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How the Differential Vulnerability of the Elderly Hinders Wider Community Capacity for Resilient Adaptation on the Atlantic and Gulf Coasts.

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Table of Contents

Abstract

The occurrence of new and more frequent natural hazard events spurred by climate change necessitates that communities along the U.S. Atlantic and Gulf coasts respond with equitable and effective strategies for resilient adaptation. To understand how current resilient adaptation strategies, fail to comprehensively address the vulnerability of marginalized populations, this paper concentrates on the differential vulnerability of elderly coastal community members. The elderly is a demographically diverse population that consists of individuals in every social, political, economic, and cultural group within the Atlantic and Gulf regions. My research evaluates how the health and socioeconomic well-being of this population detrimentally impacts their ability to carry out three resilient adaptation strategies: evacuation, reconstruction, and managed retreat. I argue that the intersectionality of this population reveals that the failure to address the elderly's susceptibility to coastal risks, breaks down the resilient capacity of coastal communities as a whole.

Keywords: Vulnerability, resilience, equity, adaptation, evacuation, reconstruction, managed retreat, elderly, coastal communities, U.S. Atlantic and Gulf Coasts.

Introduction

Climate change is amplifying the impacts of coastal hazards. The increasing recurrence of stronger, larger, and longer hazardous events amplifies the vulnerability of communities in their paths. In coastal regions, communities that bear the brunt of natural hazards must have the capacity for effective resilient adaptation that equitably targets the vulnerability of residents. However, the experiences of people living in coastal areas highlight the differential vulnerability of these communities. Failure to address and serve the needs of the vulnerable populations within a coastal community impedes the wider resilient adaptive capacity of these communities as a whole. Along the Atlantic and Gulf coasts of the United States, urban and rural developments coexist with the environmental landscape, necessitating a balance between human development and the coastal landscape. To maintain this relationship, the needs of both systems must be upheld or as a consequence, they each will deteriorate. The occurrence of natural coastal hazards along the Atlantic and Gulf coasts demonstrates the impact of this ecological imbalance on the human residents of these coastal communities. For coastal community members, the impacts of hazardous events undoubtedly pose risk but, this risk is not evenly distributed amongst each individual within these communities. Within societally marginalized populations, Atlantic and Gulf Coast community residents will face greater vulnerability to the impact of a hazardous event and have a lower capacity for resilient adaptation. This is true for the elderly members of coastal communities, who are becoming increasingly more vulnerable to the incidence of coastal hazard impacts. The elderly population of the U.S. is growing and is expected to double in size in

coming years (Gamble et al., 2013), and so too is the elderly population of Atlantic and Gulf communities. , many of which are "experiencing increased population growth and almost three times higher population densities than the national average," (Bukvic et al., 2018). Many residents of these areas have lived in these landscapes for many generations (Simms, 2021), while others are newer residents who have moved to the area to retire and/or build their second homes (Park, 2021). As the risk of a hazardous event continues to grow along the Atlantic and Gulf coastlines, many younger residents are choosing to establish their livelihoods elsewhere (Logan et al., 2016). While recognizing the intersectionality that differentiates each individual, I attribute the health and wellbeing and socio-economic well-being of elderly residents as the pathways that result in their differential vulnerability to the impact of a coastal hazard. Through this paper, I aim to explain how these pathways contribute to the differential vulnerability of the elderly in coastal communities along the Atlantic and Gulf coasts of the United States, through the assessment of three resilient adaptation strategies: evacuation, reconstruction, and managed retreat. I identify how each of these efforts respectively fails to effectively and equitably address this vulnerability, and as a result, fails to equitably and effectively serve these coastal communities as a whole.

Defining Vulnerability, Resilience, and Equity

First and foremost, when discussing the relationship between the elderly residents of Atlantic and Gulf Coast communities and the climate change-induced hazards prone to these

regions, it is necessary to define three key concepts. Vulnerability, resilience, and equity provide the basis for which experts, leaders (local, state, and federal), and residents understand how those residing in coastal communities are impacted and affected by coastal hazardous events. As the climates along the Atlantic and Gulf coasts of the United States continue to change and hazardous coastal events become increasingly prevalent in these regions, these concepts must be concretely defined within coastal adaptation, with the understanding that they must continue to evolve and reflect the changing needs of not only the elderly in coastal regions but also the communities in which they reside as a whole.

Vulnerability

Vulnerability as understood by my research "is a state in which the likelihood of experiencing harm from a hazardous event is high and recovery time is long… As such, researchers conceptualize vulnerability as the inability of a community to withstand adverse impacts from hazardous events," (Jurjonas et al., 2020). The main pathway through which my research understands the differential nature of vulnerability is where "different people or groups may be exposed to different magnitudes of loss or may be exposed to different types of loss," (Buckle, 1999). In this way, the occurrence of vulnerability within a community is attributed to unequal exposure to risk coupled with unequal access to resources (Morrow, 2008). Differential vulnerability includes geospatial location and social vulnerability. Geospatial locations may be vulnerable due to "the processes that sort individuals into different locations and put them in harm's way," (Logan et al., 2016). Social vulnerability is defined as the existing inequalities in a

community based on the power hierarchies among people based on their social, racial, cultural, and economic differences (Morrow, 2008). In this way, the occurrence of vulnerability within a community can be attributed to unequal exposure to risk paired with unequal access to resources (Morrow, 2008).

Resilience

Inherently, the concept of resilience is contextual, most simply expressed as "the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events," (Cai et al., 2016). Consequently, resiliency is intrinsically individualistic, reflective neo-liberal ideology apparent in popular top-down strategies and policies for coastal adaptation. This perspective generalizes resilient capacity across populations, lacking the frame of reference necessary to specialize strategies based on the vulnerabilities of community members. In order to establish resilience in relation to the differential vulnerability of the elderly to coastal hazards in communities along the Atlantic and Gulf coasts of the United States, resilient practices must move away from this narrow ideology towards one that emphasizes a more holistic and community-centered approach. To facilitate this ideological shift, the scope in which resilience is defined needs to be further specified. Within my analysis, I focus on three relevant grades of resilience: climate, coastal, and community. Most broadly, climate resilience is identified as "part of a system which assesses the capacity of a certain geographic area, population, group, or otherwise to adapt, withstand, and respond to climate impacts," (Taylor, 2021). Next, my research understands coastal resilience as "the capacity of the socioeconomic and natural systems in the coastal environment to cope with disturbances, induced by factors such as sea-level rise,

extreme events, and human impacts, by adapting whilst maintaining their essential functions," (Masselink & Lazarus, 2019). Most specialized, community resilience is defined as "the capability of a community to absorb external as well as internal shocks during any hazard, resist the impacts, and take less time to recover... the intrinsic capability of a community to resist hazard with minimal impacts, and not only bounce back to its 'normal' state after in an efficient manner but also to bounce forward for the betterment in the future,"(Sajjad & Chan, 2019). Additionally, my research addresses each type of resilience through a lens wherein the emphasis of the segmented resilience affirms "the impact and recovery of populations from disasters are highly uneven and differentiated," (Logan et al., 2016).

