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Assessing Disaster Preparedness of Officials and Residents in Two North Carolina Counties

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Abstract

Emergency management professionals devote significant expertise and resources to preparing for emergencies through planning and exercises. Despite this preparation by professionals, residents are often unprepared for emergencies and unfamiliar with recommended practices. This is a concern particularly for those who are socially vulnerable, such as the elderly, those without transportation, or those who speak English less than well. To improve understanding of this gap in disaster preparedness, we interviewed emergency managers and others with professional knowledge about emergency preparedness and management at the County level. Findings were validated by surveying households to gather information about services and information received from officials before, during, and after emergencies. Results suggest emergency managers are aware that improved communication with residents could improve preparedness. Residents cite clear priorities in the types of information they want from emergency managers, including where and when to evacuate, how to maintain safe water and sanitation during a disaster, and how to prepare their property for a disaster. Attention should be given to identifying vulnerable groups and providing them with information about preparing disaster plans and related topics.

Keywords: Planning; Disaster preparedness; Vulnerability; Assessment

Introduction

Communities face a variety of serious threats, both natural (such as hurricanes, floods, fires and earthquakes) and technological (Eg explosions or spills). Some aspects of modern life, including encroachment of settlements into environmentally sensitive or hazardous areas and certain economic activities such as mining, refining, manufacturing and distribution, increase the threat of disasters and amplify negative impacts on physical and social systems. Injury and loss of life, along with property damage and social disruption, can devastate a community and require years or decades of recovery. Extreme events, like recent Hurricanes Irene (2011) and Sandy (2012), have drawn attention to the disproportionate impacts emergencies may have on vulnerable populations such as low-income households, the very young or very old, those with limited mobility, those facing language or cultural barriers, and those living in flood zones or in structurally deficient housing. Hurricane Sandy, which devastated the northeastern U.S. in 2012, also raised the specter of climate change, which is expected to produce more frequent and more severe natural disasters.

North Carolina, on the central Atlantic coast of the U.S., faces various natural hazards, including tropical storms and hurricanes; floods, severe storms and tornadoes (some incidental to tropical systems moving inland, and others generated by other weather systems); and drought, wildfires and winter storms. In addition, the state is vulnerable to technological hazards such as nuclear emergencies, industrial explosions, highway spills, or train derailments. While emergencies in North Carolina vary widely, communities in the state-whether urban or rural, coastal or inland-face common challenges in understanding, preparing for and responding to these events.

Emergency planning and response in North Carolina is generally handled locally by County-or municipal-level professional staff, often working collaboratively and regionally across jurisdictional lines. Emergency planning and response draws in not only emergency management, but other local professionals such as social services, public health, public schools, transportation planners and others.

This paper draws from key informant interviews with 13 emergency planning and response professionals in two North Carolina counties (Alamance and Cabarrus). Interviews were conducted to learn about key informants' experience in planning for and responding to emergencies. In addition, we use data gathered from surveys of 396 households in the same two counties to assess what residents know about emergency preparedness and response and how they prepare for and behave during emergencies. Findings from the interviews and surveys may be useful to public health and emergency management officials seeking to improve citizen response to evacuation or sheltering orders during emergencies, and help improve preparedness and communications by citizens and officials before, during, and after an emergency.

Alamance County, North Carolina is located in the north-central piedmont between Greensboro and Raleigh. Burlington, the County seat, has approximately 50,000 residents; otherwise, the County is largely rural. Local experts knowledgeable about emergency

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management report that Alamance County is at risk of major weather events such as severe thunderstorms, tornadoes, straight-line winds, ice storms, heat waves and flooding, as well as road and rail accidents and hazardous materials spills and leaks. The County has also recently experienced public health emergencies, including a 2009 H1N1 virus outbreak and an outbreak of pertussis in 2011.

Cabarrus County is located in South-Central North Carolina near Charlotte, the largest metropolis in North Carolina. The County seat of Concord (population 82,000) is somewhat urban and suburban, reflecting its proximity to Charlotte and to nearby Kannapolis, a former textile center now transitioning to an information technology center. Much of the rest of the County remains very rural. Local experts report the major hazards to be weather events (strong winds, heavy rain, and flooding, as well as winter storms), and the threat of nuclear accident posed by two nearby facilities.

Background

Previous research has suggested that residents may not be fully aware of how their County's emergency management office plans for and responds to emergencies, and may have done little, if any, household planning [1-3]. This lack of planning and limitations in understanding may be most critical for socially vulnerable populations (e.g., low-income, mobility-limited, very old or very young, or those with low English proficiency) and physically vulnerable residents (e.g., those who live in floodplains or near environmental and industrial hazards). Both types of vulnerability may increase the risk and severity of negative outcomes during disasters.

