home insurance as premiums have gone through the roof following the tornado.

Discussion

Major disaster events, such as the May 2011 EF-5 tornado in Joplin, Missouri, can inflict considerable physical and psychological destruction on individuals, families, and communities. As a result, disaster survivors can experience many post-disaster needs, and the range and types of needs may change over time. From 359 open-ended responses, findings from this study revealed several key themes related to long-term needs following the Joplin tornado. These themes include mental health needs, affordable housing and safe shelters, community rebuilding, and household financial needs. Each theme represents a significant area of concern voiced by residents of Joplin and highlights the ongoing challenges individuals and communities face during disaster recovery.

First, our findings indicate that the Joplin tornado's aftermath revealed mental health as a critical area of concern, with nearly half of the respondents describing unmet mental health needs 2.5 years after the tornado. Participants expressed the lingering impact of the tornado on their daily lives, describing various psychological distress symptoms such as anxiety, depression, post-traumatic stress, and difficulty coping with tornado-related triggers. In addition, participants noted the lack of access to affordable mental health resources, and counseling was a significant barrier to treating their unmet mental health needs. These results align with previous studies that have documented the prevalence of mental health needs during long-term recovery (Abramson et al., 2015; Fernández et al., 2022; First & Houston, 2022). Our findings underscore the importance of addressing mental health as an essential component of long-term disaster recovery and highlight the need for affordable and accessible mental health services in the community.

Next, accessible and affordable housing availability in the long-term recovery period was also highlighted as a persistent concern by participants, particularly for marginalized and vulnerable populations. Multiple studies have highlighted the intersection of post-disaster housing needs

with social inequalities, including issues related to race, ethnicity, income disparity, and access to resources (Gaillard et al., 2019; Hamideh et al., 2021; Norris et al., 2002; Peacock et al., 2014; Peleg et al., 2002; Peek et al., 2021; Rathfon et al., 2013; Stough et al., 2016). Additionally, participants continually discussed the need for safe shelters, particularly for individuals without basements or adequate shelter during severe weather events. According to the National Institute of Standards and Technology (Kuligowski et al., 2014), a disproportionately high number of fatalities from the Joplin tornado occurred in residential homes due to inadequate structural conditions and the absence of basements, surpassing historical averages. Our findings suggest that long-term efforts to address housing needs should focus on affordability, accessibility, and the provision of offering safe sheltering options for all residents during future storms.

Furthermore, community rebuilding emerged as a prominent theme of need that encompassed various aspects of long-term infrastructure restoration and recovery. Participants expressed the continued need to rebuild businesses, schools, and hospitals and restore the tree canopy across the city. As many participants noted in their responses, the ongoing and long-term exposure to the tornado destruction served as a constant reminder of the losses endured, emphasizing the significance of comprehensive and continued community rebuilding efforts moving forward. Additionally, many participants noted the destruction of the natural environment (e.g., tree canopy) caused by the tornado. Prior studies have shown addressing damage to the local natural ecosystem, which is known to foster better individual health and well-being (Bratman et al., 2019). Together, these findings highlight the importance of community rebuilding involving restoring a sense of normalcy, promoting economic growth, and creating a social and natural environment to support the well-being of individuals and the community. In addition, household financial needs were also identified as a significant concern among respondents. The tornado brought about increased financial burdens for many individuals and families, including expenses related to housing, insurance, transportation, and personal belongings. Participants reported increased difficulties meeting financial obligations and expressed frustrations with the lack of government assistance and higher home insurance premiums. These findings support and underscore prior research that has identified the long-term economic impact of disaster on communities and the need for financial support, resources, and policies that address long-term financial challenges faced by affected households (Abramson et al., 2015; Hawkins & Maurer, 2011; Saunders & Becker, 2015).