Equity

The notion of equity can often be observed within environmental justice and adaptation discussions but requires a concrete definition. Without establishing the definition of equity, the foundation for resilient adaptation strategies will always be segmented, unable to realize the differential vulnerability of community members. In this way, communities are therefore unable to effectively carry out the functions necessary to *bounce back* and *bounce forwards* from the losses associated with a hazardous event. [KB1] As I discuss the concept of equity and equitable strategies and policies, my understanding is guided by my participation in research in the WELS Group at the University of Colorado Boulder under Dr. Sarah Walker PhD. Through conducting a scoping review, our research "aims to investigate the diversity of ways in which climate adaptation researchers explore concepts of equity and justice," (Walker et al., forthcoming). In this upcoming publication, our team differentiates between the concepts of *procedural equity;* as

the "meaningful involvement of the various actors in decision-making processes and recognitional justice/equity references the valuing of experiences, perspectives, knowledge, and well-being of affected actors," (Walker et al., forthcoming) and *distributional equity*; as the "difference in risks, costs and benefits of climate adaptation experienced by affected actors; it acknowledges that the distribution of these 'goods' and 'bads' occurs simultaneously and is interconnected," (Walker et al., forthcoming).

The reciprocal nature of vulnerability and resilience asserts that in a high-risk circumstance, the populations that cannot withstand the impacts of an adverse event, cannot do so because they cannot plan for and prepare for, endure, and recover from an adverse event. Conversely, these populations lack resilient capacity because of their unequal exposure to risk and their unequal access to resources, trapping populations vulnerable to a hazardous event in a continuous cycle. [KB2] This characterization of the relationship between resilience and vulnerability concedes structural inequality, where conditions of a certain population place them at further risk in an adverse event. In this sense, there is an evident need to "level the playing field" so to speak. Environmental justice movements call on the concept of equality to address these disparities. Instead of the promotion of proportionate attention to resources and exposure, I give prominence to the need for specialization in risk management practices based on the vulnerability and capability for resilience within populations at risk of an adverse event.

Review Structure

In this review, I wish to explain the pathways my research has found to contribute to the differential vulnerability of the elderly in coastal communities along the Atlantic and Gulf coasts of the United States, through the assessment of three resilient adaptation strategies, I identify how these efforts fail to address this vulnerability effectively and equitably, and as a result, fail to equitably and effectively serve these coastal communities as a whole. Thus far I have identified the geographic, demographic, and hazard scope of my review and provided guiding definitions of vulnerability, resilience, and equity. After detailing my methods, the following section will identify the age parameters to define elderly individuals as well as the differences that arise with varying ages and abilities within this population. Additionally, the case for the need to study the elderly as a distinctly vulnerable population in coastal areas will be presented and will provide the health and well-being and socioeconomic pathways contributing to the elderly's differential vulnerability to hazardous events in Atlantic and Gulf Coast communities. The next three sections will explore three methods of resilient adaptation strategies for communities on the U.S. Atlantic and Gulf coasts that most prominently stood out in my analysis. Each of these strategies will be assessed through the health and well-being and socioeconomic pathways contributing to elderly vulnerability identified in section four, to understand how these strategies fail to target the needs of vulnerable elderly individuals equitably and effectively in coastal communities. The last research section will seek to explain the importance of my research, as well as highlight the lessons that resilient adaptation experts and planners can gain from the elderly in areas prone to

coastal hazards, shifting the dominant societal narrative that asserts that elderly individuals are a burden to resilient adaptation strategies to one that understands that while they are vulnerable they are valuable assets to their communities ability to adapt. [KB3] Embracing a community-based approach to adaptation will provide the template to include the needs and abilities of the elderly in resilient adaptation strategy discussions, planning, and implementation. Finally, the concluding portion of this paper will outline the limitations of my study as well as identify the areas that I believe warrant further research and future action.

Methods

My review evaluates how the health and socioeconomic well-being of the elderly in U.S. Atlantic and Gulf Coast communities detrimentally impacts their ability to carry out three resilient adaptation strategies; evacuation, reconstruction, and managed retreat and in turn impede wider community resilience.

The geographic scope of my research focuses on the communities residing on the Atlantic and Gulf coasts of the United States. Demographically, these U.S. coastal regions are demographically diverse, with major urban settlements and cities; New York City, Boston Baltimore, D.C., Charleston, Savannah, Tampa, New Orleans, Houston, etc., in addition to vast rural settlements, boasting a cumulative population of 60.2 million Americans, these coastlines are home to 34% of the United States population (United States Census Bureau, 2019). Historically, agricultural and industrial development has flourished in building the economic

foundation of the Atlantic and Gulf coasts, providing opportunities for many Americans, a trend that continues in the modern era.

The variety of hazards included within the confines of my research focuses on those that naturally occur along these coasts, predominately focusing on sea-level rise (SLR), storm surges, floods/inundations, and hurricanes. These coasts are familiar with the impacts of these hazards, within a period of 17 years (2000-2017) the Atlantic and Gulf coastline of the United States suffered the landfall of 13 hurricanes, seven of which occurred in 2004 and 2005, resulting in over $600 billion in damages (United States Census Bureau, 2019). Notoriously, the landfall of Hurricane Katrina in 2005 decimated U.S. communities along the coast of the Gulf of Mexico resulting in $165 billion in damages (United States Census Bureau, 2019) and 971 casualties in Louisiana alone (Brunkard et al., 2008). In the following years, Hurricanes Harvey, Rita, and Irene, among numerous others made landfall on U.S. Atlantic and Gulf Coasts. Hazardous events like these coincide with tremendous losses for coastal communities, as resident lose their homes, their communities, and even their lives. Looking toward the future of communities located along the U.S. Atlantic and Gulf coasts a changing global climate can be expected to decrease the recurrence interval and increase the severity of coastal hazards. Changes that can already be seen occurring in U.S. coastal regions, in October 2012 Hurricane Sandy made landfall on the U.S. Atlantic Coast (PLANYC, 2013). As a result of conditions unusual to that of late October, the size and structure of Sandy lead to the nickname “Superstorm Sandy” (*Why Sandy Became A Superstorm Ten Years Ago*, 2022). Superstorm Sandy is one of the many unusual, destructive, and powerful hazardous events that will propagate as the global climate continues to change. It is

necessary that experts and residents alike understand the consequences of rising sea levels and address the growing incidence of hazardous events endemic to these coastal regions.

Four key questions guiding my research:

1. What factors make the elderly more vulnerable to coastal hazards?
2. How does the vulnerability of the elderly impede wider community resilience in coastal regions?
3. How can we make coastal community adaptation/resilience strategies more equitable and effective?
4. What can we learn from the vulnerability of the elderly to these hazards to achieve more equitable/effective coastal community resilience?

