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NAILA HASAN

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BY THE COMMITTEE CONSISTING OF

Dr. Suchismita Bhattacharjee, Chair

Dr. Yeji Yi

Dr. Shimul Shakil

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Abstract

Living in a home designed with all the necessary elements for elderly people with disabilities can enhance their independence, safety, security, self-motivation, communication, and socialization. Consequently, this contributes to their psychological well-being. As populations age worldwide, the prevalence of disabilities among the elderly is increasing, this poses significant challenges to their living condition. This thesis explored the current challenges for ease of maneuvering and implications of Universal Design (UD) in their own home to address the psychological well-being of elders with disabilities. Literature has established that an individual's lifestyle and preferences are influenced by their domestic environment and there are different sets of guidelines. Despite the standards in place, people have different needs and conveniences for maneuvering and/or accessibility based on their usability, body structure, and types of disability. The study aimed to identify the most usable spaces within the home and variable differences due to demographics- age, gender, culture, location, and climate. Moreover, the discussion section suggested key elements of UD to enhance the living quality among the target community.

The data collection method included an online survey and snowball sampling, from 51 participants' responses, either older individuals with disabilities living in their own homes or their caregivers. Among them, 29 were eliminated due to incomplete responses and 22 were retained for further analysis. Through a mixed-method research design, the study collected data regarding accessibility challenges, psychological effects, and the reasons behind the challenges in different spaces within a home environment. Additionally, the thesis delved into the practical implications of UD in housing infrastructure, emphasizing the importance of collaboration efforts among

policymakers, architects, urban planners, and healthcare professionals to effectively integrate UD principles into the built environment.

The result section identified the most used spaces, the level of challenges, and the effects on psychological well-being due to the challenges. Additionally, the study elaborated on the correlation between ease of maneuvering and psychological well-being, reasons for challenges during maneuvering, and variation in accessibility responses based on different demographics.

Finally, this research aims to contribute to the burgeoning field of gerontology and disability studies by elucidating the nexus between UD and psychological well-being. By implementing custom solutions at homes, it is possible to make significant strides in reducing the cost of care homes and assisted living facilities. Thesisocating for inclusive design practices, this thesis seeks to enhance the quality of life and promote independence, dignity, and empowerment for this vulnerable demographic, thus fostering a more equitable, and age-friendly society.

Terms and Definitions

Accessibility- It is the quality of a space or element of being easy to use, approach, reach, and enter.

Activities of Daily Living- refer to a set of fundamental tasks that individuals typically perform daily to take care of themselves and maintain their well-being. The activities of daily living are classified into Basic Activities of Daily Living (BADL) and Instrumental Activities of Daily Living (IADL). Basic Activities of Daily Living are those skills required to manage one's basic physical needs, including personal hygiene or grooming, dressing, toileting, transferring or ambulating, and eating (NIH). The Instrumental Activities of Daily Living include more complex activities related to the ability to live independently in the community. This would include activities such as managing finances and medications, food preparation, housekeeping, and laundry (NIH). Difficulty or inability to perform BADL and IADL tasks independently can indicate challenges with physical health, cognitive functioning, or both, and may require support or assistance from caregivers or healthcare professionals.

Age-related disabilities- It refers to a condition or impairment that limits an individual's ability to perform daily activities or participate fully in society due to the natural aging process. Examples of age-related disabilities that are considered in the study include mobility limitations, knee issues, grabbing issues, and difficulties with self-care tasks. These disabilities can impact a person's independence, quality of life, and social interactions, requiring support, accommodations, or assistive technologies to help manage daily challenges effectively.

Aging-in-place- This is a concept to create houses and homes that adapt to an elderly population, segments of society who are or will begin to endure the aging process (Lawlor & Thomas, 2008).

Architectural barrier– Barriers or elements within the constructed environment that hinder individuals with disabilities from fully accessing the goods and services offered. These are also referred to as environmental obstacles.

Barrier-free- It refers to environments, facilities, products, or services that are designed and structured to be easily accessible and usable by all individuals, including those with disabilities or limited mobility. The barrier-free design promotes inclusivity, independence, and equal opportunities for individuals of all abilities, ensuring they can navigate and engage with their surroundings comfortably and safely.

Disability – A condition, either physical or mental, that significantly restricts one or more important daily activities, a documented history of such a condition, or being perceived as having such a condition.

Ease of maneuvering- Maneuvers may be defined as a series of changes in direction and position for a specified purpose (as in changing course, switching tracks, or docking). Maneuvers are typically complex, combining more than one translational and rotational component. They are usually driven by hydrodynamic forces, which may be classified as trimming (steering), driven by the kinetic energy of a moving animal, or powered forces, driven by force generation by the control surfaces themselves.

Entrance – An entrance refers to any designated point of access to a building, section of a building, or facility that is used for entry. This includes the path leading to the entrance, the vertical access leading to the entrance platform, the entrance platform itself, any vestibule that may be present, the entry door or gate, as well as the hardware associated with the entry door or gate.

Most used space- The space that is used more frequently compared to others.

Pathways to turn around- This typically refers to physical spaces or areas designed to allow vehicles or individuals to reverse direction safely. This could include turning circles, U-turn spaces, or other designated areas where a vehicle or person can maneuver to change direction.

Psychological well-being- Psychological well-being encompasses experiencing positive emotions such as healthy self-esteem or the lack of negative emotions like symptoms associated with depression or anxiety. Psychological well-being is characterized by an individual's ability to achieve their full potential, effectively manage typical life stressors, maintain productive and meaningful work, and make valuable contributions to their community (Botchwey et al., 2022). Psychological well-being consists of 6 dimensions: autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance (Ryff & Singer, 2006).

Renovation – An alteration to a building or facility refers to any modification that impacts or has the potential to impact the functionality of the building or facility, or any part of it. Examples of alterations include but are not limited to remodeling, renovation, rehabilitation, reconstruction, historic restoration, resurfacing of paths or roads, changes to structural components, and adjustments to the layout of walls and partitions. Routine maintenance, roof replacements, painting, wallpapering, and modifications to mechanical or electrical systems are not considered alterations unless they have an impact on the usability of the building or facility.

Turning Radius- This refers to the minimum space required for a vehicle or object to make a complete turn without hitting any obstacles or going off course. This measurement is important in designing spaces that are universally accessible, accommodating wheelchairs, walkers, or other mobility aids while ensuring ease of maneuvering.

Universal design – Universal design can be defined as the design of products and environments to be usable to the greatest extent possible by people of all ages and abilities. Universal design respects human diversity and promotes the inclusion of all people in all life activities (Mace, 1998).

Universal Design (UD) Elements – Universal design elements are critical throughout the design, making it possible for any user to reach every space comfortably and conveniently. The universal design facilitates access, equity, and ease of maneuvering for all users, especially people using wheelchairs or mobility devices, the elderly, people with children and strollers, and people carrying groceries or packages. The literature review section elaborated on UD, elements, principals, and goals (2.6). No steps (ramp), no door threshold, grab bar, wide doorway, level-type door handle, and height no more than 48" etc., are some examples of UD elements that assist all users, enhancing safety and accessibility.

Usability- This means the quality of space or element to use, in another way, how easy the space or element to use or access. Usability refers to the extent to which an environment or a product can be used effectively, efficiently, and satisfactorily by its intended users to achieve their goals.

Visitability- This is an accessible standard for residential construction that states that virtually all new homes must offer features that not only make aging in place easier for residents but also make it possible for any guest with a mobility impairment to visit the residence. This "inclusive movement" encourages social integration for people with disabilities rather than isolating them in their residences (Lawlor & Thomas, 2008).

Chapter 1: Introduction

"The intent of universal design is to simplify life for everyone by making products, communications, and the built environment more usable by as many people as possible at little or no extra cost. Universal design benefits people of all ages and abilities"- Ron Mace, Center for Universal Design at North Carolina State University.

1.1 Background and Problem Statement

As the number of people older than 60 years of age is increasing, the issue of the living quality and psychological well-being of senior citizens becomes increasingly important (Evans et al., 2002). The focus is on healthy individuals living independently in their communities. A better understanding of psychosocial processes will help provide effective housing quality, while mental health will also enable more effective housing policies for senior citizens. Universal design features are likely to enhance feelings of well-being and safety among elders, benefiting all citizens. Universal Design will permit more elders to age in place (Mustaquim, 2015). Positive characteristics of housing quality may also be associated with mental health. Interior design elements incorporating natural and sustainable energy sources, such as well-lit wall spaces and built-in display areas, can foster personalization and evoke memories of significant and enjoyable life events and activities (Evans et al., 2002). A future necessity is the greater development and use of universal and accessible design in all aspects of the built environment.

In the United States, the number of people aged 65 and over has reached an all-time high of 52 million (Mather et al., 2019). As per the Population Reference Bureau in 2019, the number of Americans aged 65 or older is expected to nearly double, from 52 million to 95 million by the year 2060 (Mullins, 2019b). Along with the increased population of adults who are 65 and older,

there is ever-increasing ethnic and cultural diversity within that population (Mather et al., 2019). But regardless of the cultural norms, almost 73% of adults say they would prefer to live in their own homes for as long as possible (Khalfani-Cox, 2017).

As per WHO (World Health Organization), health is a state of complete physical, mental, and social well-being. Well-being is a multi-dimensional, interactive, and all-encompassing condition. Well-being integrates both mental and physical wellness equally, relying on constructed and natural surroundings that prompt us to engage with elements of life that satisfy our human needs, stimulate our senses, and foster our creativity (Kopec, 2017).

Psychological well-being is a state of mind that can be described as the presence of positive feelings (e.g., good self-esteem) or the absence of negative feelings (e.g., symptoms of depression or anxiety). It expresses the positive attitude of the individual toward his life and reflects the individual's feelings about his past, present, or future (Yeniaras & Akarsu, 2017). It is usually difficult to achieve higher levels of life satisfaction with increasing age and psychological problems (Gholizadeh & Shirani, 2010). As per a study for psychological well-being, it is found that "high scorer → has goals in life and a sense of directedness; feels there is meaning to present and past life; hold beliefs that give life purpose; has aims and objectives for living (Friedman et al., 2007)

As per Janine Meesters "home as a place that provides security and a place where people can be together with family and friends. It can also be a material structure reflecting personal status, identity, and owner's ideas" (Meesters, 2006). The term residence/ residential is also used to describe housing which is used for legal purposes (Mitton & Nystuen, 2021). Residence can be defined as living space for human beings. Residential universal design features are as follows-

- No stairs (at the entry or within the home)

- Wide doorway to allow for wheelchairs and general ease of movement

- Wide hallways for wheelchairs and general ease of movement

- Extra floor space, especially in areas such as bathrooms and kitchens and around closets and utility areas, allowing for wheelchair use as well as extra space for movement.

- Counters can be made so that they are adjustable to adapt for user (including wheelchair). Adaptable cabinets can be designed with front and bases that can be removed to create a clear area underneath (Mitton & Nystuen, 2021).

As the population ages, Universal Design is gaining in popularity in residential home construction to allow occupants to age in place or who become disabled (Steinfeld & Maisel, 2012). Because of the ease of mobility and accessibility, it allows elderly people to stay in their homes for a longer period, thus minimizing the transition into care homes. Aging in place improves the physical and mental wellness of an increasingly growing population (National Institute on Aging, 2023). One barrier to the adoption of Universal Design in middle- and low-income countries is the perception that it is often perceived as idealistic, expensive, or an imposition of Western values (Steinfeld & Maisel, 2012). Design strategies may differ according to different countries, weather, culture, and lifestyle. It is important to address cultural context with social, economic, and physical context in universal design.

Universal Design is a set of recommendations that certify that the specific design will work for all kinds of users, despite their physical or mental abilities. A design is considered “universal” when people with differing physical, sensory, mental, or intellectual abilities can use a product without any additional adaptation or modification. By considering the needs and abilities of all users throughout the design process, it’s possible to create something that will genuinely meet the needs of people who wish to use it. It will enhance the quality of life because of the maximum

usability will lead to satisfaction and well-being. As per IDEA center, Buffalo, “experience with accessibility laws led by Ron Mace, Ruth Hall Lusher, and others to recognize the need for a different approach to the design of the built environment, which they termed “universal design.” A multidisciplinary group of experts wrote ‘The Principles of Universal Design’ in 1997 to clarify the scope of universal design, as it was perceived in the mid-1990s, and to provide guidance in both design and evaluation activities (Connell et al., 1997). These principles were developed by a team of U.S. experts organized by the Center on Universal Design at NC State University in the 1990s (WBDG Accessible Committee, 2024).

ADA, The Americans with Disabilities Act, is a civil rights law introduced in 1990. This law protects the discrimination against persons with disabilities in various aspects of life. The goal is to make sure that every person gets the same rights and opportunities despite any type of disability. ADA focuses mainly on public spaces- institutions, community and gathering spaces, parks, and recreational spaces that have public access.

Aging-in-place is an approach to address the challenges of older adults in their own homes. As per the Older American Act (OAA) of 1965 the rights for suitable housing and independence in managing life pursuits were addressed, along with issues including adequate income and access to healthcare. Living independently in a familiar environment allows aging adults freedom, increased comfort, and safety, and can impact their financial situation (Kopec, 2017). As per a study conducted by HUD “the cost of living in an assisted care facility is three times more than non-institutional or at-home care, and for over 94% of seniors the cost is paid for out of pocket.”

1.2 Purpose of Study

The purpose of the study was to investigate the impact of challenges faced by elderly individuals with disabilities while maneuvering their home environments on their psychological

well-being. Moreover, the most used spaces in a home environment, reasons for facing challenges, and data differences due to different demographics were analyzed. Additionally, the study included the psychological effects of UD elements on the elderly with disabilities.

The research aimed to understand the key elements of Universal Design within the home for elderly people with disabilities and the reasons for their psychological well-being. People want to live in their homes where they used to live for many years. It is an emotion to live there even after they are old and alone. To understand the variables of impacts on aging in place, the study aimed to collect data from different ages, genders, cultures, locations, and climatic conditions.

1.3 Research question

The research questions addressed in this study were as follows:

1. What are the most used spaces within a home environment?
2. What is the level of challenges experienced when maneuvering through the spaces in a home environment?
3. How do these challenges impact psychological well-being?
4. What are the reasons underlying the current challenges encountered when maneuvering through the spaces in a home environment?
5. Do participants' responses regarding the most used spaces vary based on age, gender, culture, location, and climate?

Hypothesis: Implementation of universal design elements will enhance the usability, safety, security, and interactivity of spaces within the home environment. Consequently, this enhancement will contribute positively to the psychological well-being of elderly people with disabilities residing in their own homes.

1.4 Research Goal

The goal of the study was to identify the most used spaces, current challenges while maneuvering, and reasons behind the challenges with the suggestion of universal design elements, which have a positive impact on the psychological well-being of senior citizens with special accessibility needs in their homes. The result was based on the data collected from people of different demographic conditions.

1.5 Research Strategy

By conducting a comprehensive investigation encompassing different demographic factors such as age, gender, culture, location, and climate, this research aimed to shed light on the diverse needs and experiences of elderly individuals with disabilities. Through a mixed-method research approach comprising a literature review, online surveys, and data analysis, this study endeavors to provide valuable insights into the role of universal design elements in promoting the psychological well-being of elderly population with disabilities living within their homes. An online survey tool was adopted to collect data. The research strategy is elaborated in Figure 1-1.

1. Literature Review: Conducted a comprehensive literature review to identify factors impacting the psychological well-being of elderly individuals with disabilities in residential settings, including safety, security, stress relief, and social interaction.
2. Online Survey: Administered a self-completed questionnaire via online platforms to collect data from elderly individuals with disabilities or their caregivers. Gathered information on most used spaces, challenges faced while maneuvering, as well as the associated psychological effects. Additionally, the study identified the reasons behind these challenges.
3. Data Analysis: Analyzed the collected data to compare challenges and psychological effects across different age groups, genders, cultures, locations, and climates. Determine variations

in participants' responses regarding the most used spaces and reasons for challenges based on demographic factors.

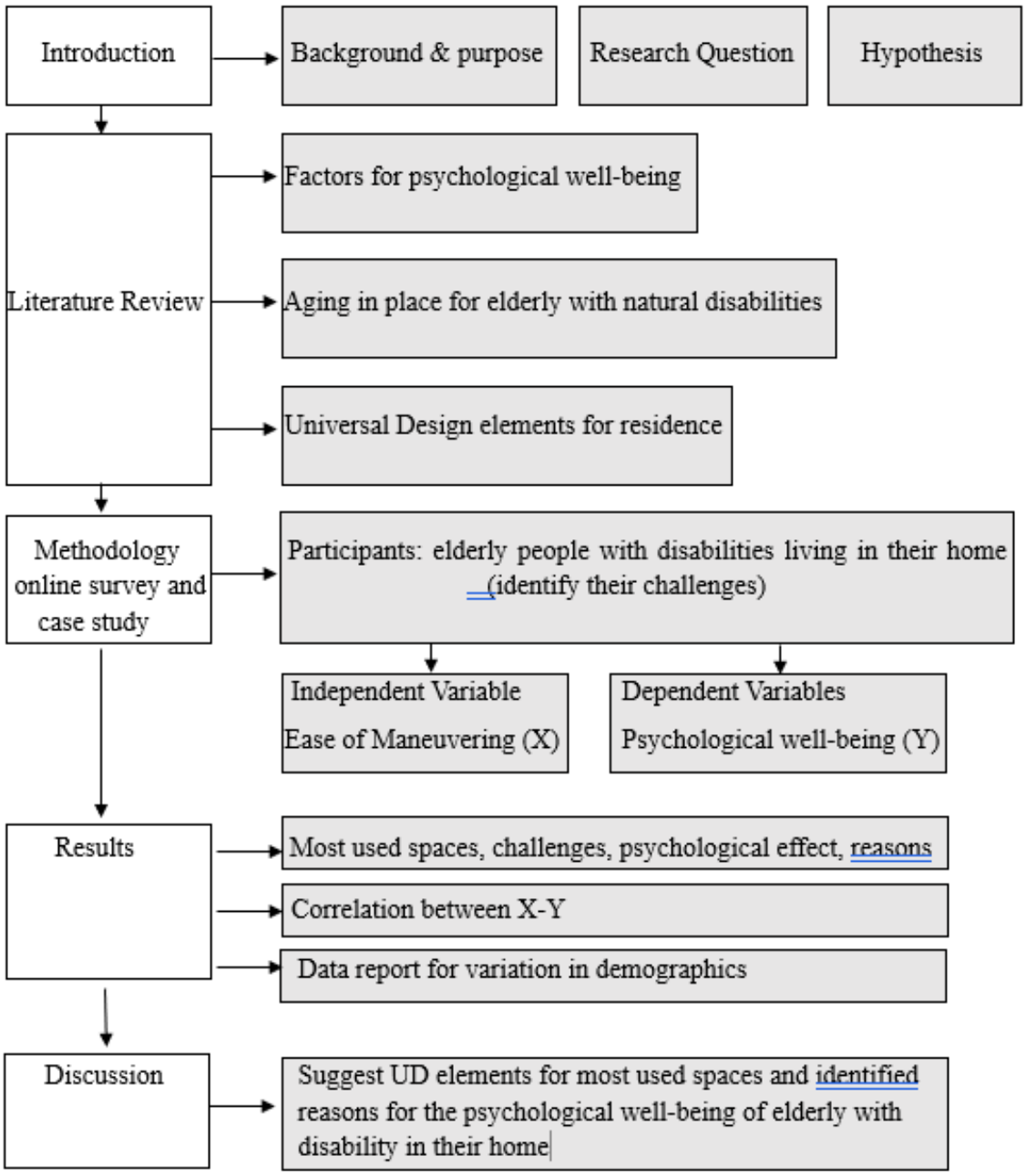


Figure 1-1 Research Strategy Chart- Source: (Yi, 2017)

1.6 Research Methodology

The study was based on a mixed-method research design combining both quantitative and qualitative techniques to comprehensively explore the research questions. The quantitative aspect involved the use of structured online surveys to collect numerical data on participants' demographics, accessibility challenges, psychological impacts, and perceptions of universal design elements. The qualitative component involved the collection of non-numerical data through open-ended questions, and responses on UD elements through the images allowing participants to express their experiences, opinions, and insights in their own words and perceptions. This qualitative data offered rich, detailed information that provided context, depth, and nuance to the quantitative findings. By integrating both qualitative and quantitative data, this mixed-method approach facilitated triangulation, whereby findings from different sources were compared to corroborate the results, enhancing the overall credibility and trustworthiness of the study.

An online survey of self-completion questionnaires was conducted with standardized language for easy understanding. The data was collected from people of different elderly ages, genders, cultures, locations, and climatic conditions within a month. Based on the collected data the current challenges and reasons behind the challenges were collected. Through reporting a result will be determined whether the age, gender, culture, location, and climate had any impact on psychological well-being.

1.6.1 Study Design

An online survey was conducted through social media platforms and contacting local institutions. A flyer was distributed in both media which had a QR code. The data was collected from different demographics to get a variety of feedback according to different older age groups, genders, cultures, locations, and climatic conditions. The survey aimed to collect data on the

current challenges of elderly people with disabilities living in their own homes and the reasons for their challenges. In the data, ease of maneuvering was determined as the independent variable, and psychological well-being was the dependent variable.

1.6.2 Participants

The participants were divided into different older age groups, genders, cultures, locations, and climatic conditions. The survey was conducted over a one-and-a-half month. Participants categories include (Table 4.2: Demographic Distribution) -

Figure 4.1: Age group- A: 45-54, B: 55-64, C: 65-74, D: 75-84, E: 85+

Figure 4.2: Gender- Male, Female

Figure 4.3: Culture- Race and Ethnicity

Figure 4.4: Location- Based on country/ state of living

Figure 4.5: Climate- Based on weather condition

1.6.3 Instrument

To gather data, an online survey was employed, prioritizing user and caregiver privacy and allowing flexibility in expressing challenges and needs. The survey aimed to understand participants' perceptions of accessibility within their indoor environments, focusing on identifying current challenges within most used spaces to meet the reasons behind the challenges. Nine specific areas within the home were examined, including the main entrance, kitchen, bathroom/toilet, bedroom, access routes, living/dining, backyard, patio, and other spaces. Participants rated accessibility by selecting between 5 difficulty level choices and indicated psychological impact on a Likert scale from 1 to 10. Reasons for challenges were selected from options like the entrance door, space to turn around, floor level differences etc. The survey

comprised four sections covering participant demographics, space-specific information, universal design, and accessibility experiences.

1.6.4 Procedure

The study obtained approval from the University of Oklahoma Institutional Review Board (IRB) and utilized the online survey for data collection. Recruitment flyers containing QR codes linked to the survey were distributed via social media and at local hospitals and wellness centers. The resulting data, collected between February 1st and March 15th, 2024, was analyzed to determine the relationship between ease of maneuvering and psychological well-being. Confidentiality measures were implemented, assigning unique identification numbers to participants. Reliability and validity were ensured through statistical analysis and a literature review to establish the relationship between ease of maneuvering and psychological well-being, focusing on universal design elements.

1.6.5 Data Analysis Plan

The data analysis process involved examining demographic information and accessibility ratings obtained from the online survey. Firstly, demographic characteristics such as age, gender, race, residency, and climatic conditions were analyzed to understand the respondent profile. Secondly, the most used spaces within homes were identified based on participant rankings, along with associated challenges while maneuvering within these spaces. Thirdly, correlations between ease of maneuvering and psychological well-being were explored, using statistical analyses to determine significant relationships. Finally, variations in accessibility responses based on demographic factors were examined to identify patterns and trends. Overall, the data analysis process provided valuable insights into the relationship between demographic variables, accessibility challenges, and psychological well-being in home environments.

