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Fire Safety Behaviors Among Residential High-Rise Building Occupants in Hawai'i: A Qualitative Study

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Abstract

The world's population is rapidly urbanizing. Today, the majority of people live in cities and many live in high-rise buildings. High-rise buildings pose many challenges with regards to occupant safety, including fire prevention and evacuation safety. The purpose of this study was to describe factors that influence fire safety behaviors among residents of high-rise buildings and the strategies that population health nurses can use to support health education for people living in high-rise environments. An exploratory, descriptive qualitative research design with purposive sampling was used. Twelve residents from 8 high-rise buildings in Honolulu, Hawai'i participated in this study. In-depth semi-structured interviews were conducted and recorded, followed by thematic analysis of the interview transcripts. Five key themes emerged from the study: (1) attitudes towards fire safety, (2) building fire safety culture, (3) perceived ability to prepare for fires, (4) intentions to prepare, and (5) occupant fire preparedness behaviors. Gaps in knowledge regarding high-rise building fire safety were identified that contributed to residents' risk and vulnerability. Fire safety is of relevance to all nurses who work with populations. Population health nursing practice addresses the health, safety, and emergency preparedness needs of clients and communities. More research should be done to improve understanding of fire safety behaviors among high-rise residents to help population health nurses and other professionals mitigate the risk of fire in residential high-rise buildings and keep individuals and families safe during actual emergencies.

Keywords

emergency preparedness, evacuation, fire safety, high-rise building, interviews, population health nursing, qualitative research, Theory of Planned Behavior

Abbreviations

EP = emergency preparedness
HR = high-rise
TPB = Theory of Planned Behavior
US = United States

The world's population is urbanizing at a rapid rate with the majority of people now living in cities.¹ As a result, cities are experiencing an increase in high-rise (HR) building construction, erecting structures with exceedingly taller heights and greater occupant densities.^{2,3} HR buildings are defined as buildings greater than 75 feet in height from the ground level to the highest floor.⁴ The rapid expansion of residential HR buildings has also occurred in Hawai'i. The City of Honolulu, which is relatively small in terms of land area, has more than 470 HR buildings. It now ranks sixth among cities in the United States (US) for the number of HR buildings.⁵ As HR occupancy becomes commonplace, the health and safety of HR building occupants are of mounting concern. People who live and work in HR buildings are susceptible to emergencies resulting from natural, human-caused, and building-related hazards, including utility disruptions, elevator or other building system failures, flooded areas, and structural weaknesses.⁶ Fire poses a great risk to HR building occupants. In the US, during 2009–2013, there was an average of 40 civilian deaths and 520 injuries due to HR fires per year. Most of these HR fires occurred in apartments and other multi-family housing structures.⁴ The September 11, 2001 attacks on New York City's World Trade Center towers resulted in the deadliest HR fire in history. The fires and building collapses that followed the attack resulted in the deaths of 2791 civilians and firefighters.⁷

Fire safety refers to preventing fire, limiting the spread of fire and smoke, extinguishing a fire, and enabling a quick and safe exit.⁸ HR fire safety research has increasingly focused on the interactions between infrastructure, procedures, and behaviors of building occupants.⁹ Research on commercial HR building occupants has found that fire safety of occupants depends

greatly on behaviors before and during fires.¹⁰⁻¹³ Little research has been conducted on residential HR building occupants' fire safety behaviors. Current disaster preparedness research and educational programs have largely overlooked important aspects regarding residential HR building occupant fire safety. Honolulu has a high density of HR condominium buildings, and HR fire safety is an important public health issue for the city. The purpose of this study was to describe factors that influence fire safety behaviors among residential HR building occupants living in Honolulu and identify relevant priority areas for nursing research and practice.

Population health nurses focus on improving population health through assessing and addressing the multiple determinants that influence health, safety, and well-being. Key roles of population health nurses include advocating for safe living environments, promoting healthy behaviors, and partnering with communities to create conditions in which people can be healthy. In regard to preparing communities for disasters, the goals of population health nurses reflect the practice standards of public health nursing, which aim to protect the population against the risk of disasters and support an all-hazards approach to emergency preparedness.¹⁴ Because of this perspective, population health nurses are well-suited to engage clients and partners in research, practice, and policy regarding residential HR fire safety.

Methods

A qualitative research study using semi-structured key informant interviews was conducted in Honolulu, Hawai'i between August and October 2018. The overarching research question for this study was "What are the factors that influence fire safety and evacuation preparedness among residential HR building occupants?" The study was granted exempt status by the University of Hawai'i Human Research Protection Program review board.