To answer these research questions, I conducted a conceptual literature review. I began by collecting peer-reviewed sources from the University of Colorado Libraries database, Google Scholar, PubMed, and JSTOR, using keywords that focused on the elderly, coastal hazards, vulnerability, and resilience. Upon having difficulty finding more and new sources, I used the references of the papers already included in my review to expand the publications included in my review. In total, my initial search yielded 153 sources, which I organized into a basic spreadsheet. The majority of my collected sources were accessible through the University of Colorado Boulder. For the publications to which I did not have university access, I reviewed their abstracts and eliminated the papers that did not fit within my study criteria. For the publications that did, I acquired access through the help of the Geography department librarian (Philip White) and the Interlibrary Loan program at the University of Colorado Boulder. This

process cut my review down to 86 sources, which underwent a full-text screening, where I extracted definitions of vulnerability, resilience, and equity.

After having compiled the definitions of vulnerability and resilience as well as the definitions of any sub-type of vulnerability and resilience (i.e., social, location, climate, etc.) provided by the source authors, I proceeded to evaluate the publications based on their geographic, hazard, and age parameters, while I also noted if the authors addressed further determinants of vulnerability and methods of resilient adaptation. I appraised their applicability to my research and selected those which aligned with the focus of my research. At this point, I found that some sources did not meet my research qualifications in at least one of the criterion categories, but they were not eliminated from my review as I found them to be beneficial to my review in other aspects. I was then able to analyze the sources for their definition of what age constitutes being elderly and the determinants that provide an explanation for the differential vulnerability that old age presents in the face of coastal hazards. During this analysis, I also searched for strategies for resilience and adaptation presented by the authors and sought to understand how they address or fail to address the needs of the elderly. Upon conducting this analysis, I opened my research questions to understand how experts can not only identify the vulnerability of the elderly to contribute to equitable coastal community resilience but also include the knowledge bases and human capital that the elderly can provide in resilient coastal communities.

Identifying and Establishing Elderly Individuals

Immediately, it is necessary to recognize the decision to center my study around the elderly population within these regions. In exploring the possible marginalized populations that I would want to address to conceptualize how inequitable resilient adaptation strategies deter wider community resilience, the elderly was a group that I found to be particularly subject to adverse risk in the U.S. Atlantic and Gulf Coast communities. I was intrigued by the disagreement in the definition of the elderly and the ways in which they are differentially vulnerable to coastal hazards. In the following section, I provide a definition of the elderly, the argument for why the needs of the elderly should be further evaluated, and the pathways through which this vulnerability is understood based on my findings.

The first finding that my review yielded was that the age parameters defining the elderly population are widely inconsistent. Definitions of this age group were observed in a range of ages consisting of individuals aged fifty and above (Al-rousan et al., 2015) to individuals aged seventy-five and above (Qiang, 2019). In accordance with the traditional American retirement age, individuals aged sixty-five years were the most recurrent baseline defining the elderly. For the sake of clarity, I maintain the elderly as those aged sixty-five and older. The discrepancies in the characterization of the elderly observed within my review are indicative of heterogeneous capabilities within this population. Though the individual's capabilities are not confined to their age, a common assumption asserts that with increasing age and disability there are increased vulnerabilities and obstacles to resilience (Clark et al., 1998). To address this discrepancy, this

age group (65+) can be further categorized into the "youngest-old" (65 to 74 years), the "aged" (75 to 84 years), and the "oldest-old" (85 years and older) (Fernandez et al., 2002). An additional distinction in the ability of the elderly identifies the *frail elderly*; those of any age (65+) who have "health conditions that limit the individual's independence and increase his or her need for assistance and dependency on others," (Fernandez et al., 2002). The *frail elderly* caveat and age categorization within the elderly population critically examine degrees of differential vulnerabilities to coastal hazards exerted on the elderly, as each elderly individual will experience the impacts differentially as a consequence of their agedness and ability. Revealing the origins of these differential vulnerabilities allows for the understanding of current practices for resilience that are segmented within Atlantic and Gulf Coast communities.

For this same reason, the role various other socio-economic determinants play in tandem with old age must be acknowledged as they too exacerbate coastal vulnerability. The Atlantic and Gulf coasts are home to many diverse populations affected by the social, cultural, political, and economic context of the United States. An elderly individual's race/ethnicity, gender, income, educational attainment, etc. contribute to their experience of differential vulnerability. By acknowledging the differential vulnerability that coastal hazards exert on coastal communities, the approach to community resilience in these regions can be reframed to be established in a more equitable and effective manner.

Why focus on the vulnerability of the elderly?

In risk management and hazard mitigation/adaptation research, the elderly have been understood within the contexts of other vulnerable populations, such as women and children,

overlooking their specialized needs (Siders, 2019). This practice, as result, is both procedurally and distributionally inequitable, as elderly individuals are not included in the planning or execution of resilient adaptation strategies. Research has recently begun to explore more in-depth the elderly's vulnerability to hurricanes and extreme heat events but has failed to examine further hazards like sea-level rise and coastal flooding (Gamble et al., 2013). The resources and data needed to fill research gaps and ameliorate resilient adaptation strategies require that focus is drawn to the elderly as a vulnerable population on their own. The CDC affirms that "older adults are more vulnerable than younger adults during a disaster because they are more likely to have impaired physical mobility, diminished sensory awareness, chronic health conditions, or social and economic limitations that interfere with their ability to prepare for disasters and to respond and adapt during such events," (Benson, n.d.-b). The natural process of aging exacerbates an individual's vulnerability to risks in relation to any range or combination of social, economic, political, and/or cultural contexts. Being over 65 does not immediately put an individual at increased risk during a hazardous impact, but the conditions that coincide with aging amplify an individual's vulnerability. In this sense old age acts as a threat multiplier, creating adverse conditions that during a hazardous event result in differential vulnerabilities. When compiled with various societal circumstances amplify hazard vulnerability and diminishes the capacity for resilient adaptation.

Furthermore, The population of those aged 65 years and older in the United States as a whole is "increasing dramatically," according to Gamble et al., projecting that older adults will account for 20% of America's population in 2040, an increase from approximately 13% in 2013 (Gamble et al., 2013). Furthermore between 1970 to 2010 coastal shoreline counties in the U.S

saw an 89% increase in the percentage of the population aged 65 years and older, a trend expected to continue between 2012 and 2050 (Bukvic et al., 2018). As of 2018, Bukvic et al. assert that across 271 coastal counties on the Atlantic coast, the average of the population 65 years and older is 15.4%. Inarguably the aging population in communities on the Atlantic and Gulf coasts is increasing. At the same time, it is unclear how this distribution will change over time between coastal locations (Bukvic et al., 2018), it is clear the diversity within these populations and a changing climate will continue to increase the risks and vulnerabilities associated with coastal residency. For these reasons, my review focuses on the elderly populations in Atlantic and Gulf Coast communities in order to assess differential vulnerability and the capacity for effective and equitable resilient adaptation.

Pathways for understanding the occurrence of elderly vulnerability.