1.7 Significance of the Study

The study first shed light on the accessibility challenges faced by elderly with disabilities within their home environments and provided valuable insights into areas where improvements were needed. By identifying the most usable spaces and reasons for maneuvering challenges, the study informed target interventions to enhance accessibility and improve the quality of life for these populations. The study further highlighted the importance of considering demographic factors such as age, gender, race, residency, and climate when addressing accessibility needs. Understanding how these factors influenced accessibility challenges helped to develop more inclusive and tailored solutions that account for diverse needs and preferences. Overall, the findings of the study contributed to the growing body of knowledge on accessibility and its impact on individuals' lives, providing valuable insights to designers, caregivers, and other stakeholders involved in creating accessible environments and supporting the needs of people with disabilities and elderly individuals. Furthermore, by addressing accessibility challenges within home environments, the study offers the potential to reduce the reliance on expensive senior care homes and independent living facilities. By enabling more individuals to age in place comfortably and safely, there is an opportunity to mitigate the financial burden associated with institutional care.

1.8 Research Limitations and Future Study Scope

The study group of people was very sensitive and vulnerable because of their age and disabilities. The survey result might be affected by the characteristics of the respondents (e.g., their memory, knowledge, experience, motivation, and personality). Online surveys normally have some disadvantages, such as low response rate, misunderstanding of survey questions, and/or not treating it seriously, which may affect the result. Because of the time limitation, the study might not be conducted in-person case studies and observations in different cities and countries to get a

variation of information. The following chart describes the advantages and disadvantages of online surveys.

Table 1-1 Limitations of online survey (Robson, 2002)

Aspect of Survey	Advantages/ disadvantages
Resource factors	
Cost	Low
Length of data collection period	Long
Distribution of sample	May be wide
Questionnaire issues	
Length of questionnaire	Short
Complexity of Questionnaire	Must be simple
Use of open-ended questions	Poor
Use of visual aids	Good
Use of personal/ family record	Very good
Sensitive topics	Good
Data-quality issues	
Sampling frame bias	Usually low
Response rate	Difficult to get high
Response bias	Medium
Control of response situation	Low

The study encountered several limitations related to the online survey method. Firstly, online surveys typically require more time to gather feedback, and researchers have less control over the survey environment, potentially affecting data quality. Due to these constraints, the study was unable to collect a large volume of data within the allotted timeframe. Additionally, the survey was conducted during February, a period when elderly individuals' participation was hindered by cold weather and associated health issues, further limiting the study's reach. Furthermore, the

sample demographics lacked diversity, which restricts the generalizability of the findings. Future research endeavors should aim to involve more time throughout the year and include a larger and more diverse sample to enhance the applicability of conclusions.

Moreover, the online survey format lacked the capacity for clarification of questions and prompts, potentially leading to misunderstandings or incomplete data. Future studies could benefit from incorporating objective measures or qualitative methods to enhance the depth of understanding when assessing psychological well-being. Additionally, external factors such as socioeconomic status, access to healthcare, and caregiver support, while acknowledged, were not extensively explored in this study. These factors are known to influence psychological well-being and should be considered in future research endeavors to provide a more comprehensive understanding of the subject matter.

The findings offer insights into the implications of universal design; however, caution is advised against generalizing beyond the study's specific context. The conclusion underscores the need for future research to delve into design components and standards tailored to different demographics.

To advance understanding, future research avenues are proposed:

- More time to be allocated in the survey to gather qualitative and quantitative data from diverse demographics, collected at different times and weather conditions of the year.
- Track changes in psychological well-being among elderly individuals with disabilities over time, focusing on the impact of universal design interventions.
- Compare various types of universal design interventions to pinpoint the most effective strategies for improving psychological well-being.

- Explore the subjective experiences and perceptions of elderly individuals with disabilities regarding universal design's impact on their well-being through in-depth qualitative methods.
- Design a prototype to implement and evaluate specific universal design interventions in real-world settings to gauge their practical effectiveness in enhancing psychological well-being.

By addressing these limitations and outlining future study scopes, the thesis aims to guide further research in enhancing the psychological well-being of the elderly population with disabilities through the lens of universal design.

1.9 Conclusion

This study addressed a pressing issue of enhancing the living quality and psychological well-being of elderly with disabilities, within their home environments. With the global population of individuals aged 65 and older projected to nearly double by 2060, the significance of understanding and addressing the challenges faced by this demographic group became increasingly apparent. The study identified a significant relationship between ease of maneuvering and psychological well-being in different spaces. Through addressing specific accessibility challenges and their impact on psychological well-being, the study offered valuable insights for designers, caregivers, and other stakeholders involved in creating accessible environments. While the study offers valuable insights, limitations such as the vulnerability of the study group, potential biases in online survey responses, and the lack of in-person case studies might affect the robustness and depth of the findings.

The following chapters offer a comprehensive exploration of the literature review findings, followed by a detailed description of the study's methodology, results, and subsequent discussion and conclusion.

Chapter 2: Literature Review

2.1 Introduction

One of the most pressing issues facing the USA today is the increasing prevalence of age-related disabilities (Mustaquim, 2015)**.** The aging population has wide-ranging implications for society, including the challenges related to pensions, healthcare, and the provision of essential services. As of August 2019, assisted living and long-term care facilities serve as alternative housing options for elderly Americans, with an average monthly cost of approximately $4,000 (Mullins, 2019a).

The literature review is structured into six sections, each designed to accomplish the target objective of the study:

- Effects of Aging- This section provides an overview of the aging process is discussed.
- Factors of Psychological Well-Being- In this section, the impact of aging on psychological well-being is examined.
- Background- This section provides a historical perspective on accessibility and mobility-related policies and standards adopted in the USA.
- Codes and Laws- This section reviews current design standards, codes, and laws governing the housing sector.
- Universal Design- The section explores the goals and implications of universal design and its impact on accessibility.
- Conclusion- Finally, this section highlights gaps in previous research and provides a summary of the literature reviewed.

2.2 Effects of Aging

Older individuals are likely to experience a loss of their dignity, privacy, independence, and autonomy due to dislocation from their familiar environments resulting from limited options (Shaw, 2011). Elderly populations are often displaced from their localities, possessions, friends, or family when transitions occur(Shaw, 2011). Depending on the individual's financial resources and care needs, they may choose one of the following options: living in the same home with community-based aged care services (an aging-in-place approach), moving to a small group home within the same community or disability service (an in-place progression approach), or relocating to nursing facilities that provide long-term care (Bigby, 2004).

The autonomy of individuals with disabilities hinges greatly on their home environments, where they engage in daily activities essential to their lives (Yi, 2017). Sufficient in-home services and policies have been established to enable individuals to remain in their original living environment for as long as possible. For example, in-home services encompass not only caregiving tasks such as medication management and assistance with daily activities but also extend to non-care related services such as organizing recreational activities and managing household tasks (Yi, 2017).

Table 2-1 Major daily activities of elderly adults, divided into two groups BADL (Basic Activities of Daily Living) and IADL (Instrumental Activities of Daily Living)
Source: (Carr et al., 2013)

Activities of daily living	Examples of universal design
BADL	
Bathing	Make provisions during construction to reinforce walls in the shower area to facilitate future installation of grab bars [50]
	Bathtub/shower controls positioned to allow for operation outside the fixture [20]
	Lever handle faucets [20]
	No threshold walk-in shower [20]
Physical ambulation	No threshold, zero step entrances [50]
	Wider doorways and corridors [50]
	Open floor plan [20]
	Straight staircases with consistent risers and treads and a stopping place (landing) midway between levels [51]
Toileting	Make provisions during construction to reinforce bathroom walls to facilitate future installation of grab bars by the toilet [50]
	Installation of a downstairs bathroom [50]
	Adjustable toilet and sink for easy access, with a short reaching distance to paper dispenser and grab bars [20]
IADL	
Food preparation	Kitchen counter tops at varying levels to accommodate standing and seated users, and people of varying heights [52]
	Kitchen cabinets that accommodate limited reach ranges and allow various ways for approach and manipulation [53]
	Color contrasts, large-print readouts, audible and tactile feedback of controls [53]
	Close access to ovens with counter space directly next to the oven [53]
Shopping	Lowering or making height adjustable electronic devices used in typical purchasing transaction (i.e., credit card reader/swipe; [54])
	Larger print on signs indicating aisle numbers and locations of goods, and on packaging of items [55]
	Larger aisle ways [55]
	Automatic powered doors at entrances and exits [56]
Transportation	Complement higher-order roads (i.e., interstates) with lower-speed, two lane through-routes [57]
	Connect local street networks within communities to create short drives and walking distances [57]

The general perception of aging often revolves around the decline in dexterity or mobility, both of which significantly impact an individual's physical independence within the built environment (Lawlor & Thomas, 2008). A progressive decline in cognitive abilities, such as concentration and memory loss, may lead to feelings of isolation and detachment from family, friends, and other social networks.

2.3 Factors of Psychological Well-Being

The aging process and human psychology over a lifetime are complex and multifaceted issues (Lawlor & Thomas, 2008). One in every ten people in their fifties has serious impairments in mobility, a number that increases to one in every two for people in their eighties(Mustaquim, 2015). Life satisfaction has recently been introduced as the best indicator of quality of life (Papi & Cheraghi, 2021). It expresses the individual's positive attitude towards their life and reflects their feelings about his past, present or future. Achieving higher levels of life satisfaction becomes increasingly difficult with age and psychological problems (Kang et al., 2022).

Figure 2-1 Factors of psychological well-being (Ryff & Singer, 2006)

Many of the predictive factors for the elderly are psychological, such as anxiety, depression, and loneliness which play influential roles in their quality of life and are likely to change (Mustaquim, 2015). However, other factors such as the level of physical activity, social

interaction, and social support also affect elderly satisfaction (Lawlor & Thomas, 2008). Carol Ryff's model of Psychological Well-Being provides a powerful framework for analyzing and organizing one's life (Ryff & Singer, 2006).

Table 2-2 Definitions of Factor of Psychological Well-Being, Source: (Ryff & Singer, 2008)

Autonomy	
High scorer	Is self-determining and independent; able to resist social pressures to think and act in certain ways; regulates behavior from within; evaluates self by personal standards
Low scorer	Is concerned about the expectations and evaluations of others; relies on judgments of others to make important decisions; conforms to social pressures to think and act in certain ways
Environmental mastery	
High scorer	Has a sense of mastery and competence in managing the environment; controls complex array of external activities; makes effective use of surrounding opportunities; able to choose or create contexts suitable to personal needs and values
Low scorer	Has difficulty managing everyday affairs; feels unable to change or improve surrounding context; is unaware of surrounding opportunities; lacks sense of control over external world
Positive relations with others	
High scorer	Has warm, satisfying, trusting relationships with others; is concerned about the welfare of others; capable of strong empathy, affection, and intimacy; understands give and take of human relationships
Low scorer	Has few close, trusting relationships with others; finds it difficult to be warm, open, concerned about others; is isolated and frustrated in interpersonal relationships; not willing to make compromises to sustain important ties with others
Purpose in life	
High scorer	Has goals in life and a sense of directedness; feels there is meaning to present and past life; holds beliefs that give life purpose; has aims and objectives for living
Low scorer	Lacks a sense of meaning in life; has few goals or aims, lacks sense of direction; does not see purpose in past life; has no outlooks or beliefs that give life meaning
Self-acceptance	
High scorer	Possesses a positive attitude toward the self; acknowledges and accepts multiple aspects of self including good and bad qualities; feels positive about past life
Low scorer	Feels dissatisfied with self; is disappointed with what has occurred in past life; is troubled about certain personal qualities; wishes to be different than what he or she is

Beyond health factors, other influences can impact the social and psychological well-being of older people-

1. The inability to drive or travel by public transportation due to diminishing eyesight, hearing, or mobility can limit access to routine healthcare and medication (Lawlor & Thomas, 2008)
2. Lack of affordable health insurance to cover unexpected medical issues can disrupt the ability to pay for home healthcare and assistance. (Lawlor & Thomas, 2008)

2.4 Background

The barrier-free movement emerged in the 1950s, sparking a transformation in public policies and design approaches. It originated from the calls of disabled veterans and disability advocates, who advocated for opportunities in education and employment rather than reliance on institutionalized healthcare and support. The movement highlighted the acknowledgment of physical barriers in the environment as major obstacles for individuals with mobility impairments (Mace, 1998).

The “Capitol Crawl” protest for disability rights (Figure 2-2) on March 12, 1990, was a critical event leading to the passage of the ADA. After months of inaction by Congress, more than 1,000 protesters gathered that day to urge Congress to approve the law. They left behind wheelchairs, power chairs, and crutches to crawl up the steps of the U.S. Capitol Building in Washington D.C.

Figure 2-2 Capital Crawl (Olin, 1990)

Viewed through a civil rights lens, the Americans with Disabilities Act (ADA) is considered a straightforward embodiment of justice, particularly when contrasted with a regrettable past marked by blatant exclusion and segregation of individuals with disabilities (Mayerson, 1992).

The design and construction of buildings, and homes with accessibility features have indeed evolved into a global concern. In the late 1990s, Great Britain faced a shortage of homes adaptable and accessible to its growing population with disabilities. In 1999, the British Parliament passed an amendment called Section M to British residential regulations, establishing a comprehensive building code addressing residential accessibility (Lawlor & Thomas, 2008). Norway, Australia, South Africa, and Canada have regulations supporting the implementation and concept of inclusive accessible design throughout the country for public buildings and, in certain areas for private spaces. In Japan, government census reports over the last decade indicated what other countries had discovered: that its elderly population was also growing in numbers as an overall percentage of the population. Laws and regulations such as the 'Heartful Building Law' were created to mandate universal design and accessibility, requiring the removal of barriers around buildings and within the workplace to address the needs of the aging and accessibility segments (Lawlor & Thomas, 2008).

2.5 Codes and Laws

Home modifications aimed at enhancing safety and security for occupants and users can be implemented without being bound by specific codes or regulations. Examples include installation of grab bars or changing passage door hardware from knobs to levers. Various organizations are dedicated to establishing codes and laws for residential homes.

2.5.1 International Code Council (ICC)

Formed in 1994 as a non-profit organization, the ICC aims to provide code enforcement officials, architects, interior designers, engineers, and constructors with a consistent set of requirements. Before the advent of international codes, the most widely used residential code was the 'One- and Two-Family Dwelling Code'. However, it is now a part of the model codes published

by the ICC and is used for single-family homes and two-family structures such as duplexes and townhomes. The International Residential Code (IRC) includes codes for building structures, electrical, plumbing, and mechanical systems (Lawlor & Thomas, 2008)

2.5.2 National Fire Protection Association (NFPA)

Established in 1896 for similar reasons as the ICC, the NFPA publishes the Life Safety Code (LSC). Unlike building code, the LSC sets minimum requirements for fire safety by focusing on protection and evacuating individuals during fire emergency (Lawlor & Thomas, 2008).

Design professionals must adhere to state, county, and local building codes throughout the design and construction phases, whether they are crafting an accessible interior for immediate client requirements or conceptualizing a residence capable of adapting to occupants' changing abilities. Federal codes, regulations, rules, standards, and guidelines related to accessibility typically do not apply to single-family residences unless incorporated by local governments into their own set of codes. (Lawlor & Thomas, 2008). However, multiple national standards address accessibility issues in public buildings, environments, and spaces within the USA.

2.5.3 American National Standards Institute (ANSI)

ANSI publishes the ANSI Standard Section #A117.1 guidelines, regulating the design of accessible building elements and spaces. First published in 1986, these guidelines serve as a voluntary consensus standard often adopted into law by local or state jurisdictions. The U.S. Department of Housing and Urban Development (HUD) included these guidelines in its ‘Fair Housing Accessibility Guidelines (FHAG)’, which was published in 1991, defining the standards for multifamily housing of four or more units (Lawlor & Thomas, 2008).

2.5.4 The Fair Housing Act (FHA) and FHA Accessibility Guidelines (FHAG)

The FHA, established in 1968 and amended in 1988, defines regulations for the sale, rental, and financing, as well as the physical design, of newly constructed multifamily housing. It ensures equal housing opportunity for all individuals, regardless of race, color, sex, religion, family status, national origin, or disability, whether the housing is privately or publicly funded. The FHA outlines seven design requirements for accessible housing that includes-

- Passage into and through the dwelling
- Easy-to-reach switches, thermostats, and electrical outlets
- Accommodating design of kitchens and bathrooms
- Accessible entrance doors
- Accessible routes to the building and to its entrance
- Walls reinforced for installation of grab bars
- Barrier-free access to public and common areas (Lawlor & Thomas, 2008)

2.5.5 Visitability- a Design Idea for an Inclusive Environment

Some parts of the USA have enacted laws addressing 'visitability', an accessible standard for residential construction. The standard requires virtually all new homes to offer features facilitating aging in place for residents and accommodating guests with mobility impairments. Visitability encourages social integration for people with disabilities, promoting accessibility beyond their own residences. Minimum design features include flat, one level walkway up to a no-step entrance, doorways with a 32" minimum clear width, and a main-floor bathroom that can ideally accommodate a wheelchair. Additional features may include lever-style door handles, wall reinforcements for future grab bar installations, and HVAC climate controls within reach that are no more than 48" above the finished floor (Lawlor & Thomas, 2008).

2.5.6 LEED

LEED encourages the design of spaces that "empower a diverse population by improving human performance, health and wellness, and social participation". Inclusive design prioritizes the experience and participation of building users by considering the full range of ability, age, gender, language, cultural understanding, and other characteristics of human diversity in the context of place. Inclusive design and the green building movement are closely related due to their shared core value of sustainability (U.S.Green Building Council, 2024).

2.5.7 Americans with Disabilities Act (ADA)

Enacted in 1990, the ADA is a law protecting the civil rights of individuals regardless of their abilities. It ensures equal access to and from commercial buildings and places of accommodation. Generally, residential buildings are excluded from the ADA with few exceptions (Lawlor & Thomas, 2008).

All paths of travel between residential units and other buildings within the project must comply with accessible design provisions, such as those outlined in the FHAA and Rehabilitation Act, as applicable. For projects with common-use or recreational facilities, accessible design provisions of the FHAA and the Rehabilitation Act apply to residential areas, while those of the American Disabilities Act (ADA) apply to non-residential areas (U.S.Green Building Council, 2024).

The universal design concepts have benefits for people with a range of abilities, from those with disabilities to baby boomers who have yet to experience any challenges with access or mobility related to age (Lawlor & Thomas, 2008). Advocates for universal design have promoted changes in design standards since the 1970s. Accessible environments provide comfort and safety for residents and may lead to savings in healthcare costs (Lawlor & Thomas, 2008).

Table 2-3 Accessibility, Universal design, Usability, Visitability (Mitton & Nystuen, 2021)

Term	Definition	Comment
Accessibility	The extent to which design specifically considers the needs of people with disabilities. Accessibility sometimes refers to characteristic of products, services, and facilities that can be independently used by people with a variety of disabilities.	Accessible and universal design both address the needs of users beyond those considered "average" or "typical." Accessibility can describe spaces that are accessible for a specific user's needs.
Universal design	The design of all products and environments to be as usable as possible by as many people as possible regardless of age, ability, or situation.	Accessible and universal design both address the needs of users beyond those considered "average" or "typical." However, universal design is a broader term meant to benefit users of all ages and abilities.
Adaptable Design	Adaptable dwelling units have accessible features that may be concealed or design elements that can easily be adapted to become accessible.	The term may also be used to describe buildings that are easily adaptable over a long life cycle.
Visitability	The extent to which new homes are designed so that they can be visited or accessed by people with physical disabilities.	Visitable homes incorporate concepts of universal design. Also known as basic home access or inclusive home design.
Usability	The extent to which products are easy and efficient to use.	While concerned with creating efficiency and ease of use, usability testing may not consider accessibility or the universal design of products because it may be focused on one specific type of user.

2.6 Universal Design

Over the last 40 years, there has been a growing need to make the built environment more accessible. Studies have shown that accessibility laws, such as the Architectural Barriers Act (1968), Section 504 of the Rehabilitation Act of 1973, the Fair Housing Act Amendments (1988), and the Americans with Disabilities Act (1990) establish minimum standards to prevent discrimination against individuals with disabilities in the built environment.

In the early stages, proponents of barrier-free design and architectural accessibility recognized the legal, economic, and social significance of an approach that addressed the shared needs of both disabled and non-disabled individuals. However, architects encountered challenges in implementing standards, as segregated accessible features were often seen as special, costlier, and aesthetically unappealing. Moreover, it became evident that many environmental adjustments necessary for accommodating people with disabilities offered benefits to everyone. This realization

led to the understanding that such features could be integrated universally, making them more affordable, visually appealing, and even marketable, thereby laying the groundwork for the universal design movement (Mace, 1998).

The Disability Act 2005 defines Universal Design, or UD, as:

1. The design and composition of an environment so that it may be accessed, understood and used
   i. To the greatest possible extent
   ii. In the most independent and natural manner possible
   iii. In the widest possible range of situations
   iv. Without the need for adaptation, modification, assistive devices or specialized solutions, by any persons of any age or size or having any particular physical, sensory, mental health or intellectual ability or disability.
2. Means, in relation to electronic systems, any electronics-based process of creating products, services or systems so that they may be used by any person.

Source: (Center for Excellence in Universal Design, 2024)

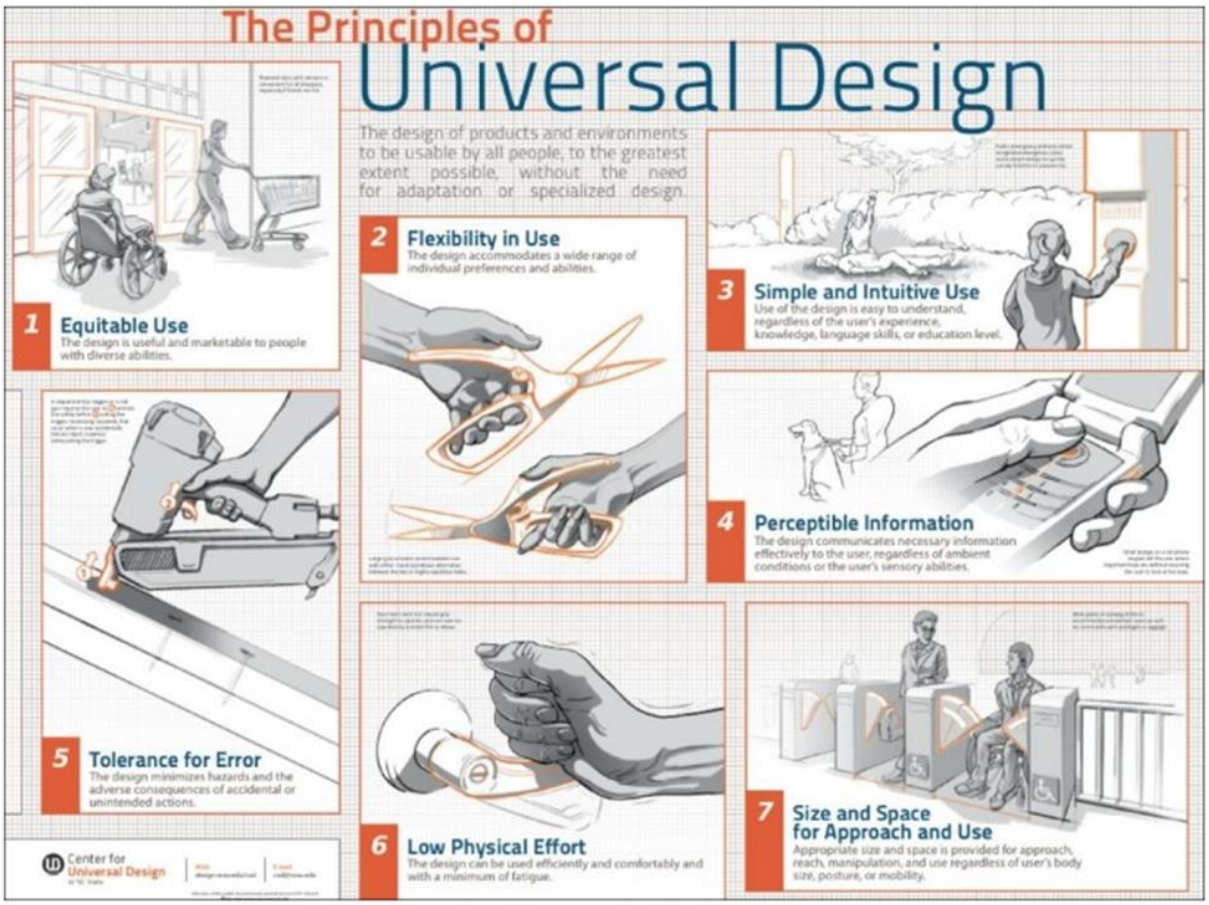
The principles of Universal Design are:

1. Equitable use
2. Flexibility in use
3. Simple and intuitive use
4. Perceptible information
5. Tolerance for error

6. Low physical effort

7. Size and space for approach and use

Source: (Center for Excellence in Universal Design, 2024)



The principles of universal design: equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, size and space for approach and use. From the **Interaction Design Foundation**.