Beyond identifying the frequencies and types of unmet needs reported at 2.5 years following the May 2011 Joplin, Tornado, this study also provides insights into the embodied and emotional dimensions of recovery challenges that quantitative research cannot fully capture. For example, regarding long-term mental health impacts many survivors reported how the tornado continued to negatively impact their daily functioning, including concentrating (labeled as "tornado brain"), parenting duties, driving, and daily flashbacks of traumatic scenes ("the many dead bodies I saw that day"). The emotional and psychological responses were also described as heightened during storm seasons, with triggers bringing back vivid memories and feelings of fear, helplessness, and vulnerability ("when the bad weather threatens and the fear and panic creep in").

Furthermore, the interconnectedness of each of the main themes is evident. For example, mental health was not found to be an isolated domain but was intricately linked to other needs that participants reported. Similarly, participants' reports of financial strain were linked to mental and physical needs. These findings highlight the importance of a comprehensive and integrated approach to long-term disaster recovery that recognizes the interdependencies of various dimensions of individual and community needs (Abramson et al., 2015). Overall, this study's analysis of open-ended responses provides insights into unmet needs and challenges during long-term recovery while honoring the voices of disaster survivors who wanted to make their needs heard.

These findings have several implications for social work, as social workers provide a broad range of micro, mezzo, and macro-level services that address immediate needs and support recovery efforts among individuals, families, and communities affected by disasters (Bauwens & Naturale, 2017). Understanding the ongoing needs and challenges individuals and communities face can inform recommendations for clinicians and policymakers about individual and community-level needs to target for long-term support and recovery. For example, social workers providing services at the micro and mezzo levels often offer psycho-social support and interventions (e.g., psychological first aid, crisis counseling) and case management support for navigating the landscape of recovery resources, such as insurance claims, government aid, and housing assistance. Understanding that many individuals and families may still be in need of psycho-social support over the long term is important for clinicians working in communities post-disaster. However, the majority of existing disaster recovery policies in the U.S. typically provide support for up to three years post-disaster (Ghosh et al., 2022). As our findings indicate, many communities may require supplemental long-term recovery programs and policies aimed at providing affordable housing options and safe shelters, facilitating community rebuilding efforts, ensuring continued access to mental health services, and offering financial support to those most impacted. At a

macro level, social workers can advocate for such policies and programs at local, state, and national levels. In addition, the findings from this study underscore the complex, multi-dimensional nature of long-term disaster recovery, emphasizing that various needs, from housing to mental health to financial stability, are frequently interlinked (First & Houston, 2022). Consequently, a comprehensive approach (e.g., micro, mezzo, macro), as opposed to only a singular one (e.g., micro level), to disaster recovery is important (Abramson et al., 2015). In this context, a multi-level disaster resilience approach is important for social workers working in long-term recovery. Such an approach can assess a range of individual and community needs, including psychological, social, economic, and infrastructure aspects, leading to a more complete picture of the recovery needs (see First & Houston, 2022 for a multi-level framework for social workers).

Finally, we also want to note that social workers and other helping professionals living in Joplin, Missouri (e.g., healthcare providers, emergency responders, etc.) may have been personally impacted while also being tasked with supporting their communities through response and recovery. For example, following Hurricane Katrina, the National Association of Social Workers estimated that at least 1,000 social workers experienced major losses due to the storm (National Association of Social Workers, 2005). Tosone and colleagues (2015) highlight how social workers working in the Gulf area after Hurricane Katrina experienced competing personal and professional needs, wherein their personal concerns and priorities (e.g., mental, social, physical needs) may be in conflict with the demands of their work. Likewise, additional studies have highlighted social workers' responses to collective traumatic events that may result in shared traumatic experiences and compassion fatigue (Boscarino et al., 2004; Figley, 1995; Tosone et al., 2003, 2010, 2011, 2012). While our study did not capture the long-term unmet needs of social workers living in communities exposed to disaster, we believe this is an important area of continued research in the wake of climate change, with essential implications for social work practice and education.