Through the review process and the analysis of peer-reviewed sources, I have determined two pathways that advance the differential vulnerability to coastal hazards experienced by elderly individuals in relation to the Atlantic and Gulf Coast communities in which they reside. I have adopted the use of the term *'pathway'* from Walker et al. as a lens through which equity issues are identified (Walker et al., forthcoming). While continuously recognizing the intersectionality that differentiates each individual, two recurrent pathways that explain how the elderly experience differential vulnerability to coastal hazards; health and wellbeing and socioeconomic well-being.

The *health and well-being* of elderly individuals were observed through the review process to be the most recurrent pathway that experts attribute to their differential vulnerability in Atlantic and Gulf Coast communities. First by addressing how the physical health and ability

of an elderly individual impact their vulnerability. The CDC argues that the frail elderly should be recognized as a "special-needs population" by emergency managers in order to develop strategies that adequately address their needs. In order to gain an understanding of the elderly's vulnerability to coastal hazards, an individual's physical health and ability need to be evaluated before, during, and after the impact of a disastrous event. Additionally, an elderly individual's health and wellbeing well-being pertains to their cognitive/psychological health and ability. A topic that societally has been stigmatized and widely understudied, in contemporary society, mental health is a topic becoming more generally accepted. The cognitive health and ability of an elderly individual pose unique challenges to how the elderly approach resilient adaptation strategies in the face of a coastal hazard event.

The *socioeconomic well-being* of an elderly individual is the second pathway that my sources attribute to the elderly's differential vulnerability within Atlantic and Gulf coastal communities. The elderly are a socioeconomically diverse population within these regions, posing complexities in the ways they are understood to be differentially vulnerable to coastal hazard impacts in their communities. Along the Atlantic and Gulf coasts, elderly populations consist of wealthy retirees and second homeowners (Park, 2021) but also of year-round retirees who live on fixed incomes (Jurjonas et al., 2020). Economic implications across these populations, while posing different risks, leave the elderly exposed to the impacts of coastal hazards. Similarly, within elderly populations, social isolation and deprivation escalate vulnerability (Brown & Frahm, 2016) but when elderly individuals are embedded in the social structure of their communities, socially prolific, their capacity for resilience is enhanced, balancing vulnerability (Timalsina & Songwathana, 2020). In any case, social status, and

well-being lead elderly individuals to behaviors and characteristics that uniquely impede resilient adaptation strategies in coastal communities.

Together, the physiologic well-being and socioeconomic status of the elderly provide the pathways through which I analyze three key strategies for resilient adaptation in Atlantic and Gulf Coast communities. I assert that these strategies neglect the conditions that propagate the differential vulnerability of elderly community members and impede the equitable and effective resilient adaptation for U.S. Atlantic and Gulf Coast communities as a whole. My analysis observes three notable strategies for resilient adaptation; evacuation, reconstruction, and managed retreat. Each of these integrally discerns a communities ability to *bounce back* and *bounce forwards* in response to the impacts of a coastal hazard. Procedural and distributional inequities within resilient adaptation strategization ostracize the elderly, deterring their adaptive capacity for coastal resilience.

Evacuation

Evacuation planning and strategy are synonymous with the risk of a coastal hazard impact, it is a concept that is widely familiar from the general public to mitigation experts to political leaders. Successful execution of evacuation prior to the impact of coastal hazards is critical to reducing the number of casualties, economic losses, and property damages incurred during that hazardous event (Arlikatti et al., 2006). Theoretically, the approach to this resilient adaptation strategy is straightforward, once a risk is identified, experts and leaders send out an evacuation order to the affected areas. From there, residents are expected to quickly gather their

valuables, then follow evacuation routes out of their areas to a safer location. Evacuation catastrophes seen during Hurricane Bret and Hurricane Rita demonstrate that the poor execution of this resilient adaptation strategy continuously goes wrong. In 2005, it is estimated that over 70% of the victims of Hurricane Katrina were among the elderly, despite only constituting 15% of the total New Orleans population (Benson, n.d.-a), these casualties can be linked to their inability or lack of support needed to leaver their residences or the inability to receive adequate care from the services on which they depend (Dostal, 2015). I seek to understand how evacuation fails to address the health and well-being and socioeconomic pathways compounded in the differential vulnerability of the elderly, impeding equitable and effective coastal community resilience.

The impact of an elderly individual's health and well-being on evacuation.

Evacuation planning and strategy do not adequately address the physiologic needs of elderly individuals in coastal communities, the health and well-being of elderly individuals have effects on their vulnerability during hazardous events. As individuals age, their physical and mental well-being and capabilities are subject to change.

Most prominently, the aging process deteriorates an individual's physical ability, impairing balance and decreasing motor strength along with many others that limit an individual's ability to perform activities of daily living (ADLs), instrumental activities of daily living (IADls), and basic personal care (Fernandez et al., 2002). Chronic conditions magnify these limitations for frail elderly individuals at any age. In the United States, 80% of the elderly population report having at least one chronic condition, and 50% report having at least two (N. Aldrich & Benson,

2008). Hypertension, arthritis, coronary heart disease, cancer, and diabetes respectively affect 50%, 36%, 20%, 20%, and 15% of elderly Americans (N. Aldrich & Benson, 2008). The prevalence of these conditions and many others inhibit the process of successfully and independently evacuating. While older/frail individuals may not be opposed to evacuating their homes, many are unable to do so by themselves. Studies have shown that a significant percentage of elderly individuals who cannot perform ADLs require public assistance evacuating their homes with some requiring stretchers and wheelchairs (Dostal, 2015). In urban residences, these impairments are further complicated in the multi-level units in which elderly individuals reside, many of whom do not have access to amenities such as elevators or stairlifts (Dostal, 2015). These restrictions on a frail, elderly individual's physical ability to evacuate are reflected in higher injury and disaster-related deaths during hazard events in the elderly population in comparison to other age groups (Fernandez et al., 2002). Presumably, preparedness would increase with levels of frailty, when in fact observation shows that preparedness is inversely related to the level of disability, as a result, the frail elderly find themselves less prepared to evacuate, leading them to shelter in place, a choice that contributed to many of the drowning related fatalities in Hurricanes Katrina and Sandy (Dostal, 2015).

Similarly, as individuals age, their cognitive and sensory abilities are also found to deteriorate. The onset of cognitive conditions such as dementia and delirium (Brown & Frahm, 2016), further inflict mental and sensory impairments upon elderly individuals. Sensory regression in vision, hearing, smell, taste, and touch can pose unique challenges to evacuation as individuals can experience difficulties hearing/understanding evacuation instructions, communicating their needs, and problems with disaster avoidance (Fernandez et al., 2002) among others.