Figure 2-3 Practical implications of principles of universal design (Zheng, 2021)

Following are the eight goals of universal design-

1. Body fit- Accommodating a wide range of body sizes and abilities
2. Comfort- Keeping demands within desirable limits of body function
3. Awareness- Ensuring that critical information for use is easily perceived
4. Understanding- Making methods of operation and use intuitive, clear, and unambiguous
5. Wellness- Contributing to health promotion, avoidance of disease, and prevention of injury
6. Social integration- Treating all groups with dignity and respect
7. Personalization- Incorporating opportunities for choice and the expression of individual preferences
8. Cultural appropriateness- Respecting and reinforcing cultural values and the social, economic, and environmental context of any design project.

Source: (Steinfeld & Maisel, 2012)

"There are several shared goals and design strategies among health and Universal Design initiatives. These shared goals, such as the improvement of ergonomics, sleep, safety, physical and mental health, among others, not only serve to create healthier environments but also can contribute to better spaces for people with disabilities. Moreover, the inclusion of health strategies in design can assist individuals currently living with disabilities by mitigating chronic symptoms or preventing certain disabilities or injuries from occurring. Major depression is one of the most common mood disorders, affecting 16 million adults in the U.S. certain aspects of the built environment can greatly improve mental health, such as beauty in design including art, music, and colors; options for social connectedness; and spaces that celebrate culture and spirit" (WBDG Accessible Committee, 2024)

Table 2-4 Principles of Universal Design (Carr et al., 2013)

Universal design principle	Description	Example
(1) Equitable use	Useful and marketable to people with diverse abilities	Doors that automatically open
(2) Flexibility of use	Accommodates a wide range of individual preferences and abilities	Automated teller machines' buttons far enough apart to be pressed accurately
(3) Simple and intuitive use	Easy to understand, regardless of user's experience, knowledge, language skills, or current concentration level	Providing furniture assembly instructions in a series of clear illustrations instead of text
(4) Perceptible information	Communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities	Computer software that relays information visually through text and pictures, and audibly through speakers
(5) Tolerance for error	Minimizes hazards and the adverse consequences of accidental or unintended actions	Hallways that return to common areas rather than stop in dead ends
(6) Low physical effort	Can be used efficiently and comfortably with a minimum of fatigue	Bottle caps that are easy to grip and require only a small range of motion to open
(7) Size/space for approach/use	Appropriate size and space is provided for approach, reach, manipulation, and use regardless of the user's body size, posture, or mobility	Wall mounted components (i.e., toilet paper) that are visible, easy to reach, and easy for all hand sizes to use

The practice of universal design holds promise for the future of physiological anthropology. However, many elderly individuals currently face exclusion from leading normal lives due to inadequate accessibility. Several factors contribute to this issue, but one crucial concern often overlooked is the improper application of the term "universal design" in enhancing the daily lives of individuals with various disabilities.

Thoughtful application of a design strategy based on specific situational needs can result in highly supportive and often long-term living environments. Intentionally accessible design is a prosthetic, specialized design that compensates for deficiencies in everyday design through a reduction or elimination of usability barriers for individuals with limitations in specific types of abilities (Kopec, 2017).

2.7 Conclusion

This chapter provided an overview of the literature on the effects of aging, factors for psychological well-being, background, codes and laws, and universal design features for the elderly with disability living in their own home. The lifestyle of people with disabilities and their

preferences are significantly impacted by home environments (Schwarz et al., 2004). However, the implication of universal design elements in residences has been limited due to a lack of consciousness, resources, and strategies. Another inhibitor to the success of these efforts is the variety of preferred domestic environmental settings for residents with a variety of types and levels of disabilities. Thus, there is a need to consider the key elements of universal design to support different types of disabilities in housing for elderly people.

The study focused on different spaces in houses, i.e., entry, lobby, corridor, living room, dining room, bedroom, kitchen, and bathroom, and identified the most important universal design elements that are needed for the specific function to facilitate independent living in their own home. The study attempted to collect data on the different needs of universal design elements based on different elder ages, gender, culture, location, and climate.

In terms of the recommended domestic environment, practical evidence is needed. However, using only a literature review has the limitation of providing practical advice for specific regions or countries, instead of a general range of information. Thus, there is a need for additional studies that provide practical evidence. This study provides an evidence-based study by conducting a survey that asks about the current living environment and challenges they face in everyday life. A comparative analysis will be based on different elderly ages, genders, cultures, locations, and climates to identify the different needs, implications, and use of UD elements by the elderly with disabilities in their own home. Finally, a correlation between ease of maneuvering and the psychological well-being of the study population will be drawn to show the importance of design elements in the built environment.

Architecture and interior design have diverse effects on individuals, encompassing both cognitive processing, such as the evaluation of perceived information, and emotional responses,

such as adaptive reactions, for example- the absence of greenery in indoor environments has been linked to stress, which in turn can negatively impact life expectancy (Zamani et al., 2022). Considering that emotions significantly contribute to decision-making, perception, learning, and overall well-being, it is crucial to acknowledge the impact of architectural spaces on human emotions.

Chapter 3: Research Methodology

This chapter outlines the research methodology and the action sequence undertaken in this study. Employing a mixed methods approach, the study utilized the data analysis tool pack. The methodology involved collecting both qualitative and quantitative data through an online survey targeting elderly individuals with age-related disability or caregivers of such individuals. Following the data collection, an analysis was performed to explore the research questions.

3.1 Research Procedure

This study aims to explore the following-

• the most utilized spaces within a home environment

• identify current challenges

• psychological effects due to current challenges

• reasons behind these challenges

The study hypothesized that UD elements may significantly impact positive behavioral outcomes for individuals with disabilities. To prove the hypothesis the study will analyze-

• the correlation between two variables- Universal Design Elements for Ease of Manuevering (X) and psychological well-being (Y) of elderly individuals with disabilities. The variables are discussed in detail in the following section.

Independent variable (X) ---------- Universal Design elements for Ease of Maneuvering

Dependent variable (Y) --------- Psychological well-being

• the differences in the mean value of psychological impact between the current condition and environment while using UD elements.

• Moreover, the study investigated if there is any impact of age, gender, culture, location, and weather on the use of spaces.

The literature review section has revealed a notable and positive impact on feelings of safety, security, social interaction, and thus the overall psychological well-being of the elderly. This research method allowed for achieving the results in the following chapter and suggesting the UD elements that can be applied to real-world housing design.

3.2 Variables:

In the study, one independent variable and one dependent variable are considered: the independent variable includes universal design elements (X), and the dependent variable is psychological well-being (Y).

3.2.1 Independent variable: universal design elements (X)

Through a literature review of the universal design guidelines, a series of independent variables are found. Based on the findings, the survey incorporated the UD elements in each space and asked questions regarding the current challenges and psychological impact. There were 9 spaces and 39 elements that were relevant for accessing/ maneuvering (Table 3-1). Each variable is evaluated by responses based on the following questions:

- What is the accessibility level while maneuvering the spaces
- What design factors affect their experienced accessibility

Table 3-1 Independent Variables: Design Standards Relevant to Living Environment

Space	Variables	Descriptions
Main Entrance	Ramp/ Stair	Presence, width, slope, handrail
	Space before entrance and pathways	Dimension, swing direction, width, space to turn around
	Accessible entrance	Door and doorway width, maneuvering clearance, door threshold, hardware height, door weight
	Seating/ Furniture	Seater presence, height, countertop presence

Kitchen	Accessible entrance	Door and doorway width, maneuvering clearance, door threshold, door hardware height, door weight
	Pathways and space to turn around	Pathway width, space to turn around
	Layout/ overall arrangement	Kitchen size, turn around between counter spaces, counter-top height, width to reach till end, counter-top underneath space, fixture arrangement
	Fixture/ Equipment	Sink, burner, oven, microwave
	Electric points	Number, position/ height, operation type
Bathroom	Accessible entrance	Door and doorway width, maneuvering clearance, door threshold, door hardware height, door weight
	Pathways and space to turn around	Pathway width, space to turn around
	Wheelchair-accessible bathroom stall	Clear floor space, toilet location to side wall, toilet seat height, grab bar location/ height
	Wheelchair-accessible handwashing station	Sink height, clear floor space, reach to faucet
	Shower space	Floor level difference, maneuvering clearance, seater presence/ height, shower knob type, grab bar
	Electrical point	Number, position, operating type
Bedroom	Accessible entrance	Door and doorway width, maneuvering clearance, door threshold, door hardware height, door weight
	Pathways and space to turn around	Pathway width, space to turn around
	Layout/ overall arrangement	Kitchen size, turn around between counter spaces, counter-top height, width to reach till end, counter-top underneath space, fixture arrangement
	Electrical point	Number, position, operating type
Access Routes	Accessible entrance	Door and doorway width, maneuvering clearance, door threshold, door hardware height, door weight

Access Routes (hallway, corridor, etc.)	Pathways and space to turn around	Pathway width, space to turn around
	Layout/ overall arrangement	Kitchen size, turn around between counter spaces, counter-top height, width to reach till end, counter-top underneath space, fixture arrangement
	Electrical point	Number, position, operating type
Living/ Dining	Accessible entrance	Door and doorway width, maneuvering clearance, door threshold, door hardware height, door weight
	Pathways and space to turn around	Pathway width, space to turn around
	Layout/ overall arrangement	Kitchen size, turn around between counter spaces, counter-top height, width to reach till end, counter-top underneath space, fixture arrangement
	Electrical point	Number, position, operating type
Patio	Accessible entrance	No description
	Pathways and space to turn around	
	Layout/ overall arrangement	
	Electrical point	
Backyard	Accessible entrance	
	Pathways and space to turn around	
	Layout/ overall arrangement	
	Electrical point	
Other	Accessible entrance	
	Pathways and space to turn around	
	Layout/ overall arrangement	
	Electrical point	

3.2.2 Dependent variable: psychological well-being (Y)

Psychological and social contexts influence psychosocial ability, including the capacity to accurately perceive emotional states and relate them to social environments (Dixson et al., 2016). Key components encompass communication skills, interpersonal relationships, and maintaining confidence and autonomy (Yi, 2017). The literature review identified factors affecting psychological well-being, including autonomy, acceptance, positive relationships, environmental mastery, and life purpose (Ryff & Singer, 2006). Recently, life satisfaction has emerged as a significant indicator of overall quality of life (Papi & Cheraghi, 2021), reflecting an individual's positive outlook on their life and their feelings regarding past, present, or future circumstances. Achieving higher levels of life satisfaction can pose challenges with age and psychological issues (Kang et al., 2022).

Through the online survey, the study collects feedback from participants on two main aspects.

• The difficulties they currently experience in their home environments, which are rated on a scale from 'extremely easy' to 'extremely difficult.'

• The psychological effects stemming from these challenges, assessed using a Likert scale ranging from 'satisfied' to 'dissatisfied'

3.3 Participants

3.3.1 Sampling procedures

The study recruited individuals with age-related disabilities living in either single-family or multi-family residences both with and without their caregivers. The participant poll was intentionally diverse, encompassing variations in age, gender, culture, location, and climate. Participants may have had experience using a mobility device themselves or assisting other elderly

individuals they care for. Some participants were mobility device users, while others were not. Individuals assisting mobility device users are referred to as caregivers/assistants in this study. Accessibility challenges examined in this study included mobility issues, falls, foot and/or knee problems, difficulties walking, grip issues, and others. In total, the study included 51 participants: 43 users and 8 caregivers.

3.3.2 Sample size

The sample size for this survey was determined through careful consideration of the aim of the study, population demographics, and available resources. Aiming for a representative sample, efforts were made to recruit a diverse group of participants, including both elderly individuals with accessibility issues and their caregivers. The recruitment strategies employed, such as the dissemination of recruitment flyers on social media platforms and the distribution of printed materials to local healthcare and wellness facilities, aimed to reach a wide audience within the target demographic. Ultimately 51 individuals participated in the survey, with a total of 22 completed responses providing valuable insights into their demographics, experiences, and perceptions regarding accessibility within home environments.

3.4 Online Survey

3.4.1 Introduction

For data collection, an online survey was utilized in this study. This method was chosen to prioritize the privacy of both users and their caregivers, offering them the flexibility to express their challenges and needs. The primary focus of the survey was to gather insights into the participants' perceptions of accessibility within the indoor environments of their homes. It aimed to identify current challenges, highlight critical spaces, and pinpoint key design elements that users and caregivers found problematic, thus impeding, or restricting their access to the interior spaces.

The survey delineated nine specific areas within a home environment where users and caregivers might encounter accessibility issues. The spaces are as follows:

- Main Entrance
- Kitchen
- Bathroom/ Toilet
- Bedroom
- Access routes (hallway, corridor, etc.)
- Living/ Dining
- Backyard
- Patio
- Other

The survey inquired how participants perceived the accessibility of each area when maneuvering individually or assisting them as caregivers.

- Accessibility ratings are based on the scale that introduced 5 different options for participants to choose from: extremely easy, somewhat easy, neutral, somewhat difficult, and extremely difficult.
- The psychological impact was measured with a Likert scale which includes 3 options to choose from 1 to 10, where 1 is being dissatisfied and 10 is satisfied.
- The reasons for these challenges while maneuvering/ accessing the spaces were selection-based answers between choices- entrance door, space to turn around, floor level difference, front/ side reach, finish material, grab bar, height of fixture/ furniture, and others.

The online survey consisted of 4 sections:

- Participant demographics and background information
- Section 1: Space-specific information
- Section 2: Universal Design related information
- Section 4: Accessibility experience-related information

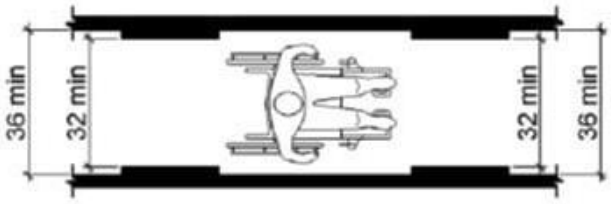
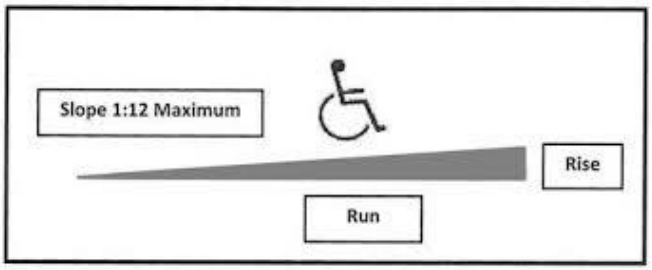
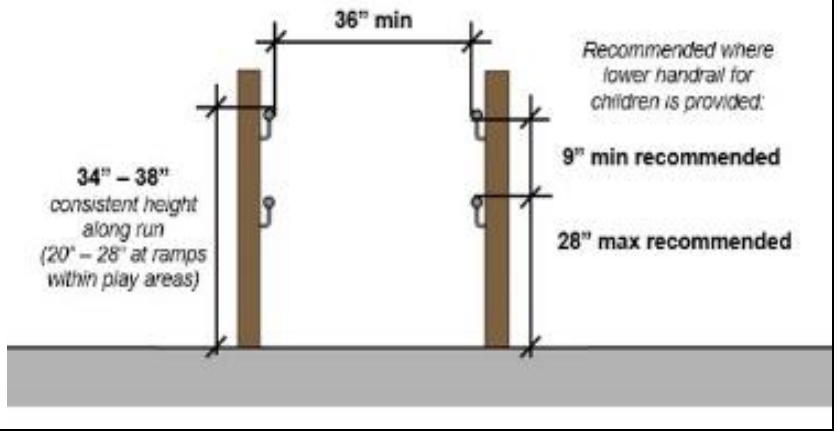
All sections of the online survey were instrumental in capturing the perceptions of both users and their caregivers. The data from the survey was analyzed to determine the psychological impact experienced by the study population due to their perception of environmental barriers within their living spaces. Chapter 4 provides the detailed results and analysis of the study.

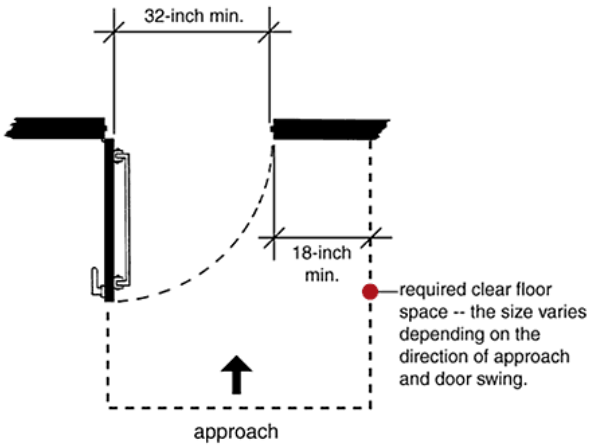
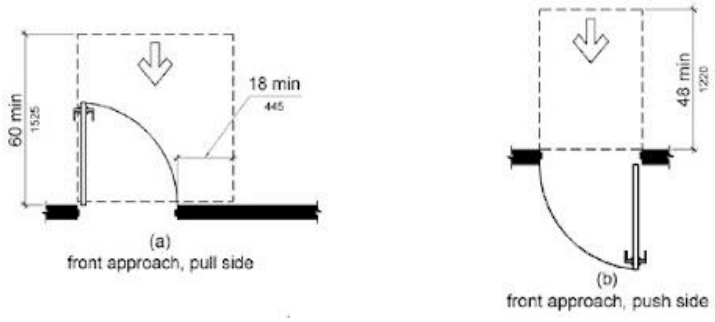
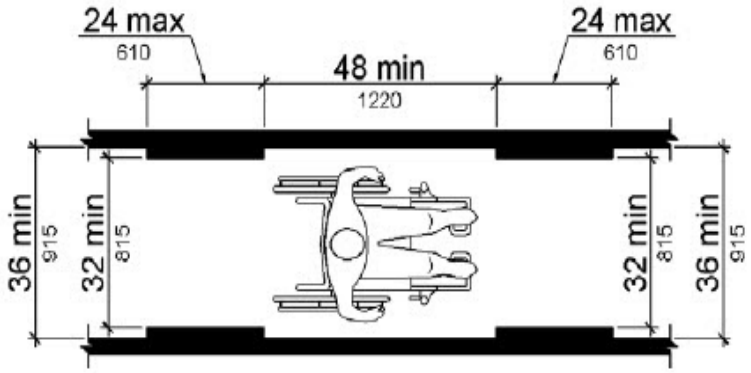
3.4.2 Method of Contact

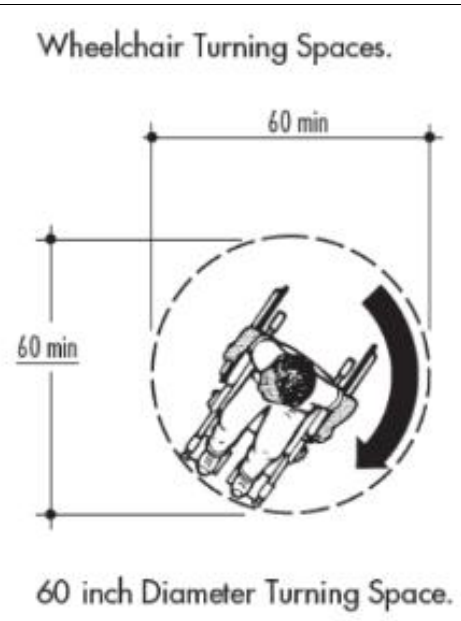
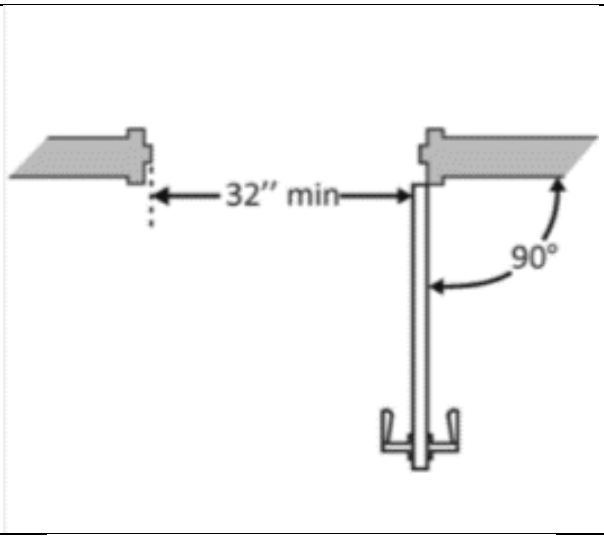
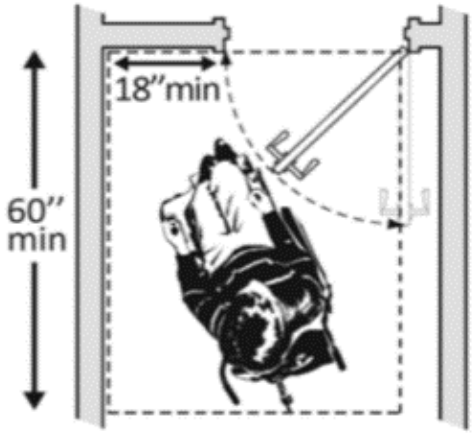
The University of Oklahoma Institutional Review Board (IRB) conducted a thorough review and granted permission for this study. Upon receiving approval, a recruitment flyer containing a QR code linked to the online survey was circulated through various social media platforms. Additionally, printed copies of the flyer were distributed to nearby hospitals and wellness centers frequently visited by individuals within the targeted demographic. The flyer provided detailed information on the purpose of the study, timeline, potential benefits and risks, confidentiality measures, and instructions for completing the survey. Participants were asked to review and approve this information before proceeding with the survey. Caregivers were specifically instructed to provide ratings on behalf of the elderly individuals with accessibility issues under their care.