Participants and Sampling

Twelve residents of 8 HR buildings participated in the study. Inclusion criteria for participants included English-speaking persons aged 18 or older who were HR building residents in Honolulu at the time of the study. Purposive sampling using a snowball recruitment technique was used to recruit participants. Sampling continued until data saturation was reached. Participants provided written consent before participating in the study. A gift card was provided to each participant in appreciation for their time. Buildings from which the participants were recruited were concentrated in the urban Honolulu area and were included on a publicly available list developed by the City & County of Honolulu and the Honolulu Fire Department as having an elevated risk for a HR fire. These buildings were deemed as having elevated risk due to being at least 10 stories in height, having interior hallways, and lacking fire sprinkler systems.

Data Collection

A sociodemographic questionnaire was developed to collect information about participants and their households. It included questions about previous experience with HR fires, building evacuation, and prior exposure to emergency or fire safety training. An initial semi-structured interview guide was developed to collect qualitative data. It was informed by the Theory of Planned Behavior (TPB)¹⁵ and refined after input from City and County of Honolulu HR fire safety experts for appropriateness and validity. Each interview lasted 30-60 minutes and was audio recorded.

Data Analysis

Responses to the sociodemographic questionnaire were analyzed using descriptive statistics. Interviews were recorded and transcribed. Thematic analysis of the interview transcripts was performed by two researchers using techniques described by Nowell, Norris, White, Moulès.¹⁶ Various techniques were practiced to maintain trustworthiness.¹⁷ For example, credibility was enhanced through extended engagement with participants and frequent member checks. Direct quotations were employed to achieve transferability of findings. An audit trail was maintained to enhance the study's confirmability. Dependability of the findings was enhanced through double-coding of the transcripts. Two researchers worked independently, then compared results and mutually resolved the few differences in coding.

Results

Demographics

The majority of the participants (n=9, 75%) were female. Participant ages were evenly distributed among young, middle-aged, and older adults. The majority of participants had some college education (n=11, 92%). Seven participants (58%) reported that at least 1 member of the apartment household was 65 years or older. The large majority of participants (n=11, 92%) owned their apartment versus being a renter. The years of tenure living in the HR building was evenly split between 0-5 years and ≥6 years. Most had apartment insurance (n=11, 92%). Participant and household characteristics are summarized in Table 1.

Participant experience with HR building fires. Most of the participants (n=8, 67%) reported having had prior experience with a fire event in the HR building where they currently live. Of these 8 participants, 2 experienced 3 fires in their HR building, 3 experienced 2 fires, and 3 experienced 1 fire in their current building. One experienced a fire in their own apartment. Seven of the participants reported having to evacuate their building due to a fire, in which 3 participants had to evacuate once, 2 evacuated twice, and 2 evacuated 3 or more times. A summary of prior experience with HR building fires and evacuation is provided in Table 2.

	n	(%)		n	(%)
Sex			Household member >65 years old		
Male	3	(25)	Yes	7	(58)
Female	9	(75)	No	5	(42)
Age (years; n=11)^b			Number of household members		
25-39	3	(27)	One	5	(42)
40-64	4	(36)	Two	5	(42)
65-79	4	(36)	Three	2	(17)
Highest education completed			Years in current HR		
High School	1	(8)	0-5	6	(50)
Associate	0	(0)	6-10	1	(8)
Bachelor	6	(50)	11-15	3	(25)
Graduate	5	(42)	>15	2	(17)
Tenure			Total years lived in HR		
Owner	11	(92)	0-5	5	(42)
Renter	1	(8)	6-10	1	(8)
			11-20	2	(17)
Insurance Policy			>20	4	(33)
Yes	11	(92)			
No	1	(8)			

HR = high-rise. ^a Total of 12 study participants. ^b One participant declined to answer.

Prior emergency preparedness (EP) training. Half of the participants had prior EP training (Table 2). Specific types included annual fire and safety training at work, occupational training, annual fire safety video at school, and fire drills. Half of the participants had experience working in an HR, which are subject to the US Occupational Safety and Health Administration regulations regarding fire prevention, such as periodic drills and emergency planning. Table 3 summarizes the types of EP training experienced by participants.

Qualitative Findings

Five primary themes emerged from the data. Themes and sub-themes mapped to TPB theoretical model and are summarized in Table 4 and discussed below.