Furthermore, cognitive ability deterioration compounded with the occurrence and reoccurrence of stressful, traumatic events, places elderly individuals at higher risk for developing psychological conditions such as post-traumatic stress disorder (PTSD), generalized anxiety disorder (GAD), depression, and suicidal ideation (Lane et al., 2013). Not only is a coastal hazard impact a traumatic and stressful occurrence but so too is the evacuation process. Enduring the rapid and unpredictable process of evacuation takes a tremendous toll on one's mental health, when an elderly individual is afflicted by a condition that impacts their cognitive health and well-being the stresses of this process are exacerbated. The onset of disorders such as PTSD are accompanied by symptoms of "severe anxiety, significant sleep problems and nervousness, functional impairment, and avoidance of anything connected with the event," (Benson, n.d.-a). The diagnosis of PTSD is typically comorbid with other serious mental health disorders (Lane et al., 2013). In elderly individuals, these illnesses are seen to go undiagnosed and untreated as the elderly are reluctant to accept or seek out mental health services (Benson, n.d.-a).

Healthcare institutions like hospitals, nursing homes, and hospice facilities provide the frail elderly with the specialized care required to meet their physiologic needs. In the United States, 4.5% (1.5 million) of elderly adults live in these facilities (Institute of Medicine (US) Food Forum, 2010), reliant on their doctors, nurses, and other essential workers to carry out the needs of their everyday lives. In the event of a coastal hazard impact, the first priority of these types of facilities is to provide safety and shelter to their patients within their facilities as evacuation can amplify their pre-existing health conditions and put them at risk for "transfer trauma," (Benson, n.d.-b). The most prominent concern in the evacuation of long-term care facilities is that more residents may die from evacuation rather than remain in place (Benson, n.d.-a). The physical

process of evacuating frail elderly patients is easier said than done as there are safety and logistical concerns when relocating one frail individual let alone hundreds of frail individuals. The first step necessary to evacuate these facilities is locating another facility outside of the danger zone that can accommodate the needs of their patients (Gamble et al., 2013) in many cases the receiving facilities are located in another state (Benson, n.d.-a). It is necessary that facilities can adequately track their residents, and transfer their medical records, medications, and equipment (Gamble et al., 2013). Ill-planned and unsafe transportation like that of Hurricane Rita (Gamble et al., 2013) can result in patient fatalities. Additionally, it is not uncommon that the receiving facilities do not have the capacity to accommodate the large influx of patients (Kar, 2016), especially when individuals are dropped off without instructions for their care or even their medical records (Fernandez et al., 2002). In the absolute worst of cases, it is also not uncommon that in the event of evacuation patients in healthcare facilities are abandoned by their caretakers (Gibson & Institute, 2006).

When and if an elderly individual is successfully able to evacuate their high-risk location, more than likely, they will be directed to a state-facilitated disaster shelter. In these shelters, the specialized health and well-being needs of the elderly are rarely anticipated. Issues as small as standing for long periods of time, sleeping in cots, loud noises and confusion (Benson, n.d.-a), and even prepackaged meals (N. Aldrich & Benson, 2008) make these facilities inaccessible and detrimental to the health and wellbeing well-being of elderly individuals. Not only are the pre-existing conditions of an elderly individual neglected in disaster shelters but there is also a high possibility that an elderly individual will contract a condition that could prove to be a

detriment to their health (Lane et al., 2013). Similarly, evacuation is ineffective to the elderly because of their socioeconomic well-being.

The impact of an elderly individual's socioeconomic well-being on evacuation.

The socioeconomic status of an individual can serve as an additional explanation as to why strategies for evacuation are inaccessible to elderly populations. Despite being socioeconomically diverse, I observe that elderly residents of Atlantic and Gulf Coast communities are found to consistently (voluntarily or not) practice non-migration. The elderly's perception of risk and perception of their own capabilities during the impact of a hazardous event explain their tendency towards non-migration. When an elderly individual perceives their risk of an impending coastal hazard to be low, they are less likely to heed evacuation orders and voluntarily choose to remain in place during a hazardous event. An observed correlation between age and evacuation wherein older residents only expect to evacuate in the case of an intense storm (Arlikatti et al., 2006) meaning through misidentifying the severity of a hazardous event elderly individuals may be more inclined to stay in place regardless of evacuation orders. The way in which older individuals view their capabilities within an emergency situation contributes to a skewed risk perception wherein an individual believes that they are prepared for and/or can (Almazan et al., 2019)withstand the impacts of a hazardous event when in reality they cannot (Shaw et al., 2014). Other elderly individuals in these coastal communities believe that coastal hazards are an act of God and in that way feel that they must endure the consequences of these hazards.

Understanding the level to which elderly individuals trust their local governments to adequately make decisions in the event of a coastal hazard impact influences their resistance to evacuation orders. In a study of homebound older adults, 40% of elderly individuals only trusted the government of Philadelphia to 'do what is right' some of the time, and an additional 5% responded that they would never trust their government (Dostal, 2015). In these cases, it is more likely that upon receiving evacuation mandates, these older citizens will voluntarily choose to remain in place, putting themselves at risk of injury or death (Lane et al., 2013).

In many cases, it has been observed that elderly individuals intend to comply with evacuation mandates but lack the socioeconomic resources to do so. In these circumstances, the elderly are forced to non-voluntarily remain in place during a hazardous event, a choice which can have serious possibly fatal repercussions (Dostal, 2015). Elderly residents of rural and urban coastal communities face substantial issues with transportation needed to leave the hazardous area. Driving conditions during evacuation can be unsafe due to weather extremes such as storms, flooding, and intense winds but also because of the high volume of people on the roads. Many drivers moving one direction in a hurry can lead to traffic accidents that can potentially be fatal especially for the frail elderly (Lane et al., 2013). In rural communities, unprotected by seawalls or other infrastructure, residents are more likely to be displaced (Siders & Keenan, 2020). These communities are often seen to be predominantly low-income and minority populations that reside in remote areas, the availability and accessibility of transportation is a key deterrent to their ability to evacuate (Fletcher et al., 2021) as elderly individuals may not be able to drive and/or do not have access to a car. For elderly residents of urban communities who similarly cannot drive/ do not have access to a car they rely heavily on public transportation to

reach their destinations (Lane et al., 2013). During an emergency event access to public transport can be limited (Morrow, 2008) or overcrowded, in any case public transportation is not a reliable means for evacuation but can be the only option for elderly individuals in urban areas. The most predominant socioeconomic impediment that the elderly face to evacuation is their lack of access to evacuation education and information. Without adequate resources, information, and education, elderly individuals lack the planning necessary to successfully evacuate (Dostal, 2015) and even can be unsure of whether or not they need to evacuate (Cherniack et al., 2008). During evacuation for Hurricane Rite shortly after the impact of Hurricane Katrina, confusion about the need to evacuate caused mass chaos and unnecessary fatalities (Gamble et al., 2013). For those living in isolation or by themselves, elderly individuals are observed to have less access to information on evacuation mandates or where to go to seek shelter (Krawchenko et al., 2016) In turn, elderly individuals who lack these resources are often more reluctant to heed evacuation mandates (Shaw et al., 2014).

Reconstruction

Reconstructing infrastructure impacted by or at risk of a coastal hazard is likely the most well-known and attractive resilient adaptation strategy in coastal communities. The popularity of this strategy is not unfounded, people especially the elderly are attached to their communities and the physical environment that they call home (Colten et al., 2018). For populations that experience low social vulnerability, reconstruction strengthens the resilient capacity of the social

and economic capital of an at-risk community (Masselink & Lazarus, 2019). The elderly are a population that is subject to conditions of high social vulnerability, where reconstruction strategies fail to address the differential vulnerability that they will experience in the event of a coastal hazard.