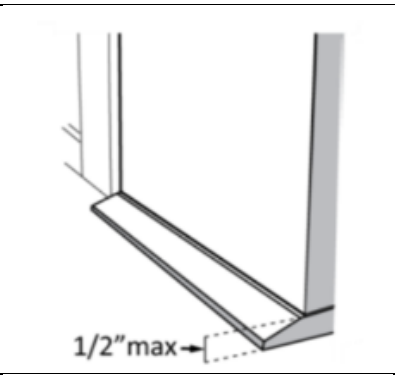
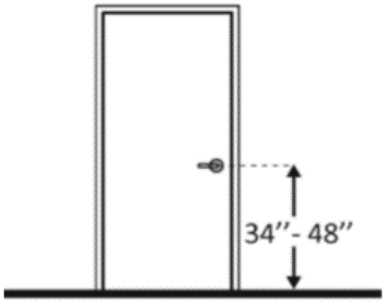
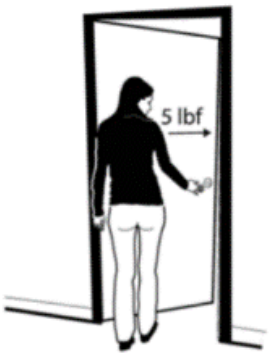
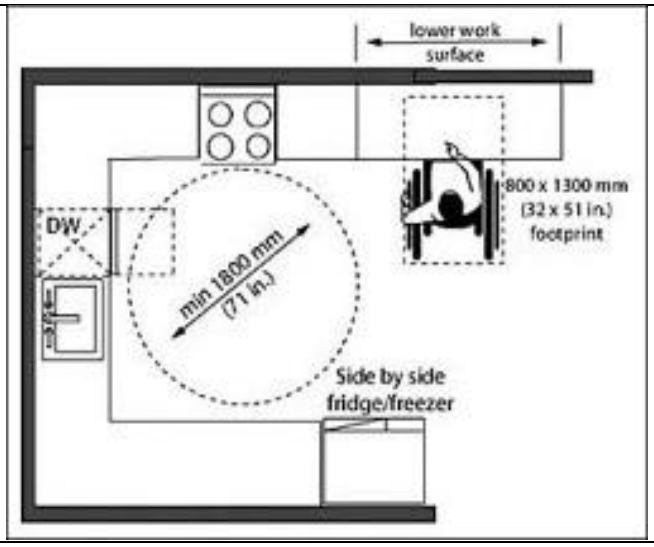
The survey's graphical elements were thoughtfully designed to effectively convey information while maintaining an overall professional and coherent presentation (Table 3-2).

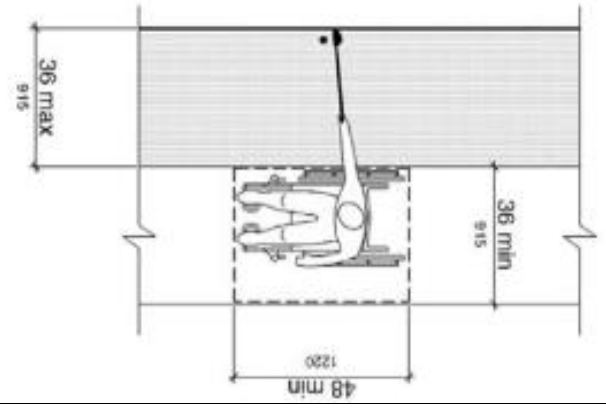
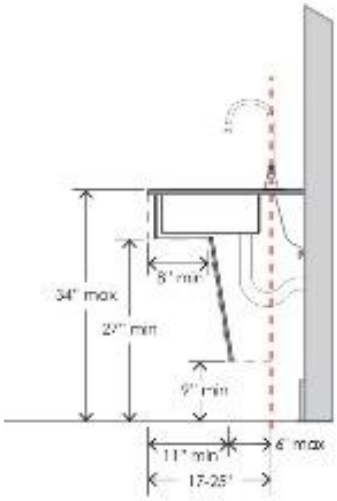
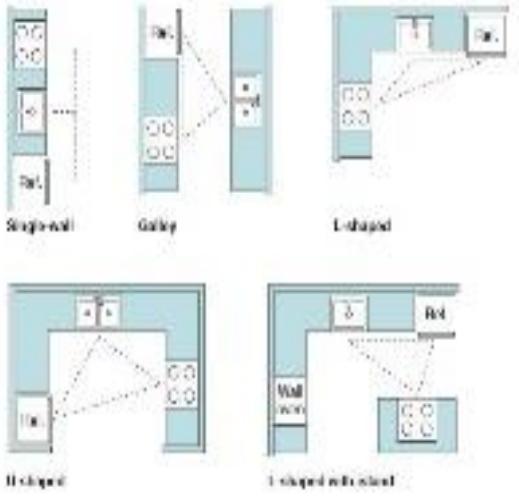
Table 3-2 Universal Design Elements with Relevant Graphics Shown in the Survey

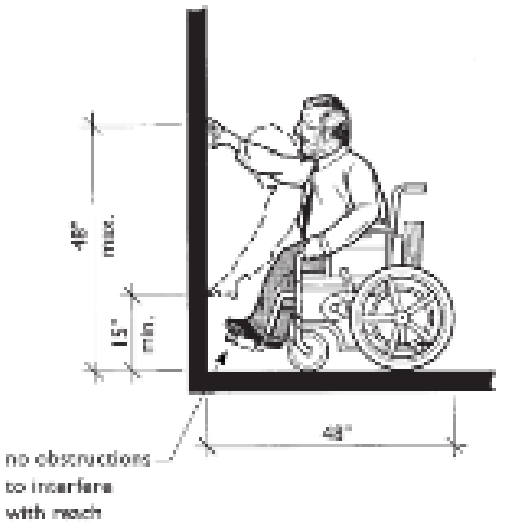
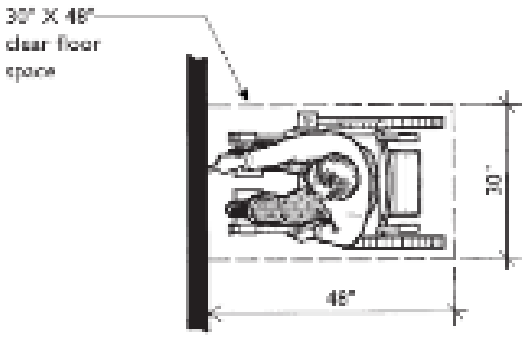
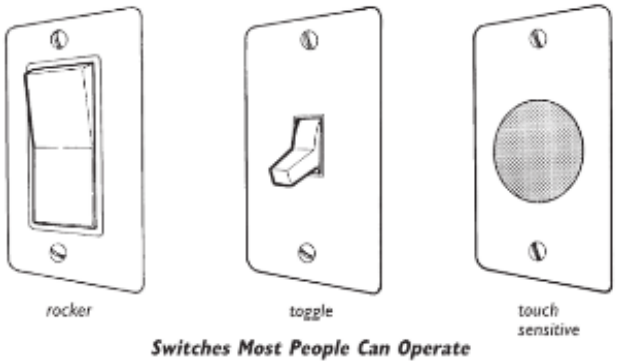
Space	UD Elements	Graphics
Ramp/ Stair	Ramp/ Stair width	
	Ramp/ Stair slope	
	Handrail/ railing	

Space before entrance/ pathways	Dimension of space before entrance	
	Door swing	
	Pathway width	 **Figure 403.5.1** **Clear Width of an Accessible Route**

	Space to turn around	
Accessible entrance	Door or doorway width	
	Maneuvering clearance	

	Door threshold	
	Door hardware height	
	Door weight	
Layout/ overall arrangement	Turn around between counter spaces	

	Countertop width to reach till end	
	Counter underneath space for wheelchair	
	Fixture arrangement	

Electrical points	Position/ height to reach	  **High and Low Forward Reach Limits From a Perpendicular Approach**
	Operating type (rocker/ toggle/ push/ soft touch/ turning)	 ***Switches Most People Can Operate***

See Appendix B for the online survey's information.

3.4.3 Data Collection

Background Information

The initial part of the online survey focused on collecting participant demographics and background details. This section aimed to ascertain whether the survey respondents met the criteria outlined for the study sample, including experiencing accessibility challenges themselves or serving as caregivers for individuals facing such challenges. Once the validation of the respondents was completed, further questions relevant to the study were introduced.

Background information inquired about the following information:

- Are you 18 years of age or older?
- Do you have any kind of age-related disability/ accessibility issues?
- Are you a caregiver of someone who has age-related disability/ accessibility issues?
- Do you currently use a mobility device or a caregiver of such a person?

After this segment, participants were prompted to provide demographic information to furnish their particulars. The questions are as follows:

- What is your age?
- What is your gender?
- What is your race?
- In which state/ country do you currently reside/ What is your country of residence?
- Which option best describes your predominant climate in your region?

Section 1: Space Specific Information

Space-specific challenges pose a high degree of difficulty when accessing and/or maneuvering because they limit or deny the complete usability of the space. This segment delved

into space-specific details to comprehend the primary spaces in use and the prevailing challenges within them. Section 1 comprised four inquiries-

- Arrange the spaces according to usability- drag and arrange question
- Day-to-day challenges when accessing the listed spaces- click in between extremely easy, somewhat easy, neutral, somewhat difficult, and extremely difficult
- How do these challenges affect your psychological well-being- Likert slider
- What are the reasons for these challenges- choice for each space in between entrance door, space to turn around, floor level difference, front/ side reach, finish material, grab bar, height of fixture/ furniture, others

The input from participants assisted in identifying the predominant spaces, existing hurdles, psychological impacts, and the underlying reasons for experiencing the issue.

Section 2: Universal Design Related Information

This section describes the comprehension of the study population regarding universal design (UD) and/or its associated needs. The definition of UD provided with the primary question is instrumental in framing the inquiries of this section. The correlation between UD elements present in their utilized spaces and the psychological impact was ascertained through the questions presented in this section.

- Are you aware of the universal design- 'Yes/ No' selection.
- Do you have any universal design elements in your listed spaces- 'Yes/ No' selection
- Select the spaces that have universal design elements
- How do the universal design elements affect your psychological well-being- likert slider
- Do you have any plan to add/ change/ renovate to accommodate any universal design elements in the future- 'Yes/ No' selection

Section 3: Accessibility Experience

The final section includes specific inquiries concerning the accessibility encounters of the study group or their caregivers. These questions are tailored to the spaces chosen as the most utilized in their homes, as indicated in Section 1: Space-Specific Information. Each space from the previous section has mostly similar types of questions:

• Select the accessibility level when maneuvering in the space- click in between extremely easy, somewhat easy, neutral, somewhat difficult, and extremely difficult.

• Based on your response- select the design factors that affect your experience accessibility- click from multiple design factors added with graphics.

See Appendix B for the online survey questionnaire for more information.

3.4.4 Measures

The participants' feedback was documented and evaluated according to their responses. For instance, 'Extremely easy' was assigned a rating of 5, whereas 'Extremely difficult' received a rating of 1. Satisfaction or dissatisfaction was assessed using a Likert scale ranging from 10 to 1.

The following steps represent how this study's weighted calculation was used to determine the degree of difficulty of each design component:

Step 1: Organize responses of each design component associated with environmental barriers by rating (somewhat difficult or extremely difficult) and determine the total number of responses.

Example: Main Entrance

Extremely Easy (EE) response total = 6

Somewhat Easy (SE) response total = 6

Neutral (NE) response total = 3

Somewhat Difficult (SD) response total = 7

Extremely Difficult (ED) response total = 1

Step 2: Multiply each rating's response total by the applicable numerical weight value to determine each rating's weighted response total.

Example: Main Entrance

Weighted EE response calculation: 6 x 5 = 30

Weighted SE response calculation: 6 x 4 = 24

Weighted NE response calculation: 3 x 3 = 9

Weighted SD response calculation: 7 x 2 = 14

Weighted ED response calculation: 1 x 1 = 1

Step 3: Add the weighted SD response and weighted ED response to determine the total barrier weighted design component response.

Example: Main Entrance

Weighted SD response calculation (14) + Weighted ED response calculation (1) = 15

Step 4: The weighted calculations represent a ranking order of the selected areas' design components with an environmental barrier. Using this ranking order, the lowest marks are selected.

3.4.5 Confidentiality

Ethical implications and trustworthiness are paramount in research endeavors, particularly concerning participant confidentiality. This document outlines the meticulous steps taken to safeguard participant data throughout the research process.

- *Secure Data Collection:* Survey data were collected using a secure network connection, ensuring data integrity during transmission.
- *Encryption and Password Protection:* All collected data were encrypted and further protected with a secured password, preventing unauthorized access.

- *Demographic Information:* Participants were asked to provide demographic information, including age, gender, race, state/country of residence, and climate, contributing to a comprehensive dataset.
- *Unique Identification Numbers:* To uphold confidentiality, each participant was assigned a unique identification number, replacing identifiable information in the dataset.
- *Anonymity Assurance:* The use of identification numbers ensured participant anonymity, maintaining their privacy and confidentiality.
- *Retention Period:* The collected data will be securely retained for three years following the conclusion of the research, adhering to data retention policies.
- *Secure Disposal:* After the retention period, a secure disposal process will be initiated, ensuring the permanent and irretrievable deletion of all data, further safeguarding participant confidentiality.
- *Informed Consent:* Participants provided informed consent, understanding the purpose of data collection and their rights regarding confidentiality.
- *Ethical Review:* The research process underwent ethical review, complying with institutional guidelines and ethical standards to uphold participant trust and integrity.

The meticulous implementation of secure data collection, encryption, unique identification numbers, ethical considerations, and a defined data retention and disposal strategy underscores our commitment to maintaining ethical implications and trustworthiness throughout the research process, prioritizing participant confidentiality and data security.

3.4.6 Reliability and Validity

Reliability and validity are crucial aspects that underpin the integrity and credibility of research methodologies and their resultant outcomes. They ensure that research findings are

trustworthy and not misleading, thus supporting informed decision-making based on robust evidence. Trustworthiness in research hinges on several factors, including the formulation of the initial research question, the methods employed for data collection (including timing and sources), the analytical processes utilized, and the conclusions drawn from the analysis (Roberts & Priest, 2006).

Reliability refers to the stability or consistency of study results (Twycross & Shields, 2004) indicating that findings can be replicated reliably. In this study, statistical tools were utilized to assess reliability. The Cronbach's Alpha test is used for the internal reliability coefficient. The reliability was found 0.81, which means that the consistency is reliable.

Validity, on the other hand, pertains to whether an instrument accurately measures what it is intended to measure (Heale & Twycross, 2015). It involves ensuring that research is well-constructed according to established standards and methods. In this study, validity was established through a thorough literature review which indicated the unique needs of elderly individuals with disabilities. Additionally, the survey instrument used was adopted from a previous study and updated with specific questions relevant to the goal of this study. The correlation study was then designed to explore the relationship between the ease of maneuvering and the psychological well-being of the study group, with a focus on universal design elements.

The study's findings are significant as they add to the academic understanding regarding the relationship between universal design attributes and psychological well-being.

3.5 Conclusion

The chapter has presented the details of the data collection process and guidance of the analysis to achieve the research purpose and the effectiveness of the study. Independent and dependent variables are set based on the previous literature. To be specific, independent variables

include a total of 39 items within 9 different spaces in a home environment. The dependent variable is psychological well-being which is measured by a satisfied/ dissatisfied question. Data are collected from specific users and caregivers through a 1 to 10 scoring system of satisfied/ dissatisfied Likert scale. Participants are recruited by flyers sent to hospitals and organizations that provide services for people with disabilities, and finally, the sample size is determined as 51. Five demographic identifiers have also been asked, including age, gender, race, country of living, and weather. However, participants are protected by assigning identification numbers, coding the data, and keeping the data with passwords. The study ensures reliability by using statistical tools. Also, the validity is achieved by being consistent with previous studies that showed the impact on psychological well-being.

In the following chapter, the study's results are presented.

Chapter 4: Result

The goal of this study was to identify the effect of challenges faced by elderly people with disabilities while maneuvering within the spaces in their homes on psychological well-being.

To achieve the above-mentioned goal, the study focused on the following objectives:

- Identified the most used spaces in a home environment
- Identified the level of challenges when maneuvering through the spaces in a home environment.
- Identify the effect on psychological well-being due to the challenges when maneuvering through the spaces in a home environment
- Identify and report the reason for current challenges when maneuvering through the spaces in a home environment
- Report if participants' responses about the most used spaces, and the reasons behind the challenges faced vary based on age, gender, culture, location, and climate.

The resulting data through an online survey was aggregated between February 1st and March 15th, 2024. The survey was completed by elderly people with disabilities, and/ or caregivers who take care of the study group. Information was collected from 51 people regarding their current domestic environments. SPSS has been used for quantitative data to compute descriptive and correlational statistics. The qualitative data was assembled, organized, and reported through graphs and tables.

4.1 Distribution

The survey was distributed through social media and anonymous links. A QR code was generated and published with the survey flyer. The participant rates according to different types of distribution methods are shown in Table 4-1.

Table 4-1 Data Collection Method Distribution

Distribution Channel	Survey Participants	Participant Rate
Social media	14	27.45%
QR code	18	35.29%
Anonymous link	19	37.25%
Total	51	100%

Survey link: https://ousurvey.qualtrics.com/jfe/form/SV_4PjFzisaOhbd5rg

The survey consisted of 51 participants, among them 29 were eliminated due to incomplete responses and 22 were retained for further analysis.

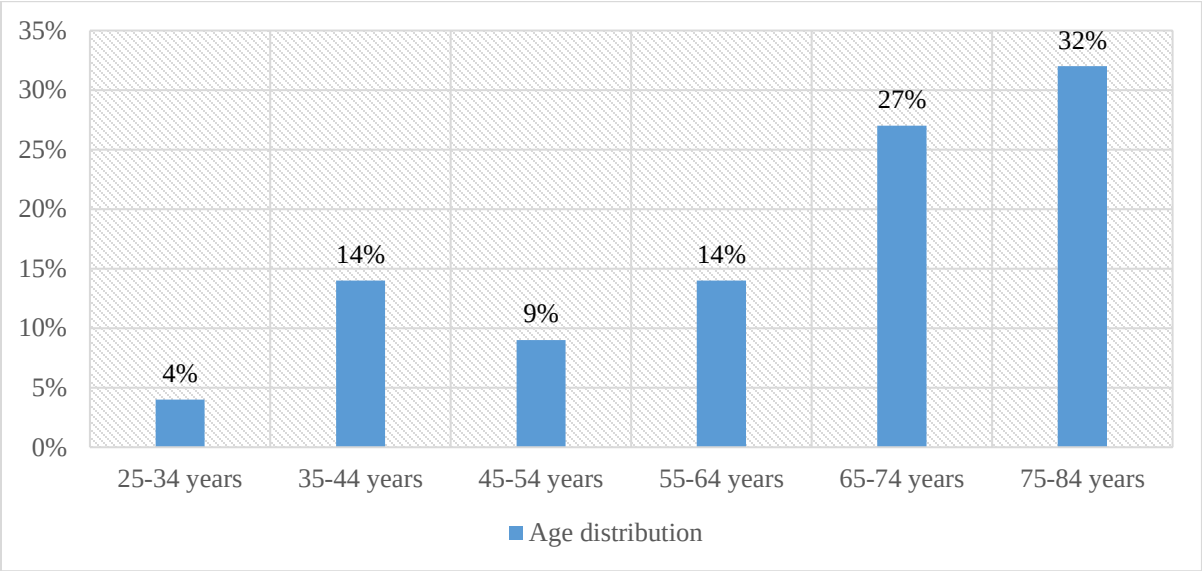
4.2 Demographics

The online survey responses consisted of 22 individuals: 8 caregivers and 14 people with disabilities and among all 50% were mobility device users. All respondents must be 18 or older to participate in the survey. Among the total participants, 32% were between 75-84 years, 27% were 65-74 years, 14% were both 35-44 and 55-64 years, and 9% were 45-54 years of age. Female participants dominated male participants with 59%. Regarding race, 55% were Asian, 37% were White, and 4% were both American Indian or Alaska and Black or African American. Comparing the residency, Oklahoma State commanded over all other states with 64%, while in terms of climate, 'Hot and Humid' and 'Hot and Dry' both consisted of 32%. The following table illustrates the frequency of participants' demographic information.