Limitations

This study focused on unmet needs identified by residents of Joplin, Missouri, who experienced an EF-5 tornado. Our study sample was from a rural area in the United States with a majority of white respondents. The findings may not be generalizable to other populations or those affected by other types of disasters, as geographical, cultural, and social factors may influence both the needs arising after a disaster and the resources available for recovery. The data was collected 2.5 years after the tornado and provides valuable insight into long-term recovery needs but may not reflect the immediate needs in the aftermath of the disaster. However, it also does not capture changes in needs that may occur beyond this time point, and future longitudinal studies on unmet needs are warranted. In addition, this study did not examine associations with demographic factors such as race, sex, and age, which may represent important factors to be investigated in further research. Another limitation is that more than 10 years have elapsed since these data were collected, which might influence the analysis. However, Patsopoulos and Ioannidis (2009) caution against undervaluing data due to its age, and Abu-Hamad et al. (2022) note that ongoing increases in knowledge about disaster mental health may improve the interpretation of findings across the passages of time. Furthermore, additional research studies have been recently conducted on the impacts of the Joplin 2021 EF-5 tornado to uncover additional findings and apply lessons learned to other U.S. tornado-prone communities (Kuligowski, 2014;, 2021). Finally, in terms of additional limitations, while our open-ended responses were capable of yielding meaningful qualitative insights, the data may not be as in-depth as qualitative narratives and interviews, and we encourage these types of qualitative data collection to capture unmet needs in long-term disaster recovery. Despite these limitations, this study provides a valuable contribution to the understanding of long-term recovery needs following a major disaster.

Conclusion

In the current study, we used qualitative, open-ended responses gathered from 359 residents of Joplin, Missouri to assess their ongoing, unmet needs 2.5 years post the EF-5 tornado that took place on May 22, 2011. Employing content analysis methodologies, the study identified four primary themes that embody long-term recovery needs: mental health support, accessibility to affordable and safe housing, community rebuilding, and household financial needs. These findings provide an understanding of the individual experiences, perceptions, and challenges that emerged during long-term recovery and can be used to inform future disaster recovery interventions, policies, and programs.

Acknowledgements The authors wish to thank Ozark Center and Will's Place in Joplin, Missouri for their assistance with recruitment.

Funding This research was supported by the U.S. Substance Abuse and Mental Health Services Administration (SAMHSA) through the Disaster and Community Crisis Center (DCC; http://dcc.missouri.edu) at the University of Missouri.

Declarations

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the University of Missouri Institutional Review Board and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of Interest The authors declare no conflict of interest.

Informed Consent Informed consent was obtained from all subjects involved in the study.

References

Abramson, D. M., Grattan, L. M., Mayer, B., Colten, C. E., Arosemena, F. A., Bedimo-Rung, A., & Lichtveld, M. (2015). The resilience activation framework: A conceptual model of how access to social resources promotes adaptation and rapid recovery in post-disaster settings. *Journal of Behavioral Health Service and Research*, *42*(1), 42–57. https://doi.org/10.1007/s11414-014-9410-2.

Abu-Hamad, S. J., Pollio, D. E., Moden, M., & North, C. S. (2022). A qualitative study of immediate and evolving reactions of directly-exposed survivors of the oklahoma city bombing. *International Journal of Mass Emergencies & Disasters*, *40*(2), 184–204. https://doi.org/10.1177/028072702204000204

Alipour, F., Khankeh, H., Fekrazad, H., Kamali, M., Rafiey, H., & Ahmadi, S. (2015). Social issues and post-disaster recovery: A qualitative study in an Iranian context. *International Social Work*, *58*(5), 689–703. https://doi.org/10.1177/0020872815584426.

Bame, S. I., Parker, K., Lee, J. Y., Norman, A., Finley, D., Desai, A., Grover, A., Payne, C., Garza, A., Shaw, A., Bell-Shaw, R., Davis, T., Harrison, E., Dunn, R., Mhatre, P., Shaw, F., & Robinson, C. (2012). Monitoring unmet deeds: Using 2-1-1 during natural disasters. *American Journal of Preventive Medicine*, *43*(6, Supplement 5), S435–S442. https://doi.org/10.1016/j.amepre.2012.09.002.