The impact of an elderly individual's health and wellbeing well-being on reconstruction.

The health and well-being implications of coastal community reconstruction on the differential vulnerability of the elderly while limited, still pose a significant impediment to their capacity for resilient adaptation. After the destructive impact of a coastal hazard, reconstruction is a very attractive resilient adaptation strategy to many, especially the elderly who experience profound ties to the landscapes and communities in which they live and have lived for many years. While residents rush to rebuild their beloved communities, the health and well-being implications of this strategy for elderly individuals are often overlooked. The destruction and rubble caused by a hazardous event paired with reconstruction infrastructure and vehicles can make traveling difficult within affected areas (Lane et al., 2013). Consequently, infringing on the elderly's to access essential services that they require. For long-term healthcare facilities and the homebound, this means that healthcare workers, aid volunteers, and their necessary services may experience some difficulty reaching the elderly populations that require care, the remaining elderly in these areas, may not be able to access their pharmacies, doctors' offices, even grocery stores. Additionally, these obstructions can lead to the isolation of a mentally vulnerable population that relies upon their social support and relations to effectively recover from the mental detriments caused by the hazardous impact (Brown & Frahm, 2016).

Trauma and stress are very real consequences of a hazardous event for elderly individuals. Cherniack et al. found within their study of 547 elderly individuals "more than two-thirds had lived through at least five hurricanes," (Cherniack et al., 2008). The accumulation of losses over a lifetime (Benson, n.d.-a) and the constant threat of a hazardous event make the elderly more susceptible to trauma. While depression, anxiety, and other symptoms of mental distress are natural and normal for a short period of time after enduring such a traumatic event, the persistence of these symptoms can develop into severe disorders such as PTSD (Benson, n.d.-b), and have the propensity to exacerbate their preexisting cognitive impairments. It has been observed that residents of nursing homes suffer adverse mental health needs 5 months after the impact of a hurricane (Gamble et al., 2013). The physical process of reconstruction and recovery can also pose serious threats to the health and wellbeing well-being of the elderly in the affected areas. Respiratory disorders are one of the leading causes of physical impairments and limitations in the elderly population (N. Aldrich & Benson, 2008). Air pollution from infrastructure reconstruction and debris removal can exacerbate respiratory disorders. When moving back into their residences individuals are at risk for respiring indoor mold which is associated with respiratory illnesses (Gamble et al., 2013), a serious health risk to the elderly especially those with pre-existing health conditions of any kind. In reconstruction efforts the differential vulnerability of the elderly can more clearly be seen through their socioeconomic well-being.

The impact of an elderly individual's socioeconomic well-being on reconstruction.

A substantially more apparent pathway leading to the differential vulnerability impeding the elderly's ability for reconstruction is their socioeconomic status/context. Along the Atlantic and Gulf coasts, the elderly are notably a socioeconomically diverse population and individuals within every aspect of this diverse population experience differential vulnerability to varying degrees. Regardless of economic status, rebuilding residences in areas at risk of a coastal hazard places elderly individuals in harm's way. [KB4] The reconstruction and strengthening of infrastructure in coastal communities champions the engineering components of resilience at the expense of the ecological and psychological components (Masselink & Lazarus, 2019). After Superstorm Sandy, New York City implemented the *A Stronger More Resilient New York*, a plan that sought to strengthen structural mitigation and emphasized the importance of remaining a "coastal city" (Masselink & Lazarus, 2019). Similarly, insurance policies anchor people to the coastal regions by providing a false sense of security to residents (Colten et al., 2018). These resilient adaptation strategies and others like them that seek to outsmart the ecological balance of society reinforce Masselink and Lazarus' build-destroy-rebuild cycle (Masselink & Lazarus, 2019) that continuously resituate vulnerable populations such as the elderly in hazardous landscapes. Those who experience low income and economic status, within the elderly populations are observed to be more susceptible to the impacts of a coastal hazard event. On one end of the economic extreme, these hazard-prone regions are popular destinations for second homeowners and affluent retirees (Park, 2021). The economic status of this leaves this subset of the elderly populations in Atlantic and Gulf Coast communities more vulnerable to the monetary and material losses and damages associated with SLR, hurricanes, and flooding (Cutter et al.,

2000). Nevertheless, this elevated economic status provides these individuals with the tools necessary to effectively recover after incurring these losses reflective of a lower social vulnerability (Carpenter, 2015). The home value of affluent residences is observed to have a positive relationship with resilience as these homeowners have more and stronger resources to protect and rebuild their properties (Carpenter, 2015) At the opposite end of the economic spectrum, are the elderly residents of coastal communities who have fewer economic resources and capabilities with as many as 10.2% residing below the poverty rate in 2000 (Fernandez et al., 2002), and in this way are both vulnerable to coastal hazards and unsuited for reconstruction because of their economic status. For these populations, reconstructing their homes and properties is a financially arduous undertaking. After the impact of Hurricane Katrina homes with at least 50% structural damage were required to rebuild based on new building codes, including raising the elevation of homes and other strategies that were financially expensive and failed to account for those with mobility impairments such as the elderly (Carpenter, 2015). Changes in building codes and land privatization mean resilient reconstruction is widely inaccessible to the poor (Gould & Lewis, 2021). The notion that the elderly are in less need of financial assistance as they rebuild their homes stems from the assumption that they commonly live in debt-free housing. This fails to realize that as a population the elderly tend to lack insurance, have a smaller financial cushion, and have poor creditworthiness (Fernandez et al., 2002) that limit their ability to meet qualifications for financial aid. Uncovered losses (Bukvic et al., 2018), lower housing values, and lower incomes restrict these individuals from financial compensation after hurricanes, storm surges, and other flood events. Older individuals who live

alone are more likely to be exploited by fraudulent contractors and "con men" (Benson, n.d.-a) when rebuilding and repairing their homes (Gamble et al., 2013).

Managed Retreat

The final strategy for resilient coastal community adaptation that fails to account for the differential vulnerability of the elderly is the practice of managed retreat, is the "purposeful movement of people and infrastructure out of vulnerable floodplains," (Siders, 2019) in order to reduce risks associated with hazardous events. This practice as described by Gould and Lewis is a result of the interests of social systems compromising to the ecological limits of the environment that they inhabit (Gould & Lewis, 2021). Although managed retreat lacks general popularity, it is not an uncommon resilient adaptation strategy, especially as the incidence rate of coastal hazards increases with climate change.

The impact of an elderly individual's health and wellbeing well-being on managed retreat.

The concept of solastalgia poses one of the strongest impediments to managed retreat for the elderly. Solastalgia "is the distress that is produced by environmental change impacting on people while they are directly connected to their home environment," (Albrecht et al., 2007). Personal, psychological, and place are the three key dimensions embedded within this concept (Solecki & Friedman, 2021), focusing on the psychological dimension, the relationship between the cognitive and behavioral effects tied to place attachment (Solecki & Friedman, 2021).For many elderly individuals, the physical landscape they inhabit is deeply sentimental and valuable.