Table 4-2 Demographic Distribution

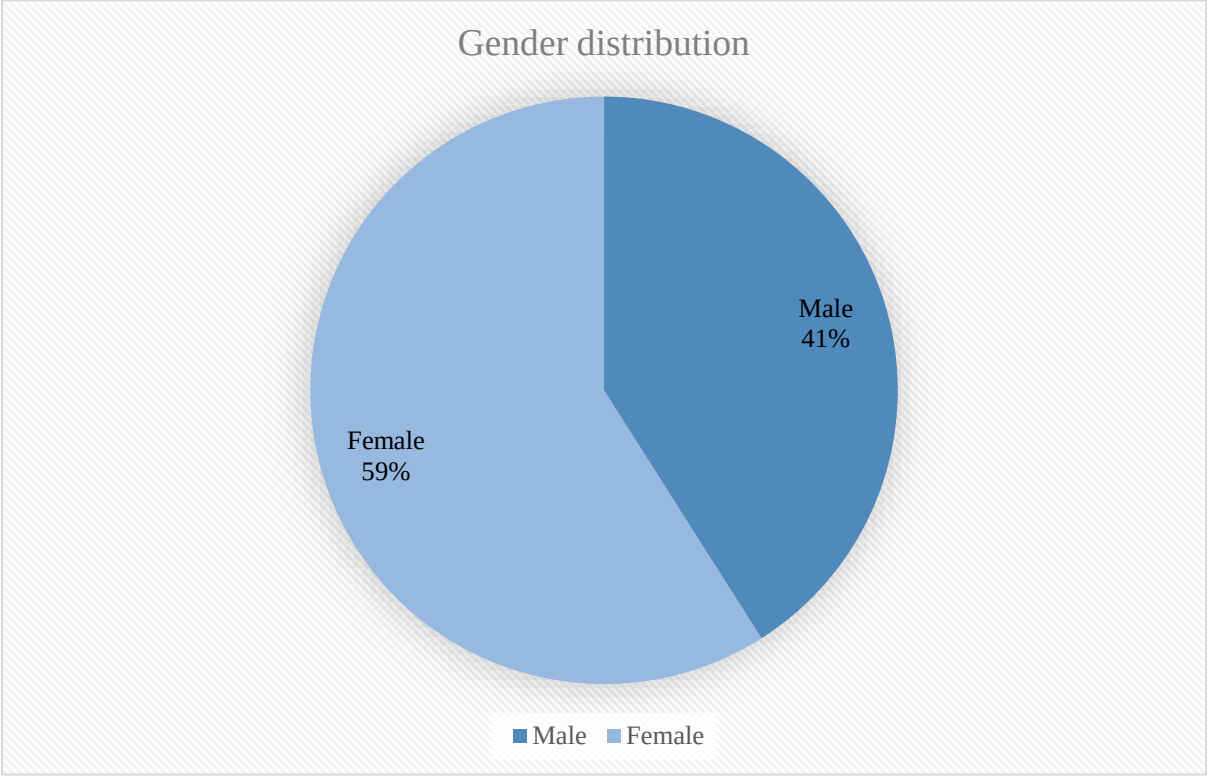
Variables	Description	Number of Responses	Percentage
Age	18-24		
	25-34	1	4%
	35-44	3	14%
	45-54	2	9%
	55-64	3	14%
	65-74	6	27%
	75-84	7	32%
	Total	22	100%
Gender	Male	9	41%
	Female	13	59%
	Total	22	100%
Race	American Indian or Alaska Native	1	4%
	Asian	12	55%
	Black or African American	1	4%
	White	8	37%
	Total	22	100%
State/ Country of residence	Oklahoma	14	64%
	Texas	1	4%
	California	3	14%
	New York	1	4%
	Other	3	14%
	Total	22	100%
Climate	Hot and Dry	7	32%
	Hot and Humid	7	32%
	Cold and Humid	1	4%
	Other	7	32%
	Total	22	100%

N= number of responses= 22



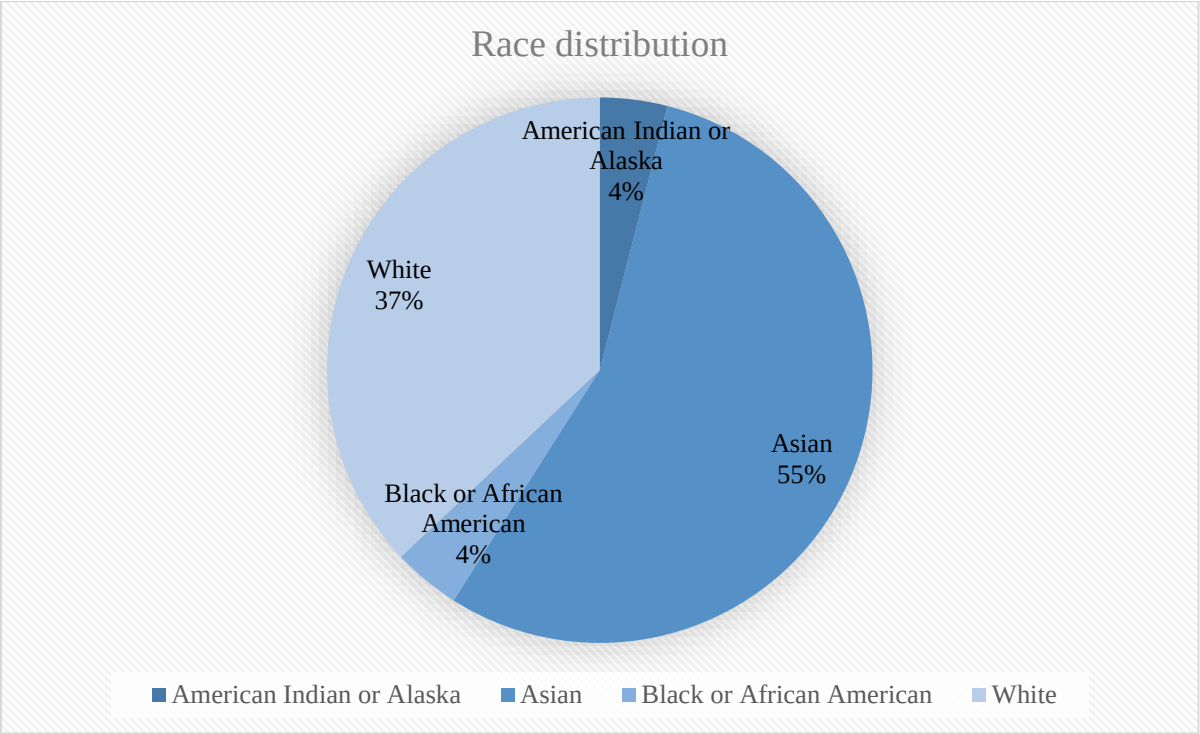
N= number of responses= 22

Figure 4-1 Response rate based on age distribution



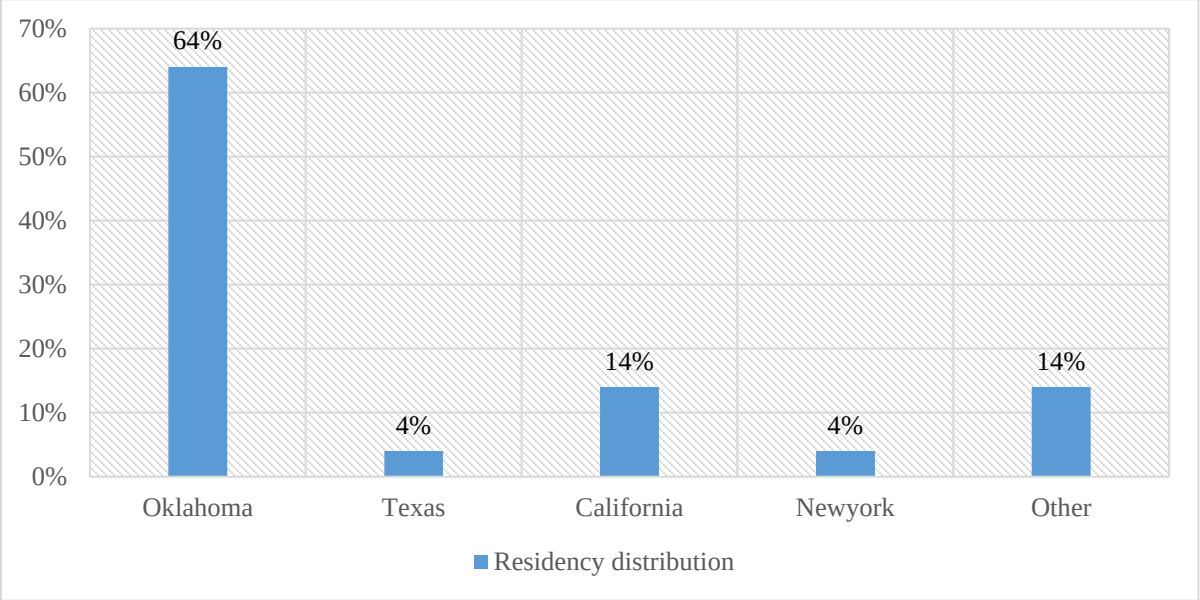
N= number of responses= 22

Figure 4-2 Response rate based on gender distribution



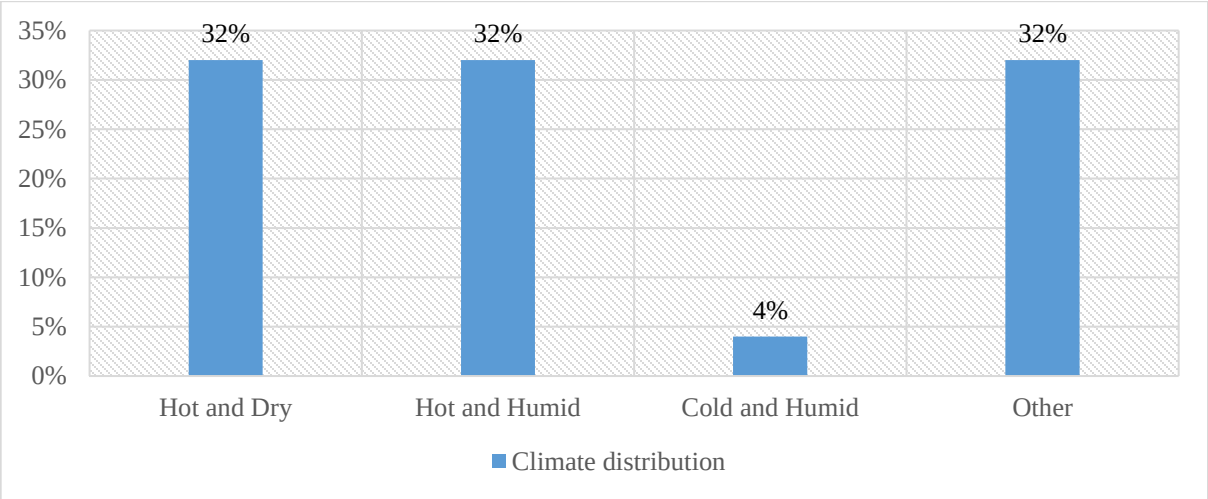
N= number of responses= 22

Figure 4-3 Response rate based on race distribution



N= number of responses= 22

Figure 4-4 Response rate based on location



N= number of responses= 22

Figure 4-5 Response rate based on climate distribution

4.3 Accessibility Analysis

Responses from the online survey presented the usability ratings of spaces for elderly people with disabilities, which identified the most used spaces within and around the home environment. The choice of spaces was-

- Main Entrance
- Kitchen
- Bathroom/ Toilet
- Bedroom
- Access Route (hallway, corridor, etc.)
- Living/ Dining
- Backyard
- Patio
- Other

Accessibility ratings within the mentioned spaces were based on the selection between extremely easy, somewhat easy, neutral, somewhat difficult, or extremely difficult. Challenges for maneuvering were associated with a somewhat difficult or extremely difficult rating and ease of maneuvering was associated with a somewhat easy or extremely easy rating.

The psychological effects due to the level of challenges were measured by a Likert scale of dissatisfied, neutral, and satisfied. Additionally, the reason to feel the challenges while maneuvering/ accessing the listed spaces was the selection between-

- entrance door
- space to turn around
- floor level difference
- front/ side reach
- finish material
- grab bar
- height of fixture/ furniture
- other

Collected data helped to determine-

1. most used spaces in the home environment
2. level of day-to-day challenges the study group feel
3. effect on psychological well-being due to these challenges
4. reason for these challenges

Additionally, the accessibility data and demographic data helped to report on how participants' responses about the most used spaces, ease of maneuvering within the home, their

psychological well-being, and the reasons behind the challenges faced vary based on age, gender, culture, location, and climate.

The tables and figures in the following sections illustrate the frequencies and percentages of accessibility ratings.

4.3.1 Frequently Used Spaces in a Home

According to the space sequence arranged from 1 to 5 by the participants, it is marked 5 as the most used space, and 1 as the least used space. The sequence numbers were multiplied by the number of participants to get the total. From the calculation, the 5 most usable spaces were the Kitchen, followed by the Bathroom/Toilet, Bedroom, Living/Dining, and Main Entrance. The following table shows the sequence of spaces according to individuals' preferences-

Table 4-3 Most used space rank order calculated based on usability and number of responses

Name of space	no. of people ranked 1st	no. of people ranked 2nd	no. of people ranked 3rd	no. of people ranked 4th	no. of people ranked 5th	Weighted calculation	Ranking order based on usability
Main Entrance	4	1	0	5	3	37	5
Kitchen	6	9	3	2	1	80	1
Bathroom/ Toilet	2	6	7	5	2	67	2
Bedroom	5	2	8	3	1	64	3
Access routes (hallway, corridor, etc.)	0	0	1	4	7	18	6
Living/ Dining	4	4	3	0	3	48	4
Backyard	0	0	0	2	2	6	8
Patio	0	0	0	0	3	3	9
Other	1	0	0	1	0	7	7

N= number of respondents= 22

4.3.2 Level of Challenges during Maneuvering

To compute the level of challenges quantitatively the responses from the survey 'extremely difficult', 'somewhat difficult', 'neutral', 'somewhat easy', and 'extremely easy' are multiplied by 1, 2, 3, 4, and 5 respectively with the number of responses. This process helped to get an understanding of the level of challenges faced between spaces as indicated by participants.

Table 4-4 Level of challenges while maneuvering

Spaces	Extremely easy (5)	Somewhat easy (4)	Neutral (3)	Somewhat difficult (2)	Extremely difficult (1)	Calculated level of challenge while maneuvering
Main Entrance	6	6	4	7	1	75
Kitchen	4	6	2	9	0	68
Bathroom/ Toilet	6	5	2	5	3	63
Bedroom	3	6	6	4	1	63
Access routes	4	3	10	3	2	65
Living/ Dining	7	6	4	3	0	77
Backyard	0	6	6	5	3	55
Patio	5	5	1	5	1	68
Other	3	3	0	2	1	17

The following graph shows the day-to-day challenges of the study group when maneuvering/ accessing the listed spaces.

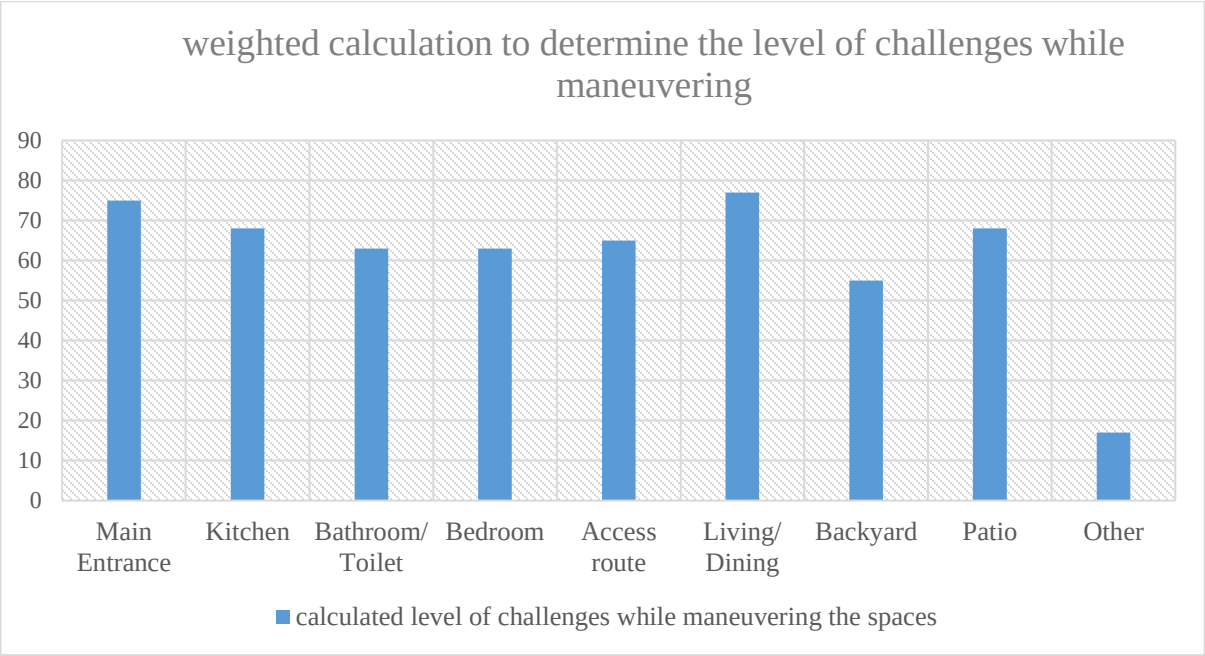


Figure 4-6 Level of challenges when maneuvering/ accessing the listed spaces

4.4 Effect of Challenges during Maneuvering on Psychological Well-being

The following Table 5 shows mean data of effects on psychological well-being due to the challenges identified in the previous table (Table: 4)

Table 4-5 Effect of maneuvering challenges on psychological well-being

Name of spaces	Mean	Minimum	Maximum	No. of responses
Main Entrance	5.41	1.00	10.00	22
Kitchen	5.68	1.00	10.00	22
Bathroom/ Toilet	5.86	1.00	10.00	22
Bedroom	5.86	1.00	10.00	22
Access routes (hallway, corridor, etc.)	6.00	1.00	9.00	22
Living/ Dining	6.45	1.00	10.00	22
Backyard	5.00	1.00	10.00	22
Patio	4.90	1.00	10.00	20
Other	6.60	5.00	9.00	5

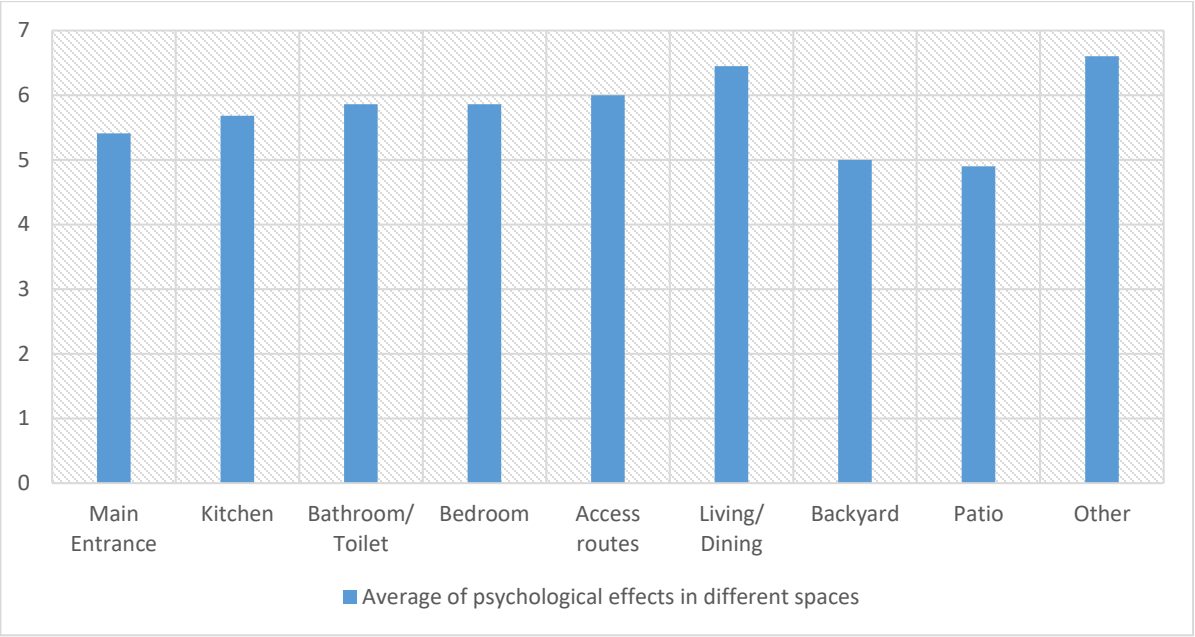


Figure 4-7 Effect of maneuvering challenges on psychological well-being

Because the mean values were almost homogenous, the study required further analysis to understand which independent variable affected the dependent variable.

1. Independent variables: Space and Ease of maneuvering
2. Dependent variable: Psychological well-being

A two-way Analysis of variance (ANOVA) was conducted to analyze the significance of the effects of the ease of maneuvering and type of spaces on the psychological well-being of the participants. For this analysis, ease of maneuvering, types of spaces, and space with ease of maneuvering were the independent variables, while psychological well-being was the dependent variable. The analysis revealed that there was no significant change in means of psychological well-being with changes in spaces. However, there has been a significant change in the mean of psychological well-being of the occupants with a change in ease of maneuvering at $p<0.01$[$F = 8.244$, $df = 4, 34$]. Also, the analysis revealed that there was not a statistically significant interaction between space with ease of maneuvering and psychological well-being.

Table 4-6 Levene's test for Variance in Responses

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	327.018[a]	34	9.618	1.857	0.008	0.361
Intercept	2185.707	1	2185.707	421.997	0.000	0.790
Space	51.761	7	7.394	1.428	0.201	0.082
Ease of maneuvering *	170.797	4	42.699	8.244	0.000	0.227
Space and Ease of maneuvering	75.078	23	3.264	0.630	0.899	0.115
Error	580.098	112	5.179			
Total	5730.000	147				
Corrected Total	907.116	146				

Table 4-7 Levene's test of Equality of Error Variances

Levene's Test of Equality of Error Variances[a,b]

		Levene Statistic	df1	df2	Sig.
Psychological well-being	Based on Mean	1.459	30	112	0.081
	Based on Median	0.780	30	112	0.780
	Based on Median and with adjusted df	0.780	30	55.308	0.766
	Based on trimmed mean	1.428	30	112	0.094

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

The p-value for Levene's test is greater than 0. 05. Thus, the variances are not significantly different from each other (i.e., the homogeneity assumption of the variance is met.

A correlation study examined the relationship between two variables and aimed to determine whether and to what extent changes in one variable are associated with changes in another. Correlation studies helped to understand patterns, predict outcomes, and identify potential causal relationships. The correlation coefficient (r) was calculated for correlational analyses to evaluate the relationship between the two continuous variables. A Pearson correlation coefficient was performed to evaluate the relationship between the ease of maneuvering and psychological well-being for each space.

Table 4-8 Correlation between Ease of maneuvering and Psychological well-being based on specific spaces

		Psy_WB_ME	Psy_WB_Kit	Psy_WB_Bath	Psy_WB_BR	Psy_WB_AR	Psy_WB_LIV	Psy_WB_Back	Psy_WB_Patio	Psy_WB_Other
Ease_Mnv_ME	Pearson Correlation	.783**								
	Sig. (2-tailed)	0.000								
	N	22								
Ease_Mnv_Kit	Pearson Correlation		.832**							
	Sig. (2-tailed)		0.000							
	N		21							
Ease_Mnv_Bath	Pearson Correlation			.631**						
	Sig. (2-tailed)			0.004						
	N			19						
Ease_Mnv_BR	Pearson Correlation				0.447					
	Sig. (2-tailed)				0.055					
	N				19					
Ease_Mnv_AR	Pearson Correlation					.548*				
	Sig. (2-tailed)					0.012				
	N					20				
Ease_Mnv_LIV/DIN	Pearson Correlation						.655**			
	Sig. (2-tailed)						0.002			
	N						20			
Ease_Mnv_Back	Pearson Correlation							0.420		
	Sig. (2-tailed)							0.065		
	N							20		
Ease_Mnv_Patio	Pearson Correlation								.687**	
	Sig. (2-tailed)								0.001	
	N								19	
Ease_Mnv_Others	Pearson Correlation									0.500
	Sig. (2-tailed)									0.667
	N	5	5	5	5	5	5	5	5	3

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

N= number of responses

Table 4-8 shows that there is a significant and positive relationship between the ease of maneuvering and the psychological well-being of the Main Entrance, Kitchen, Bathroom, Living/ Dining, Patio (at 0.01 level), and Access Route (at 0.05 level).

4.5 Reasons for Challenges during Maneuvering:

Table 4-9 Reasons associated with the challenges determined by the number of respondents

Name of spaces	Entrance door	Space to turn around	Floor level difference	Front /side reach	Finish material	Grab bar	Height of fixture/ furniture	Other	Percentage of responses for major challenge
Main Entrance	7	6	12	1	0	6	2	0	35%
Kitchen	3	4	0	2	2	2	7	4	29%
Bathroom/ Toilet	3	7	2	1	2	7	3	1	27%
Bedroom	2	4	1	0	0	2	9	1	47%
Access routes	2	9	0	0	0	2	1	2	56%
Living/ Dining	1	4	2	0	0	1	6	3	35%
Backyard	1	2	8	0	0	0	1	3	53%
Patio	1	0	5	0	0	1	1	2	50%
Total responses	20	36	30	4	4	21	30	16	-

N= number of respondents= 22

The above table (4-9) shows the reasons associated with challenges in each space, the number of responses, and the response rate within each category. The data shows that most of the people faced challenges due to space to turn around, which got 36 responses, among all the spaces bathroom/ toilet and access routes were chosen by most of the participants for this category. The

second largest responses were associated with floor level difference (30) and height of furniture/ fixture (30). Floor level difference was selected for the main entrance, backyard, and patio, whereas the height of furniture/fixtures was associated with the kitchen, bedroom, and living/ dining. Bathroom/ toilet was the third highest category with a grab bar issue.

We found the most used 5 spaces, which were kitchen, bathroom/ toilet, bedroom, living/ dining, and main entrance according to ranking order (Table 4-3). In the main entrance, floor level difference was identified by 12 respondents, which got the maximum number of responses for each category, which is 35% of responses who identified the reason as the major difficulty within the space. For the bedroom, the major issue was identified as the height of furniture/ fixture with 9 responses (47%), same issue is for the kitchen with 7 (29%) and living/ dining with 6 (35%) responses within their category. Space to turn around and grab-bar was the major difficulty in the bathroom/ toilet with 7 responses and a 27% response rate for each reason.