Bauwens, J., & Naturale, A. (2017). The role of Social Work in the Aftermath of disasters and traumatic events. *Clinical Social Work Journal*, *45*, 99–101. https://doi.org/10.1007/s10615-017-0623-8.

Boscarino, J. A., Figley, C. R., & Adams, R. E. (2004). Compassion fatigue following the September 11 terrorist attacks: A study of secondary trauma among New York City social workers. *International Journal of Emergency Mental Health*, *6*(2), 57–66.

Bratman, G. N., Anderson, C. B., Berman, M. G., Cochran, B., de Vries, S., Flanders, J., Folke, C., Frumkin, H., Gross, J. J., Hartig, T., Kahn, P. H. Jr., Kuo, M., Lawler, J. J., Levin, P. S., Lindahl, T., Meyer-Lindenberg, A., Mitchell, R., Ouyang, Z., Roe, J., Scarlett, L., Smith, J. R., van den Bosch, M., Wheeler, B. W., White, M. P., Zheng, H., & Daily, G. C. (2019). Nature and mental health: An ecosystem service perspective. *Science Advances*, *5*(7), eaax0903. https://doi.org/10.1126/sciadv.aax0903.

Chang, S. E., & Rose, A. Z. (2012). Towards a theory of economic recovery from disasters. *International Journal of Mass Emergencies & Disasters*, *30*(2), 171–181. https://doi.org/10.1177/028072701203000202.

Chen, J., Chen, T. H. Y., Vertinsky, I., Yumagulova, L., & Park, C. (2013). Public–private partnerships for the development of disaster resilient communities. *Journal of Contingencies and Crisis Management*, *21*(3), 130–143. https://doi.org/10.1111/1468-5973.12021.

Coffman, M., & Noy, I. (2012). Hurricane Iniki: Measuring the long-term economic impact of a natural disaster using synthetic control. *Environment and Development Economics*, *17*(2), 187–205. https://doi.org/10.1017/S1355770X11000350.

Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social vulnerability to environmental hazards. *Social Science Quarterly*, *84*(2), 242–261. https://doi.org/10.1111/1540-6237.8402002.

Deryugina, T., Kawano, L., & Levitt, S. (2018). The economic impact of hurricane Katrina on its victims: Evidence from individual tax returns. *American Economic Journal: Applied Economics*, *10*(2), 202–233. https://doi.org/10.1257/app.20160307.

Enarson, E. P. (2012). *Women confronting natural disaster: From vulnerability to resilience*. Lynne Rienner. https://books.google.com/books?id=De7zoAEACAAJ.

FEMA. (2016). What is recovery- FEMA Training, Chap. 11. Community Disaster Recovery https://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=0CAIQw7AJahcKEwi4qP67i4-AAxUAAAAAHQAAAAAQAw&url=https%3A%2F%2Ftraining.fema.gov%2Fhiedu%2Fdocs%2Ffem%2Fchapter%252011%2520-%2520community%2520disaster%2520recovery.doc&psig=AOvVaw38DHtkrOTq72h8dIbgcZ54&ust=1689454733288517&opi=89978449. (accessed on 14 July, 2023)

Fernández-de-las-Peñas, C., Martín-Guerrero, J. D., Cancela-Cilleruelo, I., Rodríguez-Jiménez, J., Moro-López-Menchero, P., & Pellicer-Valero, O. J. (2022). Exploring trajectory recovery curves of post-COVID cognitive symptoms in previously hospitalized COVID-19 survivors: The LONG-COVID-EXP-CM multicenter study. *Journal of Neurology*, *269*(9), 4613–4617. https://doi.org/10.1007/s00415-022-11176-x.

Figley, C. R. (Ed.). (1995). *Compassion fatigue: Coping with secondary traumatic stress disorder in those who treat the traumatized*. Brunner/Mazel.

