FACTORs INFLUENCING FIRE SAFETY AND EVACUATION PREPAREDNESS AMONG RESIDENTIAL HIGH-RISE BUILDING OCCUPANTS

A DISSERTATION SUBMITTED TO THE OFFICE OF GRADUATE EDUCATION OF THE UNIVERSITY OF HAWAI‘I AT MĀNOA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY IN

NURSING

DECEMBER 2018

BY

Gary H Glauberman

Dissertation committee:
Kristine Qureshi, Chairperson
Maureen Shannon
Alice Tse
Chen-Yen Wang
Robert Cooney

Keywords: building, disaster, emergency preparedness, evacuation, fire safety, high-rise, qualitative research, theory of planned behavior, TPB
DEDICATION

For my daughter, Monica.
ACKNOWLEDGEMENTS

There are many I would like to acknowledge. First, I wouldn’t be where I am today without the mentorship and encouragement of my committee chair, Dr. Kristine Qureshi. This journey began a long time ago, when she told me that “the sky is the limit,” and I believed it. Dr. Qureshi has been a constant source of inspiration and motivation, and has guided me through this dissertation, and many other remarkable adventures, with unwavering support. For this, I am forever grateful! Thank you.

To my wonderful Ph.D. committee members, Dr. Alice Tse, Dr. Chen Yen Wang, Dr. Maureen Shannon, Dr. Robert Cooney, and Dr. John Casken, thank you for investing your time and sharing your knowledge with me, and for the enthusiasm you have shown for this project. To Dr. Robyn Gershon, whose expertise on high-rise evacuation provided the foundation for the pilot study that led to this dissertation research, I am extremely thankful for your valuable input. I am also thankful for the assistance provided by Captain Daryl Mau and the Honolulu Fire Department, who shared their time and knowledge with me, and helped me realize how important this study is for the Honolulu community.

To my mother and father, who instilled within me a passion to learn, and compassion to help others; I am what I am because of you. To my grandparents, who always stressed the importance of hard work and education; these values that have led me to continually aspire to greater heights.

To my wife, Naoko, who has endured this PhD journey with me, and whose experience during a fire in our apartment building was the impetus for this whole project. Without you, none of this would have been possible. Thank you.
ABSTRACT

**Purpose.** As urban populations grow, the number of people living in high-rise buildings will increase, resulting in higher occupant densities and an amplified risk in the event of a fire. Most of what is known regarding high-rise fire safety is from research involving commercial high-rise building occupants. Less is known about residential high-rise occupants’ fire preparedness. This report shares findings from a study that sought to better understand factors influencing fire safety and evacuation preparedness among residential high-rise occupants.

**Methods.** A qualitative research study was done using semi-structured interviews. Thematic analysis was conducted on interview data and themes on preparedness for fires and building evacuation were extracted. Analysis was guided by Ajzen’s theory of planned behavior (TPB).

**Results.** Twelve (N = 12) residents from 8 buildings participated, 25% male, 75% female, ages ranged from 31-71. Years living in their current high-rise building ranged from 1-35 years. Most (67%) had experienced a high-rise fire in their building, and most (67%) had experience evacuating a high-rise. One half had some form of exposure to fire safety or emergency preparedness (EP) training. Five primary themes emerged from qualitative interview data: attitudes towards fire safety, building fire safety culture, perceived ability to prepare for fires, intentions to prepare, and occupant fire preparedness behaviors.

**Discussion.** Having at least one household member with prior training in fire safety/EP, and building fire safety culture, were found to be important factors influencing occupant fire safety behaviors. The TPB was found to be useful for describing fire preparedness among residential high-rise occupants. Factors influencing evacuation decision-making differed somewhat from commercial high-rise occupants due to the presence of children, pets, and older residents. These factors may prolong total evacuation time in residential high-rises. Implications for nursing and policy, and future research on this topic were also discussed.
# TABLE OF CONTENTS

ACKNOWLEDGEMENTS ........................................................................................................ iii

ABSTRACT ........................................................................................................................ iv

LIST OF TABLES ............................................................................................................... vii

LIST OF FIGURES ........................................................................................................... viii

CHAPTER 1: INTRODUCTION .......................................................................................... 1
  Fire Hazards in the U.S. ................................................................................................. 2
  Home Fire Safety ......................................................................................................... 4
  High-Rise Building Fire Hazards in the U.S. ............................................................... 5
  Characteristics of High-Rise Buildings that Contribute to Fire Hazard Risk .......... 7
  Fire Safety in High-Rise Buildings ........................................................................... 7
  Human Behavior in High-Rise Fires .......................................................................... 8

Problem Statement ......................................................................................................... 9

Purpose .......................................................................................................................... 9

Rational and Significance .............................................................................................. 10

Definition of Terms ....................................................................................................... 11

CHAPTER 2: REVIEW OF LITERATURE ...................................................................... 13
  Literature Review Search Process ............................................................................ 13
  Elements of Fire Safety Among High-Rise Building Occupants ............................... 14
  Familiarity and Knowledge of Building Fire Safety Features .................................. 14
  Knowledge of Building Emergency Plan and Participation in Drills .................... 16
  Organizational Emergency Preparedness ............................................................... 18
  Evacuation Preparedness and Evacuation Decision-Making .................................... 18
  Fire-Safety for High-Rise Occupants with Mobility Impairments ............................ 21

Theoretical Framework ................................................................................................. 22

Research Questions ....................................................................................................... 24

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY ...................................... 25

Research Questions ....................................................................................................... 25

Theoretical Framework ................................................................................................. 26

Research Design ........................................................................................................... 26
  Participants .................................................................................................................. 27
  Role of the Researcher ................................................................................................. 29
  Instruments .................................................................................................................. 30
  Procedures ................................................................................................................... 30
  Data Analysis Procedure ........................................................................................... 31
  Limitations ................................................................................................................... 33
  Protection of Human Subjects .................................................................................... 33

Summary ........................................................................................................................ 34
LIST OF TABLES

Table 1. Characteristics of study participants ................................................................. 35
Table 2. Characteristics of study participants' household ................................................. 36
Table 3. Prior exposure to high-rise (HR) building fires and evacuation .......................... 37
Table 4. Characteristics related to emergency preparedness .......................................... 38
Table 5. Types of emergency preparedness training ..................................................... 38
Table 6. Thematic analysis procedure ............................................................................ 39
Table 7: Thematic analysis ............................................................................................. 39
LIST OF FIGURES

Figure 1. Fire death rate per 1 million population (2015) (U.S. Fire Administration, n.d.-b)........ 4
Figure 2. Theory of planned behavior (Ajzen, 1991). ................................................................. 24
Figure 3. Number of fires in current building................................................................. 37
Figure 4. Number of times evacuated from a high-rise building................................. 37
CHAPTER 1: INTRODUCTION

Currently, over half of the world’s population lives in urban areas, a proportion the United Nations expects to rise to two-thirds by 2050 (United Nations Department of Economic and Social Affairs, 2014). This growth is reflected in the number and size of the world’s cities. In 2016, there were 512 cities with at least 1 million inhabitants globally, and 31 megacities, cities with more than 10 million inhabitants. By the year 2030, it is projected that the world will have 662 cities will have at least 1 million residents and 41 megacities (United Nations, 2016).

Population growth in urban centers is driving a demand for high-density urban housing and workplaces as land becomes more scarce and expensive. These trends have resulted in a boom in high-rise building construction in the past few decades. These structures are becoming more prevalent in numbers and are being constructed with exceedingly taller heights and occupant densities (Cowlard, Bittern, Abecassis-Empis, & Torero, 2013). In fact, nearly 60% of the tallest 100 buildings in the world were completed after the year 2011 (CTBUH, 2018). There are now an unprecedented proportion of people occupying high-rise buildings. As population and density continue to increase globally and high-rise occupancy becomes commonplace, the health and safety of high-rise building occupants are of mounting concern.

High-rise building occupant safety during emergencies or disasters is a topic of growing importance for public health preparedness. Natural and human-influenced disasters are becoming more frequent and severe in nature, resulting in great numbers of injuries and lives lost (International Federation of Red Cross and Red Crescent Societies, 2016; United Nations, 2015). The United Nations predicts an increasing number of urban disasters as the world’s population becomes more urbanized (United Nations Human Settlements Program, 2007). High-rise buildings are exceedingly susceptible to emergencies resulting from natural hazards (extreme weather, earthquakes, tsunami, flooding), human-caused hazards (accidental, criminal or terrorist...
in nature), and building-related hazards, including utility disruptions, elevator or other building system failures, flooded areas, and structural weaknesses (National Fire Protection Association, 2013; World Health Organization, 1989). Many factors contribute to these structures’ vulnerability to the effects of natural and man-made hazards. Buildings may have been erected before adequate standards and controls were designed, or were built without observing standards and regulations. Older residential buildings in densely populated areas may have been poorly maintained, altered or extended, or are overcrowded. Modern buildings may also be of poor design or construction quality (Twigg, 2015). Perhaps above all other types of hazards, high-rise occupants have the greatest risk for fire emergencies.

**Fire Hazards in the U.S.**

Incidence of fire and fire deaths in the U.S. has declined drastically in the last three decades. In 1974, the year that the U.S. Fire Administration (USFA) was established, there were approximately 12,000 deaths due to fire, or 34.4 per million population (Federal Emergency Management Agency, 2011, 2017). At the time, the U.S. ranked among the top three industrialized nations with the highest fire death rate (Federal Emergency Management Agency, 2011). In the decades since the inception of the USFA, the U.S. fire problem has improved dramatically. Fires per million population reached a new low in 2013, and injuries and deaths per million continue to decline. The fire death rate decreased 10 percent from 2006 to 2015 and is less than a third of what it was in the late 1970s. The decreases in fire incidences and fire deaths have been attributed to many factors including increased use of smoke alarms and fire sprinkler systems, strengthened fire codes and enforcement, fire-protective construction materials and methods, improved firefighting equipment and training, and public education at the community, county, state and federal levels (Federal Emergency Management Agency, 2017).

Despite improving fire statistics, thousands of Americans still die and tens of thousands
of people are injured each year due to fires. Indirect costs of fire, such as temporary lodging, medical expenses, and psychological damage, are also substantial (Federal Emergency Management Agency, 2017). Furthermore, the risk of death due to fire is spread disproportionately among specific populations and geographic areas in the U.S. In 2015, three states (Alabama, Arkansas, and Mississippi) and the District of Columbia had fire death rates that exceeded 20 deaths per million population, nearly double the national fire death rate of 10.5 deaths per million population (Figure 1). Rates of fire deaths per million population are highest among American Indian males (21.8) and African American males (20.9) (U.S. Fire Administration, n.d.-b). Fire deaths among older adults (> 65 years old) are disproportionately higher to their proportion of the U.S. population (Gilbert & Butry, 2017). Persons age 65 years and older accounted for 40% of all fire deaths in 2015 while accounting for only 13% of the total U.S. population (Lehna, Coty, et al., 2015). This means that persons age 65 or older are 2.7 more likely to die in a fire than the total population. For people age 85 and older, the risk is even higher (3.8 times more likely than the total population) (U.S. Fire Administration, n.d.-b).

Persons with mobility impairments also have a higher risk for injury and death during residential fires (Rooney & White, 2007). Children ages 4 and younger were considered to be at a high risk of death from fire in the past. Data now indicate that that trend is changing. The relative risk of children ages 4 and younger dying in a fire in 2015 was 30 percent less than that of the general population (Federal Emergency Management Agency, 2017).
Home Fire Safety

Home fire safety involves avoiding behaviors or situations that are most likely to cause fires, maintaining fire safety equipment, and developing and practicing a fire escape plan (Ready.gov, n.d.). The USFA (n.d.-a) provides a checklist of specific actions conditions that constitute home fire safety. Numerous approaches to improving home fire safety have been reported on. Most home fire safety programs are centered on the distribution and installation of smoke alarms (Ta, Frattaroli, Bergen, & Gielen, 2006). This approach has been proven to reduce fire-related deaths and injuries in many types of populations (Gielen et al., 2014; Istre et al., 2013; Yellman et al., 2018). A meta-analysis found that smoke alarm programs were the most effective at increasing possession of functioning devices when they provided a combination fire safety education, low cost or free equipment and direct installations, and lithium battery alarms (Cooper et al., 2011). Other common fire safety programs incorporate home visits to assess potential fire hazards or include fire safety education as a component of multi-faceted injury

Figure 1. Fire death rate per 1 million population (2015) (U.S. Fire Administration, n.d.-b).
prevention programs (Lehna et al., 2017; Omaki et al., 2018; Reddy, Gomez, & Dixon, 2017; Ta et al., 2006).

While much has been done to improve home fire safety among various types of populations, reported fire safety knowledge and practices remain mixed. Prevalence of smoke detectors in homes is reportedly very high (Ballesteros & Kresnow, 2007; Wood et al., 2016). However, smoke detectors are often not present on every floor or room, not audible in sleeping areas, or non-functioning (Gielen et al., 2012; Omaki et al., 2018; Reddy et al., 2017). Only a fraction of those who report having smoke detectors test their functionality every month (Ballesteros & Kresnow, 2007; Wood et al., 2016). Missing batteries were reported the most common cause for non-working smoke-alarms (Ta et al., 2006). About half of U.S. households report possession of a family fire escape plan (Ballesteros & Kresnow, 2007; Wood et al., 2016). Of the households that do have fire escape plans, most report never having actually practiced it (Ballesteros & Kresnow, 2007; Lehna, Fahey, et al., 2015; Lehna et al., 2017). Fire safety knowledge tends to be dependent on the population surveyed. Parents of small children tend to demonstrate somewhat higher levels of home fire safety knowledge, while older adults have shown deficits in overall home fire safety knowledge (Lehna, Fahey, et al., 2015; Omaki et al., 2018; W. C. Shields et al., 2013). Researchers on this subject often conclude that study results indicate a need for more targeted and population-specific interventions. One population that has received little attention is residential high-rise building occupants. While such a population may be diverse in terms of demographics, these persons share a living environment that is distinct from other types of dwellings.

**High-Rise Building Fire Hazards in the U.S.**

High-rise buildings are defined as buildings greater than 75 feet (23 m) in height from the ground level to the highest floor. The main uses for this type of building are residential
apartments, dormitories or other multi-family housing), office buildings, hotels, and facilities that care for the sick (National Fire Protection Association, 2016a). Between 2009 and 2013, U.S. fire departments responded to an estimated 14,500 structure fires in high-rise buildings per year. These fires resulted in an annual average of 40 civilian deaths, 520 injuries, and $154 million in direct fire damage (National Fire Protection Association, 2016a). The majority of these fires (62%) occurred in apartments and other multi-family housing. Hotels (4%), dormitories (4%), offices (2%) and facilities that care for the sick (2%) accounted for most of the other high-rise fire incidences. The leading cause of fires in all types of high-rise buildings in the U.S. is cooking equipment. The kitchen accounted for 73% of the origin of high-rise apartment fires (Hall, 2013; National Fire Protection Association, 2016a). Other leading causes of fire in the U.S. are smoking materials, heating equipment, and electrical distribution or lighting equipment (National Fire Protection Association, 2016a, 2016b). High-rise building fires tend to result in a lower number of fatalities when compared to low-rise buildings of the same type. However, these incidences can be extremely dangerous because a single fire has the potential to cause a significantly greater amount of fatalities due to the larger number of people involved (National Fire Protection Association, 2016a; Ronchi & Nilsson, 2013).

Two of the U.S.’s most notable high-rise building fires were also among the most deadly high-rise fires in world history. Both were caused by acts of terrorism. The September 11, 2001 attacks on New York City’s World Trade Center towers resulted in the deadliest high-rise fire in history. The fires and building collapses that followed the attack claimed the lives of 2,791 civilians and firefighters. The country’s second deadliest high-rise fire (and the third deadliest in the world) occurred in the nine-story federal office building in Oklahoma City, Oklahoma on April 19, 1995, when a truck bomb exploded outside the building. The blast and ensuing fire killed 169 people (Hall, 2013). Such occurrences are rare but serve as tragic reminders of risks
and devastating consequences of fire hazards for high-rise building occupants.

**Characteristics of High-Rise Buildings that Contribute to Fire Hazard Risk**

Fire hazards in high-rise buildings differ from other types of structures in many ways that increase risk for occupants. In high-rise structures, the building height extends beyond the maximum reach of available fire-fighting equipment, requiring fire personnel to fight fires from inside the building rather than from the outside using fire hoses and ladders (Craighead, 2009). Due to high-rise buildings’ vertical construction, there is a probability of a large uncontrolled fire moving upward. Access by the fire department – from both outside and inside the building – may be restricted, which may result in delays in reaching affected areas to provide assistance. High-rise buildings have natural forces affecting fire and smoke that are not normally significant in lower buildings, such as the impact of winds, stack effect (temperature differences between two areas), and the dynamics of air movement (Craighead, 2009).