The following graph shows the reasons associated with the challenges of maneuvering in each space-

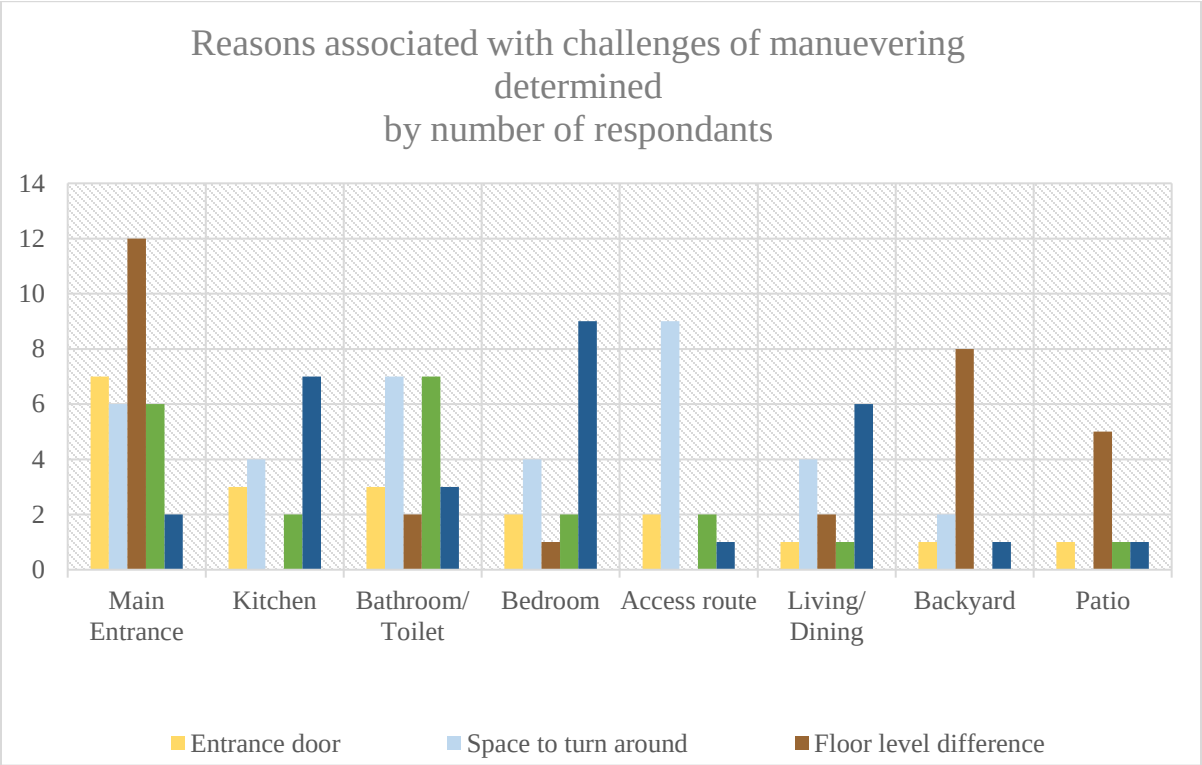


Figure 4-8 Reasons associated with challenges of maneuvering as indicated by the number of respondents.

N= number of respondents= 22

From the figure (4-8), it is determined that the Main Entrance faced challenges primarily due to the floor level difference responses by 12 individuals, which dominated the rest of the data numbers, while the Kitchen was particularly concerned with the height of fixtures/ furniture. In the Bathroom, both the space for turnaround and the need for grab-bar were significant issues (7), whereas the Bedroom (9) and Living/Dining (6) areas highlighted challenges with the height of fixtures/ furniture. The backyard and Patio also identified floor-level differences as challenging aspects of the spaces.

Descriptive analysis is a crucial aspect of research and data analysis that focuses on summarizing and describing the basic features of a dataset. It involves organizing, displaying, and

summarizing data meaningfully to facilitate better understanding and interpretation. In this study, descriptive statistics calculate variables' means, standard deviations, interquartile ranges, total numbers, and categorical variables (frequency, percentiles, and total numbers).

Table 4-10 Supporting data to express value label and number of responses

		Value Label	N
Space	1	Main Entrance	22
	2	Kitchen	21
	3	Bathroom/Toilet	20
	4	Bedroom	21
	5	Access Routes	21
	6	Living/Dining	20
	7	Backyard	18
	8	Patio	4
		Total responses	147
Ease_Mnv	1.00	Extremely difficult	8
	2.00	Somewhat difficult	34
	3.00	Neutral	35
	4.00	Somewhat easy	39
	5.00	Extremely easy	31
		Total responses	147

N= number of responses

Table 4-10 displays the spaces along with the respective number of responses received for each space. Additionally, it includes the weight assigned to Ease of Maneuvering and the corresponding number of responses related to that aspect. Notably, both Space and Ease of Maneuvering received an equal number of responses, totaling 147 each. The scale used for Ease of Maneuvering ranges from 1.00 to 5.00, where difficulty levels are weighted to provide a value, with 1.00 representing "extremely difficult" and 5.00 representing "extremely easy."

Table 4-11 Descriptive statistics of Ease of Maneuvering based on different spaces

Space	Ease of Maneuvering	Mean	Std. Deviation	N	Number/ percentage of persons identify levels of difficulty
Main Entrance	1.00	1.0000		1	7
	2.00	4.5000	1.87083	6	
	3.00	5.5000	2.08167	4	
	4.00	6.2000	3.11448	5	
	5.00	7.3333	1.50555	6	
	Total	5.6818	2.47629	22	39%
Kitchen	2.00	4.3333	2.39792	9	9
	3.00	6.0000	2.82843	2	
	4.00	7.0000	1.67332	6	
	5.00	7.5000	2.38048	4	
	Total	5.8571	2.49571	21	47%
Bathroom/Toilet	1.00	2.5000	2.12132	2	7
	2.00	4.8000	2.38747	5	
	3.00	8.5000	2.12132	2	
	4.00	6.5000	1.87083	6	
	5.00	6.4000	2.30217	5	
	Total	5.8500	2.47673	20	39%
Bedroom	1.00	1.0000		1	5
	2.00	6.5000	2.38048	4	
	3.00	5.3333	1.03280	6	
	4.00	6.8571	1.86445	7	
	5.00	6.3333	2.51661	3	
	Total	6.0000	2.12132	21	33%
Access Routes	1.00	1.5000	0.70711	2	4
	2.00	8.5000	2.12132	2	
	3.00	6.5000	2.59272	10	
	4.00	7.3333	2.08167	3	

	5.00	7.2500	1.25831	4	
	Total	6.4762	2.65742	21	36%
Living/Dining	2.00	4.6667	4.72582	3	3
	3.00	3.5000	1.91485	4	
	4.00	5.1667	2.31661	6	
	5.00	6.1429	2.41030	7	
	Total	5.1000	2.67346	20	19%
Backyard	1.00	2.5000	2.12132	2	6
	2.00	4.0000	3.82971	4	
	3.00	4.3333	1.36626	6	
	4.00	6.5000	2.42899	6	
	Total	4.7778	2.64699	18	50%
Patio	2.00	7.0000		1	1
	3.00	5.0000		1	
	5.00	7.5000	2.12132	2	
	Total	6.7500	1.70783	4	33%
Total	1.00	1.8750	1.35620	8	42
	2.00	5.0000	2.71918	34	
	3.00	5.5143	2.20122	35	
	4.00	6.4615	2.12561	39	
	5.00	6.8387	1.96802	31	
	Total	5.7279	2.49261	147	38%

Table 4-11 presents data on the mean, standard deviation (SD), number of responses, and the percentage of respondents who perceive difficulty in specific spaces. The table is organized based on various levels of Ease of Maneuvering. According to the data, the Backyard and Kitchen received the highest percentage of responses indicating difficulty, at 50% and 47% respectively.

Specifically, for the Backyard, the mean difficulty rating was 4.7 with an SD of 2.6 and N=18 responses. However, 33% (6) of the responses were neutral, resulting in a lower response

rate. On the other hand, the Kitchen had a mean difficulty rating of 5.9 with an SD of 2.5 and N=21 responses, with only 2 neutral responses, indicating a higher level of difficulty perception among respondents.

4.6 Variation in Accessibility Responses based on Demographics

Table 4-12 Identify data differences according to age

Age distribution	number of responses	Most used space
25-34	1	Bedroom (1)
35-44	3	Main Entrance (1)
		Bathroom (1)
		Bedroom (1)
45-54	2	Main Entrance (1)
		Kitchen (1)
55-64	3	Main Entrance (2)
65-74	6	Bedroom (3)
75-84	7	Kitchen (4)

Table 4-12 describes that the highest age group of people responded to the Kitchen as the most usable space, while the Main entrance and Bedroom were mentioned by different groups frequently.

Table 4-13 Identify data differences according to gender

Gender distribution	Number of responses	Most used space
Male	9	Main Entrance (3)
		Bedroom (3)
Female	13	Kitchen (5)

Considering gender, the Female participants responded that the Kitchen was the most used space, while males indicated the Main entrance and Bedroom (Table 4-13).

Table 4-14 Identify data differences according to race

Race distribution	Number of responses	Most used space
American Indian or Alaska Native	1	Bathroom (1)
Asian	12	Kitchen (4)
Black or African American	1	Bedroom (1)
White	8	Living/ Dining (3)

Among Asians, the Kitchen was found to be the most used space, while the White population responded to the Living/ Dining (Table 4-14)

Table 4-15 Identify data differences according to state/ country of residence

Residency distribution	Number of responses	Most used space
Oklahoma	14	Bedroom (4)
		Living/ dining (4)
Texas	1	Bathroom (1)
California	3	Main Entrance (2)
New York	1	Kitchen (1)
Other	3	Bedroom (1)

In Table 4-15, we found Bedroom and Living/ Dining got the same number of responses (4) which is 29% within Oklahoma state. In California, the Main entrance got the highest response.

Table 4-16 Identify data differences according to climate

Climate distribution	Number of responses	Most used space
Hot and Dry	7	Kitchen (2)
		Bedroom (2)
		Living/ dining (2)
Hot and Humid	7	Main entrance (2)
		Bedroom (2)
Cold and Humid	1	Kitchen (1)
Other	7	Main entrance (2)
		Kitchen (2)

Table 4-16 shows Kitchen was mentioned by all climate types except Hot and Humid.

Table 4-17 Psychological effects while using UD elements

Name of spaces	Average	Minimum	Maximum	Count
Main Entrance	6.50	4.00	9.00	2
Kitchen	6.00	6.00	6.00	1
Bathroom/ Toilet	8.00	5.00	9.00	6
Bedroom	5.50	5.00	6.00	2
Access routes	4.00	4.00	4.00	1
Living/ Dining	6.50	5.00	8.00	2
Backyard	0	0	0	0
Patio	9.00	9.00	9.00	1
Other	4.00	4.00	4.00	1

Table 4-17 describes the mean data of psychological effects while using universal design elements in the home environment. The Bathroom/ Toilet got the most responses (40%) and a higher mean value (8.00) compared to others.

Table 4-18 Data differences in psychological effects due to current challenges and while using UD elements

Name of spaces	Average of psychological effects due to challenges	Average of psychological effects while using UD elements
Main Entrance	5.41	6.50
Kitchen	5.68	6.00
Bathroom/ Toilet	5.86	8.00
Bedroom	5.86	5.50
Living/ Dining	6.45	6.50

Table 4-18 shows the mean data between psychological effects for both conditions- due to challenges and while using UD elements. Most of the data for psychological effects increased while using UD elements compared to the effects of challenges. Comparing the mean value, the Bathroom/ Toilet had the largest number toward satisfaction level while using UD.

Table 4-19 Data report between most used spaces, challenges, psychological effects, and reasons

Rank order	List of most used spaces	Calculated level of challenge	psychological effect	Reasons behind the challenges		
1	Kitchen	68	5.68	height of fixture/ furniture	space to turn around	entrance door
2	Bathroom/ Toilet	63	5.86	grab bar	space to turn around	entrance door, height of fixture
3	Bedroom	63	5.86	height of fixture/ furniture	space to turn around	entrance door
4	Living/ Dining	77	6.45	height of fixture/ furniture	space to turn around	floor level difference
5	Main Entrance	75	5.41	Floor level difference	entrance door	Space to turn around, grab bar

Table 4-19 shows the 5 most used spaces arranged according to ranking order, their calculated level of challenges, average (mean) psychological effects, and reasons behind the challenges. The kitchen is the most used space among all, with the calculated level of challenge 68, and the mean psychological effect is 5.68. The 3 main reasons to face challenges identified by participants' response rate were- the height of fixture/ furniture, space to turn around, and entrance door. Living/ dining had the highest calculated level of challenges (77), with a 6.45 mean psychological effect, and the reasons identified by most of the participants were- the height of fixture/ furniture, space to turn around, and floor level difference.

4.7 Result Summary

The online survey had 22 completed responses, out of which 50% of respondents used mobility devices. Participants were aged 18 or older, among which, 32% were aged 75-84, 27% were 65-74, 14% were in both the 35-44 and 55-64 age groups, and 9% were 45-54. The majority were Asian (55%), followed by White (37%) and 4% were a combination of American Indian or

Alaska Native and Black or African American. Oklahoma State had the highest representation at 64%.

Upon assessing the usability of spaces for elderly people with disabilities in and around the home, spaces like the Main Entrance, Kitchen, Bathroom/Toilet, etc., were rated based on ease of use. Data helped determine the most used spaces, which are the Kitchen, Bathroom/Toilet, Bedroom, Living/Dining, and Main Entrance. Day-to-day challenges faced by participants when accessing these spaces were identified and noted through figures.

The effect of challenges during maneuvering on psychological well-being was studied and mean scores for each space were calculated, indicating moderate to high impact across spaces. A two-way ANOVA analysis showed that ease of maneuvering significantly affected psychological well-being ($p<0.01$), but there was no significant effect of space type. Upon further analysis, a correlation study revealed a positive relationship between ease of maneuvering and psychological well-being for spaces like the Main Entrance, Kitchen, Bathroom, Living/Dining, Patio (at $p<0.01$), and Access Route (at $p<0.05$).

The reasons for challenges in different spaces, with responses from 22 participants indicated that major difficulty across spaces was the lack of space to turn around, followed by issues with floor level difference and height of fixtures/furniture. The Main Entrance faced challenges primarily due to floor level differences, while the Kitchen had concerns mainly with fixture height. In the Bathroom, both turning space and grab bars were significant issues, while the Bedroom and Living/Dining areas highlighted challenges with fixture height. Backyard and Patio also identified floor-level differences as challenging aspects. Descriptive statistics provide further insights into the level of difficulty perceived in each space, with Kitchen and Backyard receiving the highest percentages of responses indicating difficulty.

The responses indicated variations in space preferences and the impact of accessibility challenges across demographics. Preferences differed by age, gender, race, and climatic conditions. Additionally, using universal design elements leads to higher satisfaction compared to facing challenges, particularly in the Bathroom/Toilet. Overall, the Kitchen is the most used space, while the Living/Dining area faces the highest level of challenges.

Chapter 5: Discussion

The discussion chapter draws from the results section and presents a comprehensive analysis of the online survey results. The previous section delved into participant demographics, identified accessibility challenges in different spaces within and around the home environment, explored the effect of challenges during maneuvering on psychological well-being in conditions with and without universal design elements, and investigated the reasons for these challenges. The conclusion highlighted differences in space preferences and how accessibility challenges vary across demographic groups. Moreover, it showed that employing universal design elements results in greater satisfaction compared to encountering challenges.

The presented study sought to answer the research questions:

Section 1- What are the most used spaces in residential settings to enhance the psychological well-being of elderly adults with disabilities?

The ranking order of weighted calculation of spaces answered this question. The participants responded and arranged the spaces in order from 1-9 based on their usability. Table 4-3 describes the calculation, and the findings will be discussed here.

Section 2- What are the challenges that impact the psychological well-being of elderly adults with disabilities in residential settings?

The level of challenges while maneuvering was calculated based on the participants' choice between extremely difficult, somewhat difficult, neutral, somewhat easy, and extremely easy. Table 4-4 and Figure 4-6 helped to visualize the weighted challenge level.

Table 4-5 and Figure 4-7 expressed the effect on psychological well-being due to the challenges. The data was derived from the 22 responses on a Likert scale from 10-1, satisfied-neutral-dissatisfied. Because the results were mostly homogenous, further analysis was necessary

to know the specific variable that has significance on participants' psychological well-being. A two-way Analysis of Variance (ANOVA) was conducted to analyze the significance of the effects of ease of maneuvering and type of spaces on the psychological well-being of the participants. From Table 4-6 and Table 4-7, it is determined that Ease of Maneuvering on psychological well-being is the most significant variable compared to types of spaces. Correlational analyses between ease of maneuvering and psychological well-being in different spaces (Table 4-8) were conducted to answer the questions. The findings will be discussed in this chapter.

The reasons behind the challenges in different spaces were documented in Table 4-9 and Figure 4-8, which described different reasons for challenges while maneuvering.

Section 3: Do different elder ages, genders, cultures, locations, and climates have any influence on accessibility responses in residential settings?

From Table 4-12 to Table 4-16 elaborates variations in accessibility responses based on demographics- age, gender, culture, location, and climate. It is determined that there are different needs based on individuals' demographic conditions.

Drawing from these findings, the chapter proposes essential universal design elements tailored for elderly individuals with disabilities. Furthermore, the study acknowledges its limitations, including a brief duration for the online survey and a relatively small sample size. As a result, the conclusions are based on the study's findings while also highlighting the need for future research to conduct surveys over a longer duration throughout the year and include a more diverse sample size encompassing a wider range of demographics.

5.1 Demographics

From the Demographic Distribution table (Table 4-2), we got that one-third of the participants were at 75-84 years of age limit, and the second highest was 65-74. More than 50% of responses were from the highest age limit group of the survey, so anticipate getting the reflection of challenges. Additionally, more than one-third of the responses were from caregivers, who take care of the study group. They must have great knowledge of the maneuvering challenges and psychological well-being of the population.

The survey got most of the female responses (59%), while Asians and Whites took 1st and 2nd position regarding race. Oklahoma State dominated over other states and climate got the same responses from 3 types, hot and dry, hot and humid, and others. The result may be biased with the location and climate because we did not get any responses from northern locations and cold climatic conditions.

5.2 Accessibility Analysis

In this section, the most usable space in a home environment and the calculated level of challenges were analyzed. The data shows the ranking order of spaces from 1-9, 1 being the most used space and 9 being the least.

5.2.1 Frequently Used Spaces in a Home

Table 4-3 describes the space ranking according to usability. The Kitchen was found to be the most used space, and 27% of respondents ranked the Kitchen in 1st place. Comparing the weighted calculation there was a gap between the 1st and 2nd category, whereas Bathroom/ Toilet was in 2nd rank. Bedroom, Living/ Dining, and Main Entrance were 3rd, 4th, and 5th respectively, though they got more responses as 1st choice compared to Bathroom.

For seniors, the kitchen and the bathroom are the most problematic areas in a house, which is why they also present greater opportunities for improvement (Martin, I. et al., 2012). Research showed that the main place where the falling occurred was in the kitchen (Messias & Neves, 2009). The kitchen was the room that presented the highest number of complaints by seniors (Júnior, N. et al., 2013). In another study, the kitchen was marked for a high number of accidents, which gives a dangerous characteristic to the environment (Porto & Rezende, 2017). Each family must plan their kitchen based on their lifestyle, assuring an efficient and pleasant result. The kitchen's organization, the color used, and the distribution of the products in it are very important for the health and happiness of the users (Ricardo, *et al.,* 2005). The design attributes will be mentioned in Table 5-1.

5.2.2 Level of Challenges during Maneuvering

According to Table 4-4, it was observed that maneuvering posed the greatest challenges in the Living/Dining area, closely followed by the Main Entrance and then the Kitchen. On the other hand, the Kitchen received more 'difficulty' responses than other areas. This aligns with the earlier section's findings, which highlighted the Kitchen as the most utilized space, and in this section, it is the one with the highest number of responses indicating difficulty- 'somewhat difficult' or 'extremely difficult.' These results emphasize the Kitchen's significance as a focal point for attention.

The kitchen is the most expensive room to build in a house and the permanent nature of the kitchen's fixtures, such as its counters and cabinets, hampers the evolutional ability of the kitchen to meet life's progressively changing needs (Porto & Rezende, 2017). Therefore, the kitchen must be planned with universal design elements because a universal kitchen allows the house dwellers to use it auto-sufficiently (DeMerchant & Beamish, 1995).

5.3 Effect of Challenges during Maneuvering on Psychological Well-being

The data from Table 4-5 elaborated on how the challenges affect participants' psychological well-being and the mean value varied between 5 to 6. Among 22 responses for most of the spaces, the data expressed a homogenous figure (4-7) that leads to the two-way Analysis of Variance. Table 4-6 discussed the significance of the independent variables- Ease of Maneuvering, types of spaces, and space with ease of maneuvering, with the dependent variable- psychological well-being. It was found that Ease of Maneuvering had a significant relationship with psychological well-being, while the types of space had no significance. Additionally, space with ease of maneuvering had no significant interaction with the dependent variable. It can be determined from the result that the change of spaces will not affect the elderly psychological well-being, rather it will have a strong effect if the ease of maneuvering declines.

A Pearson correlation study examined the relationship between two variables and aimed to determine whether and to what extent changes in one variable are associated with changes in another. The correlation coefficient (r) was calculated for analysis to evaluate the relationship between the two continuous variables. Ease of Maneuvering and Psychological Well-being in the Kitchen had the strongest positive correlation (.832), which means if ease of maneuvering increases by 1-point, psychological well-being will increase by .832 and vice-versa. This proved a very significant and positive correlation between the two factors of the Kitchen. Considering the most used 5 spaces, the Main Entrance had the 2nd strong and positive significance, followed by Living/ Dining, and then Bathroom/ Toilet. Bedroom had found no significance between the mentioned factors.

The kitchen holds a central position as one of the most vital and popular spaces within a home, serving as a hub for various activities and social interactions (Miller, and Rama, 2011;

Sâmia, 2008). Because of its multifunctional nature, layout, counter height, and arrangement of appliances should have careful attention while designing the space. The emphasis on interaction with people is evident in the desire for a cohesive and pleasing arrangement of utensils, furniture, and appliances, reflecting a harmonious blend of functionality and style (Porto & Rezende, 2017).

5.4 Reasons for Challenges during Maneuvering

There were multiple reasons identified by the participants as the cause of their challenges in the specific space and documented in Table 4-9. Considering the most used 5 spaces, the reasons for challenges during maneuvering were-

Kitchen ---------- height of fixture

Bathroom/ Toilet ------- space to turn around, grab bar

Bedroom ---------- height of furniture

Living/ Dining ---------- height of furniture

Main Entrance ---------- floor level difference

Main Entrance floor level difference got the highest responses (12). In the Bedroom and Living/ Dining, there must be a variety of loose furniture, which may cause challenges, despite the layout planning. Bathroom and Kitchen were the most vulnerable spaces for the study population, regarding falls and accidents (Porto & Rezende, 2017), and these were also the most used spaces (Table 4-3). The study will suggest the design attributes for these spaces in Table 5-1.

In the descriptive analysis (Table 4-11), considering the 5 most usable spaces, Kitchen got the maximum difficulty response rate (47%), followed by Bathroom (39%) and Main Entrance (39%). Bedroom and Living/ Dining response rates for difficulty were relatively low, 33% and 19% respectively.