They have built their lives in these environments over the course of many years and even through many generations, all of their memories and experiences are rooted in the physical landscape, to these elderly individuals managed retreat means relinquishing and abandoning a critical part of their self-identities which are tied to their psychological well-being (Solecki & Friedman, 2021). This deep attachment to place can result in serious mental disorders such as PTSD, depression, and even suicide (Solecki & Friedman, 2021) when an individual incurs severe loss during a hazardous event and/ or is forcibly removed from their beloved landscapes. The elderly who have accumulated these losses over a lifetime (Benson, n.d.-a) and have established their livelihoods in these areas are more at risk to develop these disorders.

The elderly rely on their social networks and relationships in order to maintain their health and wellbeing, the process of managed retreat can separate and isolate them from these necessary supports. Amongst the frail elderly and the oldest-old, individuals require specialized and attentive care to address their physical and mental impairments and limitations. For the youngest-elderly and the aged, the support of their friends, family, and community provides them with the tools to prevent the decline of their mental health. While health and wellness have implications for the elderly's ability for managed retreat, the socioeconomic well-being of elderly individuals further contributes to their reluctance to accept managed retreat.

The impact of an elderly individual's socioeconomic well-being on managed retreat

The literature included in my review broadly discusses many socioeconomic factors that contribute to the inaccessibility of managed retreat, but they do not acknowledge the ways in which managed retreat is inaccessible specifically to the elderly members of coastal

communities. That said, these implications are widely applicable to the elderly population because of the intersectionality of this demographic. Socially, the perception of managed retreat as a resilient adaptation strategy is emphasized by the word *retreat*. As a result, this strategy is widely unpopular amongst the elderly as they associate *retreat* with failure when they want to fight to preserve and reside in the landscapes that they love. Age is observed to have a negative relationship to relocation as older adults have developed social capital in their coastal communities (Hotard, 2019). With increasing age, the likelihood of relocating diminishes, as individuals have a greater sense of place, and social establishment, and are averse to the physical burdens of relocation. After age sixty-five the likelihood of considering relocation drops to 27.43%, compared to 42.30% for individuals aged 18-24 years and 30.88% for those 45-64 years (Hotard, 2019).

In many communities, relocation seems inevitable, and members must assess their options, shifting attention to government buyout programs. Through the use of the Hazard Mitigation Grant Program (HMGP) and Community Development Block Grants-Disaster Recovery (CDBG-GR) funding, the government will buy a property back from the owner (Siders, 2019) theoretically promoting community relocation. However, buyout programs can be highly inequitable having adverse repercussions within coastal communities. Using a cost-benefit analysis governments seek to acquire properties that have incurred damages that cost to repair would exceed 50% of the original home value (Siders, 2019) suggesting that low-income housing would be more likely to be labeled as “substantially damaged”. Homeowners in these residences who are unable to pay for the required repairments to their homes are often forced into accepting buyout offers regardless of their desire to remain in place.

In turn, those who are able to pay for repairs, rebuild and the cost of housing values increase, pushing out the less affluent members of coastal communities (Gould & Lewis, 2021). This means that low-income elderly residents and elderly residents of color are often the targets of these buyout programs and are bullied into relocating. Conversely as 26.28% of individuals aged sixty-five years and older are likely to consider a buyout program (Hotard, 2019), elderly individuals who have the financial means to remain in place will be left without resources as younger populations who are willing to relocate, and take buyouts to emigrate from their communities, threatening community continuity (Colten et al., 2018). Regardless of socioeconomic status and well-being, many managed retreat strategies do not equitably undertake the needs and vulnerabilities of elderly community members.

Exploring Resilient Adaptation

The final aspect of my research explores the development of equitable coastal community-based adaptation and resilience, guided by the vulnerability of the elderly to coastal hazards. I explore a shift from the traditional approach to resilient adaptation, which has repeatedly demonstrated an inability to execute procedural and distributional equity across the Atlantic and Gulf coastlines, reflective of a neo-liberal ideology, to approaches that align with the notion of community-based adaptation, highlighting and utilizing the knowledge bases, capabilities and resources embedded within each community in these regions.

The importance of the differential vulnerability of the elderly in assessing resilient adaptation.

In acknowledging that the pathways through which differential vulnerability to coastal hazard occurs are not isolated to elderly populations, I assert that the differential vulnerability of the elderly in Atlantic and Gulf Coast communities can be understood through their health and wellbeing well-being and their socio-economic status, both of which impede an elderly individual's capacity for resilient adaptation. Within coastal communities on the Atlantic and Gulf coasts, residents regardless of age are susceptible to the same health and well-being and socioeconomic impediments that limit their capacity to access and execute resilient adaptation strategies. Through my research, I argue that not only is it necessary to understand how these pathways target the elderly, resulting in their differential vulnerability to coastal hazards, but also that these pathways are not isolated to just elderly individuals. Therefore, I argue that within Atlantic and Gulf Coast communities, every resident will at some point in their lives be adversely affected by health and well-being and socioeconomic factors that plausibly will impede their ability to anticipate, cope, endure, and respond to coastal hazard risk. In this way, every community member will at some point experience a degree of differential vulnerability to the impacts of a coastal hazard along the Atlantic and Gulf coasts of the United States. If one resilient adaptation strategy fails to account for the needs of one vulnerable population, it fails to protect the entire community equitably and effectively. At any given point in time, these strategies will fail to address one or more of any individual's differential vulnerabilities to the impact of a hazardous event. Factors contributing to an individual's vulnerability should not be viewed as a burden to their communities, that prevents their successful resilient adaptation, but instead should be acknowledged as a guide for experts to construct resilient adaptation strategies that equitably and effectively anticipate the needs of coastal communities as a whole—in doing

so, using the capital and resources that are embedded with each coastal community to maximize the benefits of resilient adaptation.

Lessons from the Elderly to ameliorate adaptation and resilience strategy.

As a society we must not only recognize the elderly as a vulnerable population but also a valuable one. Undeniably, there are many ways in which older individuals will incur differential vulnerabilities in comparison to their wider communities. But what many overlook is that the elderly possesses certain traits and capabilities that can be utilized in resilient adaptation strategies. By narrowing the lens through which we understand a community's capability to adapt to a changing environment, we minimize the number of insightful approaches that can strengthen the resilient and adaptive capacity of coastal communities. The elderly populations within these regions possess certain unique characteristics that enhance resilient adaptation. Elderly individuals have traditionally been viewed as caregivers, leaders, and educators for their communities. These roles the elderly demonstrate are traditionally reflective of the inter-generational social contract "based on the idea that each generation should take care of each other," (Wells, 2005). This reciprocal relationship understands the elderly as a population capable of providing care, guidance, and other expertise to their communities.