The existence of multiple occupied floors results in higher concentrations of occupants, and therefore more property and greater fuel load. Higher numbers of individuals assembled in one location increases the likelihood that some of these people can be injured or killed. High-rise building residents must also be able to evacuate quickly in emergency situations. Yet evacuation of large numbers of occupants takes more time because not all can leave the structure at once via elevators and emergency exit stairwells. Residents may have to travel long distances to get from the area of residency to safety, especially if they reside at higher elevations. The route to safety may be crowded with others trying to evacuate at the same time. Evacuation routes may be more challenging to navigate for persons with disabilities or other health conditions that impair mobility.

**Fire Safety in High-Rise Buildings**

Fire safety involves minimizing possible danger to life and property from various threats,
including fire. The term fire safety is synonymous with fire life safety, fire and life safety, and life safety (Craighead, 2009). It refers to preventing fire, limiting the spread of fire and smoke, extinguishing a fire, and enabling a quick and safe exit (Kobes, Helsloot, De Vries, & Post, 2010). Fire protection features in modern high-rise buildings tend to make them safer than other buildings, contributing to lower occurrence of fire fatalities in high-rise building fires than low-rise buildings of the same use (National Fire Protection Association, 2016a). Examples of high-rise building fire protection features include fire-resistant construction, automatic fire detection and suppression systems, automatic closing fire doors for compartmentation and maintenance of occupant escape routes, automatic smoke control systems to restrict the spread of smoke, early warning systems to warn occupants of fire, and automated fire sprinklers. Other important fire safety equipment include portable fire extinguishers and photoluminescent exit signs or emergency exit path lighting (Craighead, 2009).

**Human Behavior in High-Rise Fires**

Fire safety in high-rise buildings also depends greatly on occupant behavior prior to, and during the time of a fire. Research on human behavior during high-rise building fires is a relatively new and developing field. Early research high-rise building fire safety focused on design of exit stairs, the maximum flow rate capacity for fire exits, the number of fire exits, and other architectural solutions (Kobes et al., 2010; Ronchi & Nilsson, 2013). Consideration of how buildings were used and real evacuation behavior in the case of fire was neglected (Kobes et al., 2010). The September 11, 2001 terrorist attack on the World Trade Center (WTC), “resulted in a paradigm shift in the assessment of high-rise building safety” (Ronchi & Nilsson, 2013, p. 2). Following the terrorist attacks on WTC buildings, high-rise building fire safety research has increasingly focused on the interactions between infrastructure, procedures, and behaviors of building occupants (Ronchi & Nilsson, 2013). Major changes to building safety have been
implemented based on recommendations on the National Institute of Standards and Technology (NIST) final reports of the 9/11 WTC terrorist attacks (Gann et al., 2008; Shyam-Sunder, 2005). Recommendations from the reports included improving high-rise building occupants’ preparedness for emergencies and evacuation.

**Problem Statement**

As urban populations grow, the number of people living in high-rise buildings will increase. Higher densities of people living in high-rise buildings will result in an amplified risk of injury or death in the event of a fire emergency. Most of what is known regarding fire safety has arisen from research on home fire safety and fire safety in commercial high-rise buildings. Less is known about fire safety and evacuation preparedness among residential high-rise occupants. Currently available research on fire safety may overlook important aspects influencing residential high-rise occupant fire safety and preparedness for evacuation. Fire safety education programs and policies informed by available research may not adequately address needs and concerns of people living in high-rise buildings. With little knowledge currently available on this topic, it is important that qualitative research be conducted to better understand the influences of fire safety and evacuation preparedness among residential high-rise dwellers.

**Purpose**

The purpose of this qualitative descriptive study was to examine influences on fire safety and evacuation preparedness among residential high-rise building occupants. Facilitators and barriers to fire safety and evacuation preparedness among high-rise residents were identified. Better understanding of these influences will allow for improved residential high-rise fire safety education and planning at the individual/household, building association, and community or local governmental levels.
Rational and Significance

Health professionals have a responsibility to prepare community members for emergencies. Due to the great number of fatalities possible in high-rise building fires, minimizing risk for fire hazards in these structures is an important public health preparedness priority. This need will become ever greater as population density increases in urban areas across the world and more people reside in high-rise apartment buildings. Nurses represent the largest group of health professionals in the world (World Health Organization, 2013). As such, nurses have the ability to significantly impact health and safety of high-rise residents in many different countries. Nurses have always been engaged in injury prevention, home safety, emergency preparedness, and advocacy. Due to their intimate knowledge of health and safety needs of various groups of people, nursing professionals are well suited to lead multidisciplinary teams in efforts to mitigate the risk of fire in residential high-rise buildings. Research that provides a deeper understanding of the factors that influence fire safety and evacuation preparedness among residential high-rise occupants will inform fire safety education programs, policies and future studies. Ultimately, it is hoped that such efforts will result in fewer fire-related injuries or deaths among residential high-rise building occupants.
Definition of Terms

Building code. A set of ordinances or regulations and associated standards intended to control aspects of the design, construction, materials, alteration and occupancy of structures that are necessary to ensure human safety and welfare, including resistance to collapse and damage (United Nations Office for Disaster Risk Reduction, 2009).

Disaster. A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources (United Nations Office for Disaster Risk Reduction, 2009).

Fire safety. The minimizing of possible danger to life and property from various threats, including fire. Synonymous terms include fire life safety, fire and life safety, and life safety (Craighead, 2009).

Hazard. A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage (United Nations Office for Disaster Risk Reduction, 2009).

High-rise. A building that extends higher than the maximum reach of available fire-fighting equipment. In absolute numbers, this has been set variously between 75 feet (23 m) and 100 feet (30 m), or about 7 to 10 stories (depending on the slab-to-slab distance between floors). The exact height above which a particular building is deemed a high-rise is specified by the fire and building codes in the area in which the building is located (as cited in Craighead, 2009).

Mitigation. The lessening or limitation of the adverse impacts of hazards and related disasters (United Nations Office for Disaster Risk Reduction, 2009).
**Preparedness.** The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions (United Nations Office for Disaster Risk Reduction, 2009).

**Risk.** The combination of the probability of an event and its negative consequences. The word “risk” has two distinctive connotations: in popular usage the emphasis is usually placed on the concept of chance or possibility, such as in “the risk of an accident”; whereas in technical settings the emphasis is usually placed on the consequences, in terms of “potential losses” for some particular cause, place and period (United Nations Office for Disaster Risk Reduction, 2009).

**Vulnerability.** The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard (United Nations Office for Disaster Risk Reduction, 2009).
CHAPTER 2: REVIEW OF LITERATURE

This chapter begins with a review of the literature about fire safety and evacuation preparedness in high-rise buildings factors that contribute to the concept. A theoretical framework for conceptualizing fire safety and evacuation preparedness behaviors will also be discussed. In the final section of this chapter, the proposed research questions are outlined.

Literature Review Search Process

A literature review was conducted using five online databases (CINAHL, Academic Search Complete, PubMed, Science Direct, and Web of Science) using a combination of the following keywords: evacuation, emergency preparedness, fire safety, high-rise, and building. The search was conducted in January 2018. Search results were limited to English-language peer-reviewed journal articles published 2001 or later (September 11, 2001, was specified if the database allowed for exact dates). Articles were limited to this time period due to major changes to high-rise fire safety policies following the September 11, 2001 terrorist attacks on the WTC. A manual search was also conducted to retrieve other important articles.

The search returned 835 articles in total. Titles and abstracts of the search results were examined for relevance to the review. Duplicate titles found in multiple databases were read once. Full-text review of 51 articles was completed. Articles retained described primary research pertaining to fire preparedness among occupants of residential and commercial office high-rise buildings in the United States (U.S.). Excluded from the review were articles that did not focus specifically on human behavior prior to or during a high-rise building fire. These included fire preparedness among residential structures other than high-rises, such as single-family homes, or low-rise apartments. Articles pertaining to the evacuation of hospitals or other medical facilities were also excluded because the occupants and purpose of these types of buildings vary greatly from commercial or residential high-rise buildings. Other articles were excluded because they
focused on fire-fighter professional rescue techniques, technology, or policies; fire safety architecture, construction and technology; or computer-simulations of building evacuation, topics that are beyond the scope of this review. Finally, articles reporting on high-rise fires or fire safety in countries other than the U.S. were excluded because fire safety standards and procedures may between different nations and cultures. Grey literature was not included in this review, however reports from governmental and other organizations were used to provide context and statistics.

In total 14 articles were included in the final review. Articles were published between the years 2006 - 2015. Most articles (n = 12) reported exclusively on commercial high-rise building fire safety. Two (n = 2) reported on both residential and commercial high-rise building fire safety. Many (n = 11) articles reported on events related to the attack and emergency evacuation of the WTC towers. Studies used a range of quantitative (n = 5), qualitative (n = 5) and mixed methods (n = 4). Five articles provided secondary analyses of data collected in large studies that captured detailed behaviors and experiences of WTC evacuees. The following summarizes elements of fire safety among residential and commercial high-rise building occupants, evacuation preparedness and decision-making during high-rise building emergencies, and special fire safety considerations for high-rise occupants with mobility impairments.

**Elements of Fire Safety Among High-Rise Building Occupants**

Commonly cited elements of fire safety among high-rise building occupants included familiarity and knowledge of building fire safety features, knowledge of building emergency plan and participation in drills, and organizational preparedness.

**Familiarity and Knowledge of Building Fire Safety Features**

Knowledge and awareness of a building’s notification systems, evacuation routes, and familiarity with emergency evacuation plans or procedures have frequently been used to assess
high-rise occupants’ preparedness for fire. It is thought that higher degrees of familiarity with a building and its fire safety features would facilitate greater ease of evacuation.

**Residential high-rise occupants’ familiarity with fire safety features.** The National Fire Protection Association (n.d.) encourages high-rise building residents to gain knowledge of the building’s fire safety features and evacuation procedures. Based on this knowledge, residents can develop household evacuation plans. In a study comparing residential and commercial high-rise building occupants, residential high-rise building occupants were found to be less knowledgeable of their buildings’ fire safety features, such as fire pull stations, fire exits, or public address (PA) systems. Knowledge of building evacuation routes was comparable between groups. Residential and commercial high-rise occupants were also equally knowledgeable of fire exit locations and alternative exits or stairs (Zmud, 2008).

**Commercial high-rise occupants’ familiarity with fire safety features.** Gershon, Magda, Riley, and Sherman (2012) developed the *Emergency Preparedness Knowledge and Experience Scale* to measure building familiarity and knowledge among WTC evacuees. The 10-item scale assessed occupants’ knowledge of the number of stairwells and fire alarm pull boxes on the floor; location of exit doors, non-reentry floors and exit doors on sky lobby floors; and where all stairwells would lead. It also assessed occupants’ ability to safely leave without instructions, the degree of familiarity with the building, fire drill participation, and history of previous building evacuation experience. An internal consistency estimate of responses to the ten-item scale yielded a Cronbach alpha of 0.77. Results of the scale indicated low levels of emergency-related knowledge among WTC evacuees. Less than half (42%) knew the number of fire stairwells in the building. Only 20% of respondents were confident they knew the location of all exit doors that led to stairs on their floor. Close to half (45%) did not know certain floors were locked for security reasons and most (86%) did not know where all the stairwells would lead.
Many (50%) did not feel confident about exiting their building without instructions.

In a study examining occupant behavior and evacuation of a fatal high-rise office fire, Proulx and Reid (2006) reported that while most (75%) of building occupants surveyed had used the stairwell prior to the fire, nearly half of them (48%) were unaware that stairwell doors would lock behind them upon stairwell entry. This lack of awareness regarding locked stairwell doors likely contributed to the six fatalities and several injured occupants found in the stairwell. Glenshaw et al. (2007) reported on factors contributing to fatalities in the Oklahoma Federal building terrorist attack. The study used occupancy status (employee vs. visitor) as a proxy for building familiarity. It was found that employee status (greater familiarity with the building) was found to be protective against fatality during the high-rise building collapse (although the finding was not statistically significant at $\alpha = 0.05$ level).

**Knowledge of Building Emergency Plan and Participation in Drills**

**Residential high-rise building emergency plans & drill participation.** The National Fire Protection Association (n.d.) recommends that residents of high-rise buildings develop and practice an evacuation plan. Residents should also consult with building managers or owners to understand the building’s emergency plan. Zmud (2008) reported that knowledge of new occupant training was low (11%) among residential building occupants compared to commercial building occupants (31%). The same study also found that while both residential and commercial high-rise building occupants correctly believed that using elevators was not safe during a fire, a quarter of all respondents in the study (commercial and residential high-rise occupants) incorrectly believed that going to the roof was a possible safe alternative to evacuating down the stairs (Zmud, 2008).

Zmud (2008) also examined respondents’ attitudes towards and participation in fire drills. Most residential high-rise occupants (80%) believed that fire drills are beneficial to
building safety, a proportion similar to commercial high-rise occupants (89%). Despite this, only 19% of residential occupants reported participation in fire drills within the last year compared to 83% of commercial high-rise building occupants surveyed.

**Commercial high-rise building emergency plans & drill participation.** The U.S. Department of Labor Occupational Safety and Health Administration (OSHA) requires employers to develop fire prevention and emergency preparedness plans for high-rise office buildings (Ball, 2001). These plans, called emergency action plans (EAPs), include emergency procedures that building occupants should follow, procedures to account for employees after emergency evacuation, evacuation roles and duties of the designated personnel, emergency communication systems, and information about how to assist persons with disabilities during emergencies. High-rise office building occupants should be instructed annually on the procedures to be followed in case of a fire or other emergency and should participate in mandatory emergency drills (Ball, 2001; National Fire Protection Association, 2013). Despite these requirements, multiple studies have found that commercial high-rise building occupants had little to no knowledge of building evacuation procedures, or were not able to identify proper procedures that corresponded to the building’s emergency plan (Gershon et al., 2012; Proulx & Reid, 2006; Zmud, 2008).

Commercial high-rise building occupants have generally reported high levels of participation in fire drills (Gershon et al., 2012; Proulx & Reid, 2006; T. J. Shields, Boyce, & McConnell, 2009; Zmud, 2008). However, respondents reported that behaviors during these drills varied. Some respondents reported they had never actually entered a stairwell during these drills, had not moved to another floor, nor had they ever exited the building during drills, or ever evacuated their building for any reason (Gershon et al., 2012; Proulx & Reid, 2006; Rooney & White, 2007; T. J. Shields et al., 2009; Zmud, 2008).
Organizational Emergency Preparedness

Gershon et al. (2012) developed the *Emergency Preparedness Safety Climate Scale* to assess organizational emergency preparedness among WTC evacuees. The eight-item scale assessed key elements of building management/employer emergency preparedness as required under OSHA. Items included an assessment of the designation of an individual responsible for ensuring that everyone evacuated, the provision of written fire safety and evacuation information, post-evacuation designation meeting places and plans for conducting a head-count, designation of a person in charge of fire drills, and management and co-worker participation in fire drills. An internal consistency estimate of the responses yielded a Cronbach alpha of 0.66. Reported scores on this scale among WTC evacuees were low. For example, less than one-fourth of respondents reported that their employer had provided fire safety information or a written evacuation plan. A third of respondents did not know or were not sure if someone on their floor was in charge of ensuring that everyone on the floor evacuated. Most (84%) reported that they had never been apprised of plans for gathering after evacuation. Few respondents (15%) reported that their employer had a plan to conduct a head count (Gershon et al., 2012).

Evacuation Preparedness and Evacuation Decision-Making

Safety during high-rise building fires depends on swift recognition of fire or emergency cues, rapid initiation of evacuation, and quick completion of building evacuation process.

**Cues for evacuation.** Proulx and Reid (2006) examined cues that informed high-rise office occupants of a fire emergency in their building. Emergency cues described by respondents included hearing a public announcement (P.A.) message (38%), seeing or hearing others (28%), smelling something (24%) or seeing something (10%). When asked what they thought was happening in those initial moments, 30% thought there was a fire, 29% thought there was a minor problem, 29% did not know what was happening, and 12% thought it was a false alarm or
drill. Analysis of the data using a chi-square test ($\chi^2$) showed that respondents’ initial assessment of the situation significantly affected their perception of how serious the situation was.

Cues received by evacuees of the attack on the WTC were not characteristic of a typical fire incident, but are still helpful in understanding how high-rise occupants perceive building emergency situations. WTC evacuees reported that initial cues alerting WTC evacuees to an emergency were feeling the impact or sway of the building, hearing something unusual, and seeing or smelling something unusual, such as fire, smoke, or falling debris (Gershon et al., 2012; McConnell et al., 2010b).