5.5 Variation in Accessibility Responses based on Demographics

Various demographic factors such as age, gender, culture, location, and climate contributed to differences in preferences. As people age, data from Table 4-12 indicated that the kitchen became the focal point of their home environment. While primarily used for food preparation, it also doubles as a dining area and a gathering spot for residents and guests. This social aspect is accentuated by the cooking process itself, turning the kitchen into a communal space (Porto & Rezende, 2017). This trend may be attributed to reduced outdoor activities and socialization among older individuals who prefer in-house activities. Mobility issues among friends and partners in this age group could also limit access to outdoor spaces, further influencing these choices.

Regarding gender, Females mostly used the Kitchen, while men were inclined to use the Main entrance and Bedroom. The Kitchen was the most used space for 33% of Asians, among Whites, it was the Living/ Dining (37%). Considering the State, clear data was not found because the demographics were dominated by Oklahomans, where Bedroom and Living/ Dining were the most used spaces with the same response rate of 29%. The Climate also did not receive a lot of diversified data, though the Kitchen was mentioned in all types with more responses.

5.6 Implication of Universal Design Elements

Data was gathered from individuals utilizing Universal Design elements in their home spaces, assessing their psychological well-being on a Likert scale ranging from 1 to 10, where 1 signified dissatisfaction and 10 represented satisfaction. According to the average scores shown in Table 4-17, all spaces exhibited increased satisfaction levels in contrast to existing challenges, with the Bathroom recording the most responses (6) and the highest level of satisfaction (8.00) when using Universal Design elements. The comparison is shown in Table 4-18.

In Table 4-19, data reporting was based on space usability, challenges during maneuvering, the effect of psychological well-being, and reasons behind the challenges- the 3 most responded reasons for each space were recorded. The study will suggest the design attributes for the most used 5 spaces in Table 5-1.

Table 5-1 Universal Design attributes in relationship to variables of different spaces

Space	**Variables**	**Universal Design attributes**
Kitchen	Accessible entrance	Door or doorway width
		Maneuvering clearance
		Door threshold
		Door hardware height
		Door weight
	Pathways and space to turn around	Pathway width
		Space to turn around
	Layout/ overall arrangement	Kitchen size
		Turn around between counter spaces
		Countertop height
		Countertop width to reach till end
		Countertop underneath space for whellchair
		Fixture arrangement
	Fixture/ Equipment	Sink
		Burner
		Oven
		Microwave
	Electrical points	Number of electrical points
		Position/ height to reach
		Operating type (rocker/ toggle/ push/ soft touch/ turning)
Bathroom/ Toilet	Accessible entrance	Door or doorway width
		Maneuvering clearance
		Door threshold
		Door hardware height

		Door weight
	Pathways and space to turn around	Pathway width
		Space to turn around
	Wheelchair-accessible bathroom stall	Clear floor space
		Toilet location to side wall
		Toilet seat height
		Grab bar location
		Grab bar height
	Wheelchair-accessible hand-washing station	Sink height
		Clear floor space
		Reach to faucet
	Shower space	Floor level difference
		Space to turn around
		Seater (presence/ height)
		Shower knob
		Grab bar
	Electrical points	Number of electrical points
		Position/ height to reach
		Operating type (rocker/ toggle/ push/ soft touch/ turning)
Bedroom	Accessible entrance	Door or doorway width
		Maneuvering clearance
		Door threshold
		Door hardware height
		Door weight
	Pathways and space to turn around	Pathway width
		Space to turn around
	Layout/ overall arrangement	Furniture layout/ arrangement
		Clear spaces between furniture
		Furniture height
		Furniture underneath space for wheelchair
	Electrical points	Number of electrical points
		Position/ height to reach

		Operating type (rocker/ toggle/ push/ soft touch/ turning)
Living/ Dining	Accessible entrance	Door or doorway width
		Maneuvering clearance
		Door threshold
		Door hardware height
		Door weight
	Pathways and space to turn around	Pathway width
		Space to turn around
	Layout/ overall arrangement	Furniture layout/ arrangement
		Clear spaces between furniture
		Furniture height
		Furniture underneath space for wheelchair
	Electrical points	Number of electrical points
		Position/ height to reach
		Operating type (rocker/ toggle/ push/ soft touch/ turning)
Main Entrance	Ramp/ Stair	Ramp or Stair
		Ramp/ stair width
		Ramp slope
		Handrail/ railing
	Space before entrance and pathways	Dimension of space before entrance
		Door swing
		Pathway width
		Space to turn around
	Accessible entrance	Door/ doorway width
		Maneuvering clearance
		Door threshold
		Door hardware height
		Door weight
	Seating/ Furniture	Seater presence
		Seater height
		Countertop presence for bags/ keys

According to accessibility responses, the study elaborates on the two most used spaces and the three reasons to feel challenged within these spaces. The following are suggestive UD elements to ease the maneuvering in the Kitchen and Bathroom.

5.6.1 Kitchen

Table 5-2 List of home features with characteristics and benefits: Kitchen

Kitchen	Space	• Space between face of cabinets and walls. • 30"x48" clear floor space	• Usable by children, shorter adults and disabled.
	Height	• Clear knee space under table and sink. • Adjustable height in wall cabinet. • Max reach controls 24"x46"	• Allow person to work while seat (e.g. wheelchair users).

Source: City of Irvine, 2014; The Center for Universal Design College of Design (CUDC), 2006 (Kalkhalah & Rosilawati, 2015)

5.6.1.1 Accessible entrance

The required door dimension is at least 32" when opens 90 degrees and the hardware mounted no higher than 48 inches above the floor (Levine, 2003). The kitchen entrance should be clear and barrier-free for any kind of mobility device users. For maximum accessibility, maintain a minimum distance of 42" to 48" between counters when planning an aisle (Lawlor & Thomas, 2008).

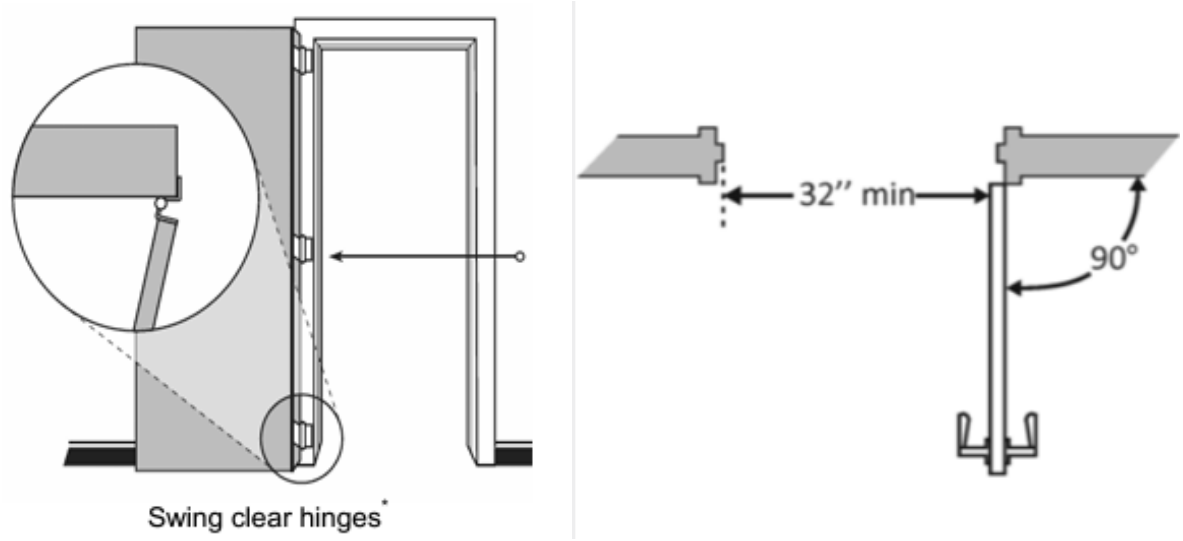


Figure 5-1 Accessible entrance doorway with clear dimension
Source:(Lawlor & Thomas, 2008)

5.6.1.2 Pathways and space to turn around

The standard dimensions and placement of the kitchen components- cabinetry, plumbing, electrical, ventilation, and appliances, prohibit spaces from being fully accessible to those with a physical disability (Lawlor & Thomas, 2008). There should be clear floor space for turning a wheelchair if the kitchen counter is closed on the other side/ dead-end.

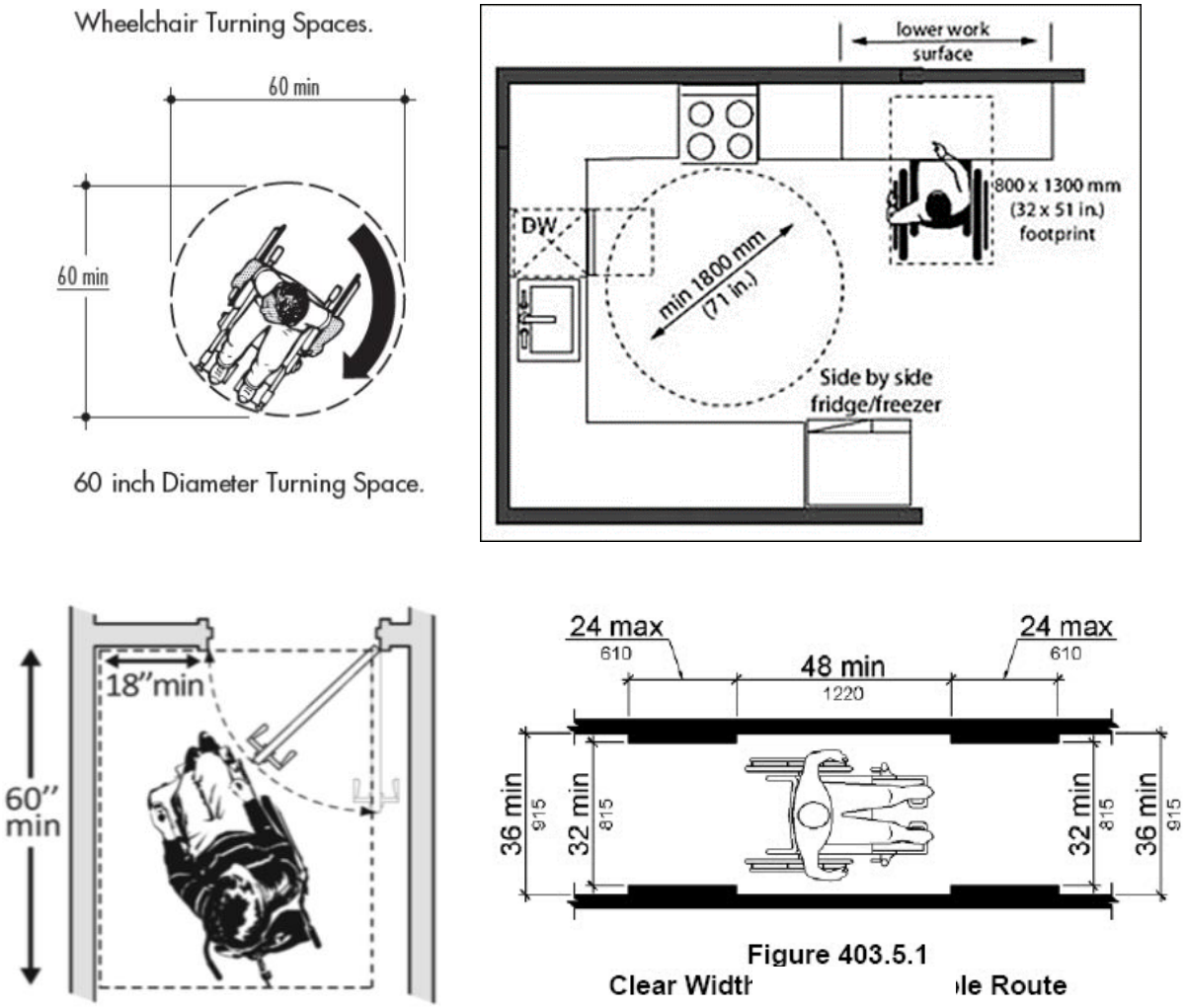


Figure 5-2 Accessible pathway and turning radius clear dimension
Source:(Lawlor & Thomas, 2008)

5.6.1.3 Fixture/ Equipment

Although there are several kitchen layouts, there are four primary types-

1. I-shaped, in which the storage area, cleaning station, and cooking station are located on the same wall
2. L-shaped, in which the stations formerly mentioned are distributed between two walls
3. U-shaped, in which the stations are present in three walls and

4. Island-shaped, in which the stations are distributed considering the existence of a central sector (Costa, *et al.*, 2009)

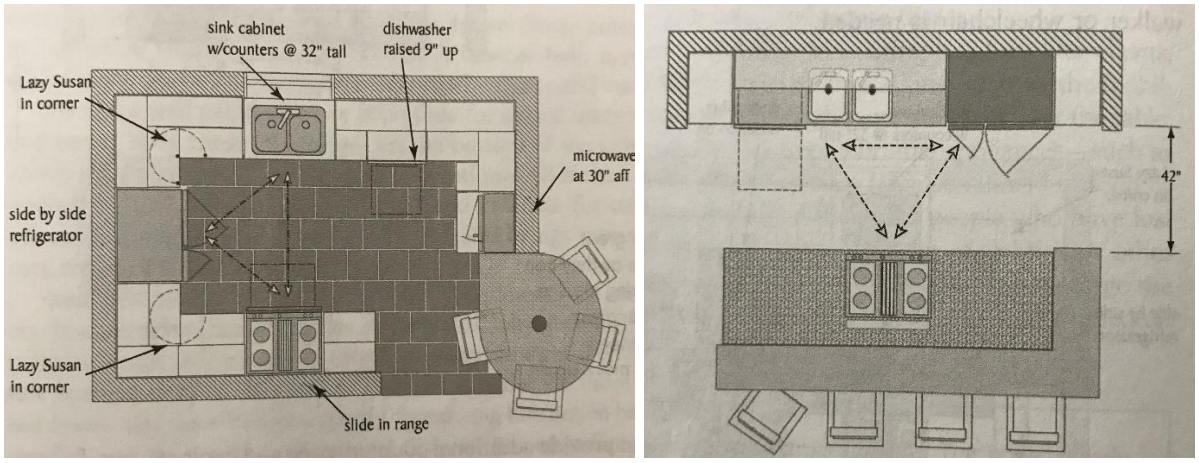


Figure 5-3 Kitchen plan with work triangle
Source: (Lawlor & Thomas, 2008)

The most basic kitchen layout concept is the one that minimizes walking and has clean and clear paths between the workstations. Traditionally, the kitchen layout was a triangle, but currently, with the use of appliances, the kitchen may have four or more stations. The distance between these stations must be greater than 1.2 m and less than 2.75 m, and if there is an island or obstacle, it must not obstruct the path by more than 30 cm (Mitchell, 2017).

The organization of the activities performed in the kitchen, its layouts, and its design depends upon the sociocultural and historical context in which they are present. This influences the actions and desires of people while also creating some of the problems that seniors experience (Johanssona et al., 2011). A counter with a space underneath it for people's knees creates a dual purpose for the counter, allowing for eating or studying. The different heights of the counter assist in food preparation while seated and reduce fatigue for shorter people (Porto & Rezende, 2017).

The appliances must be stored with lower-reach and easy-to-reach access in mind, so they can be retrieved with greater ease (Flores, 2010). In an L-shaped kitchen, the appliances can be stored in the corner, which allows a senior easier access to the items (Boschetti, 2002).

Regarding the sinks, faucets with single-lever controls are best for people who have difficulty securely grasping the controls (Flores, 2010). The sinks should be at a lower height, have space underneath to provide adequate wheelchair access, and have a spray hose that facilitates watering dishes and vegetables (Ma, 2002). Having frontal or lateral controls lowers burn risks, and press buttons are easier to use (Porto & Rezende, 2017).

5.6.2 Bathroom/ Toilet

Table 5-3 List of home features with characteristics and benefits: Kitchen
Source: City of Irvine, 2014; The Center for Universal Design College of Design (CUDC), 2006

Bathrooms and toilet	Space	• Provide clear floor space • Curbless shower	• Space for transfers to/from toilet.
	Handrail	• Provide handrails	• Easy to grab and move.
	Handle, faucet, control.	• Single lever handles	• Easy to open.
	Dimension	• 36"x69" toilet with min 32" width door.	• Accessible.

(Kalkhalah & Rosilawati, 2015)

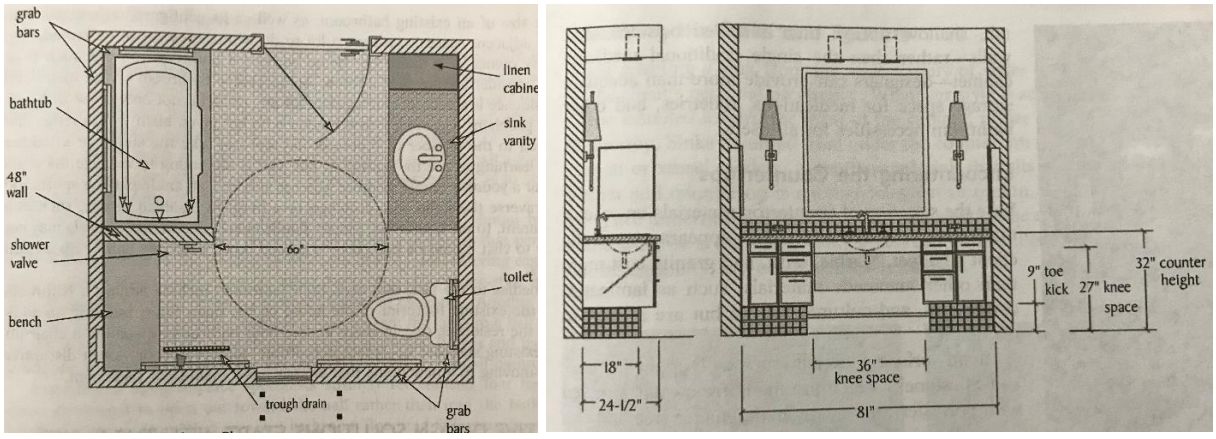


Figure 5-4 Accessible bathroom plan and elevation
Source: (Lawlor & Thomas, 2008)

5.6.2.1 Grab bar and Height of fixture

Grab bars are critical elements to mobility; they can aid in the safe transfer of someone on and off the toilet; they provide a secure grip for someone getting in and out of a toilet/ shower/ bathtub (Lawlor & Thomas, 2008). The height and position of grab bars are shown in the following picture-

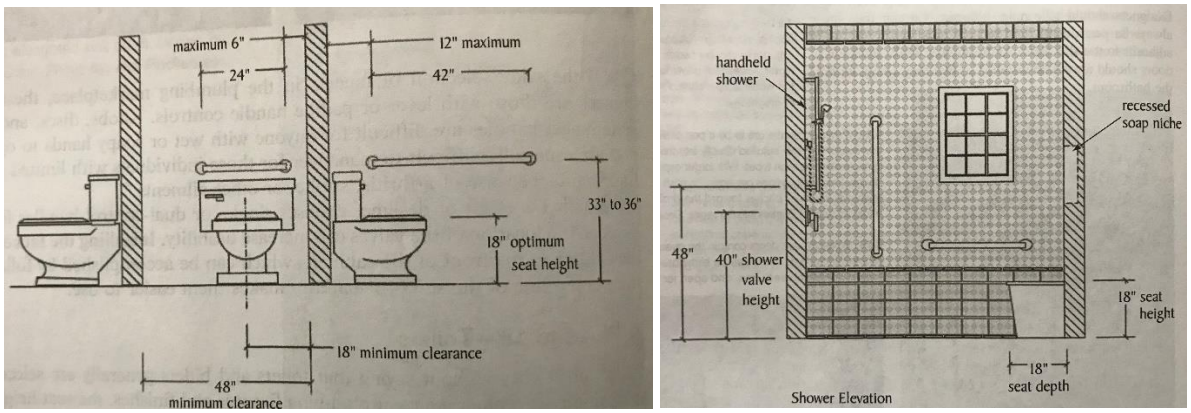


Figure 5-5 Accessible bathroom elevation and Shower section
Source: (Lawlor & Thomas, 2008)

5.6.2.2 Space to turn around

As discussed in the previous section (figure 5-2)

5.6.2.3 Entrance door

As discussed in the previous section (figure 5-1)

5.7 Summary

Universal Design (UD) is inherently adaptable, and its preferences may vary based on demographics and individual lifestyles. Here are some ideas showcasing how UD can change its focus to accommodate different groups:

Age-Related Focus: Older adults prioritized features like fixture height in the kitchen, grab bars in the bathroom, wider doorways for easier mobility in all spaces, and space for turning radius.

Gender-Specific Considerations: UD can consider gender-specific needs by offering customizable features. For instance, adjustable-height countertops can benefit individuals of different heights and preferences, including those who may prefer sitting while working in the kitchen.

Cultural Sensitivity: Incorporating cultural elements into UD can be essential. This could mean designing spaces that accommodate cultural cooking practices, religious rituals, or communal gathering areas that align with specific cultural norms.

Location and Climate: UD can adapt to regional differences in climate and location. For example, in warmer climates, the focus might be on natural ventilation, shading, and materials that reduce heat absorption. In colder regions, emphasis may be on insulation, heated flooring, and accessibility during snowfall.

Health and Mobility Needs: UD can address varying health and mobility needs. This could range from installing ramps and elevators for wheelchair users to incorporating soft-touch electrical points/ fixtures.

Lifestyle Preferences: UD can cater to different lifestyles and preferences. For example, incorporating outdoor living spaces for those who enjoy gardening or relaxing outdoors, or want to socialize.

Multi-Generational Living: Homes designed with UD principles can be adaptable for multi-generational living. This may involve flexible layouts, separate living spaces, and shared communal areas that meet the needs and preferences of different demographics.

Chapter 6: Conclusion

The rapid growth of the elderly population has amplified concerns and discussions about their well-being, leading to a focus on solutions. The concept of active aging has been extensively researched to enhance seniors' quality of life. Defined by WHO (2005), active aging emphasizes autonomy, allowing seniors to recognize their physical, social, and mental capacities (Kalkhalah & Rosilawati, 2015). This approach facilitates their participation in society while honoring their capabilities, preferences, and needs, ultimately aiming to promote their overall well-being. The home environment should be designed to encourage socialization for all senior citizens, which will have a positive effect on psychological well-being.

The flexibility of Universal Design allows for the incorporation of innovative solutions that address unique challenges faced by individuals, ensuring that no one is left behind or excluded from participating fully in society. By tailoring Universal Design principles to specific demographics, such as age, gender, culture, location, and climate, we can create environments that are truly inclusive and accessible to everyone. Emphasizing individual preferences within Universal Design fosters a sense of satisfaction, enabling people to live more independently and comfortably in their environments.

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Appendix I – Survey Instrument

Psychological Wellbeing for Elderly

Start of Block: Background Information

1-a **Consent to Participate in Research at the University of Oklahoma** OU-NC IRB Number: 16832 Approval Date: 01/30/2024

1-b I am Naila Hasan from the Division of Interior Design, and I invite you to participate in my research entitled Psychological Well-Being for Elderly Population with Disability: Implications of Universal Design. This research is being conducted through social media and snowball sampling and survey participants will be recruited for online survey. You were selected as a possible participant because you are a person with age-related disability living in your home or a caregiver of such person, and you must be at least 18 years of age to participate in this research.

Please read this document and contact me to ask any questions you may have BEFORE agreeing to participate in my research.

What is the purpose of this research?