For example, in a review of preparedness and evacuation of carless residents, Renne et al. [4] describe the need for integrated multi-modal evacuation planning for efficient response and targeted relief for those without cars. People with low English proficiency (LEP) are often difficult to reach both with advance information about emergency preparedness and with timely warnings and announcements about impending threats and how to access services. Community-based organizations may be one route to reaching LEP populations and to assisting on needs such as documentation and immigration status protection [5]. Gares and Montz [6] examined the relationship between hazard risk and the spatial distribution of migrant and seasonal laborers in North Carolina, where prior research has identified overlap, and in Texas, which also hosts a large farm labor force. They identified several concerns relating to emergency preparedness among this population, including language and financial difficulties, lack of knowledge, complex logistics, and apathy or lack of sense of vulnerability. Another study of Latino farmworkers in North Carolina [7] found low-income and socially isolated seasonal laborers to be vulnerable to disasters, with limited knowledge about how to prepare their households for emergencies, and constrained by language and transportation.

Older adults are another population of concern, whether living in their own homes (alone or with others) or in group settings such as retirement homes or skilled nursing facilities. Approximately 80% of older adults have at least one health condition that puts them at risk during an emergency, which requires special planning and strong coordination [8]. In particular, the frail elderly with chronic conditions often require special equipment and supplies [9]. Laditka et al. [10,11] report in-home health care services for older and disabled people to be less prepared to respond to emergencies than skilled nursing facilities, although they find that the latter could benefit from more direct inclusion in community emergency planning and practice. Emergency planning and response for children is similarly underdeveloped and understudied [12], particularly for those with disabilities and special medical needs who may require medication, technology (e.g., ventilators, pumps), and customized management plans-all of which may depend on utilities like power and water [13,14].

Minority populations may prepare for and respond to the threat of a disaster differently than others. Peguero [15] compared responses of Latino and Non-Latino single-family homeowners in Florida to the 1999 Florida Statewide Mitigation Survey to understand the dissemination and use of information on hurricane preparedness and response. Latino respondents preferred to rely on personal networks of family and friends for information about preparing for disasters.

Emergency managers note that their work during emergency conditions may be hampered by residents who are uninformed about emergency protocols or unwilling to heed advice or follow official advisories, particularly regarding evacuation. For example, households who had experienced hurricanes in the past were less likely to go to public shelters than households who had not [16]; in this case, the previous experience may have involved perceived inadequate shelters. Other studies have shown that evacuees may hesitate to take cover in public shelters even without alternative arrangements [17]. This evidence of a deterrent effect of perceived low quality of public shelters suggests a potentially useful avenue for increasing use of public shelters and reducing risk-particularly important for the very old and very young and the disabled [17].

Communication and networks are cited by many researchers as important factors in how well a community weathers a disaster. Kim & Kang [18] found that communications resources (such as local media and community groups as well as personal networks) correlate directly and positively with hurricane preparedness and indirectly with how residents behave during hurricanes. Prior experience also may play a role, according to a study by Adeola [19] of resident behavior under threat of a weather emergency in a disaster-vulnerable region. Wisner et al. [20] assert that social, political, and economic factors are as important in emergencies as natural processes, such that a better understanding of vulnerability and response models may be the foundation for mitigating the threat of disasters.

Finally, some notable events have undermined public confidence in the capacity of government agencies at various levels to respond to major disasters or to assist people who may have particular needs during emergency conditions [21]. The Katrina aftermath drew world attention to socioeconomic and demographic differences in New Orleans [22] and elsewhere in the region, and energized research into social and physical vulnerability as it relates to emergency planning and response. Greenberger [23] characterized the federal response to Hurricanes Katina and Wilma as a failure to grasp the impacts and needs of unprepared inner-city neighborhoods and a demonstration of how profoundly disasters may affect low-resource individuals and communities. Emergency response for vulnerable communities, including minority and low-income, face significant obstacles beyond simply transport and sheltering [24], and should account for the role of family ties and social networks for more effective response.