**Initiation of evacuation movement.** A key factor that determines the success of an evacuation during high-rise emergencies is the duration of occupants’ “response time.” Response time is the period of time occurring between occupants’ response to the cue to evacuate and the beginning of purposeful movement to an exit point or a place of safety (Day, Hulse, & Galea, 2013). Building evacuation studies have shown that people do not immediately react to verbal warnings or physical cues. Multiple factors are thought to influence the length of time to initiate evacuation.

**Demographic factors.** Individual demographic factors such as age and gender, and health/disability status have been linked to response times (Gershon et al., 2012; Gershon, Rubin, Qureshi, Canton, & Matzner, 2008; Groeger, Stellman, Kravitt, & Brackbill, 2013; Kuligowski, 2015; McConnell et al., 2010b; Sherman, Peyrot, Magda, & Gershon, 2011). Older aged persons, males, and persons with health conditions that limit mobility tend to have longer pre-evacuation times. Glenshaw et al. (2007) found that occupants aged 60 or older had greater odds of dying in a building collapse than younger adults after controlling for other factors.

**Experience or training for emergency situations.** Experience or job training in responding to emergencies may also be linked to response times. Gershon et al. (2012) found
occupational experience in the military, first responder, security, or having a building rescue role (fire safety team members) was a significant predictor for longer evacuation initiation periods. However, these factors did not serve as significant predictors for pre-evacuation delay in other studies (Day et al., 2013; McConnell et al., 2010b).

**Risk perception.** Risk perception is the perceived seriousness of a situation and how much risk/danger someone feels as a result of an event (Kuligowski & Mileti, 2009). It has been shown to be influential in evacuation decisions among commercial high-rise building occupants during emergencies (Day et al., 2013; Gershon et al., 2012; Kuligowski, 2015; McConnell et al., 2010b). Persons deemed to have perceived a high level of risk in building emergencies are less likely to engage in pre-evacuation tasks and more likely to quickly initiate evacuation. Conversely, persons with lower perceptions of risk tend to have longer pre-evacuation times because they continue working after receiving initial cues or undertake more information-seeking or preparatory tasks prior to evacuating (Day et al., 2013; Gershon et al., 2012; Sherman et al., 2011).

**Pre-evacuation tasks.** During the pre-evacuation period, occupants often undertake a variety of activities that serve to postpone the initiation of evacuation (Day et al., 2013; Gershon et al., 2012; Gershon, Qureshi, Rubin, & Raveis, 2007; McConnell et al., 2010b; Proulx & Reid, 2006). The number of tasks undertaken prior to evacuation has been directly linked to total evacuation times. WTC occupants who reported rapid response times performed fewer tasks prior to evacuating. Conversely, occupants who reported very long response times performed a higher number of pre-evacuation tasks (Day et al., 2013).

Some tasks that people undertook were related to receiving and transmitting information. Occupants sought information from co-workers, supervisors, emergency personnel or the media. They communicated with others, provided verbal instructions to evacuate, or waited for
directions prior to evacuating (Day et al., 2013; Gershon et al., 2012). People also undertook tasks related to preparing for evacuation. Such tasks included gathering personal items, seeking out other persons, changing shoes to prepare to walk down the stairwell, or completing work-related activities (making phone calls/shutting down computers) (Day et al., 2013; Gershon et al., 2012). Similar behaviors were described by Proulx and Reid (2006) during a high-rise office fire. Upon hearing a P.A. message to evacuate one of the floors, only 22% started their evacuation, while the other 78% undertook similar tasks described above.

**Fire-Safety for High-Rise Occupants with Mobility Impairments**

Gershon et al. (2012) developed the *Disability Preparedness Scale (DPS)* to assess organizational preparedness for evacuating persons with disabilities from the WTC towers. The four-item scale assessed whether specific areas were designated for persons with disabilities to gather during emergencies, the existence of plans for their evacuation, whether or not co-workers were assigned to assist them during emergencies, and the availability of special evacuation equipment (Gershon et al., 2012). An internal consistency estimate of the responses to the four-item scale yielded a Cronbach alpha of 0.76. The scores reported among WTC evacuees were very low. Very few reported knowledge of specially designated gathering areas for persons with disabilities. Most were unaware of plans or special equipment in place for their evacuation. Ten percent thought that someone was assigned to assist them. On a positive note, fire safety team members were four times more likely to score above the mean score on the DPS.

T. J. Shields et al. (2009) reported on the behavior and evacuation experiences of six WTC 9/11 evacuees with self-designated mobility impairments. Participants in this study described varying levels of personal preparedness for building emergencies, such as having awareness of the location of exits and stairwells, knowledge of the existence of fire safety wardens and who they were, knowledge of the hazards associated with elevator evacuation, and
having an emergency backpack of supplies. None had used the stairways as part of their regular route and none of them knew where the stairwells would lead if they had to use them. All participants described having participated in fire drills in the year prior to the September 11, 2001 evacuation.

Proulx and Reid (2006) reported on an office building fire in which five respondents with self-identified mobility limitations described their evacuation during the event. Three used the elevators and two used the stairwells. One respondent using the elevator used a wheelchair and was accompanied to the ground by an aide. Both respondents who used the stairs reported having arthritis. Rooney and White (2007) found that persons with disabilities have found themselves abandoned during emergency drills or building evacuations. Such experiences exposed a lack of plans or equipment to assist their evacuation and left these persons distressed and concerned for their safety during emergencies.

**Theoretical Framework**

This qualitative descriptive study used the theory of planned behavior (TPB) (Ajzen, 1985, 1991) to guide inquiry into residential high-rise occupants’ fire safety and evacuation preparedness attitudes and behaviors. TPB postulates that three antecedents shape behavior or behavioral intentions: an individual’s attitude towards a behavior, subjective or social norms, and perceived behavioral control. Attitude refers to whether or not a person has a favorable or unfavorable evaluation or appraisal of the behavior in question. Subjective norms refer to the perceived social pressure to perform (or not perform) a behavior. Perceived behavioral control refers to the perceived ease or difficulty of performing the behavior (Ajzen, 1991).

Ajzen’s (1991) TPB suggests that behavioral beliefs, normative beliefs, and control beliefs contribute to the formation of attitude, subjective norm, and perceived behavioral control. Behavioral beliefs refer to beliefs about the likelihood that performing the behavior would lead
to certain outcomes. The likelihood that these outcomes would occur along with the individual’s favorable or unfavorable evaluations of these outcomes, leads to attitude. Normative beliefs are composed of 1) perceived behavioral expectations from an individual’s family, friends, and other important referent groups; and 2) the individual’s motivation to comply with these expectations. Control beliefs describe factors that facilitate or impede one’s performance of the behavior.

The TPB model has been used in varies studies related to health behaviors (Taylor et al., 2006). In recent years, the TPB has been utilized to describe behaviors related to disaster and emergency health preparedness. It has been used to describe intent to carry out household disaster preparedness tasks (Dantzler, 2013; Najafi, Ardalan, Akbarisari, Noorbala, & Elmi, 2017). It has been when examining intentions for conducting wildfire mitigation activities (Bates, Quick, & Kloss, 2009; Nox & Myles, 2017). The TPB has also been used to investigate disease outbreak preparedness in terms of determining intention of getting the H1N1 vaccine (Myers & Goodwin, 2012; Yang, 2015), and investigating nurses’ intentions to respond to bioterrorism and other infectious disease emergencies (Grimes & Mendias, 2010). Kinateder, Kuligowski, Reneke, and Peacock (2014) proposed that the TPB could possibly be applied to high-rise building evacuation behavior. However, it may not be as well suited for spontaneous and unplanned behavior because the model leaves out affective situational variables (e.g. fear and anxiety) that may influence evacuation decisions.
Research Questions

The overarching research question for this study was “What are the influences on fire safety and evacuation preparedness among residential high-rise building occupants?” The specific research questions were:

1) How do high-rise building residents’ perceive their household fire safety and evacuation preparedness?

2) What actions are residential high-rise building occupants taking towards establishing their household’s fire safety and evacuation preparedness?

3) What are residential high-rise building occupants’ perceptions of other residents’ fire safety and evacuation preparedness?

4) What are the perceived barriers/facilitators to household fire safety and evacuation preparedness?

5) How does prior experience with fires, or knowledge of previous fires in the building of residence, influence individual/household fire safety and evacuation preparedness?
CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

The aim of this qualitative descriptive study was to gain a better understanding of the status of fire safety and evacuation preparedness among high-rise building residents and families. The study identified influences of fire safety and evacuation preparedness among residential high-rise building occupants. Little research has been done in this area in the U.S. The outcomes of this study will better inform the development of fire safety research tools, as well as fire safety educational programs and policies designed to prevent fire injuries and fatalities among high-rise residents. The purpose of this chapter is to provide a summary of the research study’s methods and design, the theoretical framework guiding inquiry, sample and setting, data collection and analysis methods, and ethical considerations.

Research Questions

The overarching research question was “What are the influences on fire safety and evacuation preparedness among residential high-rise building occupants?” The specific research questions were:

1) How do residential high-rise building occupants perceive their household fire safety and evacuation preparedness?

2) What actions are residential high-rise building occupants taking towards establishing their household’s fire safety and evacuation preparedness?

3) What are residential high-rise building occupants’ perceptions of other residents’ fire safety and evacuation preparedness?

4) What are the perceived barriers/facilitators to household fire safety and evacuation preparedness?

5) How does prior experience with fires, or knowledge of previous fires in the building of residence, influence individual/household fire safety and evacuation preparedness?
Theoretical Framework

This qualitative research study used the theory of planned behavior (TPB) (Ajzen, 1985, 1991) as a framework to guide its inquiry. The TPB postulates that behavior or behavioral intentions are shaped by an individual’s attitude towards a behavior, subjective or social norms, and perceived behavioral control. Attitude refers to whether or not a person has a favorable or unfavorable evaluation or appraisal of the behavior in question. Subjective norms refer to the perceived social pressure to perform (or not perform) a behavior. Perceived behavioral control refers to the perceived ease or difficulty of performing the behavior. Generally, the more favorable the attitude and subjective norm, and the greater the perceived control, the stronger the person’s intention to perform the behavior in question should be. Finally, with a sufficient degree of actual control over the behavior in question, people are expected to carry out their intentions when the opportunity arises (Ajzen, 1991).

Research Design

Qualitative research embraces a constructivist worldview, allowing researchers to describe a phenomenon from the views of participants (Creswell, 2013). Little is currently known about the factors influencing fire safety and evacuation preparedness among high-rise building residents. In order to better understand these factors from the perspectives of the participants, this research study employed a descriptive qualitative approach to inquiry. According to Sandelowski (2000), qualitative descriptive studies are useful when straight descriptions of the phenomena of interest are desired. The result of a qualitative descriptive research study is a summary of an event or phenomenon, organized in a way that best contains the data collected and will be most relevant for the audience it was written for. Such summaries may yield concepts, hypotheses, and themes for future grounded theory or phenomenological study (Sandelowski, 2000).
Qualitative descriptive research design shares commonalities with other qualitative traditions. It typically involves purposive sampling, semi-structured interviews with open-ended questions, and data analysis conducted by qualitative content analysis using modifiable coding systems (Neergaard, Olesen, Andersen, & Sondergaard, 2009; Sandelowski, 2000). However, the method also differs from other qualitative traditions in key ways. First, it aims for a rich, straight description of an experience or event in a language similar to the informants’ own language. In qualitative descriptive studies, the researcher works and stays close to the data, whereas other qualitative approaches, in comparison, often aim to develop concepts and analyze data in more reflective or interpretive ways (Neergaard et al., 2009; Sandelowski, 2000, 2010). Second, qualitative description interview guides are slightly more structured than other qualitative methods. Interview guides used are based on expert knowledge and are focused on areas poorly understood in a healthcare context (Neergaard et al., 2009).

While the qualitative descriptive method is distinct from other qualitative traditions, it may take “hues, tones or textures” from these approaches (Sandelowski, 2000, p. 337). Researchers using qualitative descriptive method may employ techniques associated with grounded theory, but not produce a theoretical rendering of the target phenomenon. Or they may use techniques belonging to phenomenology, but not produce narrative or phenomenological renderings of the target phenomenon (Sandelowski, 2000). This study used qualitative descriptive methods to produce a summative description of factors influencing fire safety and evacuation preparedness from the perspective of residential high-rise building occupants.

Participants

English-speaking adults who were current residential high-rise building occupants in the Honolulu area were recruited for this study. People who live in residential high-rise buildings are excellent informants regarding the topic of interest, which involves knowledge about high-rise
building safety and evacuation procedures. Only adults were included in the study because they are more likely to be concerned with personal/family fire safety decisions. People who speak English were included because that is the native language of the researcher.

**Criteria for inclusion or exclusion.** Inclusion criteria for all participants included: (a) age 18 or older, (b) English-speaking and able to communicate verbally, (c) able to provide consent to participate in the study, and (d) living in a residential high-rise building at the time they were recruited to the study. Exclusion criteria included: (a) persons younger than 18 years of age, persons who are not English-speaking or not able to communicate verbally, (c) persons unable to provide consent to participate in the study, and (d) persons who did not live in a residential high-rise building at the time of the study.

**Sampling and recruitment.** The study used purposive sampling with snowball technique to recruit study participants. Purposive sampling is used in qualitative studies to deliberately select particular persons who are uniquely able to be informative because they are experts in an area, or have experienced a particular phenomenon, and can provide information that is relevant to research questions and goals (Maxwell, 2012). Twelve (N=12) individuals from eight different high-rise buildings participated in the study. Buildings from which the participants were recruited were at least 10 stories high, had interior hallways, and lacked fire-sprinkler systems. Each of these buildings was included on a list developed by the City & County of Honolulu and the Honolulu Fire Department as having an elevated risk for a high-rise building fire. After sampling 12 individuals, data saturation was reached and sampling ceased. Saturation is considered the point at which the data gathered no longer provides new information or fresh perspectives and becomes repetitive (Creswell, 2013).

Recruitment of study participants was done in-person and through IRB-approved emailed letters. The researcher first began by informing people he knew who lived in residential high-rise
buildings about the project. The researcher then asked these individuals of their interest in participating in the project, and identified and recruited others by using a snowball technique. Prior to participation in the study, all participants were provided oral and printed information regarding the topic under investigation, a description of the study’s purpose, and an explanation regarding ethical details of the study.

**Setting.** The research study was conducted in Honolulu, Hawai‘i. This community was suitable for the study due to its large number of residential high-rise buildings. All key informant interviews were conducted areas that were convenient and comfortable to participants, suitable for interviews, and maintain privacy from the general public, such as residential high-rise building units and common areas.

**Role of the Researcher**

In qualitative studies, the researcher is considered the instrument of research. Researchers are part of the world that they study, and have a powerful and inescapable influence on data collected (Maxwell, 2012). Because the main method for data collection relied upon participant interviews, several characteristics of the researcher role were kept in mind during the interviewing process. Interviewing techniques involved: a) asking one question at a time, b) attempting to remain as neutral as possible or not showing strong emotional reactions to responses, c) encouraging responses with an occasional head nod or affirmations, d) being careful about note taking, e) providing transitions between major topics, f) and remaining in control of the interview by intervening when respondent strayed away from topic, or took a very long to answer a question, or began asking questions of the interviewer (Turner, 2010).

**Reflexivity.** While interviewing, the researcher acknowledged the possible influence that the researcher had on what informants said. To mitigate this influence, the researcher monitored for personal bias or subjectivity through the process of reflexivity (Maxwell, 2012). Reflexivity
is the process of identifying preconceptions brought into the project by the researcher representing previous personal and professional experiences, pre-study beliefs about how things are and what is to be investigated (Malterud, 2001). The researcher was a resident of a high-rise building that had experienced multiple fires in the past. In order to mitigate the influence of the researcher’s personal beliefs or biases regarding fire safety and evacuation preparedness, the researcher maintained reflexivity during data collection and analysis process. This was done by focusing solely on the data collected from interviews and being open and consciously looking for competing ideas and conclusions that contrasted with the researcher’s own perspective.

**Instruments**

A socio-demographic questionnaire was developed and used to collect descriptive demographic data of study participants. Qualitative data was collected via one-on-one interviews centered on the study’s research questions. Interviews followed the format of a semi-structured interview guide. The interview guide used was developed by the researcher and informed by Ajzen’s (1991) theory of planned behavior (TPB). It was also refined with input from high-rise building fire safety experts for appropriateness and validity prior to its use.

