Research Report

Cognitive Interview Validation of a Novel Household Hazard Vulnerability Assessment Instrument

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Abstract

Background: Weather and climate disasters are responsible for over 13 000 US deaths, worsened morbidity, and $1.7 trillion in additional costs over the last 40 years with profound racial disparities.

Objectives: This project empirically generated items for a novel survey instrument of household hazard vulnerability with initial construct validation while addressing racial bias in the data collection process.

Methods: Cognitive interviews facilitated understanding regarding the performance of drafted survey questions with transdisciplinary expert panelists from diverse US regions on unique hazard/disaster/event items. To prevent representation bias in data collection, those with Black and/or African American racial, biracial, or multiracial identities were over-sampled. Interview video recordings were qualitatively analyzed using thematic and pattern coding.

Results: A cognitive process mapped to themes of disaster characteristics, resources, individual life facets, and felt effects was revealed. We identified 379 unique instances of linked terms as synonyms, co-occurring, compounding, or cascading events. Potential for racial bias in data collection was elucidated. Analysis of radiation exposure, trauma, and criminal acts of intent items revealed participants may not interpret survey items with these terms as intended.

Conclusion: Potential for racial bias exists relative to water dam failure, evacuation, external flood, suspicious packages/substances, and transportation failure. Hazard terms that were not interpreted as intended require further revision in the validation process of individual or household disaster vulnerability assessments. Several commonalities in the cognitive process and mapping of disaster terms may be utilized in disaster and climate change research aimed at the individual and household unit of analysis.

Keywords

racial bias, survey and questionnaire development, validation studies, disasters, environment and public health, hazard analysis

In the United States, weather and climate disasters are increasing in frequency and severity, responsible for over 13 000 deaths, $1.75 trillion in additional costs, and worsened morbidity over the last 40 years.[1] Marginalized groups may be more at risk for persistent, negative health outcomes following disasters, and quantifying this risk is a necessary initial step in working to eliminate disparities in large-scale disaster health outcomes. Hazard vulnerability analyses are often used by health care organizations and the US government to systematically assess risk and aid in response planning and risk reduction; however, no household-level hazard vulnerability assessment currently exists.[2] A valid and reliable assessment tool to measure household hazard vulnerability assessment is necessary to identify and reduce risk for individuals and households most impacted by climate change and weather-related disasters. This work prioritizes people at the intersection of 3 at-risk groups: (1) older adults, (2) individuals with Black racial identities, and (3) those with chronic obstructive respiratory diseases (COPDs, chronic

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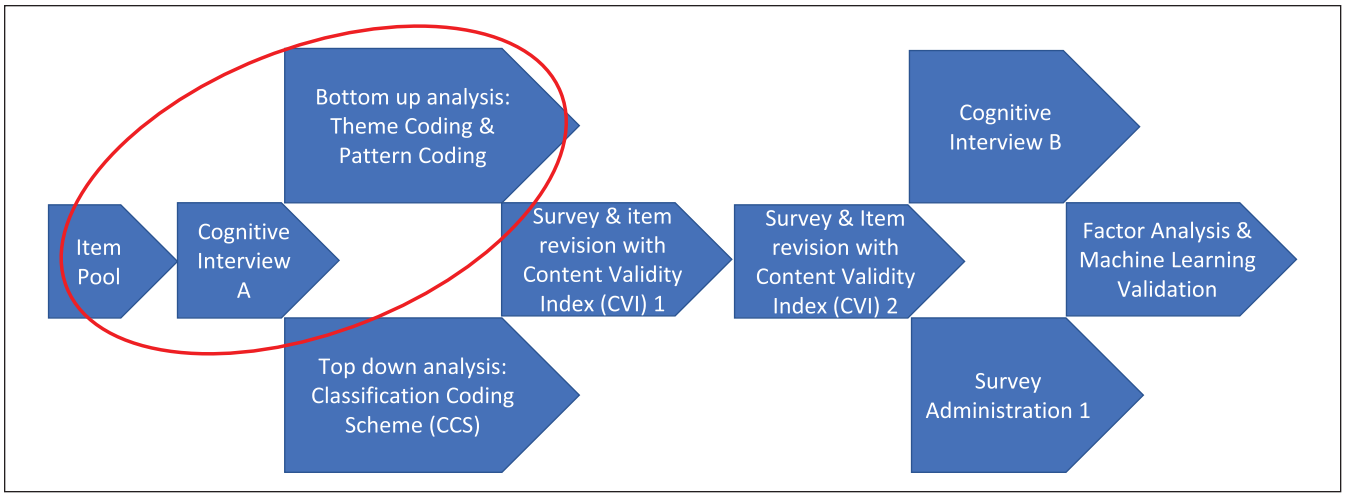

Figure 1. A depiction of how this manuscript fits into the overall project.

bronchitis, pulmonary emphysema, asthma, long-COVID with respiratory symptoms).

Older adults and those with Black/African American racial identities have been reported to more frequently experience respiratory symptoms, disease exacerbation, unscheduled health care utilization, and decreased quality of life after disaster exposure to particulates, mold, and flooding.[3-7] Community-dwelling older adults with complex health needs are generally very poorly prepared for disasters[8-10] and account for half of recent disaster deaths.[11] For older adults with COPD, disasters are linked to an increased risk for hospitalization in the 30-day window after the disaster.[12] In the United States, only 12% of households have the most basic elements of household disaster preparedness needed to shelter in place at home for 3 days.[13] Furthermore, profound racial disparities for those with Black racial identities have been observed in disasters, such as the COVID-19 pandemic and weather-related disasters,[14-17] driven by long-standing structural racism and racial bias inherent to macro-level segregated housing and sociopolitical networks with fewer financial savings resources set aside for disasters. It is important to note after controlling for pre-disaster disease burden, social network support, social vulnerability, and socioeconomic resources, racial disparity in other large-scale disasters was no longer associated with health outcomes like post-disaster depression.[18,19] Given centuries-long structural racism with resulting segregated education, housing, and policy/law enforcement, multi-level conceptualizations, and research designs are essential to adequate understanding of disaster-related racial disparities.[20-23]