Methods

Key informant interviews

Interviews were conducted with 13 key informants, including planners, emergency management officials, and other practitioners, in two central North Carolina counties in order to improve understanding of how they prepare for, communicate the risks of, and respond

to emergencies. These counties were chosen because of existing professional ties, and because emergency management professionals there expressed interest and willingness to participate in research that involved undergraduate and graduate students as part of the research team. Key informant interviews were conducted via telephone by pairs of researchers, and were recorded, transcribed, double coded, and analyzed using ATLAS.ti (v7.0, Berlin, Germany) to identify major themes. Each interview lasted between 20 and 60 minutes. The interview guide was adapted from an instrument used in an earlier study of disaster response coordination in six North Carolina counties and was customized for each of the two counties in the current study with input from the cooperating emergency management officials. The interview guide probed key informants' knowledge of the most common and the most recent emergencies to affect their counties, which populations they saw as most vulnerable, and how they coordinate emergency planning and response with other local agencies and individuals.

Survey

We administered a household survey designed to (a) Collect information on the level of awareness residents have regarding services available before, during, and after emergencies; (b) Estimate the percentage of households that may need support during an emergency for a household member with special needs; (c) Estimate the percentage of households that actively prepare for possible emergencies; and (d) Shed light on the factors associated with preparedness behaviors. The survey asked for demographic information (gender, race/ethnicity, age, homeownership status and number of years at the current address), information about social vulnerability (whether the household included any persons that may be particularly vulnerable to disaster, such as children under the age of 6, adults over the age of 65, disabled persons, or persons that do not speak English well), and information about prior experience with disasters and evacuation. The survey also asked for respondents' perception of their household's vulnerability to a number of different types of disasters, as well as their disaster preparedness, including whether or not they had a plan of where they and their pets would go during a disaster, whether they had an emergency supply kit, and who they felt was primarily responsible for their food, water, and shelter during and immediately following a disaster. Finally, respondents were asked to report what type of information they typically received during a disaster and from what sources.

A community population-based sample in each County was selected using the 30x7 Expanded Program on Immunization (EPI) cluster sampling method; 30 census blocks were randomly selected based on probability proportionate to population and seven households were randomly selected within each block for interviews [25]. Survey teams were routed to the residence closest to each point with a map generated with ESRI ArcPad 10.0 and StreetMap Premium North America Tele Atlas (Redlands, CA). If no one was available or willing to participate in the survey at the closest household, the survey team moved systematically to the next available household until a valid survey was obtained. This highly efficient sampling scheme produces estimated values that are generalizable to the entire County population, and has been validated and used effectively for rapid assessment since the 1960s. The selection process was automated using a Geographic Information Systems (GIS)-based survey site selection toolkit developed by the N.C. Division of Public Health in ESRI ArcMap 9 (Redlands, CA).

Surveys were conducted on August 10-11, 2012 (Alamance County) and December 7-8, 2012 (Cabarrus County). After obtaining consent, trained two-person teams surveyed one adult member of each selected household. Survey locations and data were electronically recorded at the time of the interview using global positioning systems (GPS) equipped Magellan Mobile Mapper Field Data Collectors. Upon completion of the survey, all respondents were given information about resources in the community that provide assistance with emergency planning and recovery (e.g., preparedness checklists, emergency kit checklists) as well as a small participant incentive (valued at approximately $2.00).

Descriptive data analysis was conducted using SAS 9.3 software (SAS Institute, Cary, NC). The count, percentage, and 95% confidence interval (CI) was calculated for each answer choice. Questions asked of all respondents were weighted to account for cluster sampling. Questions asked of a subset of respondents were not weighted, and thus the 95% CIs for these measures are less precise. The interview guide and the household survey were approved by the University of North Carolina at Chapel Hill Institutional Review Board (#12-1540).

Results

Key informant interviews

Interviews were conducted with 13 experts in the two counties, with knowledge and experience relating to emergency planning and response, providing a useful body of information about emergency management standards and practices against which results from the household survey were compared.

Alamance County: Alamance County's professional corps of emergency responders includes emergency management operations, law enforcement, and the Fire Marshall's office. Emergency personnel engage in ongoing planning and training and use the incident command system for command, control and coordination of emergency responses. A local emergency planning committee (LEPC), established by the 1986 Superfund Amendment and Reauthorization Act to increase awareness and preparedness for chemical emergencies, consists of representatives from private business, local government, and residents. Training and drills are offered throughout the year for LEPC members. One key informant suggested that more private partners should be involved in training to allow the emergency management planning committee to effectively reach more citizens and to help fill in the gaps of hard-to-reach at-risk populations.

Aside from a special needs registry, there is no mass notification system to reach the public during an emergency in Alamance County. Rather, the County relies on television and radio outlets to get messages out, which may miss certain populations because of language or media access barriers. Alamance County's Department of Social Services (DSS) has twelve trained shelter teams in place (each with a leader and 10-12 members), and a system to determine which teams are needed and to keep teams updated and ready to go at any time. DSS works closely with the Red Cross to determine whether or not a site meets Red Cross shelter criteria and to decide when to open and operate a given shelter. The Alamance County Public Health Department deploys mass clinics and vaccinations in case of an outbreak and interfaces with the Centers for Disease Control and state agencies as needed for immunizations and prophylaxis.