(1) Attitudes Towards Fire Safety

Fire risk perception. All participants felt some degree of risk for fire in their building. Residents of lower floors, namely the second through fifth floors, described a lower fire risk perception than those living on higher floors due to closer proximity to the ground and the option to escape from their window or balcony. Participants living on lower floors were less inclined to prepare for evacuation or initiate evacuation immediately in response to a fire alarm. One person stated, *“Its five stories,*

	n	(%)		n	(%)
Fire in current HR			Household member EP training		
Yes	8	(67)	Yes	6	(50)
No	4	(33)	No	6	(50)
Fire in own apartment			Experience working in HR		
Yes	1	(8)	Yes	6	(50)
No	11	(92)	No	6	(50)
Fire incidences in current HR (n=8)^a			Experience evacuating HR		
One	3	(38)	Yes	8	(67)
Two	3	(38)	No	4	(33)
Three	2	(25)			
			Number times evacuated HR (n=7)^b		
			One	3	(43)
			Two	2	(29)
			Three or more	2	(29)

HR = high-rise, EP = emergency preparedness.

^a Eight of 12 study participants experienced fire in their current HR.

^b Eight of 12 study participants had experience evacuating a HR, with 1 participant being unable to recall how many times.

Types of emergency preparedness training
• Annual fire safety or emergency preparedness
• Crisis management
• Annual fire safety class
• Partner's occupational training
• Annual school fire safety video about proper use of a fire extinguisher
• Emergency or disaster training, fire drills, earthquake preparedness drills

so it's not too bad. If I were on the 15th or 20th floor, I would probably be a little more cautious and probably be more aggressive in being prepared.”

All participants lived in buildings that lacked sprinkler systems, and most stated that they would feel safer if their building had sprinklers. However, many opposed retrofitting fire sprinkler systems into their building because they believed the cost of retrofitting sprinklers outweighed any safety benefit. Some participants shared that fire sprinklers were not necessary because sufficient safeguards were already in place to ensure safety, such as their buildings' structure, or efforts by building management to bolster fire safety among residents.

Table 4. Thematic Analysis from Semi-Structured Interviews about High-Rise (HR) Fire Safety		
TPB domain	Theme	Subthemes
Behavioral beliefs/attitudes	Attitudes towards fire safety	Fire risk perception influenced by beliefs <ul style="list-style-type: none"> • Causes of high-rise fires • Floor of residence (higher floor = greater risk) • Fire sprinkler systems • Fire hazard risk assessment Prior experience with HR building fire <ul style="list-style-type: none"> • Direct • Indirect Self-responsibility for household fire safety
Normative beliefs/subjective norms	Building fire safety culture	Building management fire safety leadership <ul style="list-style-type: none"> • Inspections, enforcement drills • Communication with residents • Occupant trust in building management • Management linkages with EP community Occupant perception of neighbors' fire safety Social connectedness of the building community
Control beliefs/perceived behavioral control	Occupant perceived ability to prepare for fires	Self-efficacy related to prior knowledge and training in fire safety and EP
Behavioral intentions	Intentions to prepare for fire	
Behavior	Occupant fire preparedness behaviors	Fire prevention and preparedness <ul style="list-style-type: none"> • Fire safety precautions and equipment • Awareness of building fire safety features Evacuation preparedness <ul style="list-style-type: none"> • Awareness of evacuation routes • Cues for evacuation • Barriers to swift evacuation

TPB = Theory of Planned Behavior, EP = emergency preparedness.

Participants' assessment of fire hazard risks also influenced their fire risk perception. This subtheme emerged from a combination of remarks expressing complacency or comfortableness, fatalism, risk denial, avoidance, or a false sense of security regarding the risk of fire in their building. These beliefs prevented many from adopting fire safety behaviors. One participant who had recently experienced a fire in his building stated, *"I need to buy at least [a fire extinguisher]. I'm going to put up some smoke alarms... but I haven't done it yet. It should be a priority but it's not for me. Playing the odds I guess."*

Prior experience with HR building fires. Having direct experience with a fire in their building spurred action to improve household fire safety. Participants described purchasing fire safety supplies, planning evacuation routes, or adopting other EP behaviors. One individual explained that after a fire occurred in her building, she created a detailed family emergency plan that included multiple contact persons, meeting places, adequate insurance coverage, and a financial cushion. Persons who had indirectly experienced a HR fire, such as witnessing a neighboring building fire or learned about a HR fire from the media or a neighbor, explained that these experiences had prompted them to purchase new fire safety equipment, recheck existing supplies, or discuss fire safety in their building.

Self-responsibility for household fire safety. Participants who felt a strong sense of self-responsibility for their household's fire safety tended to be well prepared for fires. Others who ex-

pressed an expectation that their buildings' management should take the lead in preparing residents for fires were less likely to have fire safety knowledge or engage in fire safety behaviors.