Racial Bias in Survey Research

Data-driven protocols, models, and algorithms are increasingly being used to inform clinical decisions and resource allocation,[24] yet these decisions are only as effective as the data used to make them. The underrepresentation of racial and ethnic minoritized groups in research can perpetuate representation bias in data collection, discrimination, and disparities.[25,26] Broadly, racial bias can be described as preconceptions, unconscious ideas, or experiences that make people think and act in a prejudiced manner.[27] Bias in data indicates errors that arise when certain elements of a database get more attention or overrepresented. Systemic prejudice, low accuracy, and distorted outcomes may result.[24] Self-reported data procedures on disasters (eg, survey instruments developed without adequate representation) may be particularly prone to validity problems and errors when utilized among marginalized groups. Variations in participants' comprehension of the question wording, recall of information, meaning-making of their memories, and matching these ideas to the response options may result in very different information than the survey item developer had intended to obtain. Health care organizations using such data to inform protocols, program screenings, models, or algorithms risk having inherent bias in generated results.[26] For example, incomplete risk scores used to inform resource allocation (ie, before/during/after disasters) could perpetuate racial disparities rather than eliminate them.[24] Prioritizing the perspectives and contributions of minoritized groups who have been disproportionately harmed by disasters can help address representation bias in the data collection process and facilitate more equitable knowledge construction and survey tools.[25,26,28]

Purpose

The purpose of this research was to empirically generate items for a novel survey instrument of household hazard vulnerability assessment and initiate the process of validating these items (construct validity) using a process to minimize

racial bias in these data by prioritizing the lived experience of Black/African American individuals. This research is the initial step of a multi-phase project[29] and focuses on the thematic and pattern coding and analyses of 60 disaster/hazard terms (Figure 1).

Methods

Qualitative Approach and Research Paradigm

Cognitive interviewing is a research method used to: (1) identify problems participants may experience with survey questions, (2) study survey item construct validity, and (3) examine differences in thought processes in response to survey items across different demographic, linguistic, or cultural groups.[30] Cognitive interviews facilitate understanding regarding the performance of the drafted survey questions; specifically, if the respondents understand the questions according to their intended design, and if accurate answers are given based on that intent. Utilizing this method with a diverse group of participants yields deep, contextual insight into how respondents interpret questions, consider relevant aspects of their lives, and formulate responses based on those considerations.[31] The technique can be used through a descriptive process for nascent survey items, or using a reparative approach to revise established items. Here, we utilized a descriptive process with an expert panel of 18 transdisciplinary participants, and a reparative approach with a final 2 additional participants.

Sampling Strategy

Purposeful and snowball recruitment techniques were employed to assemble an expert panel of 20 members. We intended to sample a group of people who had a high likelihood of experiencing the disasters or hazards in the survey items we were testing. Thus, rather than future survey respondents, we sampled disaster experts at this stage due to the total number of disaster/hazard terms and the geographic variability in frequency of impact. Our strategy intentionally over-sampled (up to 50%) those with Black and/or African American racial, biracial, or multiracial identities (see Supplemental Appendix A for more information on our rationale for including 20 expert panelists). Inclusion criteria were a nationally or internationally recognized expert in their disaster-related discipline as evidenced by publications, awards, and/or fellowships and professional work experience as a first responder or disaster responder, public health, home health, emergency nursing, disaster nursing, and health care management expertise, and reside in the United States. We recruited through our professional network, which enabled access to the necessary national experts. We recruited the first 18 participants for the full iteration of procedures, and a final 2 panel participants for a reparative approach after final item revision.

Protection of Human Subjects and Data Security

Using the Department of Health and Human Services regulations found at 45 CFR 46.104(d)(2), a commercial institutional review board (IRB) reviewed this protocol and study materials and determined that this research was exempt from IRB oversight.

Data Collection Methods, Instruments, and Technologies

An item pool was created from existing organizational hazard vulnerability assessments (Kaiser Permanente, Risk Identification and Site Criticality Toolkit, and Center for Research on the Epidemiology of Disasters listings) and a literature review for use at the household level.[32-34] A semi-structured cognitive interview guide was designed by a member of the research team (JC) with extensive experience in emergency nursing and instrument development and pilot tested with a consulting member of the expert panel.

Interviews were conducted by the same member of the research team (TA) from December 2021 through May 2022. The purpose of the interviews was to ascertain perceptions of standard hazard vulnerability assessment domain items and responses when applied to the household level. Participants provided written and verbal informed consent in advance of the interview. Additional detail regarding the interview structure is reported in Supplemental Appendix A.

Demographic information collected included sex at birth, current gender, age, racial and ethnic identities, language spoken in the home, veteran status, household member veteran status, and highest completed level of education. All demographic information was self-reported by participants.

Data Processing and Analysis

The video-recording of the interview was utilized as the raw data for analysis. No transcription was used to fully incorporate non-verbal information in the analytic process.[35] Interviewer notes augmented the video-recording data. Theme and pattern coding were used for analyses (Figure 1). Refer to Supplemental Appendix A for additional detail regarding data analyses.

Techniques to enhance trustworthiness. We maintained an audit trail and triangulation to enhance trustworthiness and credibility of data analysis. Our audit trail included original recordings, double-entered interviewer notes, double-reviewed interviews for thematic codes, and duplicate files for each stage. The findings were triangulated with a content validity index, which will be reported elsewhere.

Member checking is ongoing as part of the multi-faceted, overarching project.

Context. All participants confirmed they were located within the United States or US territories at the time of the interview. The interviews were conducted over the web and recorded (audio and video, as available). We allotted 90 minutes for each meeting with expert panelists. Here, we report the results of our thematic and pattern coding analysis.[36]

Results

Expert Panelist Characteristics (Units of Study)

This transdisciplinary panel represented a variety of occupations, including epidemiology, chemistry, fire service, first responder, nursing, academic professor, consulting, and roles of disaster planning and response throughout all phases of the disaster management cycle. Panelists' areas of professional expertise reflected disaster-related leadership, expertise, and service that spanned all levels of government (local, state, national, and international) and included (but were not limited to) sectors of public health, emergency preparedness, management and response, emergency medical services, global health security, non-profit engagement, and health care leadership.

Table 1 lists the demographic characteristics of the expert panel. Of the initial 18 interviews completed with a descriptive approach, 7 (38.8%) expert panelists identified as cisgender men. Ten (55.5%) expert panelists identified as cisgender women, and 1 respondent chose not to report their sex or gender. Eight (44.4%) expert panelists were between the ages of 30 to 49, 5 (27.7%) were between the ages of 50 to 64, and another 5 (27.7%) were aged 65 years and older. Eight expert panelists (44.4%) endorsed a Black/African American racial identity. Of these, 2 participants indicated additional racial identities (Biracial, White/Caucasian, Native American, or a combination) to Black/African American. Eight expert panelists (44.4%) identified as White. Of these, 1 participant indicated an additional racial identity of Native American in addition to White. One expert panelist endorsed a Native Hawaiian/Other Pacific Islander racial identity, and the final expert panelist interviewed with a descriptive approach vocalized the desire for an "Other" or blank/fill-in category in response to this question. All participants spoke English, with 2 participants also speaking other languages in their home (Arabic and French). Collectively, panelists mapped their answers pertaining to personal or professional experience of the 60 hazards/disasters to every region of the Mainland United States, Alaska, Hawai'i, Puerto Rico, and the Virgin Islands. International geographies mentioned, as participants cognitively mapped their experience with each hazard or disaster term, included Japan, Afghanistan, Honduras, Haiti, West Africa, and China. The demographics of the 2 expert panelists interviewed with a reparative approach are included in Table 1 as well.