The concept of "vulnerable populations" may be understood in universal or local terms. Indeed, one key informant stated that "I consider *everyone* in my County to be vulnerable," without regard for socioeconomic or demographic characteristics, if they are likely to bear the impacts of a major disaster. Practitioners are aware of groups typically viewed as vulnerable, such as low-income, very old or very young, mobility-limited, or with no or low English proficiency. But

vulnerability also may be specific to the location or type of emergency. For example, children were identified as a vulnerable population in a recent pertussis outbreak because of exposure on school buses and in classrooms. However, in the case of a tornado, vulnerable populations would be those living in structurally vulnerable homes in the path of a storm, particularly in one of Alamance County's 133 mobile home parks. People with no access to technology may be disadvantaged when notifications about any type of disaster are sent to the community via the Internet or social media. During emergencies, informants are particularly concerned with low-income, elderly and disabled people, as well as those with special medical needs (e.g., wheel-chair confined, those using supplemental oxygen, or those who need special medications), as well as the growing Hispanic community and others with low English proficiency. Transportation options are limited for people of low income or who are physically unable to drive.

Cabarrus County: In Cabarrus County, there are robust relationships among agencies in emergency management supporting communications and operations. According to key informants, however, there remains room for improvement, such as better, and earlier, coordination of planning and exercises "(Some people may be) included in a lot of exercises on the back end. From a preparedness standpoint it would benefit us if all the key shareholders got invited to those initial planning meetings to submit objectives for the exercises so we're meeting everyone's needs and we are able to test all the parts of the plans". Cabarrus County built a new Emergency Operations Center (EOC) in 2011, and implemented a reverse 911 system to disseminate information to the public; they have increased the number of documents and media announcements in other languages to reach more residents.

Cabarrus County practitioners described the challenges of providing emergency planning and response in an expansive county that ranges from urban to very rural. The most common emergencies in Cabarrus relate to severe weather, such as heavy rain and wind events, as well as severe winter storms. As a designated receiving County for two nearby nuclear power plants, Cabarrus County's emergency operations plan addresses a potential nuclear emergency. County emergency personnel plan and train for emergencies both natural (such as storms or fires) and technological (explosions or hazardous materials spills). However, the distinction between natural and human-caused emergency may not carry through to residents, as the same impact may result from either; for example, flooding may accompany a tropical storm, or follow a failure in infrastructure (such as a water main burst).

Adequate funding for emergency planning and response is an ongoing problem: "Emergencies don't happen all the time and there's a tendency to want to reduce the amount of funding" for emergency planning. Yet adequate funding is critical to maintaining preparedness for "when disaster strikes, because it's too late once you get to the crisis." Power outages during emergencies often impede communication, with residents lacking access to television, radio, or the internet. Vulnerable populations pose particular challenges: mobility limitations, language barriers, and other factors may hinder communications and complicate delivery of services (Figure 1).

Populations identified as vulnerable during an emergency include the elderly and non-English speaking populations, principally because these residents may not take advantage of shelters during an emergency. Because older residents often lack transportation, the County established a special needs registry where citizens can identify themselves as likely to need special assistance in case of an emergency. The Hispanic population (9.4% of County residents, compared to 8.4% for the state) may include some who avoid using services or shelters where they may need to identify themselves: As one key informant put it, "They don't trust the police; they don't trust any kind of authority here in the United States because they feel like if they have any contact they're going to be deported." Other potentially vulnerable populations identified by key informants include children and hospital patients. Long-term residents may also be vulnerable if they simply prefer to fend for themselves. Some especially "resilient" populations in the rural, agricultural areas of the County have lived on their farms for many years and feel that they "don't need help from anybody."