**Procedures**

Each time a research participant was recruited, the researcher determined a mutually agreeable time and place to conduct one-on-one interviews. Scheduling was done in person, by phone, or email. At the outset of the interview, each participant was reminded that the interview was being recorded. The order questions during each interview followed a semi-structured interview guide. When respondents replied, the researcher posed follow-up or probing questions as needed. Each interview was conducted until the researcher and the participant mutually agreed that their perspective on the factors influencing fire safety and evacuation preparedness had been completely covered.
Each interview was recorded with a voice recorder and transcribed verbatim. The researcher transcribed and analyzed all data collected, and repeated the procedure with different participants until data saturation was reached. Data collection was be conducted concurrently with data analysis.

**Data Analysis Procedure**

The overarching research question of the proposed study was: “What are the influences on fire safety and evacuation preparedness among residential high-rise building occupants?” To address this question, data collected from residential high-rise building occupants was analyzed using qualitative content analysis techniques.

**Demographic data.** Data from the socio-demographic questionnaire was entered into Microsoft Excel software to provide descriptive statistics regarding study participants.

**Qualitative data.** Interview data was analyzed using qualitative content analysis methods. Qualitative content analysis is an appropriate approach to analyzing data for qualitative descriptive studies. Hsieh and Shannon (2005) define qualitative content analysis as a “research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns” (p. 1278). It is commonly used in health studies to analyze text data, focusing on the characteristics of language as communication with attention to the content or contextual meaning of the text. The goal of content analysis is to provide knowledge and understanding of the phenomenon studied (Hsieh & Shannon, 2005).

Miles et al provides six analytic strategies involved in content analysis: a) coding of data from notes observations or interviews, b) recording insights and reflections on the data, c) sorting through data to identify similar phrases patterns or themes, d) finding commonalities and
differences among data, e) deciding on generalizations, and f) examining generalizations in light of existing knowledge (Neergaard et al., 2009).

For this study, the researcher transcribed interview data, then read the data while listening to the recordings in order to ensure the accuracy of the text. Following this step, two researchers concurrently and independently analyzed the data using content analysis techniques (Graneheim & Lundman, 2004; Hsieh & Shannon, 2005; Neergaard et al., 2009). The researchers compared codes with each other. Differences in codes were discussed and mutually resolved. Codes were sorted and combined to generate overarching themes and subthemes. Themes were reviewed and refined to assure they accurately reflect the data set as a whole.

**Trustworthiness.** Milne and Oberle (2005) describe strategies for enhancing rigor and credibility of qualitative descriptive studies, using the framework provided by Whittemore, Chase, and Mandle (2001). The framework includes four criteria: 1) *authenticity*, 2) *credibility*, 3) *criticality*, and 4) *integrity*. Authenticity describes the attention to voices of the participants. Creditability is a reflection of how believable results are (Milne & Oberle, 2005). The study ensured authenticity and credibility through a) purposeful, flexible sampling, b) a flexible interview guide that ensured that participants were free to speak and data is participant-driven, c) probing participants to promote richness rather than superficiality of data, d) ensuring accurate transcription of recorded voice data, and e) ensuring that coding during content analysis is data-driven (Milne & Oberle, 2005). Criticality is the critical appraisal of every decision made throughout the research process. Integrity is demonstrated by on-going reflection and self-criticality of the researcher (Milne & Oberle, 2005). As recommended by Milne and Oberle (2005), the researcher promoted criticality and integrity of the study by consistently reflecting on potential sources of bias and incorporating a peer-review process during coding and analysis of data.
Limitations

The qualitative descriptive method is limited in that it only provides a description of the phenomenon studied. While the method may yield the basis for future theory-based research, its low-inference approach to data analysis reduces its ability to speak in broader, general terms about a phenomenon (Neergaard et al., 2009). Furthermore, the qualitative descriptive method has also been criticized for lacking rigor and/or credibility. The analytic process can be considered somewhat subjective. In qualitative descriptive research studies, interviewer bias might occur since summary descriptions rendered depend on the researcher’s perceptions, inclinations, sensitivities and sensibilities (Neergaard et al., 2009). Rigor and credibility were enhanced with strategies described above. Subjectivity was reduced by involving peer-researchers in the data analysis process (Neergaard et al., 2009).

Protection of Human Subjects

This study received IRB approval from the University of Hawaii System Human Research Protection Program (HRPP). Participants were told orally and in writing of the purpose and methods of the study, as well as the study’s risks and benefits. To protect participants from psychological risk, they were told prior to their participation that 1) all involvement in the study was entirely voluntary, 2) they were able to withdraw from the study at any time or refuse to participate in any portion of the study, 3) they were not required to answer any question that made them feel uncomfortable, and 4) any information collected would be de-identified.

To protect participant privacy, any field notes, recordings, or other documents produced during the interview process were kept in a locked file in the researcher’s office. Informed consent forms and confidentiality agreements were kept separately from the data in a locked file accessible only to the researcher. Codes were assigned to each individual participating in
individual interviews, and records of observations were kept separately from signed consent forms.

Occasionally, some people become anxious when thinking or speaking about high-rise building fire safety, disasters and disaster preparedness. Plans were put into place in the event that a participant appeared to be getting anxious during the discussion. Such plans would have involved stopping the discussion and asking if the participant he or she wanted to continue or stop the interview. If the participant chose to stop the discussion, they would have been asked if they want any assistance with securing psychological counseling. If they had said yes, they would have been referred to the Hawai‘i Department of Health mental health services.

Participants were given a $10 Long’s (CVS) gift card in appreciation for their time. They were also told that their contributions to the study would help inform and improve future residential high-rise fire safety educational programs, policies, and research.

Summary

This research study was designed to provide better insight into the factors that influence fire safety and evacuation preparedness among residential high-rise building occupants. In summary, the researcher conducted and transcribed interviews with 12 participants. Participants were residents of eight different residential high-rise buildings that were deemed as having an elevated risk for high-rise fires. Interview transcripts were coded and analyzed by two researchers independently, then compared to each other to develop themes and subthemes. Upon completion of all data analysis and feedback procedures, a summary description was written to describe the factors influencing residential high-rise building occupant fire safety and evacuation preparedness. The results of the research are included in the following chapter of this dissertation report.
CHAPTER 4: RESULTS

The aim of this research study was to provide a better understanding of the factors that influence fire safety and evacuation preparedness among occupants of residential high-rise buildings. The results of this study are presented in this chapter. The first section provides a description of the study sample. A report of the thematic analysis of data collected from qualitative interviews then follows. Analysis is supported by the participants’ own words.

Sample

Twelve (N=12) high-rise building residents participated in this study. Characteristics of the participants are summarized in Table 1. Three were men and nine were women. Ages of participants ranged from 31 to 71. One participant declined to give their age. Eleven (n = 11) participants had some form of higher education. Years living in their current high-rise building ranged from 1- 35 years. Total years living in high-rise buildings including their current building ranged from 3 to 35 years.

<table>
<thead>
<tr>
<th>Gender</th>
<th>n</th>
<th>(%)</th>
<th>Personal mobility impairment</th>
<th>n</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>3</td>
<td>(25)</td>
<td>Yes</td>
<td>0</td>
<td>(0)</td>
</tr>
<tr>
<td>Female</td>
<td>9</td>
<td>(75)</td>
<td>No</td>
<td>12</td>
<td>(100)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age (n=11)</th>
<th>n</th>
<th>(%)</th>
<th>Years lived in current HR building</th>
<th>n</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-24</td>
<td>0</td>
<td>(0)</td>
<td>0–5</td>
<td>6</td>
<td>(50)</td>
</tr>
<tr>
<td>25-39</td>
<td>3</td>
<td>(25)</td>
<td>6–10</td>
<td>1</td>
<td>(8)</td>
</tr>
<tr>
<td>40-64</td>
<td>4</td>
<td>(33)</td>
<td>11–15</td>
<td>3</td>
<td>(25)</td>
</tr>
<tr>
<td>65-79</td>
<td>4</td>
<td>(33)</td>
<td>&gt;15</td>
<td>2</td>
<td>(17)</td>
</tr>
<tr>
<td>&gt;80</td>
<td>0</td>
<td>(0)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education completed</th>
<th>n</th>
<th>(%)</th>
<th>Total years lived in HR building(s)</th>
<th>n</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High School</td>
<td>1</td>
<td>(8)</td>
<td>0 – 5</td>
<td>5</td>
<td>(42)</td>
</tr>
<tr>
<td>Associate</td>
<td>9</td>
<td>(75)</td>
<td>6–10</td>
<td>1</td>
<td>(8)</td>
</tr>
<tr>
<td>Bachelor</td>
<td>6</td>
<td>(50)</td>
<td>11–20</td>
<td>2</td>
<td>(17)</td>
</tr>
<tr>
<td>Graduate</td>
<td>5</td>
<td>(42)</td>
<td>&gt;20</td>
<td>4</td>
<td>(33)</td>
</tr>
</tbody>
</table>
Characteristics of participants’ households are summarized in Table 2. Most participants lived in households of one or two members. Over half of the participants’ households (n = 7) included older adults (65 years of age or older). Floor of occupancy of participants ranged from the 2nd floor to the 19th floor. Nearly all participants (n = 11) were owners. Only one participant was a renter. All but one participant had some form of residential insurance.

Table 2. Characteristics of study participants’ household

<table>
<thead>
<tr>
<th># of household members</th>
<th>n</th>
<th>%</th>
<th>Floor of occupancy</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>5</td>
<td>(42)</td>
<td>0–5</td>
<td>5</td>
<td>(42)</td>
</tr>
<tr>
<td>Two</td>
<td>5</td>
<td>(42)</td>
<td>6-9</td>
<td>3</td>
<td>(25)</td>
</tr>
<tr>
<td>Three</td>
<td>2</td>
<td>(17)</td>
<td>10-15</td>
<td>2</td>
<td>(17)</td>
</tr>
<tr>
<td>Four or more</td>
<td>0</td>
<td>(0)</td>
<td>16-20</td>
<td>2</td>
<td>(17)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Members &lt; 18 or &gt; 65 years old</th>
<th>n</th>
<th>%</th>
<th>Tenure</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children</td>
<td>0</td>
<td>(0)</td>
<td>Owner</td>
<td>11</td>
<td>(92)</td>
</tr>
<tr>
<td>Older adults</td>
<td>7</td>
<td>(58)</td>
<td>Renter</td>
<td>1</td>
<td>(8)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Members with mobility impairments</th>
<th>Insurance (renter/condo) policy</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>11</td>
<td>(92)</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>1</td>
<td>(8)</td>
</tr>
</tbody>
</table>

Participants were asked about their past experience with high-building fires and evacuation. A majority of the participants (n = 8) stated that at least one fire had occurred in their current building in the past. One participant had experienced a fire in their unit of residence. The number of fire incidences among those who reported a fire in their building is summarized in Figure 3. Most participants (n = 8) had experience evacuating from a high-rise building during an emergency. The number of times evacuated (among people who had this experience) is summarized in Figure 4.
Table 3. Prior exposure to high-rise (HR) building fires and evacuation

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire in current HR building</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>8</td>
<td>67</td>
</tr>
<tr>
<td>No</td>
<td>4</td>
<td>33</td>
</tr>
<tr>
<td>Experienced fire in own apartment unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>No</td>
<td>11</td>
<td>92</td>
</tr>
<tr>
<td>Experience evacuating HR building</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>8</td>
<td>67</td>
</tr>
<tr>
<td>No</td>
<td>4</td>
<td>33</td>
</tr>
</tbody>
</table>

Figure 3. Number of fires in current building

Figure 4. Number of times evacuated from a high-rise building
Participants were asked two questions related to emergency preparedness. Responses are summarized in Table 4. One question asked whether a participant had ever worked in a high-rise building, to which half (n = 6) of the respondents responded positively. This question was included in the demographic information survey because persons that work in high-rise buildings are subject to the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) regulations regarding fire prevention, such as periodic drills and emergency planning. Another question asked whether any household member (including themselves) had received some form of emergency preparedness (EP) training, to which half of the participants (n = 6) responded positively that at least one person in their household had received EP training.

Participants were asked to specify the type of EP training received. Responses to this question are listed in Table 5.

**Table 4. Characteristics related to emergency preparedness**

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household member with EP training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>6</td>
<td>(50)</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>(50)</td>
</tr>
<tr>
<td>Personal experience working in HR building</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>6</td>
<td>(50)</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>(50)</td>
</tr>
</tbody>
</table>

**Table 5. Types of emergency preparedness training**

**Types of emergency preparedness training**

- Annual fire safety/emergency preparedness
- Crisis management
- Annual fire safety class
- Husband's occupational training
- Annual school fire safety video (fire extinguisher use)
- Emergency/disaster training, fire drills, earthquake preparedness drills
Findings

Ajzen’s (1991) theory of planned behavior (TPB) was used to guide thematic analysis of the data. Thematic analysis was conducted using the procedure outlined by (Nowell, Norris, White, & Moules, 2017). Steps taken in the thematic process are listed in Table 6.

Table 6. Thematic analysis procedure

<table>
<thead>
<tr>
<th>Phases of thematic analysis</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1: Familiarization of the data</td>
<td>Researchers independently read through each transcript in entirety.</td>
</tr>
<tr>
<td>Phase 2: Generating initial codes</td>
<td>Researchers conducted initial coding of the transcripts concurrently and independently. Codes were then compared, and differences in codes were discussed and mutually resolved.</td>
</tr>
<tr>
<td>Phase 3: Searching for themes</td>
<td>Researchers sorted and collated potentially relevant coded data into themes.</td>
</tr>
<tr>
<td>Phase 4: Reviewing themes</td>
<td>Both researchers worked together to review and refine themes, combining some and breaking down others, until the data was reduced into a set of significant themes that succinctly summarized the text.</td>
</tr>
<tr>
<td>Phase 5: Defining/naming themes</td>
<td>Themes and subthemes were defined and named to accurately reflect the aspects of the data that they captured.</td>
</tr>
<tr>
<td>Phase 6: Producing the report</td>
<td>One researcher generated a report of the analysis. The second researcher reviewed the report for coherence and clarity. Recommended revisions were made, and a final report was produced.</td>
</tr>
</tbody>
</table>

Five primary themes emerged from the interview data: *attitudes towards fire safety*, *building fire safety culture*, *occupants’ perceived ability to prepare for fires*, *intentions to prepare*, and *occupant fire preparedness behaviors*. Primary themes were comprised of sub-themes. Table 7 summarizes the themes and sub-themes. Each theme and sub-theme is discussed in detail below.
Table 7: Thematic analysis

<table>
<thead>
<tr>
<th>TPB Domain</th>
<th>Theme</th>
<th>Subthemes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral beliefs/Attitudes</td>
<td>Attitudes towards fire safety</td>
<td>• Fire risk perception influenced by beliefs regarding:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Causes of high-rise fires</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Floor of residence (higher floor = greater risk)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Fire sprinkler systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Fire hazard risk assessment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Prior experience with HR building fire</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Direct</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Indirect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Self responsibility for household fire safety</td>
</tr>
<tr>
<td>Normative beliefs/subjective norms</td>
<td>Building fire safety culture</td>
<td>• Building management fire safety leadership</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Inspections, enforcement drills</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Communication with residents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Management linkages with EP community</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Occupant trust in building management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Occupant perception of neighbors’ fire safety</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Social connectedness of the building community</td>
</tr>
<tr>
<td>Control beliefs/Perceived</td>
<td>Occupant perceived ability to prepare for</td>
<td>• Self-efficacy (related to):</td>
</tr>
<tr>
<td>behavioral control</td>
<td>fires</td>
<td>- Prior knowledge and training in fire safety &amp; EP</td>
</tr>
<tr>
<td>Behavioral intentions</td>
<td>Intentions to prepare for fire</td>
<td></td>
</tr>
<tr>
<td>Behavior</td>
<td>Occupant fire preparedness behaviors</td>
<td>• Fire prevention &amp; preparedness</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Fire safety precautions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Household fire safety equipment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Awareness of building fire safety features</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Evacuation preparedness</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Awareness of evacuation routes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Cues for evacuation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Barriers to swift evacuation</td>
</tr>
</tbody>
</table>

Attitudes towards fire safety

Participants described many different factors that influence their personal attitudes towards fire safety and evacuation preparedness in their household. These factors included fire
risk perception, prior experience with high-rise building fire, and feelings of responsibility for household fire safety.

**Fire risk perception.** All participants felt some degree of risk for fire in their building. Fire risk perception was influenced by beliefs about the causes of high-rise fires, floor of residence, fire sprinkler systems, and fire hazard risk assessment.