Pattern Coding Results

The results of the pattern coding we utilized are depicted in Table 2. Here, we used pattern coding to assess for the potential for racial data bias and ascertain group differences between those with Black/African American racial identities and those who did not report any Black/African American racial identity.

Theme Coding Results

Overall, across participants and items, 4 overarching themes emerged in the general conceptualizations examined in response to the items worded as "In your lifetime, have you ever been directly impacted by [disaster/hazard/event term]?" These themes were *disaster characteristics*, *resources*, *individual life facets*, and *felt effects*. Figure 2 depicts a flowchart of these themes with subthemes. Participants consistently mapped their stories and responses along this overarching flowchart as part of both their comprehension of the question and in judging or justifying their retrieved information as warranting the response as either yes or no. For example, 1 participant endorsed a secondary, emotional impact to the *active shooter* disaster/hazard. Although they were not physically present for the actual event, they felt emotionally impacted, although "not directly," while supporting family members (including minor children) who were processing and psychologically recovering following this event. In addition, participant's cognitive walk-through of individual life facets was also used as an aid in the retrieval of relevant information from memory.

Linked terms. The theme coding process was also used to generate item-specific schemas for each of the 60 hazard/disaster/event terms, revealing variation and commonalities across participants in their understanding of each term or concept. Across many of the terms, the question-answer narrative revealed multiple synonyms with other terms, co-occurring, compounding, or cascading events with other survey item terms. For example, across the 18 expert panelists interviewed with a descriptive approach, the term *water disruption* was compounded with other disasters/hazards like other *utility failure*, *water contamination*, *sewer failure*, *hurricane*, *temperature extremes*, *seriously inclement weather*, and *unplanned power outage*. In another example, the term *external flood* revealed synonyms as well as co-occurring and cascading events with other survey items terms like *hurricane*, *flood*, *seriously inclement weather*, *evacuation*, *water contamination*, *internal flood*, *flood*, *telephone/communication failure/disruption* and *water dam failure*. One participant stated when they were a child, their "house was under a

Table 1. Demographic Characteristics.

Demographic characteristics	Descriptive approach ($n = 18$), n (%)	Reparative approach ($n = 2$), n (%)
Sex at birth		
Male	7 (38.9%)	1 (50%)
Female	10 (55.6%)	1 (50%)
Refused	1 (5.6%)	0
Current gender		
Man	7 (38.9%)	1 (50%)
Woman	10 (55.6%)	1 (50%)
Other	1 (5.6%)	0
Age, year		
30-49	8 (44.4%)	1 (50%)
50-64	5 (27.8%)	1 (50%)
65 and over	5 (27.8%)	0
Marital status		
Married couple	13 (72.2%)	2 (100%)
Separated/divorced	3 (16.7%)	0
Never married	2 (11.1%)	0
Veteran status—Have you ever served in the US military?		
No	13 (72.2%)	2 (100%)
Active duty	1 (5.6%)	0
Reserve or national guard	2 (11.1%)	0
Both active duty and reserve or national guard	2 (11.1%)	0
Veteran status—Have members of your current household ever served in the US military?		
No	16 (88.9%)	1 (50%)
Active duty	2 (11.1%)	1 (50%)
Reserve or national guard	-	-
Both active duty and reserve or national guard	-	-
Main household language		
English	16 (88.9%)	2 (100%)
English and other (French, Arabic)	2 (11.1%)	0
Racial identities[a]		
American Indian/Alaskan Native	1 (5.6%)	0
Asian	-	-
Black or African American	8 (44.4%)	1 (50%)
White/Caucasian	8 (44.4%)	1 (50%)
Native Hawaiian or other Pacific Islander	1 (5.6%)	0
Don't know/unsure ("Other"[b])	1 (5.6%)	0
Refused		
Ethnic identity		
Hispanic, Latinx, or Spanish origin (yes)	0	0
Education level		
Less than high school completion/diploma	—	—
High school degree/GED/or equivalent	—	—
Some college, no degree	0	1 (50%)
Associate's degree	1 (5.6%)	0
Bachelor's degree	0	1 (50%)
Master's, doctorate, or professional degree	17 (94.4%)	0

All demographics are self-reported by participants. Percentages may not add up to 100% due to rounding.
[a]Participants could choose more than 1 category for racial identity.
[b]Category of "Other" was requested by the participant.

boil water order, but the flooding did not actually impact where I was staying, but I relocated to a shelter as part of the flood." This participant recalled disruption to telephones as a cascading event. We coded a total of 379 unique instances of linked terms across the 18 interviews and 60 terms. As an example, Figure 3 provides a data visualization of the 20

Table 2. Pattern Coding Results: Frequency of "Yes" to Direct Impact by Disaster/Hazard Impact ($n = 18$).