Some populations were identified as vulnerable not because of who they are (socio-demographics), but rather where they live. This includes buildings in flood-prone areas, such as nursing homes and special needs facilities, as well as several schools built in flood plains, where land is cheaper. The hazardous substance anhydrous ammonia

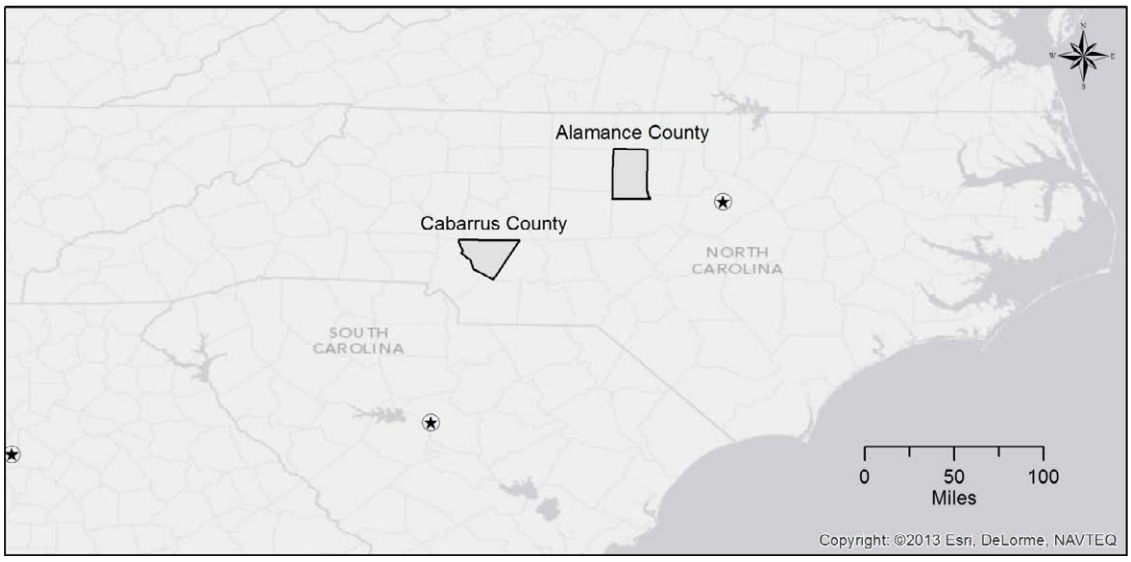

Figure 1: Map of Alamance and Cabarrus Counties, North Carolina, USA.

is used at several plants in the County, relatively close to a dense government-subsidized housing community, a hospital, two nursing homes, a major mall and business district, government offices, and both of the County's EOCs. A railroad running through the County, which transports hazardous materials among other freight, runs near the EOCs, several schools, a police station and a biotech campus in Kannapolis.

Surveys

Alamance County: A total of 678 houses were approached by an interview team. Of those where contact with an eligible individual was made, the response rate was 64.3% percent (196/304).

Study population demographics: Just over half of the respondents in Alamance County were male (52.9%; n=103), white (68.6%; n=137), and homeowners (75.1%; n=147). Two-thirds have lived at their current address for more than five years (n=130). The weighted mean length of residence at the current address was 15.5 years (95% CI: 13.3, 17.7). The weighted mean age of all respondents was 53 years old (95% CI: 55.0, 50.4). Most households have fewer than three occupants (54.1%; n=106) and 12% of households (n=23) reported an annual income below the federal poverty guidelines for their household size.

Vulnerable populations: Nearly three in ten households had a resident over the age of 65 (29.1%; n=60), while 16.7% (n=34) reported a child under the age of 6 (Table 1). Less than one in ten households (8.5%; n=17) had a resident who does not speak English well, and 2.9% (n=7) of households did not have access to a car that they could use to evacuate in the event of a disaster. Nearly 18% of households reported a resident with a disability that might make it more difficult to deal with a disaster (n=33) Of those, 27.3% (n=9) had made arrangements for special needs residents in the event of a disaster, though less than one in ten (9.1%; n=3) knew of the Alamance County, NC, registry for special needs residents.

Disaster experiences and perceived vulnerability: Fifty-four (27.2%) respondents reported that they had experienced a disaster while living in Alamance County, NC, and just 18 (8.5%) had ever evacuated due to a disaster (Table 2).

Most respondents felt that their homes were vulnerable to tornadoes (75.2%; n=146) and hurricanes (65.2%; n=125). More than a quarter also felt vulnerable to winter storms (41.5%; n=86), droughts or heat waves (41.4%; n=81), and earthquakes (26.4%; n=50). Wildfires (24.3%; n=48), floods (20.1%; n=41), and landslides (8.0%; n=18) were cited by the fewest respondents. Twenty-one (10.5%) of respondents did not consider their household vulnerable to any type of natural disaster.