**Beliefs regarding causes of high-rise fires.** Participants’ beliefs regarding causes of high-rise building fires contributed to their fire risk perception. All of the participants believed cooking-related activities and electrical problems were the most common causes for high-rise fires. Participants explained that occupant carelessness or inattentiveness while cooking or using electrical appliances (e.g. irons, hair straighteners) was what most likely to put them at risk for fire. They also believed that their buildings’ older electrical wiring and outlets put them at increased risk for electricity-caused fires. Other causes of fire mentioned were the use of candles, children playing with matches, cigarette smoking, using flammable liquids or chemicals, or making or using drugs.

Many participants also expressed belief that older residents are the cause of high-rise building fires. One participant said, “I am concerned… in our condo [are] a lot of elderly… I’ve dealt with my mother and dementia. People tend to forget as you get older. So, it's a concern… We have too many elderlys [sic] here, both as a possible cause of the fire and also for their safety too.”

**Beliefs about floor of residence.** The floor of residence was also linked to perception of risk for fire. Participants living on higher floors expressed that they felt heightened risk perception related to the possibility of having to evacuate long distances down stairwells during an emergency. Residents who lived on lower (2nd or 5th) floors described a lower perception of risk for fires. They explained this was due to their closer proximity to the ground, the shorter
distance to travel via stairs, and the option to escape from their window or balcony. This lower perception of risk seemed to have contributed to people on lower floors being less inclined to prepare for evacuation. One person stated:

*I’m on the 5th floor... it’s not too bad... if we were trapped in our house, I’ve thought about climbing down a ladder to my neighbors downstairs... 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...*

Another person noted that she was less likely to immediately initiate evacuation in response to a fire alarm, stating that when the alarm sounded:

*I’ve never walked down. I look outside my window and observe the fire department doing whatever they need to do. But I never felt the need to actually evacuate. I guess false sense of security because I’m on a low floor.*

Some participants mentioned that choosing a lower floor was an important factor when purchasing their apartment: “*One of the reasons I chose the second [floor] to live on is I thought... easiest to evacuate.***

**Beliefs regarding fire sprinkler systems.** Beliefs about fire sprinkler systems were found to be influential to occupants’ perception of fire risk. All participants lived in buildings that lacked sprinklers systems, and most participants shared that they would feel safer if their building had sprinklers. One participant stated, “*We need sprinklers. That would help ease the concern if there is a fire. If we had a sprinkler system that would be more comforting and safe.*” Another person said that if they were to choose to move, the presence of fire sprinklers in a building would be an important factor in purchasing an apartment residence going forward.

Not all participants felt that sprinklers were necessary to ensure fire safety in their building. This opinion was found even among persons who had experienced a fire in their
building in the past. Some felt sufficient safeguards were in place to ensure occupant safety in the event of a fire, such as their building’s structure, or building management’s efforts to bolster fire safety among residents. For example, one participant stated, “We’re trying to avoid [installing sprinklers] because… personally I don’t think every building needs them. It has a lot to do with the structure of the building.”

Despite most participants acknowledging that sprinkler systems would make them feel safer in their building, many opposed retrofitting these systems into their building. Those who opposed installing sprinklers in their building often explained that the financial burden of retrofitting sprinklers outweighed any safety benefit. One person said:

_I think a lot of homeowners aren’t going to want to put up the money for that. That’s what it comes down to. If they would look the long scheme of things, like the safety of the place, it would be worth it. But again the costs…_

Another person explained that installing a sprinkler system in their building would be financially burdensome for older persons:

_We have a lot of older people that have bought years ago and years ago, and are now retired… it makes a financial burden to retrofit anything… I don’t know how people get loans if they’re retired even! When you’re working it’s easier to get a loan._

**Beliefs about fire hazard risk assessment.** Participants’ assessment of fire hazard risks also influenced their fire risk perception. This subtheme emerged as a combination of remarks expressing complacency or comfortableness, fatalism, risk denial, avoidance, or false sense of security in relation to the risk of fire in their building. Some participants explained that these beliefs prevented them from adopting fire safety behaviors. For example, one participant stated, “Laziness prevents me… I should have those things (fire extinguishers and smoke alarms)... I’ll put them up for sure.” Another person attributed their neglect to adopt fire safety behaviors to a
false sense of security, stating, “I think people are just comfortable. We think it won’t happen to us.” A sense of fatalism was another common view among residents. One person who held this belief explained, “If it happens, it happens! So just evacuate.” Another participant stated, “I need to buy at least [a fire extinguisher]. I’m going to put up some smoke alarms, in the kitchen probably, maybe one in the bedroom... but I haven’t done it yet. It should be a priority but it’s not for me... Playing the odds I guess.” One participant felt that the building’s construction influenced beliefs about fire hazard risk assessment: [My building] is old and it was very solidly constructed... So even if there would be a fire it’s not going to travel from one apartment to the other... It’s not going to spread anywhere else...”

**Prior experience with high-rise building fires.** Another major influence on attitudes towards fire safety was prior experience with a high-rise building fire. Experience could either be direct or indirect. Direct experiences included those where a resident lived in high-rise building at the time that a fire occurred. Indirect experience occurred either through having personally having witnessed a high-rise fire in a neighboring building, or hearing about a fire from a personal contact, or in local news outlets.

**Direct experience.** Participants who had personally experienced a fire in their building described this experience as being very influential to their attitudes about household fire safety. Experience with fire in their building increased occupants’ consciousness regarding fire safety and fire risk perception, and spurred increased motivation to prepare their household for fires and other emergencies. Some individuals purchased new fire safety supplies for their household. Others planned out evacuation routes from their units. Other persons described how the experience led to adoption of broader emergency or disaster household preparedness behaviors. For example, one individual explained how she created a detailed family emergency plan, including multiple contact persons, meeting places, adequate insurance coverage, and a financial
cushion. She was also motivated to share her experience with colleagues in hopes of encouraging people around her to become prepared for emergencies. Another participant mentioned how after experiencing a fire in his building, he now explains to visiting guests how to evacuate from his apartment in the event of a fire during their visit.

**Indirect experience.** Indirect experience with high-rise fire was also very influential to some participants. Witnessing or hearing about a fire served as a catalyst to start thinking about household fire safety and evacuation preparation in their own households and/or buildings. Participants explained how witnessing a fire event triggered discussions about fire safety with other residents in their building, or prompted them to purchase fire safety equipment or rechecked their existing supplies. For example, after witnessing a major high-rise fire incidence in a neighboring building, one participant stated, “It really did trigger a lot of conversation around fire safety. I did have a conversation with one of my neighbors… It sounded like she was looking into getting… a fire extinguisher… it was definitely a hot topic, literally.”

There was even evidence of wider communal impact. In the aftermath of a major high-rise fire event, one participant recalled her experience of going to purchase a fire extinguisher one week after this fire occurred: “I heard Costco was wiped out. So I went to [the hardware store] and I took the last two medium-sized ones... The guy at [the hardware store] said ever since the [building name] fire, he said ‘we’ve had a run on fire extinguishers.’

**Self-responsibility for household fire safety.** A feeling of self-responsibility was also influential for participants’ attitudes towards household fire safety. Participants’ who felt a strong sense of self-responsibility for fire safety tended to be well prepared for fires. However, one participant explained how relying on self-responsibility alone does not result in safety of everyone in the building, and may even serve as a barrier toward overall building-level fire preparedness. She described her experience serving on her building’s board of directors. During
this time, the board was not willing to institute stronger fire safety rules in the condo because, “It's independent living, you know. So everybody must, has to take care of themselves. [The board members] are not wanting to get into a whole lot of taking care of individuals.” She acknowledged her own concern that certain households are at a disadvantage with this perspective, including older persons and people who do not speak English. She said, “You know, I feel sorry that we were not able to do more but... it's kind of outside our scope to put up all these things for other people.”

Building fire safety culture

Another major influence on occupant household fire safety and evacuation preparedness was their building’s fire safety culture. These factors included the building management’s fire safety leadership, occupant perception of neighbor’s fire safety, and social connectedness within the building.

Building management fire safety leadership. Household fire safety was greatly influenced by the degree of fire safety leadership demonstrated by the building’s resident board of directors, management, and staff. Buildings with strong fire safety leadership were those that demonstrated proactive steps towards preventing fires and preparing residents for fire emergencies. Building-level initiative on fire safety collectively enhanced residents’ household fire safety in terms of equipment and supplies present in households. It also increased residents’ own confidence, trust in building leadership, and feeling of safety and security in their building. According to participants who lived in buildings with strong fire safety leadership, policies were developed in response to local fire safety legislation (actual or proposed). Examples of building-level fire safety leadership included fire safety inspections, enforcement of rules, evacuation drills; communication to residents; and management linkages with the local EP community.
**Fire safety inspections, enforcement and drills.** Participants described varying degrees of mandated inspections organized by the building management. Inspections involved checking each household’s compliance with building safety rules. This included checking for the number and functionality of smoke alarms and/or fire extinguishers. One participant described these inspections, stating that her building’s managers “hold them at different times to let everybody get inspected. You give them the time that would be good time for you... to see if you had your fire extinguishers and smoke detectors. And they also offered smoke detectors at a nominal price.”

Participants also provided examples of how management enforced fire safety rules in their building. This was particularly evident in regards to fire doors (to individual units and to stairwells). One participant stated, 

*We don’t leave our apartment doors... propped open. Which is unfortunate because it’s so freaking hot. But we can’t do that, we’re not allowed to do that. We’re not allowed to prop open the end door that goes down to the cement stairway... They remained closed at all times. Absolutely. And if someone props it open, somebody closes it. So I would say that our staff and our building managers are well aware.

Building-level fire safety enforcement affected renters as well as owners. According to one renter, the owner of the unit purchased fire safety equipment for the renter to comply with the building’s safety rules. “My landlord, she bought us a fire extinguisher. We didn't have one in there. It was actually one of the requirements for the building after the [neighboring building] fire incident. Our resident manager posted something that said all tenants need to have these certain things in place.”

In buildings with less evidence of fire safety leadership, participants noted that this is something that they desired. One participant described her efforts to establish a building fire
safety policy when she was a resident board member. She had developed a plan for the building homeowners’ association in consultation with the fire department, but it was not was carried through, and the effort was eventually abandoned. This participant explained,

“At one time I was on the board and I did draw up a plan for fire safety and talked to the fire department about it. But it never... we never got around to OK’ing it. And they never voted. It was never posted or anything. There was no real plan... You know the association, their main focus is financial, taking care the building, taking care of finances and maintenance of the building.

Another participant who worked as a teacher recommended that drills required at her workplace would also be helpful in her building, recommending that they be held “maybe every other month just so that people are more aware of the procedures.”

**Communication with residents.** Buildings provided residents with varying forms of communication regarding fire safety. Communication occurred through printed materials that were distributed to households, or posted in common areas such as lobbies or elevators. Some buildings used a mobile alert system such as smart phone apps or text messaging systems. One participant explained how messages regarding emergencies were transmitted to households over closed-circuit TV.

In buildings with lower levels of fire safety leadership, residents perceived communication as insufficient. Participants described not receiving any form of communication regarding fire safety from their buildings’ leadership. Among these participants, better communication was cited as being important for improving household preparedness for fires and overall building fire safety. One person suggested that that her building “should have the fire safety tip of the month or something. Or newsletters. Or hang it on a board... You would prefer
Building management linkage with EP community. A few residents commented on the importance of their building management being linked to their local emergency preparedness community. One participant mentioned that a firefighter lives in their building, who works with the management to consult with them regarding improved fire safety. Another participant mentioned that a community emergency preparedness agency was present in their building to assist residents in improving household fire safety. This person stated that the “Red Cross came to our building and they provided fire extinguishers... And I saw a handful of names on the list. So people were interested.”

Among residents whose buildings demonstrated less connection with local emergency preparedness agencies, it was suggested that such links be established. One participant suggested,

*The building board should work with the fire department board... Have the captain from the fire department come [to the monthly board meeting], just a five-minute refresh. Like, ‘Don’t forget you guys have at least three stairwells...’ They go to the neighborhood board meetings... So maybe come here because there are so many people living in this footprint.*

Occupant trust in building management. An outcome of building management fire safety leadership was increased trust and confidence among residents for their management to handle building emergencies. This increased trust was influential to occupants’ household’s fire preparedness. One participant explained:

*When it comes to any type of emergency like that, [management is] on it! The fire control panel is there, right next to the office. They know how to use it... Anything that happens,*
even if it's a false alarm, they'll call. So they're very on top of it when it comes to the fire alarm and fire safety and being able to relay that information to the first responders.

Another resident described how she looks to management for instructions on how to prepare and respond to emergencies, stating, “The fire alarm rang, and the manager made us go outside [to] the parking garage... We thought, ‘it’s just the bell,’ but the manager looked seriously [sic], so I just followed whatever he asked... [I do] Whatever the manager says please do... ‘set up fire alarm,’ or ‘please check where the exit,’ [sic].”

**Occupant perception of neighbors’ fire safety.** Participants described how their perceptions of fire safety among other people living in their building influenced their own household fire preparedness. People with higher levels of fire preparedness often assumed that their neighbors possessed a similar level of knowledge, or engaged in the same preparedness behaviors that they did. However, most participants felt that people in their building are not prepared for fires. Reasons given for this fact are that their neighbors are too busy, are careless, don’t have knowledge regarding the causes of fires, don’t know how to prepare for fires, or don’t follow fire safety rules. One participant explained how people who choose to live in high-rises should recognize that neighbors’ behaviors may pose a risk to their own household safety, and in acknowledging this, should take actions to mitigate that risk. She stated:

> *It just makes common sense to me that, number one, if you’re going to buy a unit in a high-rise building, you should already know what you’re getting yourself into. That you’re going to be surrounded by a bunch of people you do not know and whose lifestyles you do not know. Number two, because of that, you need to do all you can to protect yourself and your condo... It’s just that simple.*

Participants’ who felt their neighbors practiced poor fire safety habits described varied emotions about this situation, such as disapproval, annoyance, anger, and even fear. For
example, when asked about her neighbors’ fire safety behaviors, one participant stated that,

“They are not ready! They are busy. And my neighbor... smoking is prohibited, but I find all the
time in the corridor smoke butts [sic]... So, I’m actually afraid.”

Some participants recalled observations of other residents during fire emergencies in their building to illustrate how varied reactions were among other residents. One participant said,

“When there was a fire on our third floor, on the street you can obviously see how many people are out there... And by looking at the numbers, it was very low compared to the occupancy of the building. I’m pretty sure I saw... people on higher floors just looking out the window thinking that... it’s not going to affect them.” Another person shared similar observations, stating that

“people may not choose to evacuate when they should... that whether it’s a drill or not, you should still evacuate. And it seems sometimes you don’t quite have the turnout of people you would expect to be evacuating.”

Many participants expressed concern for persons who they believed are at higher risk for fires in the building. These included older people, young people, renters, persons with mobility or sensory impairments, and those who do not speak English. One person stated, “Although I might have a plan, I do have elderly people in my building, more elderly than I am, who might have mobility issues.” She added, “We have a few units that are rented to college students. Hey, when you’re a young pup at 19, you are fireproof, you’re bulletproof... I’m sure they haven’t thought about it. I’m going to guess that their landlords haven’t said anything to them about it either.”

Social connectedness within the building. Individuals with higher levels of engagement with the building community tended to have higher levels of household fire preparedness. These individuals described having experience serving on the resident board of directors, attending board meetings, or maintained a personal connection with the building managers or staff. Other
participants who described lower engagement with building matters did not go to owner meetings, and paid less attention building communications, such as resident board meeting minutes, or posted notices in common areas. These participants tended to have a lower level of awareness of fire safety efforts or building fire safety features and policies. When one participant was asked whether fire safety was ever discussed in the building community, he responded, “I want to say no... there’s a monthly meeting that I don't attend... those topics could be of discussion. I just don’t know about it.” In another case, another participant described being excluded from building fire safety discussions because of his renter status. He said, “The board always meets. I see them meeting downstairs but I don't know. I’m assuming they must have had a conversation about [fire safety]. I wasn’t a part of it. I’m a renter.”