Disaster/hazard	African American/Black racial identity ($n = 8$), *n* (%)	All other racial identities[a] ($n = 10$), *n* (%)
Active shooter	4 (50%)	3 (30%)
Criminal acts of intent	4 (57.1%)[b]	6 (60%)
Bomb threat	4 (50%)	5 (50%)
Building move, collapse, or shift from foundation	4 (50%)	5 (50%)
Chemical exposure, outside structure	2 (25%)	6 (60%)
Communication/telephone failure	6 (75%)	8 (80%)
Water dam failure	3 (37.5%)	1 (10%)
Earthquake	6 (75%)	6 (60%)
Epidemic	8 (100%)	10 (100%)
Evacuation	7 (87.5%)	6 (60%)
Explosion	1 (12.5%)	3 (30%)
External flood	6 (75%)	5 (50%)
Fire	5 (62.5%)	6 (60%)
Flood	5 (62.5%)	7 (70%)
Prisoner, house arrest prisoner, or escaped prisoner in the home or apartment	0 (0)	1 (10%)
Gas/emissions leak	2 (25%)	3 (30%)
Generator failure or no availability for rent/purchase in power outage	4 (50%)	3 (30%)
Hazardous material incident	2 (25%)	5 (50%)
Hazardous material incident with mass casualties in the neighborhood that includes your residence	0 (0)	0 (0)
Hostage situation	0 (0)	2 (20%)
Hurricane	6 (75%)	8 (80%)
HVAC failure	4 (50%)	7 (70%)
Seriously inclement weather	7 (87.5%)	9 (90%)
Infectious disease outbreak	8 (100%)	9 (90%)
Fire from inside structure	4 (50%)	5 (50%)
Flood from inside structure	4 (50%)	6 (60%)
Computer/IT system outage	6 (75%)	7 (70%)
Landslide	0 (0)	2 (20%)
Large spill inside structure	1 (12.5%)	0 (0)
Mass casualty incident in neighborhood that includes residence	1 (12.5%)	1 (10%)
Natural gas disruption	0 (0)	2 (20%)
Natural gas failure	0 (0)	1 (10%)
Other utility failure	4 (50%)	10 (100%)
Pandemic	8 (100%)	10 (100%)
Everyone in household requiring hospitalization at the same time	1 (12.5%)	0 (0)
Picketing	2 (25%)	1 (10%)
Planned power outages	5 (62.5%)	6 (60%)
Unplanned power outages	8 (100%)	9 (90%)
Radiation exposure	2 (25%)	2 (20%)
Seasonal influenza	7 (87.5%)	9 (90%)
Sewer failure	2 (25%)	2 (20%)
Shelter in place	6 (75%)	8 (80%)
Strikes/labor action/work stoppage in the neighborhood that includes your residence	0 (0)	1[b] (1.1%)[b]
Suicide	3 (37.5%)	4 (40%)
Supply chain shortage/failure at local shopping stores, including grocery	7 (87.5%)	10 (100%)
Suspicious odor	3 (37.5%)	4 (40%)
Suspicious package or substance	2 (25%)	0 (0)
Temperature extremes	6 (75%)	9 (90%)
Tornado	4 (50%)	3 (30%)
Transportation failure	6 (75%)	5 (50%)
Trauma	8 (100%)	8 (80%)
Tsunami	0 (0)	1 (10%)
VIP situation in the neighborhood that includes your residence	1 (12.5%)	3 (37.5%)[b]
Water contamination	4 (50%)	5 (50%)
Water disruption	5 (62.5%)	7 (70%)
Weapons	2 (25%)	6 (60%)
Violence/violence threat	6 (75%)	6 (60%)
Volcanic eruption/activity	2 (25%)	3 (30%)
Other hazard of disaster	1 (12.5%)	4 (40%)
Zombies. This means any not listed or yet unimagined disaster	0 (0)	1 (10%)

Racial identities were self-reported by participants.
Abbreviations: HVAC: heating/ventilation/air conditioning; VIP: very important person.
[a]"All other racial identities" include Native American, Native Hawaiian/other Pacific Islander, and White/Caucasian racial identities.
[b]Percentages differ due to uncodable response(s) that were not included in denominator.

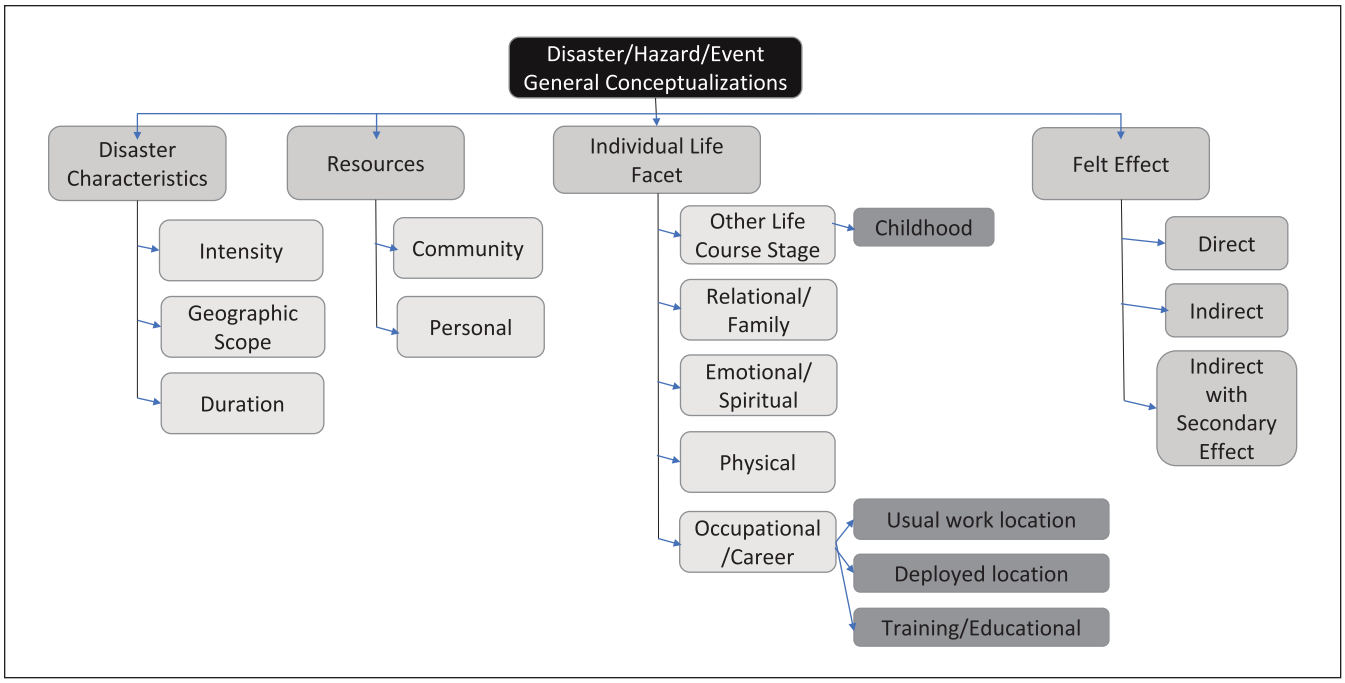

Figure 2. Flowchart organization of themes uncovered across all items and participants.

instances of terms linked to *building move*, *collapse*, *or shift from foundation* in a chord diagram.

Item-specific schemas. Item-specific schemas emerged from the theme coding as well. For example, the item-specific schema for *water contamination* revealed additional detail to the general flowchart of mapped common cognitive processes, as participant narratives focused on details relative to the antecedents of the water contamination, physical location within various life facets, and specific consequences and felt effects. Figure 4 details these additions to the general schema elucidated from the theme codes.

Other disaster terms elucidated specific major events or specific places in the recall and cognitive mapping of the term. For example, the term *hurricane* evoked responses and memory retrieval specific to unique disaster events, such as Hurricane Katrina or Hurricane Ida (Figure 5). Alternately, the term *active shooter* evoked narratives and memory retrieval specific to the location of the event (Figure 6).