Disaster preparedness: Fewer than half of respondents (43.6%; n=86) know where they would go in the event of a disaster, and fewer than one in three (30.1%; n=60) have a designated family meeting location for emergencies. Just over half have an emergency supply kit (50.9%; n=96), and 39.7% of pet owners (50/126) have made arrangements for pets during an emergency. However, 61.4% of respondents (n=123) feel that they are primarily responsible for providing food, water, and shelter for their household during and immediately after a disaster. The majority of respondents would like to learn more about preparing a

		Alamance County				Cabarrus County			
		Population=151,131				Population=178,011			
		Census (%)	n	%	95% CI	Census (%)	n	%	95% CI
Access to vehicle									
	Yes	93.2	189	97.1	94.8, 99.3	95.3	190	94.7	89.7, 99.8
	No	6.8	7	2.9	0.7, 5.2	4.7	10	5.3	0.3, 10.3
Speak English less than well									
	Yes	11.5	17	8.5	3.0, 13.9	9.5	5	2.6	0.4, 4.9
	No	88.5	178	91.0	85.6, 96.4	90.5	195	97.4	95.1, 99.6
	Refused		1						
Household member with disability									
	Yes	9.5†	33	18.0	12.7, 23.2	8.9†	23	11.7	6.6, 16.7
	No	90.5	163	82.0	76.8, 87.3	91.1	176	87.8	82.9, 92.8
	Don't Know						1		
Children<6 years of age									
	Yes	6.3	34	16.7	11.1, 22.3	7.3	40	19.4	12.6, 26.1
	No	93.7	162	83.3	77.7, 88.9	92.7	160	80.6	73.9, 87.4
Adults>65 years of age									
	Yes	14.6	60	29.1	21.6, 36.7	11.3	53	25.6	18.1, 26.1
	No	85.4	136	70.9	63.3, 78.5	88.7	146	74.1	73.9, 87.4
	Don't Know						1		
Income>HHS poverty guidelines									
	Yes	16.1	147	76.2	68.9, 83.5	11.9	154	77.5	61.2, 86.8
	No	83.9	25	11.8	6.3, 17.2	88.1	29	14.9	6.9, 22.9
	Don't Know		7	4.8	0.6, 9.1		7	3.7	0.7, 6.7
	Refused		15	7.2	3.4, 11.1		8	3.9	0.6, 7.2

*U.S. Census, American Fact Finder, 2010

†Because these percentages exclude youth under age 16 and adults over age 65-groups that are considered vulnerable and may be disabled-they are an underestimate of the share of residents with a disability

Table 1: Estimated vulnerable populations in Alamance and Cabarrus Counties, U.S. Census* (Census (%) and household survey (frequency (n), percent (%), and 95% Confidence Interval (95% CI)); n=396.

		Alamance County			Cabarrus County		
		n	%	95% CI	n	%	95% CI
Prior disaster experience							
	Yes	54	27.2	18.6, 35.8	81	41.4	30.2, 52.7
	No	139	72.0	63.3, 80.7	119	58.6	47.3, 69.8
	Don't know	2					
Considers household vulnerable to:							
	Tornado	146	75.2	67.2, 83.2	125	64.2	54.3, 74.1
	Hurricane	125	65.2	57.0, 73.4	136	67.6	60.3, 74.9
	Winter storm	86	41.5	33.1, 49.9	110	56.3	48.0, 64.5
	Drought or heat wave	81	41.4	32.3, 50.4	97	48.5	40.0, 59.0
	Earthquake	50	26.4	18.4, 34.4	44	22.9	15.5, 30.3
	Wildfire	48	24.3	17.6, 31.0	42	21.3	14.6, 27.9
	Flood	41	20.1	12.4, 27.8	30	16.0	8.7, 23.3
	Landslide	18	8.0	2.3, 13.6	13	6.3	0.9, 11.7
	None of the above	21	10.5	4.9, 16.1	15	7.9	3.9, 11.8
Responsible for providing disaster aid							
	Self	123	61.4	51.4, 71.4	104	53.5	41.7, 65.3
	Government	14	7.1	3.6, 10.7	9	4.7	2.0, 7.4
	Red Cross	26	13.0	7.3, 18.6	25	12.3	8.4, 16.1
	Family/Friends/Neighbors	18	9.3	4.6, 13.9	39	18.4	9.7, 27.0
	Community organizations or churches	8	4.2	1.2, 7.3	6	3.0	0.3, 5.7
	Don't know	7			17		
Turn to for disaster information							
	Television	118	57.6	49.0, 66.3	128	63.3	55.8, 93.6
	Family/Friends/Neighbors	22	9.5	4.3, 14.8	28	13.5	8.4, 18.6
	Radio	90	45.3	36.9, 53.6	102	50.9	41.8, 60.1
	Newspaper	7	3.2	0.8, 5.6	7	3.5	1.0, 4.0
	Local government websites	9	4.5	0.7, 8.3	4	2.0	0.1, 4.0
	Other internet sites	36	17.7	10.1, 25.4	25	13.4	8.2, 18.6
What information would you like to receive?							
	Where to evacuate	153	76.2	64.8, 87.6	175	81.8	81.8, 93.6
	When to evacuate	149	74.4	64.8, 84.0	171	78.2	78.2, 94.1
	How to get to a safe location	135	66.4	53.4, 79.5	167	75.1	78.1, 92.2
	How to maintain access to water and sanitation	117	57.7	44.5, 71.0	149	65.9	65.9, 83.7
	What to take when evacuating	109	53.1	41.0, 65.1	147	63.4	63.4, 84.5
	How to prepare property	100	48.9	37.3, 60.4	127	52.3	52.3, 74.2
	Other	58	31.5	20.9, 42.1	24	12.7	3.7, 21.6
Has disaster arrangements for special needs (n=32)					**(n=23)**		
	Yes	9	28.1	11.7, 44.6	10	43.5	21.6, 65.4
	No	20	62.5	44.8, 80.2	11	47.8	25.7, 69.9
	Don't know	3			2		
Has a disaster supply kit							
	Yes	96	50.9	41.8, 60.0	105	53.8	44.9, 62.6
	No	99	48.6	39.7, 57.5	90	43.9	35.2, 52.6
	Don't know	1			5		
Would like to know more about preparing a disaster plan							
	Yes	120	62.6	54.9, 70.2	150	74.5	66.1, 82.9
	No	74	36.4	28.7, 44.0	47	24.7	16.3, 33.1
	Don't know	2			2		