(2) Building Fire Safety Culture

Building management fire safety leadership. Buildings with strong fire safety leadership demonstrated proactive steps towards preventing fires and preparing residents for emergencies. Examples of building-level fire safety leadership included fire safety inspections, enforcement of rules, evacuation drills, communication to residents, and establishing linkages with the local EP agencies. Residents who lived in buildings with a greater degree of fire safety leadership were more likely to possess fire safety equipment and had greater confidence and trust in building leadership. In buildings with less evidence of fire safety leadership, residents felt that building management should take more initiative on fire safety efforts on behalf of residents.

Occupant perception of neighbors' fire safety. Most participants felt that residents of their buildings were not prepared for fires. Reasons given for this were that their neighbors are too busy, careless, don't understand the causes of fires or how to prevent them, or don't follow fire safety rules. Participants who felt their neighbors practiced poor fire safety habits described varied emotions about this situation, such as disapproval, annoyance, anger, and fear. One participant explained a need

to mitigate her own risk for fires due to the behaviors of her neighbors, stating, *“If you’re going to live in a HR building... you’re going to be surrounded by a bunch of people you don’t know and whose lifestyles you don’t know... Because of that, you need to do all you can to protect yourself and your condo.”*

Social connectedness of the building community. Individuals with higher levels of engagement with the building community tended to have higher levels of household fire preparedness. These individuals attended board meetings, had served on the resident board of directors, or maintained personal connections with their buildings’ managers or staff. Participants with less engagement with building matters tended to have lower levels of awareness building fire safety features and policies. Experiencing a fire in their building had the effect of galvanizing social connectedness among neighbors and building management and staff. Increased connectedness among neighbors resulted in residents helping each other improve household fire safety. For example, one participant stated, *“I bought [a fire extinguisher] for my next-door neighbor after finding out that she’s a single mom with two kids.”*

(3) Occupant Perceived Ability to Prepare for Fires

Participants who lived in a household where at least 1 member had received some form of fire safety or EP training were much more confident in their ability to prepare for household fires and were more likely to practice fire safety or EP behaviors. For example, participants who had worked in nursing, in the military, or with utility companies maintained a very high level of household fire preparedness. Elementary school fire safety education was also very influential among participants in generating positive beliefs about self-efficacy for fire preparedness. Parents of children who received fire safety training also benefitted from their children’s education. Participants without exposure to fire safety or EP training had lower confidence in their ability to prepare for fires. These persons expressed that they would like building management to organize fire safety training sessions for residents. One person explained, *“I just don’t know what I’m doing! So the building should do something about that.”*

(4) Intentions to Prepare for HR Fires

Participants expressed various intentions to better prepare their households for fire, describing plans to purchase equipment, seek out more knowledge and training, and engage with building leadership to improve fire safety for the entire building. Even though many participants had intentions to prepare for building fires, this did not always result in the actual adoption of household fire safety behaviors. This attitude was true even for participants who had direct experience with 1 or more fires in their building.

(5) Occupant Fire Preparedness Behaviors

Fire safety precautions and equipment. Possession of basic household fire safety equipment varied greatly among participants. While most participants reported having either smoke alarms or fire extinguishers in their homes, few had both. People were not certain of the expiratory date of their fire extinguishers and expressed doubt in their ability to use them. Participants admitted to not replacing expired batteries in their smoke alarms. The low battery warning signal made by smoke alarms was considered very annoying to residents. A common reaction to this alert was to remove batteries from the unit without replacing them or to remove the unit from the wall.

Awareness of building fire safety features. Most participants knew where fire extinguishers were located in the hallways. Many people were not aware that their unit entry doors were designed to remain closed at all times to deter fire from spreading. Participants who had experienced a fire in their building only learned this after a fire had occurred.

Evacuation preparedness. Participants with experience evacuating from HR buildings tended to know at least 1 evacuation route out of the building. Experience with evacuating was gained from occupational training or having had experience evacuating from their units due to a false alarm or actual fire. Most persons understood that they could not use elevators during fires, though some learned this only after a fire occurred in their building. Participants without experience evacuating had less knowledge about evacuation routes or lacked confidence in getting out during an emergency. Some participants did not know the location of emergency stairwells, had never entered their buildings’ stairwells or had only noticed emergency stairwell entrances after a fire had occurred.

Evacuation cues and barriers to swift evacuation. Fire alarms were not perceived as a serious evacuation cue. Participants described varied reactions to the alarm, such as seeking more information, waiting for 1-5 minutes before acting, or completely ignoring it. Repeated exposure to false alarms or tests had desensitized participants to the alarm. Other cues prompted residents to evacuate, including seeing smoke or fire, hearing people scream, seeing emergency vehicles or equipment, and being told to evacuate by others. Physical or sensory impairments were described as an important factor influencing participants’ ability to quickly evacuate from their building. Engaging in multiple pre-evacuation actions, such as gathering items and preparing children or pets for evacuation, was another common barrier.