Synthesis of Results by Problematic Terms

Of the 60 disaster terms, the cognitive interviewing and analysis process revealed potential problems with several of the disaster, hazard, and response terms. These terms require elimination, replacement, or further revision in our validation process and survey instrument development. The findings of the 3 terms we identified as most problematic or with

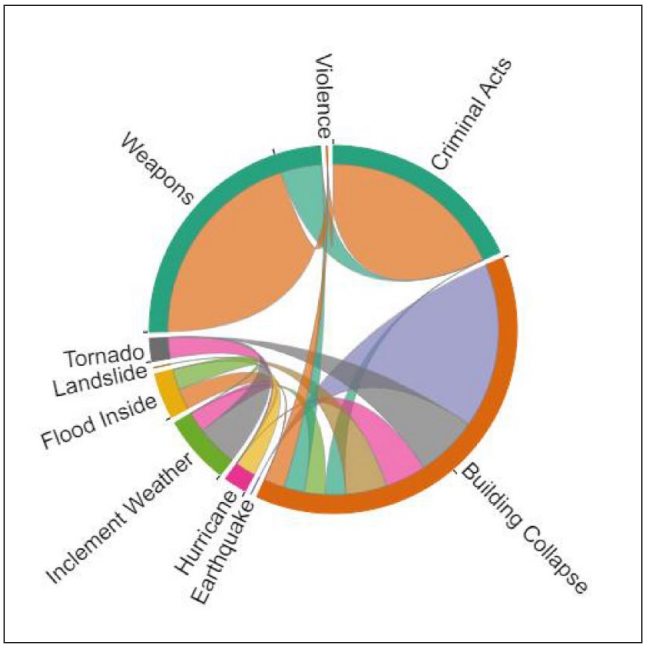

Figure 3. Chord diagram of terms linked to building move, collapse, or shift from foundation.
Building move, collapse, or shift from foundation was linked to other terms a total of 20 times: earthquake (8), tornado (3), hurricane (2), seriously inclement weather (1), landslide (2), criminal acts of intent (1), weapons (1), violence (1), and flood inside structure (1). Several of these terms were also linked to one another (eg, seriously inclement weather and tornado).

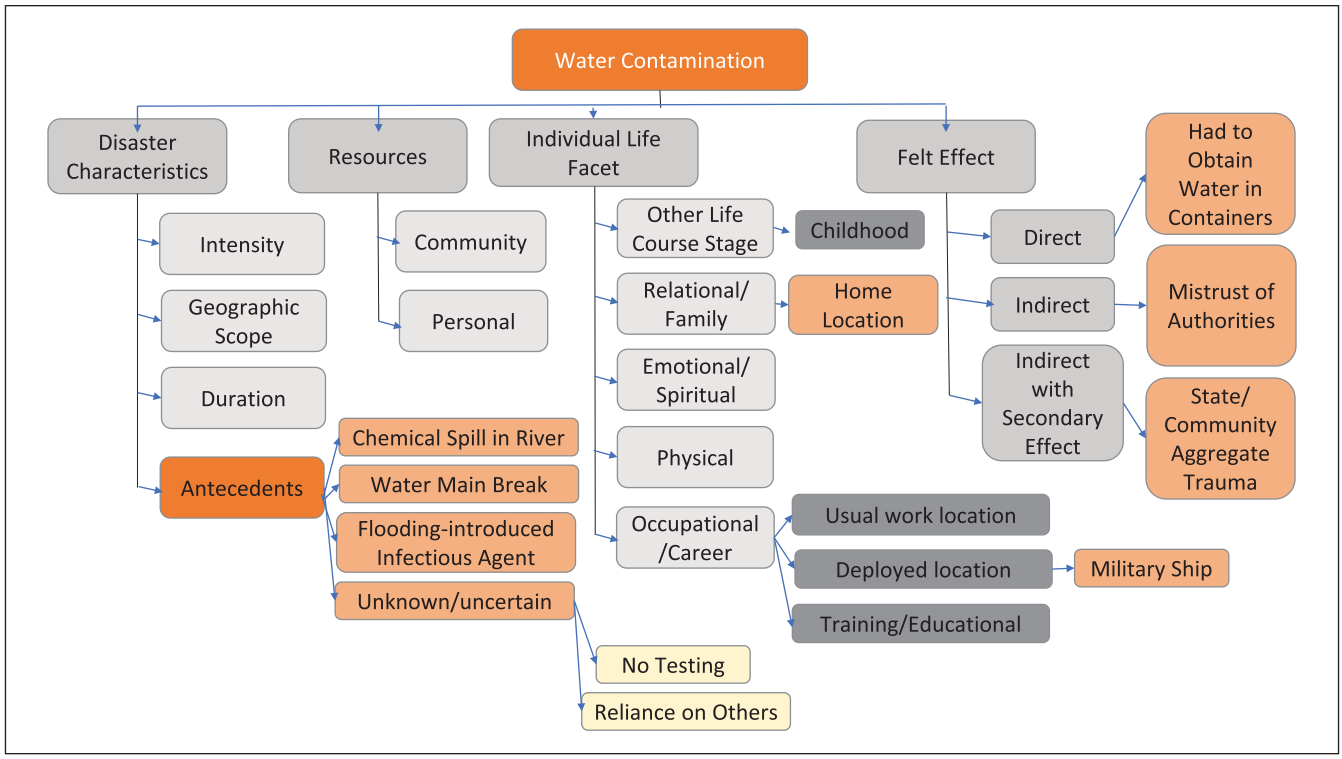

Figure 4. Schema of themes specific to Water Contamination across participants.