Table 2: Opinions on emergency preparedness in Alamance County (n=196) and Cabarrus County (n=200).

disaster plan (62.6%; n=120).

Sources of information during a disaster: Respondents most often cite television (57.6%; n=118) and radio (45.3%; n=90) as sources of information during a disaster. Other internet sites (besides local government) (17.7%; n=36), word of mouth (9.5%; n=22), local government websites (4.5%; n=9), and newspapers (3.2%; n=7) were

reported less often. Most respondents expect these sources to provide information about where to go when evacuating (76.2%; n=153), when or whether to evacuate (74.4%; n=149), how to get to a safe location (66.4%; n=135), how to maintain access to clean water and sanitation (57.7%; n=117), and what to take when evacuating (53.1%; n=109). Nearly half would like to learn how to prepare their homes and property for an impending storm (48.9%; n=100). Many also added that they would like additional information about the anticipated scope, location, and duration of the disaster.

Cabarrus County: A total of 649 houses were approached by an interview team. Of those where contact with an eligible individual was made, the response rate was 67.1% percent (200/298).

Study population demographics: A little more than half of the respondents were female (56.4%; n=111), white (77.2%; n=155), and homeowners (73.4%; n=146). Three-fifths have lived at their current address for over five years (n=120). The weighted mean length of residence at the current address was 11.9 years (95% CI: 10.0, 13.7). The weighted mean age was 50.11 years old (95% CI: 47.9, 52.4). About one-half of all households had fewer than three occupants (51.5%; n=103) and nearly 15% of households (n=29) reported an annual income below the federal poverty guidelines for their household size.

Vulnerable populations: Over a quarter of households had a resident over the age of 65 (25.6%; n=53), while 19.4% (n=40) reported a child under the age of 6 (Table 1). Few households (2.6%; n=5) had a resident who does not speak English well and few reported that they did not have access to a car that they could use to evacuate in the event of a disaster (5.3%; n=10). Twenty-three households (11.7%) reported a resident with a disability that might make it more difficult to deal with a disaster. Of those, fewer than half (43.5%; n=10) had made arrangements for special needs residents in the event of a disaster.

Disaster experiences and perceived vulnerability: Eighty-one respondents reported having experienced a disaster while living in Cabarrus County, NC, (41.4%; n=81), but of those, just 8.8% (n=7) had ever evacuated due to a disaster (Table 2).

Most respondents felt that their home was vulnerable to hurricanes (67.6%; n=136), tornadoes (64.2%; n=125), and heat waves or drought (56.3%; n=110). Nearly half also felt vulnerable to winter storms (49.5%; n=97). Wildfires (22.9%; n=44), earthquakes (21.3%; n=42), floods (16.0%; n=30), and landslides (6.3%; n=13) were cited by the fewest respondents. Fifteen respondents (7.9%) reported that they did not believe they were vulnerable to any type of natural disaster.