Discussion

Personal attitudes regarding fire safety, building fire safety culture of neighbors and building management, and perceived ability to prepare their household for fires all contributed to residents' intentions to prepare for HR fires. Occupants with higher levels of perceived risk are more likely to evacuate faster and interpret cues as dangerous faster, decreasing the total amount of time to evacuate from a building.^{13,18} Findings from this study suggest that HR residents who have not ever experienced a building emergency may not perceive fire as an urgent threat. Furthermore, negative attitudes towards fire safety influence attitudes and prevent individuals from taking action. Such factors are also known to serve as barriers to household EP.^{19,20}

Organizational leadership has previously been identified as an influencing factor for commercial HR occupant fire preparedness.^{13,21} This study found that residential HR occupants also seek building-level leadership to prepare for and respond to emergencies. Residents of buildings with proactive managers tended to be more knowledgeable regarding fire safety and benefit from the linkages building leadership make with local EP agencies. Population health nurses should encourage HR communities to build bonds among residents and their surrounding neighborhoods which will support greater fire safety within their buildings. Persons who report higher levels of engagement with their community are more likely to adopt household EP behaviors.²⁰ Furthermore, communities with strong communal linkages or bonds have personal and professional social networks that can be leveraged in disaster situations.²²

Participants who had positive beliefs about their ability to prepare for fires were more likely to have adopted more fire preparedness behaviors. This finding is consistent with research regarding commercial HR occupants.^{11,13,18} While commercial HR buildings are federally mandated to conduct periodic drills and emergency planning, residential HR buildings do not all have the same requirements. This finding indicates an area of concern, since many HR residents may not be exposed to fire safety or EP training unless they receive such exposure in the workplace, or seek it out on their own. Furthermore, participants in this study often lacked basic fire safety equipment, such as functioning smoke alarms and fire extinguishers. While this reflects what is known about household fire safety in the US,²³ this finding is particularly concerning among residential HR occupants, where a fire in 1 household can spread to multiple units. The absence of functional smoke alarms is a primary risk factor for death and injury in residential fires.²⁴ Population health nurses must be attuned to the differences in fire preparedness between commercial HR building occupants and residential HR building occupants.

Implications for Population Health Nursing Research and Practice

Population-focused nursing interventions emphasize primary prevention to promote the health of populations and prevent injury and premature death.¹⁴ Findings from this study indicate multiple areas where population health nurses can engage in promoting fire safety and evacuation preparedness among residential HR residents. Population health nurses can work with individual clients and families to improve fire safety in their units by conducting fire safety audits, which could be done during regularly scheduled home visits. Evacuation plans can be discussed and tailored to include special considerations for vulnerable members including the elderly and disabled. At the building community level, population health nurses can leverage existing partnerships with fire departments or other EP agencies to provide fire safety or EP training at health fairs or other venues convenient for HR residents. Population health nurses may also partner with building associations to cultivate fire safety leadership. For example, nurses can facilitate linkages between communities and local EP agencies or assist with the creation of building-specific educational materials for residents. At the systems level, population health nurses can advocate for health policies that improve residential HR safety, such as legislation mandating the installation of advanced fire safety features in residential buildings. Finally, generating knowledge and greater awareness of this topic through research can further influence policy to support systems change.

Limitations

This exploratory, qualitative study was limited to a single geographic area in Honolulu and involved a small number of participants. A majority of the participants were female, had high levels of education attainment, and were apartment owners. Demographics of study participants may not be representative of all HR dwellers in Honolulu. Further research among other HR residents in other areas is highly recommended. Qualitative descriptive research studies may pose risks for interviewer bias; however, strategies to enhance the rigor and credibility were used to reduce bias and subjectivity.

Conclusion

Findings from this study are significant because they bring to light important factors influencing fire safety behaviors among HR residents, a growing population in many cities. Improved understanding of fire safety behaviors among HR residents will help population health nurses and other professionals mitigate the risk of fire in residential HR buildings and keep individuals and families safe during actual emergencies. The knowledge gained from this study can be used to inform fire safety education

programs, policies, and future research on this topic. The next steps include the administration of a larger, quantitative survey regarding fire safety among high-risk building occupants across Honolulu County and the neighbor islands. Such information can inform the development of population health strategies to provide fire prevention and safety education to the HR building occupants in the state.

Conflict of Interest

None of the authors identify any conflict of interest.

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