As we move through the course of our lives we continuously are faced with a multitude of trials and from each of these experiences we absorb the lessons that they provide to us. Even in old age, individuals retain these experiences and utilize them to navigate future trials that they will encounter. While these experiences can lead to trauma (Heid et al., 2016), a skewed perception of risk to coastal hazards, and/or a stubborn sense of independence (Shaw et al., 2014) which can

heighten their vulnerability, these life experiences also have given the elderly tools for adaptation that younger generations do not possess. Maturation theory suggests that the elderly are quicker to psychological resilience (Brown & Frahm, 2016) and when provided with adequate information are more likely to evacuate when necessary (Cherniack et al., 2008)in comparison to their younger counterparts. The elderly are also more likely to turn to their religious faith in the wake of a disaster, giving them strength and direction as they face a life-threatening event (Almazan et al., 2019). Their emphasis on their faith and their connection to a higher power gives them confidence and has been observed to be an essential component of recovery and consolation after a traumatic experience (Almazan et al., 2019). Religion and faith are [KB5] not intrinsically necessary to ameliorate the capacity for resilient adaptation but it does provide a profound connection to something larger than oneself that can be beneficial to coping with loss and other coastal hazard impacts.

Additionally, elderly individuals tend to be deeply embedded within the social fabric of their communities, having formed a large web of connections through friends, family, faith, and careers for many years. It has been widely observed that individuals with ties to communities and neighbors positively impact their health and well-being as well as their capacity for economic resilience (Shih et al., 2018). The role of faith and religion is vital to many elderly individuals regardless of denomination. The role of churches in a resilience study in coastal communities in Maryland off the coast of the Chesapeake Bay highlights that churches provide a safe space for members of the congregation to be introduced to new concepts, especially surrounding impending climate risks. Churches also provide members with social connections within the congregation and loosely to other churches and religious organizations (Miller Hesed et al.,

2020). In this way, churches can be a link between members of the congregation and community leadership giving the disenfranchised a voice in decision-making processes.

Community-Based Adaptation

In order to successfully integrate the capabilities of elderly populations into resilient adaptation in Atlantic and gulf coast communities, it is necessary to shift the approach through which resilient adaptation strategies are conceived. As they stand, resilient adaptation strategies such as evacuation, reconstruction, and managed retreat, are constructed through a "top-down" approach. This neo-liberal paradigm emphasizes "government-level decision-making based on long-term regional climate change modeling and impact projections, and adaptation strategies identified through technocratic cost–benefit analyses," (Butler et al., 2015). The impending challenges that will be brought about by climate change alongside the complexity and diversity of Atlantic and Gulf Coast communities necessitate that resilient strategies are developed through a community-based approach to adaptation, aiming to" include vulnerable people in the design and implementation of adaptation measures... offers useful lessons for a broader transformation to socially inclusive forms of climate change policy, and towards seeing resilience to climate change as lying within socio-economic organization rather than in infrastructure and technology alone," (Forsyth, 2017). This approach has its limitations but has been seen to succeed to ameliorate the resilient adaptation capacity of the elderly in many contexts. In developing countries, the intergenerational social contract is easily employed through a bottom-up/ community based approach to resilient adaptation because the notion of intergenerational support is built off of a common sense of kinship instead of state-enforced

measures (Wells, 2005). Resilient adaptation strategies that build off of this relationship understand the interconnectedness of societies and promote the engagement of the community in their execution, instead of isolating roles of care within communities. The practice of *Ibasho*-meaning one's place (D. P. Aldrich & Kyota, 2017)-originates from Japan recognizing the role of place in the perception of the elderly and providing a space where elders take charge and people of any age come together to build social relationships (Kiyota et al., 2015). In a society that is experiencing a rapidly aging population, *Ibasho* strengthens the social fabric of communities and enhances a common sense of belonging, as elderly individuals are given a voice and purpose within the community (D. P. Aldrich & Kyota, 2017). In turn, these communities are more apt to anticipate, cope with, and overcome collective traumas. When resilient adaptation strategies at any scale prioritize procedural equity to lessen the vulnerability of marginalized populations such as the elderly, communities are treated holistically and better prepared to bounce back and move forward from the impact of a hazardous event.

Limitations

In conducting this review, I have found two limitations within my research. The first limitation that I encountered was access to publications surrounding the topic of elderly vulnerability to coastal hazards. While my review consists of 86 total sources, the amount of research and discussion focusing solely on elderly vulnerability is limited, having recently gained observation in recent decades. Additional access limitations arose in the publications

themselves. The University of Colorado Boulder Libraries were able to provide me with online access to many of my sources, there were many publications that I felt would strengthen my research that was not accessible through the CU Library database. Accessing these publications through other means was not pragmatically accessible within the time constraints of my study. Subsequently, I felt that a deeper foundation would have further developed my study. The most prominent limitation is a result of using only secondary sources to conduct my research. In the future to address this discrepancy and to test my thesis, would require me to perform a multi-cite study, where I would specifically collect primary data and converse with elderly community members in order to fully comprehend their experience of differential vulnerability. Focusing still on the U.S. Atlantic and Gulf Coasts, I would target communities in Florida, Maryland, North Carolina, and New York. The demographics and socio-economic systems within these states would allow for the intersectional understanding of elderly vulnerability that can further be applied to other regions and other hazards.

Conclusions

As climate change continues to exacerbate the impacts of coastal hazards on communities along the Atlantic and Gulf coasts of the U.S., it is important to understand how the differential vulnerability of the elderly impedes their capacity for resilient adaptation. The assessment of evacuation, reconstruction, and managed retreat strategies provides evidence of how the inequitable and ineffective planning and implementation of resilient strategies limit the resilience

capacity of coastal communities as a whole. My research acknowledges the role of intersectionality in differentiating the experience of each individual while maintaining that the health and wellbeing and socioeconomic well-being of the elderly are the pathways to which their differential vulnerability to coastal hazard impacts can be attributed. I identify how evacuation, reconstruction, and managed retreat respectively fail to address the differential vulnerability of elderly coastal community members effectively and equitably, and as a result, fail to serve these coastal communities equitably and effectively. Demographically, the elderly is a diverse population, including every race and ethnicity, gender, income, etc. By understanding how resilient adaptation strategies such as evacuation, reconstruction, and managed retreat fails to address the differential vulnerability of these individuals, it is apparent how they do not improve the wider resilient capacity of coastal communities. In coastal regions, the implementation of resilient adaptation strategies that directly concentrate on the differential vulnerability of the elderly will accordingly target community inequalities that hinder other marginalized populations from effectively engaging in resilient adaptation. Further research exploring the Social Vulnerability Index (SoVI) and the Baseline Resilience Indicators for Communities (BRIC) can deepen the understanding of vulnerability and resilience indicators within marginalized populations of coastal communities and in turn, can ameliorate the construction of community-based adaptation strategies that link that community social capital with expert knowledge and resources. Building the foundation for resilient adaptation that recognizes coastal populations as heterogeneous, with equitable inclusion in resilient adaptation planning and execution procedures.

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