Finucane, M. L., Acosta, J., Wicker, A., & Whipkey, K. (2020). Short-term solutions to a long-term challenge: Rethinking disaster recovery planning to reduce vulnerabilities and inequities. *International Journal of Environmental Research and Public Health*, *17*(2), 482. https://www.mdpi.com/1660-4601/17/2/482

First, J. M., & Houston, J. B. (2022). The mental health impacts of successive disasters: Examining the roles of individual and community resilience following a tornado and COVID-19. *Clinical social work journal*, *50*(2), 124–134. https://doi.org/10.1007/s10615-021-00830-y

Gaillard, J. C., Walters, V., Rickerby, M., & Shi, Y. (2019). Persistent precarity and the disaster of everyday life: Homeless people's experiences of natural and other hazards. *International Journal of Disaster Risk Science*, *10*(3), 332–342. https://doi.org/10.1007/s13753-019-00228-y.

Ghosh, A. K., Shapiro, M. F., & Abramson, D. (2022). Closing the Knowledge Gap in the Long-Term Health effects of Natural disasters: A research agenda for improving Environmental Justice in the age of Climate Change. *International Journal of Environmental Research and Public Health*, *19*(22), 15365. https://doi.org/10.3390/ijerph192215365.

Goenjian, A. K., Khachadourian, V., Armenian, H., Demirchyan, A., & Steinberg, A. M. (2018). Posttraumatic Stress Disorder 23 Years After the 1988 Spitak Earthquake in Armenia.

Graneheim, U. H., & Lundman, B. (2004). Qualitative content analysis in nursing research: Concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today*, *24*(2), 105–112. https://doi.org/10.1016/j.nedt.2003.10.001.

Hamideh, S., Peacock, W. G., & Zandt, S. V. (2021). Housing type matters for pace of recovery: Evidence from hurricane Ike. *International Journal of Disaster Risk Reduction*, *57*, 102149. https://doi.org/10.1016/j.ijdrr.2021.102149.

Hawkins, R. L., & Maurer, K. (2011). You fix my community, you have fixed my life': The disruption and rebuilding of ontological

security. *In New Orleans Disasters*, *35*(1), 143–159. https://doi.org/10.1111/j.1467-7717.2010.01197.x.

Hobfoll, S. E., Watson, P., Bell, C. C., Bryant, R. A., Brymer, M. J., Friedman, M. J., Friedman, M., Gersons, B. P. R., Jong, J. T. V. M., Layne, C. M., Maguen, S., Neria, Y., Norwood, A. E., Pynoos, R. S., Reissman, D., Ruzek, J. I., Shalev, A. Y., Solomon, Z., Steinberg, A. M., & Ursano, R. J. (2007). Five essential elements of immediate and mid–term mass trauma intervention: Empirical evidence. *Psychiatry: Interpersonal and Biological Processes*, *70*(4), 283–315. https://doi.org/10.1521/psyc.2007.70.4.283.

Houston, J. B., Spialek, M. L., Stevens, J., First, J. M., Mieseler, V. L., & Pfefferbaum, B. (2015). 2011 Joplin, missouri tornado experience, mental health reactions, and service utilization: Cross-sectional assessments at approximately 6 months and 2.5 years post-event. *PLOS Currents Disasters*, *26*(1). https://doi.org/10.1371/currents.dis.18ca227647291525ce3415bec1406aa5.

Institute of Medicine; Board on Health Sciences Policy; Committee on Post-Disaster Recovery of a Community's Public Health, Medical, and Social Services (2015). *Healthy, Resilient, and Sustainable Communities After Disasters: Strategies, Opportunities, and Planning for Recovery*. Washington (DC): National Academies Press (US); 2015 Sep 10. Available from: https://www.ncbi.nlm.nih.gov/books/NBK316532/https://doi.org/10.17226/18996.