Among participants that had experienced a fire in their building, many explained that the emergency had galvanized social connectedness among neighbors and building management and staff. For example, during a fire emergency, one participant described how she witnessed residents helping each other to evacuate. Another person said that after a major fire in her building, “People have been a lot friendlier... [I] talk to a lot more people and get to know more people. So a little more of a community kind of thing than it was before... Now people say ‘hi’ to you in the hallways and elevators... People are more connected now.” This increased connectedness among neighbors resulted in residents helping each other improve household fire safety. For example, one participant described how she purchased a fire extinguisher for her neighbor after experiencing a major fire. “I bought [a fire extinguisher] for my next door neighbor. After finding out that she’s a single mom with two kids, [I thought] ‘yeah, you better get her a fire extinguisher,’ so I just bought her one.”
**Occupant perceived ability to prepare for fires**

Occupant fire safety and evacuation preparedness was also influenced by their perceived ability to prepare their households for high-rise fires. Beliefs about self-efficacy were highly dependent on their level of knowledge and/or prior exposure to fire safety and EP training. Little to no exposure to fire safety/EP training was linked with lower confidence in ability to prepare for fire, while some exposure to such training resulted in greater confidence in the ability to prepare for fire. Those who expressed a lack of knowledge or experience in fire safety/EP training described how they would like building management to organize fire safety education and training sessions for residents. For example, when one participant was asked about what she knew about fire safety, she explained:

> Not much. I know the basics. They can’t take the elevator, gotta take the stairs. In our building there are fire hoses on each floor. I don't know if I would know how to use it… I think for the most part, nobody really knows what to do… It would be very good if we had some kind of fire training.

Another person said, “I just don’t know what I’m doing! So I think the building should do something about that. The association [should] at least put it out there…” Some participants gave specific examples of how this may be organized within their building, such as coordinating short trainings during resident owner meetings, or by holding coordinated trainings by going “floor to floor, just hold little meetings. You can set up chairs in front of the elevator for the residents on the floor... knock on everybody’s door... Come talk story.”

When at least one household member had received some form of fire safety/EP training, participants tended to express increased confidence in their ability to prepare for a high-rise fire. Two main sources of fire safety/EP training were commonly mentioned among participants: occupational training and elementary school fire safety education.
**Occupational fire safety and emergency preparedness training.** Participants whose household included at least one person (themselves or another household member) with occupational training in fire safety and emergency training were much more confident in their ability to prepare their household for fires, and were more likely to practice fire safety and EP behaviors at home. One participant described who had worked as a nurse for many years maintained very high level of household fire preparedness. She noted:

*The hospitals I worked in had fire preparation exercises and drills that you took part in... you had to undergo annual disasters security training... We had a series of [trainings for] fire, earthquake, and flood disaster training... Those also included some practice with using fire extinguishers of different types.*

Another participant described how working in the hotel industry was extremely influential to her household’s preparedness for high-rise fires and emergencies. She said:

*My experience in the hotel industry, you’re dealing with so many people and a high-rise structure, and you want to make sure that everybody is prepared and knows what to do... to assist people, having to evacuate the building in a safe manner.*

Another participant who is a teacher explained:

*We do [drills] at school so that at least you know what to prepare for. At the schools, we know how to get the kids out. We know where to go... we do fire drills every month... We have to take a fire extinguisher video that we watch every year... I can tell you ‘P.A.S.S.’ They use it at school, that's like, ‘pull the trigger, aim, squeeze and then sweep!’*

**Elementary school fire safety education.** Participants shared that elementary school fire safety education was also highly influential in generating positive beliefs about self-efficacy for fire preparedness. One person said that lessons learned in elementary school remained with him until adulthood, stating:
Going to school, you’re educated with fire safety. Basically, plan your meeting spot. How do you get out? What are you going to bring with you? Which I guess led to the simple plan of grab your [expletive] and go! Get out of there as soon as you can.

Parents of children who received the training also benefitted from this experience. One participant who practiced multiple fire safety behaviors in her household explained, “You know the fire safety week every year in [elementary] school? We all needed to do that. We used to do that with [our children].” This participant’s children are now adults, but her children’s training still influenced her current household fire safety practices and evacuation planning to this day.

**Intentions to Prepare for High-Rise Fires**

Participants described many intentions for improving their household fire safety. Individuals who did not possess basic fire safety equipment in their homes, such as fire extinguishers or smoke alarms described intentions for purchasing these items for their household. Others described an intention to seek out more knowledge and individual training for fire safety. Other participants described intent to become more engaged with building leadership to improve fire safety for the entire building. Suggestions they would like to bring to their building leadership at board meetings included initiating fire safety checks, improving existing fire safety checks to make them more robust, and encouraging the board to organize fire safety training sessions for residents.

According to the participants, many new intentions were formed during the course of their interview with the researcher. Participants often shared how being engaged in a conversation about fire safety spawned new ideas that they felt they should act upon. Even though many participants held these intentions to prepare for fires, these did not always result in the adoption of household fire safety behaviors. This was true even for participants who had direct experience with a high-rise fire (in some cases, more than one).
Occupant Fire Preparedness Behaviors

Participants described their current state of household fire safety and evacuation preparedness, including steps taken to prevent and prepare for building fires and plans for evacuation. Cues signaling the need to evacuate the building were described among individuals who had evacuation experience. Barriers to swift evacuation were also explained.

Participants explained various strategies they had adopted to prevent fire in their units and prepare for fires in their building. Strategies involved specific precautions taken to prevent fires, possession of household fire safety equipment, and awareness of their buildings’ fire safety features.

**Fire safety precautions.** Some participants described distinctive fire prevention strategies their household practices. For example, one resident whose household had a high level of fire safety always unplugged devices from electrical outlets after use. Others described checking that all electrical devices and appliances (oven, stove, fans, dryer) were off before leaving. One resident relied upon an electrical timer that would automatically shut off power to her hair straightener if she forgot to turn it off.

**Household fire safety equipment.** Possession of basic household fire safety equipment, such as smoke alarms and fire extinguishers, varied greatly among participants. One participant who maintained a very high level of fire preparedness had three fire extinguishers and three smoke alarms in her household. She explained that she had always kept one of each of these items in the kitchen and her bedroom. However, due to a recent policy implemented by her building management requiring smoke alarms and extinguishers in each room, she now maintains a third set of these items. Each of these items were checked frequently for functionality:
We check the fire extinguishers every month. We look at them to see if they’re ok. And the fire detectors... they have the two-year battery in them, but we still do a test anyway. We usually do that maybe every six months or so to test to see if they’re still orderly.

Another well-prepared participant said that in addition to fire extinguishers and alarms, she also keeps a towel near the door. She explained she had learned from a firefighter to use a wet towel to block smoke from entering the unit in the event of a fire where evacuation isn’t possible.

While most participants reported having either smoke alarms or fire extinguishers in their homes, few had both. Furthermore, though these items may have been present in the household, this did not necessarily mean that they were usable or in working order. For example, people were not certain of the expiratory date of their fire extinguishers. They also expressed doubt in their ability to effectively use a fire extinguisher if they possessed one (persons who had knowledge and confidence in using the device described having received training at their place of employment). Additionally, participants admitted to not replacing expired batteries in their smoke alarms. The low-battery warning signal made by that smoke alarms was are 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 entire smoke detector unit from the wall. One participant said, “The little smoke detectors, when they’re upset that their battery is falling dead, they scream, so you have to disassemble them, disembowel them to put in the new battery.” Another person said: “I didn’t pay attention to the smoke alarms. And the battery had run out. Its one of those that goes ‘beep, beep, beep.’ It’s so annoying! I just pulled it off... so I never had any working smoke alarms.”

Awareness of building fire safety features. There was a mixed level of awareness regarding building fire safety features among participants. Fire features identified included fire
extinguishers and hoses in common areas or hallways, fire doors, and emergency exits. Most participants were knowledgeable about where fire extinguishers and fire hoses were located in hallways, though some expressed doubt about being able to use these items. Other persons were not aware, or were unsure of whether their building had these fire safety features or equipment. For example, one participant had initially expressed doubt whether her floor had fire extinguishers in the hallway. During the interview she got up to check, and upon returning, she exclaimed, “Oh there is a fire hose! There is an extinguisher! I pass it every day! See, were all lost in our busy lives we don’t even notice.”

There was also a poor understanding of fire doors among participants of this study. Many people were not aware that their unit entry doors served as fire doors that were meant to remain closed. Residents who had experienced a fire in their building said that they learned this only after a fire had occurred. Despite knowledge of this, one participant admitted to keeping the fire door open, circumventing this building fire safety feature, stating, “This door is supposed to be shut 24/7 essentially. But… I keep this door open. Otherwise no wind goes through. It makes a difference, when the doors open it’s like a wind tunnel.”

**Evacuation preparedness.** Preparedness for evacuation varied among participants, and was influenced by many different factors. These included having past experience with high-rise building evacuation, identification of cues for evacuation, and barriers to swift evacuation.

**Prior evacuation experience.** Having prior experience evacuating was highly influential to household evacuation preparedness. Participants with experience evacuating from high-rise buildings were more likely to be prepared to evacuate in the event of a fire. Experience with evacuating was due to occupational training, or having had experience evacuating from their units due to a building false alarm or actual building fire. Persons with evacuation experience tended to have knowledge of at least one evacuation route out of the building. While most
persons understood that they could not use elevators during fires, some did not learn this until after a fire had occurred in their building.

Those without experience evacuating did not always have strong knowledge about evacuation routes, or confidence in being able to get out. Some participants did not know the location of the emergency stairwell and had never entered the stairwell in their building. One participant actually mentioned that despite living in the building for many years, she had not even noticed an emergency stairwell near her unit until after a fire emergency had occurred.

**Cues for evacuation.** An important factor influencing evacuation preparedness was the types of cues residents perceived as indicators of a fire emergency occurring in the building. Among participants with evacuation experience, multiple cues for evacuation were identified.

*Fire alarms.* For nearly all participants, fire alarms were not an ineffective cue for prompting immediate evacuation. Participants described varied reactions to the alarm, such as seeking more information, waiting for 1-5 minutes before acting, or completely ignoring the alarm. One common reason cited for this reaction was that repeated exposure to false alarms, or testing of alarm systems, had desensitized participants to the fire alarms, so they were no longer perceived as a serious cue to evacuate. Many explained that their perceptions of the fire alarm as a seriousness cue to evacuate evolved only after experiencing an actual fire in the building.

A lack of audibility also decreased the alarm’s effectiveness as an emergency cue. More than one participant mentioned that they couldn't hear the fire alarm during actual fires emergencies. Another resident stated that their alarm was so faint that they often mistook neighboring buildings’ alarms as their own. Residents also described not being able to hear alarms over indoor and outdoor noise. One participant stated, "There’s a lot of outside noise... there’s a lot of car noise especially. For me to watch TV at night sometimes gotta close the
windows, so much noise coming in. So, I can’t hear [the alarm]…. And my hearing is decent I think. I feel for those that can’t hear at all.

**Other cues.** Residents sought other cues to prompt evacuation. These included seeing or hearing smoke or fire, hearing people screaming, seeing emergency vehicles or equipment, and being told to evacuate by neighbors, building managers, or people from other buildings. One person recalled her experience with a building fire, stating:

> I heard an explosion, but didn’t realize what it was… I didn’t think it was a fire until people were screaming, ‘get out get out’ from the building across [the street]. When I went out to the lanai I saw the flames shooting out!

Another participant recalled her experience:

> The fire alarm went off. I went out on my lanai because of all the false alarms I wasn’t sure what it was. And then I saw this heavy smoke coming over the top of the building... so I just grabbed my purse and… went down the stairs. When I was looking at the smoke I saw this lady up above me... standing on her balcony calling for help. That was horrendous.

Hearing or seeing emergency vehicles arrive at their building was another important cue for evacuation. One participant noted the number of emergency vehicles was important. If there were many fire trucks, this was considered a cue to take seriously. This participant stated,

> “I would hear the fire alarm, but I really didn’t move until I saw the fire trucks downstairs. That's one of the benefits of living [on this side of the building] to me is that you can see the fire trucks. And as soon as I see them coming and in multiple, that's a hint... you know if it’s just one, well, maybe it's a false alarm. But when you see multiple units and then the battalion chief come out, it's like 'OK, it's time to go!'”
One participant explained that her building management had alerted her to evacuate via a TV announcement, stating: “The fire alarm went off. And there was an announcement on the TV channel that said please evacuate... so, we evacuated right away... Once you heard the fire alarm, and then you smelled the smoke, you kind of knew it wasn't a joke!”

**Barriers to swift evacuation.** Participants described factors that influenced their ability to quickly evacuate from their building in the event of a fire. Some participants stated that they possessed physical or sensory impairments that may act as barriers for swiftly evacuating from their building. They also mentioned great concern that their neighbors with similar impairments would also lack the ability to go down stairs, and wouldn’t know what to do.

Pets were also mentioned as influential to one owner’s evacuation decisions and processes. One person explained:

*What makes [evacuation] difficult is we have animals... making sure our animals are calm to leave the house. They’re animals, they can’t get up and go. We’ve got to make sure they’re OK... We have one about 10 pounds, another that is 70 pounds. It’s hard to carry her. Another thing is that there are other animals [in the building]... not all dogs get along! And so if we’re all in a stairwell, then that complicates things.*

Not being able to speak or understand English language was described as another barrier for swift evacuation from the building. One participant felt concern that some individuals would not be able to understand what to do in the event of a fire due to a language barrier, stating, “The lady who used to live upstairs... she didn't speak English and she lived by herself and she was elderly. So we knew that if there was anything, we needed to look out for her too.”

Engaging in multiple pre-evacuation actions was another common barrier for swift evacuation described among participants. Upon receiving one or multiple cues that evacuation is necessary, participants described engaging in various pre-evacuation actions. One participant
stated, “I grabbed my children and they grabbed their treasured items, we hauled it downstairs.” Another stated, “I just heard the alarm and I’m like [expletive] I’m going! So I put on my contacts…” Engaging in these pre-evacuation actions prolonged the total time it took these residents to evacuate from their units.

Summary

This chapter summarized findings from the sociodemographic survey and qualitative interviews. Themes that emerged from the qualitative data were organized using Ajzen’s (1991) TPB as a framework. Findings suggest that the household fire preparedness among residential high-rise occupants is influenced by occupant attitudes regarding fire safety, building safety culture, and occupants’ perceived ability to prepare for fires. These factors led to the formation of intentions to prepare for fire. Adoption of actual fire preparedness behaviors varied among residents. These behaviors involved adoption of fire prevention strategies, and preparedness for evacuation. The final chapter of this report will interpret these findings in relation to existing literature on fire safety, describe their implications, and highlight areas for future research on this topic.
CHAPTER 5: DISCUSSION

This study sought to explore the influences on fire safety and evacuation preparedness among residential high-rise building occupants. Little scholarly research has been conducted on this topic in the U.S. The following chapter provides an in-depth discussion of the study’s findings in relation to existing literature and the theory of planned behavior. This chapter concludes with a discussion on this study’s implications for nursing and policy, limitations, and areas identified for further research.

Findings in Relation to the Literature

Five primary themes emerged from the interview data: attitudes towards fire safety, building fire safety culture, occupant perceived ability to prepare for fires, intentions to prepare, and occupant fire preparedness behaviors. Themes and the sub-themes are discussed below in relation to existing literature on fire safety and emergency preparedness (EP).

Attitudes Towards Fire Safety

Attitudes towards fire safety were influenced by residents’ fire risk perception beliefs, prior experience with high-rise building fire, and feelings of self-responsibility for household fire safety. This theme and contributing subthemes are discussed below.

Fire risk perception beliefs. Risk perception has been shown to be an important factor in evacuation decisions among commercial high-rise building occupants during emergencies. Persons 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 (Day et al., 2013; Gershon et al., 2012; Sherman et al., 2011). In this study, beliefs about fire risk perception were found to be influential to residential high-rise occupants’ attitudes towards fire safety. Participants who had a higher level of risk perception for fires tended to demonstrate greater preparedness for fires and evacuation.
Contributing to fire risk perception were various beliefs about the causes of fires, floor of residence, fire sprinkler systems, and fire hazard risk assessment. All participants accurately identified cooking, kitchen equipment, and electricity (electricity-related equipment, appliances or wiring) and smoking among predominant causes of high-rise fires. These beliefs reflect what is known about the origins of high-rise fires in the U.S. In a NFPA (2016a) report on high-rise building fires between 2009-2013, 73% of high-rise building fires were caused by cooking equipment, 7% by smoking materials, and 2% by electrical distribution or lighting. Accurate knowledge of causes of fires is important because it informs the strategies people take to prevent fires in their apartment units.

Participants also shared the belief that older residents were possible causes of fires. This belief has some basis in fire statistics. In a report on fire risk to older adults, the USFA (2013) noted that older adults are more inclined to accidentally start fires than younger adults. The report explained that older adults’ declining physical and mental capacities make it more difficult for older adults to clearly hear, see or smell. When two or more senses are diminished, the fire risk for an individual dramatically increases. This may contribute to the fact that adults age 65 or older account for 35% of all fire deaths, a rate disproportionate to proportion of the population they represent (U.S. Fire Administration, 2013). Findings from this study should prompt buildings with higher densities of households with older residents to consider taking greater precautions to assist older residents to better prevent and prepare for fires.