Disaster preparedness: Sixty-four respondents (33.0%) know where they'd go in the event of a disaster, and fewer (60, or 30.1%) have a designated family meeting location for emergencies. Just over half have an emergency supply kit (53.8%; n=105), and about a third of pet owners (50 of 138) have made arrangements for their pets during an emergency. However, more than half of respondents (53.5%; n=105) feel that they are primarily responsible for providing food, water, and shelter for their household during and immediately after a disaster. Nearly three quarters of respondents would like to learn more about preparing a disaster plan (74.5%; n=150).

Sources of information during a disaster: Respondents most often cite television (63.3%; n=128) and radio (50.9%; n=102) as sources of information during a disaster. Word of mouth (13.5%; n=28), other internet sites (besides local government (13.4%; n=25), newspapers (3.5%; n=7), and local government websites (2.0%; n=4) are reported less often. Most respondents expect these sources to provide information about where to go when evacuating (87.7%; n=175), when or whether to evacuate (86.1%; n=171), how to get to a safe location (83.6%; n=167), how to maintain access to clean water and sanitation (74.8%; n=149), what to take when evacuating (73.9%; n=147), and how to prepare their homes and property for an impending storm (63.3%; n=127).

Discussion

Key informants agreed that emergency management officials and other responders need to be better prepared at all times to communicate with and take actions necessary to protect the public; that vulnerable populations can be difficult to reach during emergencies; and that the public's attention is not focused on disasters until they occur. Household survey responses from residents echoed these findings. Although many households reported a socially vulnerable member (those with a disability, over age 65, under age 6, etc.), only about 40% have made any arrangements for those household members. It is possible that when residents live each day with a "special need," they cease to think of it as a special need, or they do not want to be identified by having this need [4]. In addition, maintaining special needs registries can be expensive and time consuming for emergency management officials, particularly if residents are reluctant to sign up [26]. Reaching vulnerable populations with information under emergency conditions is likely made more difficult by the fact that relatively few residents have made plans for evacuation or designated a family meeting location. This echoes key informants' concerns that the general public does not pay very much attention to disaster plans until they are in the midst of an emergency. In addition, few had made special arrangements for special needs family members or pets.

In both counties, a majority of respondents felt that they themselves were responsible for their own needs following a disaster. While some respondents may truly be self-reliant, a large disaster can affect even those with extensive disaster experience, a practiced evacuation plan, and a personal disaster supply kit. Given North Carolina's history of natural disasters, particularly the frequently of hurricanes, it is concerning that nearly a tenth of respondents in both counties do not feel vulnerable to any natural disaster. However, it is promising that so many residents are interested in learning more about preparing a disaster plan, which seems a natural avenue for education and training by practitioners and emergency management officials.

While our research findings point to potentially useful strategies for making residents more aware of and prepared for emergencies, our study has some limitations that constrain its generalization to other contexts. Key informant interviews and face-to-face surveys may both suffer from response bias, if respondents feel that a certain answer would be viewed more favorably by the interviewer. However, study personnel who conducted the key informant interviews have a long history of working with local governments on questions related to emergency preparedness and are seen as trusted resources. Those who conducted household interviews were trained and deployed in two-person teams, matching one interviewer with a trusted local resource (such as Red Cross volunteers) where possible. While two-stage random cluster survey technique employed for the household survey provides no way of ensuring the participation of socially or physically vulnerable residents, the method is well-established for field work related to disaster preparedness [1] and allows each community member to have an equal opportunity to be selected for an interview. Also, population weighting makes it possible to capture more data from those living in the most populous census blocks. This method

also limits interviewer selection bias–the randomly generated point is mapped by GPS and the interviewer simply follows a map to the spot and conducts an interview at the nearest house located there [27-30].

Conclusion

To enhance household preparedness for emergencies and disasters, emergency managers and other professionals recognize the need to communicate better with residents before disasters. At the same time, some residents are aware they are unprepared and have an interest in knowing and doing more related to preparing for emergencies. Vulnerable populations can be particularly hard to reach and to communicate with about disasters, and some may be reluctant to use the services available or register with authorities. Working to improve communications through service providers and community advocates may be one way to effectively increase household preparedness, particularly when residents already have a trusted relationship with those providers and advocates. Increased resident preparedness should increase the effectiveness and efficiency of emergency response after a disaster and, most importantly, reduce the impacts of disasters on residents as well.

While any given geographic area faces its own unique combination of socio-demographic profile, natural and technological hazards, and emergency management processes and policies, all are bound by common interest in promoting citizen awareness and preparedness, and in delivering effective and efficient response. Therefore, the findings from this study are of interest to emergency management professionals regardless of location and context.

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