Journal of Traumatic Stress, *31*(1), 47–56. https://doi.org/10.1002/jts.22260.

Kuligowski, E. (2021). Evacuation decision-making and behavior in wildfires: Past research, current challenges and a future research agenda. *Fire Safety Journal*, *120*, 103129.

Kuligowski, E. D., & Omori, H. (2014). *General guidance on emergency communication strategies for buildings*. US Department of Commerce, National Institute of Standards and Technology. Gaithersburg, MD, [online], https://doi.org/10.6028/NIST.TN.1827 (Accessed July 14, 2023).

Kuligowski, E. D., Lombardo, F. T., Phan, L., Levitan, M. L., & Jorgensen, D. P. (2014). Final report, National Institute of Standards and Technology (NIST) technical investigation of the May 22, 2011, tornado in Joplin, Missouri. https://doi.org/10.6028/NIST.NCSTAR.3.

Lee, S., & First, J. M. (2022). Mental health impacts of tornadoes: A systematic review. *International Journal of Environmental Research and Public Health*, *19*(21), 13747. https://www.mdpi.com/1660-4601/19/21/13747.

Lincoln, Y., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.

Lumivero (2023). *NVivo* (Version 10). Colorado, Denver. https://www.lumivero.com.

Merry, S. E. (2016). *The seductions of quantification: Measuring human rights, gender violence, and sex trafficking*. University of Chicago Press.

National Association of Social Workers (2005) Social workers professionals greatly affected by hurricane katrina, available online at https://www.socialworkers.org/pressroom/2005/091505.asp.

National Weather Service (2011). NWS Central Region service assessment: Joplin, Missouri, tornado, May 22, 2011. https://repository.library.noaa.gov/view/noaa/6576 (accessed on 14 July, 2023).

National Weather Service. (n.d.). Tornado definition. www.weather.gov. https://www.weather.gov/phi/TornadoDefinition (accessed on 14 July, 2023)

NOAA National Severe Storms Laboratory (n.d.). Severe weather 101 Tornado basics. https://www.nssl.noaa.gov/education/svrwx101/tornadoes/ (accessed on 14 July, 2023)

Nomura, S., Parsons, A. J. Q., Hirabayashi, M., Kinoshita, R., Liao, Y., & Hodgson, S. (2016). Social determinants of mid- to long-term disaster impacts on health: A systematic review. *International Journal of Disaster Risk Reduction*, *16*, 53–67. https://doi.org/10.1016/j.ijdrr.2016.01.013.

Norris, F. H., Friedman, M. J., & Watson, P. J. (2002). 60,000 disaster victims speak: Part II. Summary and implications of the disaster mental health research. *Psychiatry*, *65*(3), 240–260. https://doi.org/10.1521/psyc.65.3.240.20169.

Oloruntoba, R., Sridharan, R., & Davison, G. (2018). A proposed framework of key activities and processes in the preparedness and recovery phases of disaster management. *Disasters*, *42*(3), 541–570. https://doi.org/10.1111/disa.12268.

Palinkas, L. A. (2006). Qualitative approaches to studying the effects of disasters. *Methods for disaster mental health research*. The Guilford.

Patsopoulos, N. A., & Ioannidis, J. P. (2009). The use of older studies in meta-analyses of medical interventions: A survey. Open medicine: A peer-reviewed, independent. *open-access Journal*, *3*(2), e62–e68.

Patton, M. Q. (1990). *Qualitative evaluation and research methods* (2nd ed.). Sage.

Peacock, W. G., Van Zandt, S., Zhang, Y., & Highfield, W. E. (2014). Inequities in long-term housing recovery after disasters. *Journal of the American Planning Association*, *80*(4), 356–371. https://doi.org/10.1080/01944363.2014.980440.