Beliefs about fire sprinkler system also had an influence on fire risk perception. Little research has been conducted on high-rise residents’ beliefs regarding fire sprinklers. In this study, most participants felt that installing sprinklers in their building would increase resident safety, but many felt the cost of retrofitting their building with sprinklers outweighed the perceived safety benefit. Or they felt sprinklers unnecessary due to their buildings’ structure or
fire safety efforts of the building leadership. These beliefs seem to persist despite the proven safety value of fire sprinklers. Sprinklers have reduced the fire death rate per 1,000 reported home fires by 81%, and reduced the risk of property loss by 70% (National Fire Protection Association, 2018). Findings from this study suggest that any initiative to retrofit fire sprinklers into older high-rise buildings must address both occupants concerns regarding costs as well as their beliefs about the safety value of these systems.

Participants’ beliefs about fire risk assessment also contributed to risk perception. Feelings such as avoidance, denial, complacency or comfort, and fatalism were commonly described among many participants. Little is known about how such beliefs influence household fire safety. However, these factors are commonly described in the literature as barriers to household emergency preparedness (Becker, Paton, Johnston, & Ronan, 2013; Gershon et al., 2017; Levac, Toal-Sullivan, & O'Sullivan, 2012; McIvor & Paton, 2007; Thomas, Leander-Griffith, Harp, & Cioffi, 2015). This study shows how these beliefs influence fire preparedness because individuals do not always perceived themselves to be at risk for fire, or felt that taking preventive measures may not be effective.

**Prior experience with high-rise building fire.** Both direct and indirect experience with high-rise building fire was found to be very influential towards residential high-rise occupants’ attitudes towards fire safety. Participants explained how exposure to high-rise building fire resulted in an increased perception of fire risk, and prompted many of them to engage in discussion about fire safety with neighbors and/or motivated them to take action to improve their household fire preparedness. Prior experience with emergencies has been shown to influence commercial high-rise occupants’ evacuation preparedness. For example, evacuees of the WTC September 11, 2001 terrorist attacks who had experienced the 1993 bombing, or those with first-responder or military training, reported that such experience/knowledge helped them to act
quickly and calmly during the evacuation process (Gershon et al., 2012; Gershon et al., 2007). Additionally, a review of risk perception during fire evacuation (Kinateder, Kuligowski, Reneke, & Peacock, 2015) noted that previous experience with fire emergencies or similar situations significantly affected risk perception, vigilance, and preparedness, and was a strong predictor of increased perceived risk during disasters. The same literature review, however, reported that experiencing a disaster without experiencing personal harm might actually result in a decrease in perceived risk. Findings from this study may reflect this phenomenon, as some of those who had experienced a fire in their building had yet to adopted basic fire safety measures.

**Self-responsibility.** Occupants who felt a higher degree of self-responsibility for preparing their households for fire had more positive attitudes towards fire safety and were more likely to undertake fire preparedness behaviors. While little has been reported on this topic among high-rise occupants, similar findings have been reported in household preparedness for natural disasters. People who express a stronger sense of self-responsibility for preparedness or protection from natural hazards were more likely to carry out more emergency preparedness behaviors (Becker et al., 2013; McNeill, Dunlop, Heath, Skinner, & Morrison, 2013; Mulilis, Duval, & Rombach, 2001; Perry & Lindell, 2008).

**Building Fire Safety Culture**

This study’s findings found that the safety culture of the participants’ buildings was influential to their household fire preparedness. This theme was comprised of the following sub-themes: building management fire safety leadership, occupant perception of neighbors’ fire safety, and social connectedness of the building community.

**Building management fire safety leadership.** Findings from this study suggest that high-rise residents are greatly influenced by the degree of their building’s leadership on fire safety. In cases where building management engaged in fire safety initiatives (such as enforcing
fire safety rules, conducting drills, and communicating about fire safety with occupants), these activities resulted in residents’ feeling increased confidence in their ability to prepare their households for fires and greater adoption of fire preparedness behaviors. Participants reported following fire prevention/preparedness instructions given by building managers, as well as following building managers’ directions during evacuations. In prior research on commercial high-rise buildings, organizational leadership has been found to be influential to occupant fire preparedness. During the WTC evacuation, occupants who reported higher levels of organizational preparedness had shorter evacuation initiation times. Evacuees reported that they sought leadership during the emergency, and followed the directions of authority figures prompting them to evacuate (Gershon et al., 2012; Gershon et al., 2007). Findings from this study suggests that, similar to commercial high-rise occupants, residential high-rise occupants also seek building leadership to adequately prepare for and respond to emergencies.

The degree to which building management was linked to the local EP community was an important factor in influencing occupants’ fire safety. In buildings with established connections to EP resources (fire department, American Red Cross), participants mentioned this linkage provided their households or their buildings with increased fire safety knowledge or resources that they felt may not have been available to them otherwise. Residents of buildings whose management lacked such linkages suggested that establishing these links could be a way of improving their building’s overall fire safety. Literature on household and community emergency preparedness provides examples of how interconnectivity of individuals and organizations in the community contributes to a community’s overall preparedness. Communities with strong communal linkages or bonds have personal and professional social networks that can be leveraged to share disaster-related information quickly and mobilize needed resources during disasters (Uscher-Pines, Chandra, & Acosta, 2013). This study’s findings
suggest that such linkages may be leveraged by building management to increase fire safety among residential high-rise occupants.

Trust in their building management’s ability to prevent fires and respond to fire emergencies was frequently mentioned among participants whose building management demonstrated stronger fire safety leadership. Trust in management resulted in feelings of safety and reassurance that building management is capable of responding to emergencies. Trust in community authorities has been reported as an important factor influencing household and community preparedness for disasters. In a study examining preparedness for earthquakes, Paton, Bajek, Okada, and McIvor (2010) found that the more people perceived their needs as having been met through relationships with emergency authorities, the more likely they were to trust them and the information they provided. When such trust is established, people are more likely to use the information provided to prepare for and respond to emergencies. Findings from this study suggest that this dynamic may be applicable to residential high-rise building communities. If building management can provide accurate fire safety information that meets the needs and desires of high-rise residents, greater trust can be established, which can further fuel high-rise occupant fire safety.

**Perception of neighbors’ fire safety.** Participants’ perceptions regarding their neighbors’ fire safety varied. Often times their perception of other people mirrored their own levels of fire preparedness. Those who had taken fire safety precautions frequently assumed others had taken similar precautions, and those who felt ill prepared or had not adopted any fire safety measures, assumed others hadn’t either. Research on EP has found a similar phenomenon, where people are more likely to prepare for emergencies if they believe those around them believe in the importance of preparedness and have taken preparedness actions (Levac et al., 2012).
**Social connectedness.** Findings from this study suggest that residents with greater levels of connectedness and engagement with building communal matters tend to have higher levels of household fire preparedness. While scant research has been reported on this specific phenomenon among residential high-rise occupants, there are many examples of how community engagement influences household preparedness for emergencies. Persons who reported higher level of engagement with their community were more likely to be identified as high adopters of household preparedness (Thomas et al., 2015). Findings from this study suggest similar factors may be at play in high-rise communities. This study also found that renters might feel excluded from engaging in building safety matters, possibly hampering their household fire preparedness. This finding is similar to findings from previous studies regarding renters’ perspectives on preparedness for natural and technological disasters (Burby, Steinberg, & Basolo, 2003; Mulilis et al., 2001).

Residential high-rise occupants experience a surge in social connectedness within their building community after a fire occurs. It has been reported that people who experience a disaster often feel a sense of solidarity and increased connectedness with neighbors or community members in the aftermath of a disaster, a phenomenon that may not have been an important aspect of their lives before the event (Beaudoin, 2007; Moore et al., 2004; Silver & Grek-Martin, 2015). Findings from this study suggest that maintaining and cultivating social connectedness of the building community prior to and after a fire incident may serve as a basis for influencing fire safety in residential high-rise building communities.

**Occupant Perceived Ability to Prepare for Fires**

Previous research has shown that beliefs related to self-efficacy are influential to the adoption of EP behaviors (Becker et al., 2013; Thomas et al., 2015). This study reflected these findings. Participants’ who had positive beliefs about their self-efficacy regarding their ability to
prepare for fires were more likely to have adopted more fire preparedness behaviors. Prior exposure to training in fire safety or EP was extremely influential to participant self-efficacy beliefs and actual adoption of household fire safety behaviors. This is similar to what has been described in literature among commercial-high rise occupants. In studies reporting on WTC evacuees’ EP, persons with fire safety/EP training reported higher degrees of confidence, influencing their ability to act quickly during building emergencies (Day et al., 2013; Gershon et al., 2012; McConnell et al., 2010a).

It is known that families with small children have somewhat higher levels of home fire safety knowledge (Lehna, Fahey, et al., 2015). This study’s findings demonstrate that the impact that this training has on individuals extends beyond childhood. Elementary school fire safety education has indelible influence on perceived self-efficacy of participants’ household fire safety beliefs and practices. Findings also demonstrate how persons who do not receive exposure to occupational emergency or fire safety training, or were not exposed to elementary school fire safety education, may not receive adequate opportunities to obtain fire safety knowledge or training, and seek to receive such training from building management.

**Intentions Regarding High-Rise Fire Safety**

Participants described various intentions for improving their household and overall building fire safety, such as purchasing fire safety equipment, seeking further knowledge and training, and becoming more engaged in building leadership to improve fire safety. Despite these various intentions, not all households had taken action to improve their household’s fire safety, even after experiencing a fire in their building. This finding is consistent with other literature regarding adoption of EP behaviors that shows there is distinction between behavioral intentions and actual preparedness behaviors. Behavioral intentions do not necessarily result in the adoption of protective measures. Several factors influence whether an individuals’ intentions
are converted into action (McIvor, Paton, & Johnston, 2009; McNeill et al., 2013; Najafi et al., 2017; Paton, McClure, & Burgelt, 2006).

**Occupant Fire Preparedness Behaviors**

Findings from this study regarding occupant fire preparedness behaviors reflect existing research on household fire safety, as well as high-rise fire safety and evacuation preparedness. This theme was comprised of three sub-themes: *Fire prevention and preparedness, evacuation preparedness* and *cues for evacuation*.

**Fire prevention and preparedness.** Some residents lacked basic fire safety equipment, such as smoke alarms and fire extinguishers. Even among households that had smoke alarms, participants noted that they were not functional at all times. This is a common finding in household fire safety research (Ballesteros & Kresnow, 2007; Ta et al., 2006; Wood et al., 2016). Studies show that even though most (90%) of homes in the U.S. have smoke alarms, about one quarter are not functional (Mack, Liller, Baldwin, & Sleet, 2015). It is known that the absence of a functional smoke alarm is one of the primary risk factors for death and injury in residential fires, and that installation of smoke detectors has been proven to reduce fire-related deaths and injuries (Ballesteros & Kresnow, 2007; Istre et al., 2013). In residential high-rise buildings, especially those without sprinkler systems, households without smoke alarms remain a cause of major concern.

Findings from this study show that residents had a mixed level of awareness regarding high-rise building fire safety features. While most residents were knowledgeable about where fire extinguishers and fire hoses were located in hallways, some participants had little familiarity with their buildings’ fire safety features. For example, despite having lived in their building for many years, some participants had never been in the stairwells, had not noticed stairwells, and/or had never noticed key fires safety features and equipment on their floor. None of the participants
mentioned fire pull stations as elements of fire safety in their building. It was unclear whether this is because they were not present in their buildings, or if occupants were just not aware of them. These findings contribute to what is known about high-rise occupant familiarity with building fire safety features. Zmud (2008) found that almost all high-rise occupants (commercial and residential) were knowledgeable about the locations of fire exits. Most knew whether or not their building had an alternative exit or stairs, and most were aware of fire pull stations. Gershon et al. (2012) found low levels of awareness among WTC evacuees regarding the location, number, and entry/exit points of stairwells in their building. Findings from this study suggest that residential high-rise occupants also lack basic knowledge of building fire safety features. Building managers may consider providing basic building safety orientation to new occupants to improve their knowledge of their building’s fire safety features.

Evacuation preparedness. Participants in this study explained varied factors influencing their preparedness to evacuate. Having had prior experience evacuating from their building, or other high-rise buildings, was highly influential for study participants. Those without such experience did not always possess strong knowledge about evacuation routes, or lacked confidence in their ability to exit during an emergency. This parallels Gershon et al. (2012) findings among WTC evacuees, where half of them did not feel confident about exiting their building without instructions.

Previous studies on high-rise building evacuations have demonstrated how environmental cues, when perceived as a threat, can interrupt normal activities and influence protective action. In order for people to perceive a threat, the person must first receive cue(s), pay attention to the cue(s), and comprehend the cue(s) (Gwynne, Kuligowski, & Kinsey, 2015; Kuligowski, 2015). Most cues described by participants of this study are commonly reported upon in high-rise evacuation research include seeing smoke or flames, hearing screaming, shouting or the sound of
an explosion; smelling smoke, and receiving building notifications to evacuate (Gershon et al., 2012; McConnell et al., 2010a; Proulx & Reid, 2006). This study’s findings identified that a cue indicating the severity of a situation was the number of emergency vehicles seen responding to an incident. If many fire trucks were visible, this was considered as a cue to take the situation seriously. Fire alarms proved to be an ineffective cue for indicating the need for immediate evacuation. Participants described their inability to hear the fire alarm clearly or discern it from other noises. Furthermore, multiple false alarms in the past had desensitized participants to the point that they didn’t believe it indicated a true fire threat. Upon hearing the fire alarm, participants waited and listened for 1-5 minutes, sought more information, did nothing, or completely ignored the alarm and continued what they were doing. This behavior has been described in the literature, where building occupants often ignore alarms because they fail to hear the signal, fail to recognize the signal as a fire alarm, or have lost confidence in the system due to nuisance or false alarms (Proulx, 2000).

Findings from this study also shed light on barriers for swift evacuation during residential high-rise emergencies. Sensory or mobility impairments were identified as a potential barrier by participants. This is commonly described in prior research on high-rise evacuations (Gershon et al., 2012; Gershon et al., 2007; Proulx & Reid, 2006; Rooney & White, 2007; T. J. Shields et al., 2009). Participants also mentioned engaging in multiple pre-evacuation actions after receiving a cue to evacuate during an emergency, another factor widely reported in building evacuation research (Day et al., 2013; Gershon et al., 2012; Gershon et al., 2007; McConnell et al., 2010b; Proulx & Reid, 2006). A unique finding in this study is that multiple family members, including children, take pre-evacuation actions during emergencies prior to moving towards the stairs. Also, residents with pets may take extra actions to prepare their animals for evacuation. These
factors may result in longer pre-evacuation delay in residential high-rises as compared to commercial buildings.

Ajzen’s Theory of Planned Behavior in Relation to High-Rise Fire Safety

Findings from this study show that Ajzen’s (1991) theory of planned behavior (TPB) can be applied to understand and better predict residential high-rise fire safety and evacuation preparedness behaviors. The following section describes how findings from this study can be interpreted using the TPB framework.

Behavioral Beliefs/Attitudes

Facilitators of residential high-rise fire safety related to behavioral beliefs/attitudes included heightened risk perception for fires, prior experience with high-rise building fire, and feelings of self-responsibility for household fire preparedness. Risk perception was heightened when people had accurate knowledge of causes of fires, and lived at higher floors. Direct and indirect experience with high-rise fires was another a major facilitator in shaping attitudes. Such experiences often served as the catalyst for heightened interest and awareness of fire safety in their buildings. Persons who expressed personal responsibility for fire safety in their household were more likely to adopt preparedness behaviors. Barriers to residential high-rise fire safety related to behavioral beliefs/attitudes included decreased fire risk perception due to living on a lower floor, and having lowered fire hazards risk assessment, due feelings of comfort or complacency, laziness, fatalism, or a false sense of security.

Normative Beliefs/Subjective Norms

Facilitators of fire safety among residents included building management fire safety leadership, a positive perception of neighbors’ fire safety, and social connectedness of the building community. Persons who believed that their neighbors practiced fire safety tended to exhibit positive attitudes towards fire safety themselves. Leadership demonstrated by building
management contributed to residents’ trust with management in their ability to prevent fire and respond appropriately to fire emergencies. Finally, social engagement neighbors and management tended to engender positive perspectives towards fire safety behaviors, and led to neighbors helping each other become better prepared for fires.

Barriers to adoption of fire safety behaviors related to social norms were the lack of building management fire safety leadership and a negative perspective about neighbors’ fire safety behaviors. In buildings where unsafe practices were tolerated, residents were less likely to adopt even basic fire safety measures, such as installing smoke alarms, stocking apartments with fire extinguishers, or maintaining fire doors in closed positions. When participants observed that their neighbors follow fire safety rules or participate in drills or evacuations, these behaviors were noted, and negatively influenced the overall building fire safety culture.