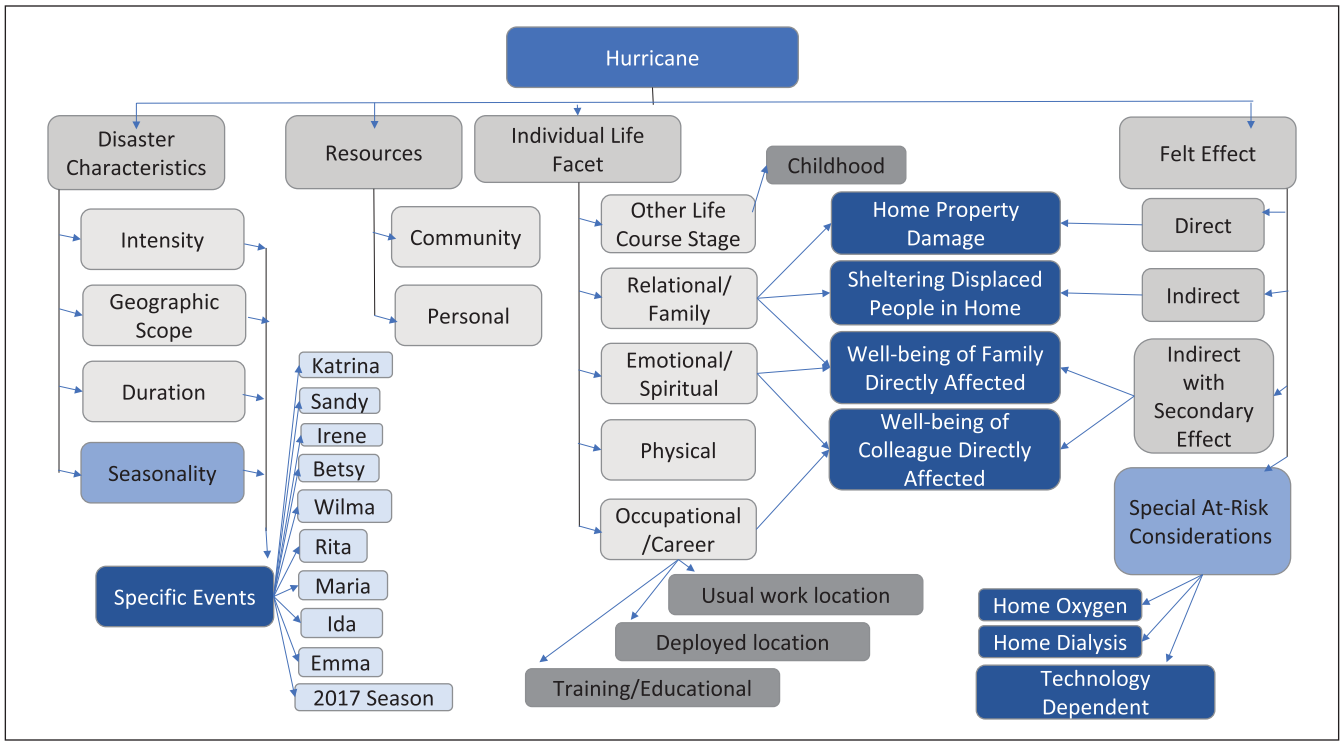

Figure 5. Schema of themes specific to Hurricane across participants.

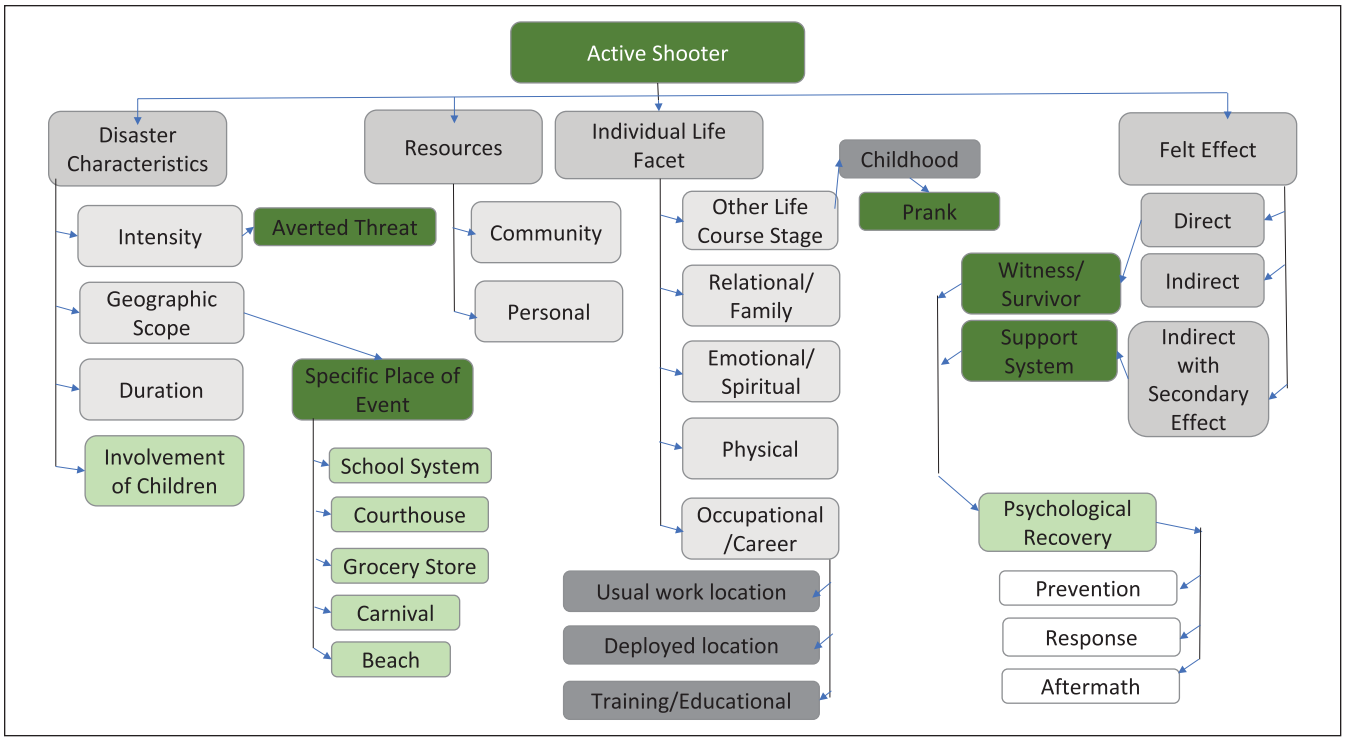

Figure 6. Schema of themes specific to Active Shooter across participants.

the most disparate interpretations by participants are summarized in the following paragraphs. These terms were *trauma*, *radiation exposure*, and *criminal acts of intent*. The findings specific to these terms are summarized below, integrating a synthesis of the empirical data from direct interview quotes, field notes, and theme coding.

Trauma. When asked if they have ever been directly impacted by "trauma" in their lifetime, multiple respondents asked if this question referred to physical or psychological trauma; with some answering this item only thinking of one form or the other. At least, 5 respondents identified this as a complex or vague topic. One respondent replied, "Trauma, that's a big word," and another identified it as a "popular" word. At least, 7 participants exhibited a long recall period or required high detail, not always being able to access the information through recall. This term was also flagged as being potentially sensitive or prone to desirability bias in at least 3 interviews. At least, 6 respondents requested clarification or expressed uncertainty regarding this term.

This question captured several themes across respondents, including primary physical trauma (car crash, fall, gunshot wound, crush injury, childbirth, and near-death injury/illness) and psychological trauma (COVID 19 sequelae, coping with friend's suicide, LGBTQ+ [lesbian, gay, bisexual, transgender, queer, or questioning]). However, psychological trauma was not independent of physical trauma in panelists' answers to this item. Vicarious, relational trauma through witnessing the suffering, illness, and/or death of loved ones and vicarious trauma from occupational experiences were also mentioned.