Peek, L., Wachtendorf, T., & Meyer, M. A. (2021). Sociology of Disasters. In: Schaefer Caniglia, B, Jorgenson, A., Malin, S.A., Peek, L., Pellow, D.N., Huang, X. (Eds.) Handbook of Environmental Sociology. Handbooks of Sociology and Social Research. Springer, Cham https://doi.org/10.1007/978-3-030-77712-8_11.

Peleg, K., Reuveni, H., & Stein, M. (2002). Earthquake disasters–lessons to be learned. *The Israel Medical Association Journal: IMAJ*, *4*(5), 361–365. http://europepmc.org/abstract/MED/12040826.

Qualtrics. (2023). *Qualtrics software*. Utah. https://www.qualtrics.com.

Rathfon, D., Davidson, R., Bevington, J., Vicini, A., & Hill, A. (2013). Quantitative assessment of post-disaster housing recovery: A case study of Punta Gorda, Florida, after Hurricane Charley. *Disasters*, *37*(2), 333–355. https://doi.org/10.1111/j.1467-7717.2012.01305.x.

Raven, J., Baral, S., Wurie, H., Witter, S., Samai, M., Paudel, P., Subedi, H. N., Martineau, T., Elsey, H., & Theobald, S. (2018). What adaptation to research is needed following crises: A comparative, qualitative study of the health workforce in Sierra Leone and Nepal. *Health Research Policy and Systems*, *16*(1), 6. https://doi.org/10.1186/s12961-018-0285-1.

Reid, M. (2013). Disasters and social inequalities. *Sociology Compass*, *7*(11), 984–997. https://doi.org/10.1111/soc4.12080.

Saunders, W. S. A., & Becker, J. S. (2015). A discussion of resilience and sustainability: Land use planning recovery from the Canterbury earthquake sequence, New Zealand. *International Journal of Disaster risk Reduction*, *14*, 73–81.

Stough, L. M., Sharp, A. N., Resch, J. A., Decker, C., & Wilker, N. (2016). Barriers to the long-term recovery of individuals with disabilities following a disaster. *Disasters*, *40*(3), 387–410. https://doi.org/10.1111/disa.12161.

Terzis, L. D., Saltzman, L. Y., Logan, D. A., Blakey, J. M., & Hansel, T. C. (2022). Utilizing a matrix approach to analyze qualitative longitudinal research: A case example during the COVID-19 pandemic. *International Journal of Qualitative Methods*, *21*, 16094069221123723. https://doi.org/10.1177/16094069221123723.

Tierney, K. (2014). *The social roots of risk: Producing disasters, promoting resilience*. Stanford University Press.

Tosone, C., Bialkin, L., Campbell, M., Charters, M., Gieri, K., Gross, S., Grounds, C., Johnson, K., Kitson, D., Lanzo, S., Lee, M., Martinez, A., Martinez, M. M., Milich, J., Riofrio, A., Rosenblatt, L., Sandler, J., Scali, M., Spiro, M., & Stefan, A. (2003). Shared Trauma: Group reflections on the September 11th

disaster. *Psychoanalytical Social Work*, *10*(1), 57–77. https://doi.org/10.1300/J032v10n01_06.

Tosone, C., Bettmann, J. E., Minami, T., & Jasperson, R. A. (2010). New York City social workers after 9/11: Their attachment, resiliency, and compassion fatigue. *International Journal of Emergency Mental Health*, *12*(2), 103–116.

Tosone, C., McTighe, J. P., Bauwens, J., & Naturale, A. (2011). Shared traumatic stress and the long-term impact of 9/11 on Manhattan clinicians. *Journal of Traumatic Stress*, *24*(5), 546–552.

Tosone, C., Nuttman-Shwartz, O., & Stephens, T. (2012). Shared trauma: When the professional is personal. *Clinical Social Work Journal*, *40*, 231–239.

Tosone, C., McTighe, J. P., & Bauwens, J. (2015). Shared traumatic stress among Social Workers in the Aftermath of Hurricane Katrina. *The British Journal of Social Work*, *45*(4), 1313–1329. http://www.jstor.org/stable/43687907.