**Control Beliefs/Perceived Behavioral Control**

Positive beliefs regarding self-efficacy was an important facilitator for adopting fire safety behaviors. Self-efficacy and confidence in their ability to take adequate household fire safety precautions was highly influenced by prior knowledge and training in fire safety/EP. Persons whose household had at least one person who had received some form of training were more likely to describe confidence in their ability to prepare for fires and effectively evacuate from their buildings. Persons who lacked prior exposure to fire safety or EP training expressed lower confidence in their ability to prepare for fires. They expressed not having adequate knowledge, or lacked important skills to adequately prepare themselves for fire. Receiving such training was considered an important step for improving their households’ fire preparedness.

**Behavioral Intentions**

Intentions were formed in response to facilitative attitudes, subjective norms, and perceived behavioral control related to high-rise resident fire safety. Many had formed these
intentions spontaneously while being engaged in a discussion about fire safety during interviews with the researcher. Intentions to prepare for fire did not always convert into action on fire safety.

Findings from this study illustrate how the theory of planned behavior can be useful for understanding how various facilitators and barriers modify intentions for adopting fire safety behaviors and contribute to the prediction of fire safety behavior adoption residential high-rise building occupants. By interpreting this study’s findings through the lens of the TPB framework, interventions can be designed to change behaviors by targeting one or more of the behavioral facilitators or barriers identified.

**Nursing Implications**

Enhanced awareness of safety, specialized knowledge regarding injury or disease prevention and health protection of many different populations, and constant preparedness for emergencies are some of the hallmarks of the nursing profession. Such qualities make nurses excellent practitioners, mentors, and advocates for improving residential high-rise building occupant fire safety. Findings from this study indicate multiple areas in which nurses can contribute to wellness and safety outcomes for high-rise residents. Nurses can exert influence on high-rise building fire safety by being personally prepared, working with individual clients, and building communities and/or leadership.

**Personal high-rise fire preparedness.** First it is imperative that nurses who live in high-rise buildings prepare their own household for fire and evacuation. Nurses receive fire safety and emergency training as part of their occupational duties. This training should be applied to their households as well. Nurses should maintain functioning fire safety equipment and stock emergency supplies. An adequate financial cushion and building insurance should be included as part of their household emergency preparedness check list. Nurses should develop a household
emergency plan that includes all household members (including pets). The plan should include household contact information, points of reunification in the event that family members are separated, building evacuation routes, and information about what to do if evacuation is not possible during a fire. Plans should be practiced at least once a year. Specifically, evacuation routes out of the building should be traversed to become familiar with the building layout and exit ways. By optimally preparing themselves for building fires, nurses can be better prepared to protect themselves and their family members, as well as assist others in the event of an emergency.

**Client high-rise fire preparedness.** Next, nurses can work with individual clients to improve fire safety in their units. For example, nurses conducting home visits can perform fire safety audits while visiting clients. Such interactions can occur as quick conversations during the course of a home visit, or as longer discussions focused on overall household emergency preparedness. Household fire safety audits should include at minimum an inspection of smoke alarms and fire extinguishers to see if they are present and in functional condition. If clients don’t possess these items, nurses can encouraged residents to purchase them, or provide referrals to community agencies that offer fire safety service to individuals, such as the American Red Cross. Nurses should also discuss evacuation planning, tailoring plans for the household, and taking care to include special considerations for vulnerable groups (such as older adults, persons with mobility or sensory impairments, non-English speaking households), families with small children, or households with pets. Participants in this study were eager to receive such information is provided. Information needs to be succinct, and easy to remember. As one participant noted, the fire safety information provided by management was good, but there was too much to remember. Nurses can partner with the fire department and building leadership to design simple fire safety cards that can be distributed to high-rise dwellers. Such cards can be
small enough to post on the refrigerator, or on the back of the entryway door. These cards can serve as reminders about what to do when the fire alarm sounds, routes for evacuation, and what to bring in the event of an emergency. It may also include expiration dates of smoke alarm batteries and fire extinguishers.

**Building community high-rise fire preparedness.** Nurses can work at the building or community level by engaging building management and resident owner associations. This can be approached formally from the role of a consulting professional, or as a resident of the building. Findings from this show that fire fighters living in high-rise buildings are active in consulting building leadership on how to improve fire safety in their building of residence. Nurses can contribute to communal fire safety/EP education and training for residents. Training sessions can include demonstrations on how to properly use a fire extinguisher, information about how the use and function of fire doors, and assistance in developing household specific evacuation plans. While fire risk is perennial, the timing of such efforts is important. If possible, fire safety education should be conducted in the immediate aftermath of a high-rise fire incident (whether locally, nationally, or globally) while there is still intense attention in the media. This study’s findings shows that people pay great attention to household fire safety immediately after a major fire incident. Building management and fire safety/emergency response professionals should take advantage of this tendency by providing rapid public health education response to such events when fire safety issues are most salient to the general population.

Education and training efforts at the individual, building-level, and community level can lay the foundation for a culture of preparedness among residents and the building community. As this study’s findings show, by merely engaging in conversation with residents about high-rise fire safety, participants came up with new ideas, and gained new knowledge about fire safety in
their own building. Such efforts, sustained over time, can lead to important changes in high-rise resident perceptions of fire safety, hopefully leading to enhanced building fire safety.

**Policy Implications**

Findings from this study suggest that working at the individual and building community level are not sufficient to ensure high-rise resident safety, especially in buildings lacking fire sprinklers. Building rules and regulations, along with public policy may be necessary to properly ensure resident safety.

**Building fire safety policies.** Findings from this study suggest that building leadership, such as condo association boards of directors and building management, are very influential to occupant household fire safety. However, leadership may be resistant to taking action on fire safety because they are focused on being good stewards of building finances. Also, they may shy from imposing stringent rules on residents that impede upon their individual preferences. Boards should review policies through the lens of resident safety to see if there are any inexpensive methods for ensuring communal fire safety. This study’s findings suggest that residents look to building management for leadership and direction on fire safety, and are willing to follow along with building manager instructions or rules. Furthermore, residents are concerned that some residents engage in risky behavior that put the safety of all building occupants at risk. At least one participants desired a blank code of conduct for fire safety be established and enforced. Building management can seek consultation from other buildings or associations to seek a successful approach that balances fire safety and property protection while also promoting individual rights of owners and being good stewards of building assets.

When considering residential high-rise building occupant fire safety matters, renters should be brought into the fold. Renters should have access to important safety information shared at residential board meetings. Consideration should be given to including renter
representation during board meetings to contribute to building safety policy decision-making processes. Including a renter’s perspective on building deliberations could serve to improve safety of all residents, decrease feelings of isolation and disconnectedness among renters, and increase renters’ household attentiveness to building safety policies, hopefully leading to improved fire safety measures in renter households.

Leadership in older buildings should also examine updating building fire safety features and systems. Modernization of alarm systems should be one priority, and should include flashing lights in addition to a clearly audible alert. Alarm systems may not be sufficient, however, as findings have shown. A public announcement system of some form should be installed to provide residents with specific instructions on what to do in the event of an emergency. Technological solutions, such as smart phone apps and TV communications described by participants in this study results are a good step. However safety messages must be accessible and understandable to all residents, even among those who do not own a smart phone or TV, those with sensory deficits, or persons who do not speak or understand English.

**Public policy.** Legislation mandating building action on fire safety measures is the only sure-fire way of compelling building leadership to take meaningful and sustained action on fire safety. In the absence of legislation, building management may not act until after a catastrophic event occurs. Findings have shown that multiple barriers to fire safety leadership exist, such as individualism, lack of risk perception, and financial costs. Such barriers may be insurmountable in some cases and impede progress for resident fire safety. Policies without financial assistance to help individual owners comply with regulations may be met with strong resistance. High-rise residents, especially older persons, have financial limitations on their ability to pay for safety upgrades. While building management may be willing to act, individual owners may not support initiatives unless they can be reassured that they will be able to afford such changes. Policy-
makers could seek solutions for high-rise residents, a growing constituency in many locales. Safe housing is a major public policy issue for any community, and the problem of ageing high-rise buildings and infrastructure is one that many communities across the country will face in the coming decades. Without coordinated efforts at the public policy level, many people will remain at risk for longer periods of time.

**Limitations**

This study involved a small number of participants from a limited number of residential high-rise buildings in one city. Azjen’s (1991) theory of planned behavior (TPB) does not contain all of the factors that could potentially predict intentions or behaviors. Therefore, other factors that were not contained in this framework may have been missed. Building statutes and policies regarding residential high-rise buildings are area specific, and the policies influencing building codes and regulations in the city where this study was conducted may not be the same in other locations. All buildings in this study had interior hallways and lacked fire sprinklers. Residents of buildings with different structural layouts and fire prevention systems may have differing perspectives from those expressed in this study. Findings may not pertain to fire safety and evacuation preparedness among occupants of other types of high-rise buildings, such as commercial office buildings or hotels. Additionally, the researcher was a resident of the building from which some of the participants were recruited. Some participants knew the researcher prior to participating in the study, which may have introduced some bias into the study’s findings. Conversely, as a result of knowing the researcher, participants may have been more open in sharing their experiences and perspectives.

**Future Directions for Research**

This study has demonstrated a need for further inquiry on residential high-rise building occupant fire safety and evacuation preparedness, and has also highlighted other areas for future
research. This research brings to light unique factors influencing fire safety and evacuation among residential high-rise buildings that do not have equivalents in the commercial high-rise environment. For example, children and pets are extremely influential in residential high-rise occupants’ evacuation decision-making and processes. Furthermore, residential high-rises may have a more diverse population mix than many commercial buildings occupants. Examples mentioned in this study include persons who may be older, younger, have mobility or sensory impairments, use various assistive devices, and have varying ability to speak or understand English. Furthermore, residential high-rise evacuation may occur at any time of the day or night, necessitating different decision-making and pre-evacuation actions when compared to commercial high-rise settings.

Another area for follow up research is whether a link exists between high-rise building community social cohesion and household fire preparedness. Residents who had positive perspectives about neighbors’ fire safety, were more engaged in building matters, had higher level of trust for management, and tended to be more prepared for fires. Conversely, people who were fearful or resentful of their neighbors’ lack of fire safety habits, suggesting that poorer communal fire safety may adversely impact building social cohesion. These findings suggest that the association between building social cohesion and fire safety should be more closely examined.

Differences in household fire safety between owner- and renter-occupants exist and should be further explored. A better understanding of renters’ perception of fire safety is important because most residential high-rise communities are usually composed of a mix of renters and owners. As noted in this study, renters perceive themselves to be at a disadvantage because of their lack of inclusion in building-level discussions, even though they share equal risk for fire.
This study also suggests a need to reconsider basic smoke alarm product design and warning function. Despite knowledge of their safety benefits, study participants viewed smoke alarms as a nuisance. New ways of informing residents of a low battery should be reconsidered. The loud sharp beeps that signal a low battery are annoying to people, and instead of replacing batteries, a common behavior is to remove the whole unit from the wall without replacing it. It may be helpful to seek input from consumers to find alternative methods of alerting residents for the need to replace batteries.

**Summation**

This research provided a deeper understanding of the factors that influence fire safety and evacuation preparedness among residential high-rise occupants. Findings indicate that multiple factors related to occupant attitudes towards fire safety, building fire safety culture, and occupant perceptions regarding their ability to prepare for fires interact to influence fire safety and evacuation preparedness behaviors among high-rise dwellers. Knowledge gained from this study can be used to inform fire safety education programs, policies and future studies. It is hoped that such efforts will result in fewer fire-related injuries or deaths among residential high-rise building occupants, and promote safer living environments for individuals and families.
Appendix A: Demographic Information Sheet

RESIDENTIAL HIGH-RISE FIRE SAFETY DEMOGRAPHIC SHEET

Directions: Please enter the information for each question.

1. What is your age? __________

2. What is your gender? □ FEMALE □ MALE □ OTHER

3. How many people live in your household (including yourself)?
   Please enter how many are in each age group:
   less than 18 yrs. ____ 18-64 yrs. ____ 65 yrs or older: ____

4. What is the highest level of education you have completed?
   □ High School Diploma □ Associate Degree
   □ Bachelor Degree □ Graduate Degree

5. Are you an owner or renter?
   □ OWNER □ RENTER

6. Do you have condo or renters insurance?
   □ YES □ NO

7. What floor do you live on?
   ______________________

8. How many years have you lived in your current apartment building?
   ______________________

9. How many years have you lived in other high-rise apartment buildings?
   ______________________

10. Have you ever worked in a high-rise building?
    □ YES □ NO

11. Do you have a medical or health condition that limits your mobility?
    □ YES □ NO

12. Do you live with someone who has a medical or health condition that limits mobility?
    □ YES □ NO

13. Has there ever been a fire in a high-rise building you were living in?
    If yes, how many fires?
    ______________________

14. Have you ever experienced a fire in your apartment unit?
    □ YES □ NO

15. Have you ever had to evacuate from a high-rise building?
    If yes, how many times have you evacuated?
    ______________________

16. Have you (or other members of your household) had any training or experience in emergency preparedness or fire safety?
    If yes, what type of training/experience?
    ______________________
Appendix B: Key Informant Interview Questions

KEY INFORMANT INTERVIEW SCRIPT QUESTIONS

The following questions will be used as a starting point for the interview:

1. Tell me your thoughts about fire safety and evacuation preparedness in high-rise apartment buildings.

2. Have you ever experienced a fire in a residential high-rise building? Would you describe your experience?

3. Tell me what you know about what causes a fire in residential high-rise buildings.

4. Tell me about any actions you have taken in terms of your household’s fire safety and evacuation preparedness in this high-rise building.

5. How would you describe fire safety/evacuation preparedness among other people who live?

6. How would you describe fire safety/evacuation preparedness among other people who live in your building or other residential high-rise buildings?

7. How would you describe the building’s staff/management level of preparedness for fires or building evacuations?

8. Are there some things that make it easier for you/your family to take actions related to fire safety and evacuation preparedness?

9. Are there some things that make it difficult for you/your family to take actions related to fire safety and evacuation preparedness?

10. Do you have any further comments about fire safety or evacuation preparedness in this building?
Appendix C: IRB Approval Letter

Office of Research Compliance  
Human Studies Program

TO: Qureshi, Kristine, PhD, University of Hawaii at Manoa, Nursing  
Glauberman, Gary, MS, Nursing, University of Hawaii at Manoa
FROM: Rivera, Victoria, Interim Dir, Ofc of Rsch Compliance, Social&Behav Exempt
PROTOCOL TITLE: Factors influencing fire safety and evacuation preparedness among residential high-rise building occupants
FUNDING SOURCE:  
PROTOCOL NUMBER: 2018-00428
Approval Date: July 05, 2018 Expiration Date: December 31, 2999

NOTICE OF APPROVAL FOR HUMAN RESEARCH

This letter is your record of the Human Studies Program approval of this study as exempt.

On July 05, 2018, the University of Hawaii (UH) Human Studies Program approved this study as exempt from federal regulations pertaining to the protection of human research participants. The authority for the exemption applicable to your study is documented in the Code of Federal Regulations at 45 CFR 46.101(b) 2.

Exempt studies are subject to the ethical principles articulated in The Belmont Report, found at the OHRP Website www.hhs.gov/ohrp/humansubjects/guidance/belmont.html.

Exempt studies do not require regular continuing review by the Human Studies Program. However, if you propose to modify your study, you must receive approval from the Human Studies Program prior to implementing any changes. You can submit your proposed changes via email at uhirb@hawaii.edu. (The subject line should read: Exempt Study Modification.) The Human Studies Program may review the exempt status at that time and request an application for approval as non-exempt research.

In order to protect the confidentiality of research participants, we encourage you to destroy private information which can be linked to the identities of individuals as soon as it is reasonable to do so. Signed consent forms, as applicable to your study, should be maintained for at least the duration of your project.

This approval does not expire. However, please notify the Human Studies Program when your study is complete. Upon notification, we will close our files pertaining to your study.

If you have any questions relating to the protection of human research participants, please contact the Human Studies Program by phone at 956-5007 or email uhirb@hawaii.edu. We wish you success in carrying out your research project.

1950 East-West Road  
Biomedical Sciences Building B104  
Honolulu, Hawaii 96822  
Telephone: (808) 956-5007  
Fax: (808) 956-8883  
An Equal Opportunity/Affirmative Action Institution
References


CTBUH. (2018). The skyscraper center, the global tall building database of the CTBUH.