Across groups, 100% ($n = 8$) of participants with Black/African American identities (inclusive of multi and biracial Black identities) said that they had been directly impacted by trauma in their lifetime. One respondent asked, "Who among us has not been impacted by trauma?" This same respondent also said, "Everyone has been touched by trauma. So that may be one where you need to clarify a bit or give a timeframe." Among participants of other racial identities, 80% ($n = 8$) said that they had been directly impacted by trauma in their lifetime. One respondent hesitated before answering "no." When probed about what the term meant to them, they explained, "For me, when I think of trauma, I think of physical trauma . . . there's a broader term now . . . to include, or to frame, psychological trauma." The respondent chose to answer this question only considering physical trauma, or "the physical environment," to maintain consistency with how they answered other questions. The other respondent who answered this question as "no" considered close secondary impact from a family member's traumatic experience.

Radiation exposure. Some terms reflected diversity in expert panelists' perceptions influenced by variability in personal and occupational experiences, identities, and geographical locations. The disaster/hazard term "radiation exposure," for example, was mapped by respondents to ideas like background exposure (sunlight), medical treatment (cancer), and diagnostic procedures (x-ray), occupational exposure, intentional

release of radioactive material, transportation accidents with radioactive material, and power plant emission issues.

Some respondents exhibited difficulty trying to source and determine the scope of impact when answering this question. For example, one respondent initially answered, "I don't think so," and thought out loud about being aware or unaware of healthy versus unhealthy levels and sources of radiation exposures, personally or occupationally. Multiple respondents mentioned routine exposures to radiation through ultraviolet rays, radon from basements, and diagnostic procedures. One respondent considered where they lived in relation to nuclear power plants.

Across respondents, interpretations of radiation exposure were categorized as beneficial versus harmful (some overlap was noted with criminal acts of intent), by occupation, by event, and unknown exposures (ie, missing radioactive materials, radioactive dispersal devices, contamination). This question also captured historical radiation-related disasters like Chernobyl and Three Mile Island.

Across groups, 25% ($n = 2$) of participants with Black/African American identities (inclusive of multi and biracial Black identities) said that they had been directly impacted by radiation in their lifetime. These 2 participants considered occupational and background/environmental sources of radiation exposure when answering this question. Among participants of other racial identities, 20% ($n = 2$) said that they had been directly impacted by radiation exposure in their lifetime. These 2 participants answered this question when thinking of health-related (diagnostic or curative) exposures.

Criminal acts of intent. Examples of responses to the disaster/hazard term "criminal acts of intent" included "What exactly is that?" "I don't know, that could be anything . . .," "It just seems so broad," and "That is a mouthful of a word . . . I think the answer is probably yes, but . . . I can't be specific." Respondents mentioned instances of theft, breaking and entering, assault, or other acts with intent to hurt or extremely inconvenience a group of people, system, or setting. One expert panelist used terms like espionage, ransomware, or drugs and another described incidents of workplace violence and verbal aggression in public spaces. At times, participants answered "yes" to this question, but could not map this term to a specific memory or access the information through recall.

This term seemed to generate confusion among expert panelists. One respondent provided an uncodable answer of "I don't know." Eight respondents expressed uncertainty and/or requested clarification of the term, with 2 of these also requiring a repeat of the question. This item was identified as a vague topic/term by 2 participants.

Across respondents, patterns of interpretation included state-level terrorism/espionage, household-level theft (car or home), breaking and entering, personal or interpersonal group-level aggressive behaviors (verbal and non-verbal) with implicit or explicit threats of violence, and adolescent misconduct (implications of non-violent pranks to gang behaviors).

Across groups, 57.1% ($n = 4$) of participants with Black/African American identities (inclusive of multi- and biracial Black identities) said that they had been directly impacted by criminal acts of intent in their lifetime. One respondent with a Black/African American racial identity provided an uncodable answer, but indicated in their answers to interviewer probes they have experienced this term in similar ways to how other panelists interpreted it. Among participants of other racial identities, 60% ($n = 6$) said that they had been directly impacted by criminal acts of intent in their lifetime. One participant noted "Having things stolen was not a disaster," which became an emerging theme throughout the interviews with expert panelists.

Discussion

Cognitive interviewing is an important qualitative method to validate survey items in research, and this method is not often reported in nursing literature. Here, we have reported the results of empirically generating and validating items for a novel survey instrument of household hazard vulnerability assessment using a cognitive interviewing process to minimize representation bias in data collection.[25] To the best of our knowledge, our work is the first to identify instrument development specific to the household disaster preparedness of older adults with COPD with a focus on the increased risk to those with Black/African American racial identities. Our work contributes uniquely to the literature by (1) mapping common cognitive processes in response to items with disaster, hazard, or disaster response terms; (2) mapping additions to this cognitive process for specific disaster contexts; (3) elucidating synonym, co-occurring, and compounding disaster events; and (4) detailing cognitive difficulties with particularly problematic or vague disaster terms. A detailed discussion of cognitive mapping and linked disaster terms can be found in Supplemental Appendix B. Generating a novel application and instrument using the cognitive interviewing process, there is little existing literature to which to compare our specific results and use of the methodology.[37] Currently, disaster-related household assessments quantify current household preparedness status, high-risk functional or health conditions of household members, or rapid needs assessment in the midst of a disaster.[38,39] Our focus was on developing and validating an instrument relevant to disaster experience and measuring how this experience informed future household disaster risk and vulnerability. This work is timely and important to inform nursing research focused on equity in systems, public health, risk assessments, and disaster planning.[40] Our work is also crucial to developing equity interventions focused on health and education,[41] such as enhancing precision in the direct provision of disaster preparedness supplies or household disaster planning services to those identified as most at-risk or affected.

Racial Identity

As identified in our pattern coding results (Table 2), we noted several areas that flag the need for further investigation into possible racial disaster disparities. We found greater than 30% difference, with a greater proportion of participants with all other racial identities reporting experiences with *chemical exposure outside structures*, *other utility failure*, and *weapons*, compared with participants with Black/African American racial identities. These items were considered for elimination and/or combination with other terms for an instrument relevant to those with Black/African American racial identities. We found a difference greater than or equal to 25% for *water dam failure*, *evacuation*, *external flood*, *suspicious package/substance*, and *transportation failure* with a greater proportion of those with Black/African American racial identities reporting an experience with these events, compared with others. In contrast, a greater proportion of those with other racial identities reported experiences with *explosion*, *hazardous material incident*, *very important person situation*, or other hazard than participants with Black/African American racial identities. Our findings align with previously published literature on the impact of historical structural racism for communities of color increasing the risks of negative health impacts related to flooding, transportation, and evacuation.[14-17] Segregated neighborhoods and social networks generate racial disparities on a macro-level[20] and perpetuate increased disaster-related racial disparities. Residents in low-income racially segregated communities, disproportionately overrepresented by Black residents, experience higher incidents of disaster toxic exposure,[42] and worsened housing and resource recovery after disasters.[43] Some people with Black/African American racial identities may both reside in high-risk disaster areas and have the least amount of resources to protect themselves and their families against or recover from climate change-related hazards or disasters.[44] Given the long-standing history of structural racism and unequal race-related wealth distribution in the United States, multi-level conceptualizations, and research designs are required to better understand disaster-related racial disparity, especially when collectively investigating climate change, health equity, and household-level disaster preparedness.[20-23]

In addition to no household-level hazard vulnerability assessment, our team found no cognitive interview reports online through QBank in the last 5 years that investigate data or racial bias for individuals or communities with Black/African American racial identities.[37] In the context of health disparity research with substance use, Burlew et al[43] note the importance of adequate measurement and cultural equivalence/appropriateness when working to eliminate health disparities, beyond a person's primary language. Investigating the relevance of different constructs for specific groups, and how they are understood and interpreted, is vital to ensure adequate measures are being used in disaster research with marginalized populations.[30,45] There is an obvious need for instrument development and assessment to eliminate data gaps and data collection most relevant to communities of color as those most at risk to climate change impacts in the United States. Valid instruments are needed to assess the disproportionate impacts of climate change on communities of color and inform climate equity interventions.

Transferability

When considering transferability, the findings reported here present a cognitive map and schema from an expert perspective relevant to all-hazards experiences, as well as those specific to disaster sub-types. These themes may be considered as an initial theory of a cognitive process map when considering individual and household vulnerability. We also identified several problematic hazard, disaster, and event terms that might not be interpreted by survey-takers as intended. Other measurements utilizing terms, such as *trauma*, *radiation exposure*, or *criminal acts of intent* may require further validity testing and refinement in research and practice. We further identified several hazard, disaster, or event terms that require clarification, elimination, replacement, or further revision in our validation process and survey instrument development. These are common terms, often used in organizational hazard vulnerability assessments, which may have relevance to other disaster and climate change research teams seeking to focus their work on individual or household units of analysis.

Limitations

The findings from this study should be interpreted in light of the limitations of the design. We conducted the interviews during the COVID-19 pandemic, which elicited strong, compounding, and consistent responses to items related to pandemic, epidemic, and infectious disease outbreaks that may not be as profound or present in the cognitive processes of future participants outside the immediate pandemic context. The interviewer originated the videoconferences from a location with known contemporaneous drinking water contamination (Hawai'i, region impacted by Red Hill fuel facility), which may have influenced the priority, order, and recall primacy of thoughts related to water contamination for participants. The methodological contribution of the cognitive interviewing was to address the construct validity of survey items, and was not meant to generate inferential conclusions that generalize their responses to the broader population. Additional methods to address construct and other forms of validity are also required in instrument development and validation. We utilized an expert panel with extensive knowledge and experience in hazard and disaster situations both in the United States and overseas. Given that most of the disasters, hazards, or events were experienced by at least one of our expert panel members, this provides foundational knowledge that is, more broadly transferable to people who have experienced disasters. However, additional validity and item

testing is needed among the intended survey-takers, namely, older adults with COPD to produce a valid survey instrument specifically for this population. In addition, the questionnaire, themes, and information presented were generated from a predominantly Western-trained and educated panel. We suggest further validating the questions and themes presented in this study, to better fit regional and cultural nuances regarding the usefulness of the questions in other settings and contexts where cultural characteristics and relaying of information may differ from the Western lens with respect to disaster preparedness both domestically in the United States and abroad. We recommend our study be replicated among other populations who are at risk for the negative health impacts of climate-related disasters, such as Indigenous people or those whose native language differs from the language in which their government's business is conducted. The intersectionality of immigration and racial disparity for current generations of Black immigrants may present unique disaster risks that warrant further research.

Researcher Characteristics

Researcher characteristics are transparently reported for readers to evaluate the potential for influence in the research, relationship with participants, and interactions in the qualitative interview and data analysis process. Our diverse team included those with biracial, Native American (Oglala Lakota), White, and Modern African diaspora identities. Our team included at least 1 member who identifies with the LGBTQ+ community. At the time of this study, the interviewer (White cisgender woman) held a Master of Public Health and a Bachelor of Science in Nursing degrees with board certifications as an emergency nursing and disaster health care professional. The same interviewer met with all 20 expert panelists.

Conclusions

This work seeks to ultimately identify pathways of equal opportunity to eliminate racial disparities in large-scale disaster health outcomes. Here, we focused on household-level hazard vulnerability analysis instrument development with unique considerations for the problem of potential for racial bias in data among those with Black or African American identities in the United States. The findings reported here identified problematic hazard, disaster, and event terms that might not be interpreted by survey-takers as intended and informed our ongoing instrument development and revisions. We also identified specific items and terms that warrant further investigation as potentially identifying racial disparities in experiences or in cognitive interpretations. This is an initial report in a multi-faceted process of survey development and validation, which includes additional content validity indices and validation with the intended population of older adults with chronic respiratory disease. Following the subsequent phases in this project, the instrument is being developed for patient-reported and clinician use to quantify risk and prioritize affirmative disaster preparedness interventions for those most impacted by climate-sensitive health risks and other disasters. This work informs precision public health directed at household disaster preparedness interventions, which is profoundly timely and important as we work toward equitable health care systems.

Nurses work on the front line of disaster care across settings and have a vital role in advancing health equity. Our novel methods were developed to detect and combat racial bias in data collection and instrument development specific to people with African American/Black racial identities, and could be used by nurses looking to detect and combat racial data bias in other settings. Pioneering this method in nursing and disseminating for nurse researchers is important for nurses to align the rigor and design of our qualitative methods with important techniques for survey validation.

Author Contributions

Taryn Amberson: Investigation, Writing—Original draft preparation, visualization, supervision, project administration; **Olive Ndayishimiye**: Investigation, Initial Data Analysis, Resources, Writing—Review and editing; **Quanah Yellow Cloud**: Investigation, Initial Data Analysis, Resources, Writing—Original draft preparation; **Jessica Castner**: Conceptualization, methodology, formal analysis, visualization, supervision, funding acquisition

Statements/disclosures

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Supplemental Material

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