The purpose of the study is to identify the relationship between psychological well-being of elders with age related disabilities and universal design within the built environment. The motive of the study is to draw a comparison between the current situation and the standard of universal design. The study will correlate the different psychological effects and the impacts of UD elements on elderly with disabilities.

How many participants will be in this research? About 200-250 people will take part in this research.

What will I be asked to do? If you agree to be in this research, you will complete a 15-minutes online survey. The survey is voluntary and you can quit the survey anytime.

What are the risks and benefits if I participate? There are no risks and no benefits from being in this research as all data are collected anonymously.

Data collected online: The organization hosting the data collection platform has its own privacy and security policies for keeping your information confidential. There is a risk that the external organization, which is not part of the research team, may gain access to or retain your data or your IP address which could be used to re-identify you. No assurance can be made as to their use of the data you provide for purposes other than this research.

Will I be compensated for participating? You will not be reimbursed for your time and participation in this research.

Who will see my information? There will be no information in research reports that will make it possible to identify you. Research records will be stored securely, and only approved researchers and the OU Institutional Review Board will have access to the records.

Do I have to participate? No. If you do not participate, you will not be penalized or lose benefits or services unrelated to the research. If you decide to participate, you don't have to answer any questions and can stop participating at any time.

Will my identity be anonymous or confidential? This survey is anonymous, and no name or address will be collected.

What will happen to my data in the future? We will not share your data with others outside the research team, however the deidentified data can be used for future research publication without obtaining additional consent from you.

Who do I contact with questions, concerns, or complaints? If you have questions, concerns, or complaints about the research or have experienced a research-related injury, contact me at (405) 325-4528 or suchi@ou.edu or (806) 283-5493 or naila.hasan-1@ou.edu

You can also contact the University of Oklahoma – Norman Campus Institutional Review Board (OU-NC IRB) at 405-325-8110 or irb@ou.edu if you have questions about your rights as a research participant, concerns, or complaints about the research and wish to talk to someone other than the researcher(s) or if you cannot reach the researcher(s).

Please print this document for your records. By providing information to the researcher(s), I am agreeing to participate in this research.

IRB # 16832 IRB Approval Date: 01/30/2024

2-a Are you 18 years of age or older?

- ○ Yes (1)
- ○ No (2)

Skip To: End of Survey If Are you 18 years of age or older? = No

---

2-b1 Do you have any kind of age related disability/accessibility issues? i.e., mobility difficulty/ falls issues/ foot and/or knee problem/ walking difficulty/ gra difficulty/ others

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Do you have any kind of age related disability/accessibility issues? i.e., mobility difficulty/ f... = No

2-b2 Are you currently a caregiver for somebody with age related disability/accessibility issues? i.e., mobility difficulty/ falls issues/ foot and/or knee problem/ walking difficulty/ grabbing difficulty/ others

- ○ Yes (1)
- ○ No (2)

Skip To: End of Survey If Are you currently a caregiver for somebody with age related disability/accessibility issues? i.e.... = No

2-c Do you currently use a mobility device or is currently a caregiver for somebody using a mobility device (wheelchair, scooter, walker etc.)?

- ○ Yes (1)
- ○ No (2)

3-a What is your age?

- ○ 18 to 24 years (10)
- ○ 25 to 34 years (8)
- ○ 35 to 44 years (7)
- ○ 45 to 54 years (1)
- ○ 55 to 64 years (2)
- ○ 65 to 74 years (3)
- ○ 75 to 84 years (4)
- ○ 85 and more, please specify (5) _____

3-b What is your gender?

- ○ Male (1)
- ○ Female (2)
- ○ Other, please specify (5) _____
- ○ Do not want to share (6)

3-c What is your race?

- ○ American Indian or Alaska Native (1)
- ○ Asian (2)
- ○ Black or African American (6)
- ○ Native Hawaiian or Other Pacific Islander (8)
- ○ White (5)
- ○ Other, please specify (9) _____

3-d In which state do you currently reside?

▼ Alabama (1) ... I do not reside in the United States (53)

Display This Question:

If 50 States, D.C. and Puerto Rico = I do not reside in the United States

3-d1 What is your country of residence?

_____

3-e Which option best describes the predominant climate in your region?

- ○ Hot and Dry (9)
- ○ Cold and Dry (10)
- ○ Hot and Humid (11)
- ○ Cold and Humid (12)
- ○ Other, please specify (1) _____

End of Block: Background Information

Start of Block: Section 1: Space specific information

4-a Please arrange your selected spaces sequentially according to usability (1 will be the most used one and 5 will be the least one), you can drag and arrange

_____ Main Entrance (2)
_____ Kitchen (3)
_____ Bathroom/ Toilet (4)
_____ Bedroom (5)
_____ Access routes (hallway, corridor etc.) (6)
_____ Living/Dining (7)
_____ Backyard (9)
_____ Patio (11)
_____ Other (10)

4-b What day-to-day challenges you feel when maneuvering/ accessing in the listed spaces.

	Extremely easy (1)	Somewhat easy (2)	Neutral (3)	Somewhat difficult (4)	Extremely difficult (5)
Main Entrance (Q12_1)	☐	☐	☐	☐	☐
Kitchen (2-2a_3)	☐	☐	☐	☐	☐
Bathroom/ Toilet (3-b_4)	☐	☐	☐	☐	☐
Bedroom (3-b_5)	☐	☐	☐	☐	☐
Access routes (hallways, corridor etc.) (2-2a_2)	☐	☐	☐	☐	☐
Living/ Dining (3-b_6)	☐	☐	☐	☐	☐
Backyard (3-b_7)	☐	☐	☐	☐	☐
Patio (3-b_8)	☐	☐	☐	☐	☐
Other (3-b_9)	☐	☐	☐	☐	☐
Other (4-b_10)	☐	☐	☐	☐	☐
Other (4-b_11)	☐	☐	☐	☐	☐
Other (4-b_12)	☐	☐	☐	☐	☐

4-c How does these challenges affect your psychological well-being

	Dissatisfied Neutral Satisfied 1 2 3 4 5 6 7 8 9 10
Main Entrance ()	
Kitchen ()	
Bathroom/ Toilet ()	
Bedroom ()	
Access routes (hallways, aisles, pathways, etc.) ()	
Living/ Dining ()	
Backyard ()	
Patio ()	
Other ()	

4-d What are the reasons that you feel these challenges when maneuvering/ accessing in the listed spaces.

	entrance door (1)	space to turn around (2)	floor level difference (3)	front/ side reach (4)	finish material (5)	grab bar (6)	height of fixture/ furniture (7)	other (8)
Main Entrance (Q12_1)	☐	☐	☐	☐	☐	☐	☐	☐
Kitchen (2-2a_3)	☐	☐	☐	☐	☐	☐	☐	☐
Bathroom/ Toilet (3-b_4)	☐	☐	☐	☐	☐	☐	☐	☐
Bedroom (3-b_5)	☐	☐	☐	☐	☐	☐	☐	☐
Access routes (hallways, corridor etc.) (2-2a_2)	☐	☐	☐	☐	☐	☐	☐	☐
Living/ Dining (3-b_6)	☐	☐	☐	☐	☐	☐	☐	☐
Backyard (3-b_7)	☐	☐	☐	☐	☐	☐	☐	☐
Patio (3-b_8)	☐	☐	☐	☐	☐	☐	☐	☐
Other (3-b_9)	☐	☐	☐	☐	☐	☐	☐	☐

End of Block: Section 1: Space specific information

Start of Block: Section 2: Universal design related information

5-a Are you aware ofuniversal design? (Universal design is the design of buildings, products or environments to make them accessible to people, regardless of age, disability or other factors. It

addresses common barriers to participation by creating things that can be used by the maximum number of people possible.)

- ○ Yes (1)
- ○ No (2)

5-b Do you have any universal design elements in your listed spaces to mitigate your current challenges within your home?

- ○ Yes (1)
- ○ No (2)

Skip To: End of Block If Do you have any universal design elements in your listed spaces to mitigate your current challeng... = No

5-c Please select the spaces that have universal design elements in your home

- ☐ Main Entrance (2)
- ☐ Kitchen (3)
- ☐ Bathroom/ Toilet(s) (4)
- ☐ Bedroom(s) (5)
- ☐ Access routes (hallway, corridor etc.) (6)
- ☐ Living/ Dining (7)
- ☐ Patio (11)
- ☐ Backyard (9)
- ☐ Other (10) _____

5-d How do the universal design elements affect your psychological well-being?

	Dissatisfied 1 2 3 4 5 6 7 8 9 10 Satisfied
Main Entrance ()	
Kitchen ()	
Bathroom/ Toilet ()	
Bedroom ()	
Access routes (hallways, aisles, pathways, etc.) ()	
Living/ Dining ()	
Patio ()	
Backyard ()	
Other, if specified before ()	

5-e Do you have any plan to add/ change/ renovate any space to accommodate universal design elements in your home (ramp, grab bars etc.)?

- ○ Yes (1)
- ○ No (2)

End of Block: Section 2: Universal design related information

Start of Block: Section 3: Accessibility Experience

Display This Question:

If Please select the spaces that have universal design elements in your home = Main Entrance

6-a Please select the accessibility level you experience when maneuvering in the following areas.

Main Entrance:

	Extremely easy (1)	Somewhat easy (2)	Neutral (3)	Somewhat difficult (4)	Extremely difficult (6)
Ramp/ Stair (6)	○	○	○	○	○
Space before entrance and pathways (2)	○	○	○	○	○
Accessible entrance (1)	○	○	○	○	○
Seating/ Furniture (4)	○	○	○	○	○
Other, please specify (7)	○	○	○	○	○

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Mai... = Ramp/ Stair [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Mai... = Ramp/ Stair [Extremely difficult]

6-b Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Main Entrance: Ramp/ Stair

- ☐ Ramp or Stair, please specify (4) _____
- ☐ Ramp/ stair width (1)
- ☐ Ramp slope (2)
- ☐ hand rail/ railing (5)
- ☐ Other: Please specify (3) _____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Mai... = Space before entrance and pathways [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Mai... = Space before entrance and pathways [Extremely difficult]

6-c Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Main Entrance: Space before entrance and pathways

- ☐ Dimension of space before entrance (4)
- ☐ Door swing (5)
- ☐ Pathway width (1)
- ☐ Space to turn around (2)
- ☐ Other: Please specify (3)

_____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Mai... = Accessible entrance [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Mai... = Accessible entrance [Extremely difficult]

6-d Based on your response...
Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*
Main Entrance: Accessible entrance

- ☐ Door or doorway width (1)
- ☐ Maneuvering clearance (2)
- ☐ Door threshold (3)
- ☐ Door hardware height (4)
- ☐ Door weight (5)
- ☐ Other: Please specify (6)

_____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Mai... = Seating/ Furniture [Somewhat difficult]

And Please select the accessibility level you experience when maneuvering in the following areas. Mai... = Seating/ Furniture [Extremely difficult]

6-e Based on your response...
Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*
Main Entrance: Seating/ Furniture

- ☐ Seater presence (1)
- ☐ Seater height (2)
- ☐ Countertop presence for bags/ keys (4)
- ☐ Other, please specify (5)

_____

Display This Question:

If Please select the spaces that have universal design elements in your home = Kitchen

7-a Please select the accessibility level you experience when maneuvering in the following areas.

Kitchen:

	Extremely easy (1)	Somewhat easy (2)	Neutral (3)	Somewhat difficult (4)	Extremely difficult (6)
Accessible entrance (1)	○	○	○	○	○
Pathways and space to turn around (2)	○	○	○	○	○
Layout/ overall arrangement (countertop height/ measurement) (6)	○	○	○	○	○
Fixture/ Equipment (position, height, reach, type of operating knob etc.) (3)	○	○	○	○	○
Electrical points (numbers, type, position, height, reach) (7)	○	○	○	○	○
Other, please specify (8)	○	○	○	○	○

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Kit... = Accessible entrance [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Kit... = Accessible entrance [Extremely difficult]

7-b Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that

apply. *Click on the image for more information.*

Kitchen: Accessible entrance

- ☐ Door or doorway width (1)
- ☐ Maneuvering clearance (2)
- ☐ Door threshold (3)
- ☐ Door hardware height (4)
- ☐ Door weight (5)
- ☐ Other: Please specify (6) _____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Kit... = Pathways and space to turn around [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Kit... = Pathways and space to turn around [Extremely difficult]

7-c Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Kitchen: Pathways and space to turn around

- ☐ Pathway width (1)
- ☐ Space to turn around (2)
- ☐ Other: Please specify (3) _____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Kit... = Layout/ overall arrangement (countertop height/ measurement) [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Kit... = Layout/ overall arrangement (countertop height/ measurement) [Extremely difficult]

7-d Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Kitchen: Layout/ overall arrangement (countertop height/ measurement)

- ☐ Kitchen size (1)
- ☐ Turn around between counter spaces (2)
- ☐ Countertop height (4)
- ☐ Countertop width to reach till end (5)
- ☐ Countertop underneath space for wheelchair (6)
- ☐ Fixture arrangement (7)
- ☐ Other: Please specify (3)

_____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Kit... = Fixture/ Equipment (position, height, reach, type of operating knob etc.) [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Kit... = Fixture/ Equipment (position, height, reach, type of operating knob etc.) [Extremely difficult]

7-e Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Kitchen: Fixture/ Equipment (position, height, reach, type of operating knob etc.)

- ☐ Sink (1)
- ☐ Burner (2)
- ☐ Oven (4)
- ☐ Microwave (5)
- ☐ Other: Please specify (3)

_____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Kit... = Electrical points (numbers, type, position, height, reach) [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Kit... = Electrical points (numbers, type, position, height, reach) [Extremely difficult]

7-f Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Kitchen: Electrical points (numbers, type, position, height, reach)

- ☐ Number of Electrical points (1)
- ☐ Position/ height to reach (2)
- ☐ Operating type (rocker/ toggle/ push/ soft touch/ turning) (4)
- ☐ Other: Please specify (3)

_____

Display This Question:

If Please select the spaces that have universal design elements in your home = Bathroom/ Toilet(s)

8-a

Please select the accessibility level you experience when maneuvering in the following areas.

Bathroom/ Toilet room(s):

	Extremely easy (1)	Somewhat easy (2)	Neutral (3)	Somewhat difficult (4)	Extremely difficult (6)
Accessible entrance (1)	○	○	○	○	○
Pathways and space to turn around (2)	○	○	○	○	○
Wheelchair accessible bathroom stall (3)	○	○	○	○	○
Wheelchair accessible hand-washing station (4)	○	○	○	○	○
Shower space (6)	○	○	○	○	○
Electrical points (numbers, type, position, height, reach) (8)	○	○	○	○	○
Other, please specify (7)	○	○	○	○	○

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Bat... = Accessible entrance [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Bat... = Accessible entrance [Extremely difficult]

8-b Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Bathroom/ Toilet room(s): Accessible entrance

- ☐ Door or doorway width (1)
- ☐ Maneuvering clearance (2)
- ☐ Door threshold (3)
- ☐ Door hardware height (4)
- ☐ Door weight (5)
- ☐ Other: Please specify (6) _____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Bat... = Pathways and space to turn around [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Bat... = Pathways and space to turn around [Extremely difficult]

8-c Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Bathroom/ Toilet room(s): Pathways and space to turn around

- ☐ Pathway width (1)
- ☐ Space to turn around (2)
- ☐ Other: Please specify (3) _____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Bat... = Wheelchair accessible bathroom stall [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Bat... = Wheelchair accessible bathroom stall [Extremely difficult]

8-d Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Bathroom/ Toilet room(s): Wheelchair accessible bathroom stall

- ☐ Clear floor space (2)
- ☐ Toilet location to side wall(s) (3)
- ☐ Toilet seat height (4)
- ☐ Grab bar(s) location to toilet (5)
- ☐ Grab bar(s) height (6)
- ☐ Other: Please specify (7) _____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Bat... = Wheelchair accessible hand-washing station [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Bat... = Wheelchair accessible hand-washing station [Extremely difficult]

8-e Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Bathroom/ Toilet room(s): Hand washing station

- ☐ Sink height (1)
- ☐ Clear floor space (approach space, knee clearance, toe clearance) (2)
- ☐ Reach to faucet (3)
- ☐ Other: Please specify (4) _____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Bat... = Shower space [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Bat... = Shower space [Extremely difficult]

8-f Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Bathroom/ Toilet room(s): Shower space

- ☐ Floor level difference (3)
- ☐ Maneuvering clearance/ space to turn around (2)
- ☐ Seater (presence/ height) (1)
- ☐ Shower knob (type/ height) (5)
- ☐ Grab bar (presence/ position) (7)
- ☐ Other: Please specify (6)

_____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Bat... = Electrical points (numbers, type, position, height, reach) [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Bat... = Electrical points (numbers, type, position, height, reach) [Extremely difficult]

8-g Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Bathroom/ Toilet room(s): Electrical points (numbers, type, position, height, reach)

- ☐ Number of Electrical points (1)
- ☐ Position/ height to reach (2)
- ☐ Operating type (rocker/ toggle/ push/ soft touch/ turning) (4)
- ☐ Other: Please specify (3) _____

Display This Question:

If Please select the spaces that have universal design elements in your home = Bedroom(s)

9-a Please select the accessibility level you experience when maneuvering in the following areas.

Bedroom(s):

	Extremely easy (1)	Somewhat easy (2)	Neutral (3)	Somewhat difficult (4)	Extremely difficult (6)
Accessible entrance (1)	○	○	○	○	○
Pathways and space to turn around (2)	○	○	○	○	○
Layout/ overall arrangement (position, height, clear space etc.) (3)	○	○	○	○	○
Electrical points (numbers, type, position, height, reach) (8)	○	○	○	○	○
Other, please specify (7)	○	○	○	○	○

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Bed... = Accessible entrance [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Bed... = Accessible entrance [Extremely difficult]

9-b Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Bedroom(s): Accessible entrance

- ☐ Door or doorway width (1)
- ☐ Maneuvering clearance (2)
- ☐ Door threshold (3)
- ☐ Door hardware height (4)
- ☐ Door weight (5)
- ☐ Other: Please specify (6) _____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Bed... = Pathways and space to turn around [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Bed... = Pathways and space to turn around [Extremely difficult]

9-c Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Bedroom(s): Pathways and space to turn around

- ☐ Pathway width (1)
- ☐ Space to turn around (2)
- ☐ Other: Please specify (3) _____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Bed... = Layout/ overall arrangement (position, height, clear space etc.) [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Bed... = Layout/ overall arrangement (position, height, clear space etc.) [Extremely difficult]

9-d Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Bedroom: Layout/ overall arrangement (position, height, clear space etc.)

- ☐ Furniture layout/ arrangement (1)
- ☐ Clear spaces between furniture to move wheelchair (2)
- ☐ Furniture height (4)
- ☐ Furniture underneath space for wheelchair to reach till end (6)
- ☐ Other: Please specify (3) _____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Bed... = Electrical points (numbers, type, position, height, reach) [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Bed... = Electrical points (numbers, type, position, height, reach) [Extremely difficult]

9-e Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Bedroom(s): Electrical points (numbers, type, position, height, reach)

- ☐ Number of Electrical points (1)
- ☐ Position/ height to reach (2)
- ☐ Operating type (rocker/ toggle/ push/ soft touch/ turning) (4)
- ☐ Other: Please specify (3)

_____

Display This Question:

If Please select the spaces that have universal design elements in your home = Access routes (hallway, corridor etc.)

10-a

Please select the accessibility level you experience when maneuvering in the following areas.

Access routes (hallway, corridor etc.):

	Extremely easy (1)	Somewhat easy (2)	Neutral (3)	Somewhat difficult (4)	Extremely difficult (6)
Accessible entrance (1)	○	○	○	○	○
Pathways and space to turn around (2)	○	○	○	○	○
Layout/ overall arrangement (position, height, reach etc.) (6)	○	○	○	○	○
Electrical points (numbers, type, position, height, reach) (8)	○	○	○	○	○
Other, please specify (7)	○	○	○	○	○

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Acc... = Accessible entrance [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Acc... = Accessible entrance [Extremely difficult]

10-b Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Access routes (hallway, corridor etc): Accessible entrance

- ☐ Door or doorway width (1)
- ☐ Maneuvering clearance (2)
- ☐ Door threshold (3)
- ☐ Door hardware height (4)
- ☐ Door weight (5)
- ☐ Other: Please specify (6)

_____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Acc... = Pathways and space to turn around [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Acc... = Pathways and space to turn around [Extremely difficult]

10-c Based on your response...
Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Access routes (hallway, corridor etc.): Pathways and space to turn around

- ☐ Pathway width (1)
- ☐ Space to turn around (2)
- ☐ Other: Please specify (3) _____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Acc... = Layout/ overall arrangement (position, height, reach etc.) [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Acc... = Layout/ overall arrangement (position, height, reach etc.) [Extremely difficult]

10-d Based on your response...
Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Access routes (hallway, corridor etc.): Layout/ overall arrangement (position, height, clear space etc.)

- ☐ Furniture layout/ arrangement (1)
- ☐ Clear spaces between furniture to move wheelchair (2)
- ☐ Furniture height (4)
- ☐ Furniture underneath space for wheelchair to reach till end (6)
- ☐ Other: Please specify (3) _____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Acc... = Electrical points (numbers, type, position, height, reach) [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Acc... = Electrical points (numbers, type, position, height, reach) [Extremely difficult]

10-e Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Access routes (hallway/ corridor): Electrical points (numbers, type, position, height, reach)

- ☐ Number of Electrical points (1)
- ☐ Position/ height to reach (2)
- ☐ Operating type (rocker/ toggle/ push/ soft touch/ turning) (4)
- ☐ Other: Please specify (3)

_____

Display This Question:

If Please select the spaces that have universal design elements in your home = Living/ Dining

11-a

Please select the accessibility level you experience when maneuvering in the following areas.

Living/ Dining:

	Extremely easy (1)	Somewhat easy (2)	Neutral (3)	Somewhat difficult (4)	Extremely difficult (6)
Accessible entrance (1)	○	○	○	○	○
Pathways and space to turn around (2)	○	○	○	○	○
Layout/ overall arrangement (position, height, reach etc.) (6)	○	○	○	○	○
Electrical points (numbers, type, position, height, reach) (8)	○	○	○	○	○
Other, please specify (7)	○	○	○	○	○

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Liv... = Accessible entrance [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Liv... = Accessible entrance [Extremely difficult]

11-b Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Living/ Dining: Accessible entrance

- ☐ Door or doorway width (1)
- ☐ Maneuvering clearance (2)
- ☐ Door threshold (3)
- ☐ Door hardware height (4)
- ☐ Door weight (5)
- ☐ Other: Please specify (6)

_____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Liv... = Pathways and space to turn around [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Liv... = Pathways and space to turn around [Extremely difficult]

11-c Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Living/ Dining: Pathways and space to turn around

- ☐ Pathway width (1)
- ☐ Space to turn around (2)
- ☐ Other: Please specify (3)

_____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Liv... = Layout/ overall arrangement (position, height, reach etc.) [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Liv... = Layout/ overall arrangement (position, height, reach etc.) [Extremely difficult]

11-d Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Living/ Dining: Layout/ overall arrangement (position, height, clear space etc.)

- ☐ Furniture layout/ arrangement (1)
- ☐ Clear spaces between furniture to move wheelchair (2)
- ☐ Furniture height (4)
- ☐ Furniture underneath space for wheelchair to reach till end (6)
- ☐ Other: Please specify (3)

_____

Display This Question:

If Please select the accessibility level you experience when maneuvering in the following areas. Liv... = Electrical points (numbers, type, position, height, reach) [Somewhat difficult]

Or Please select the accessibility level you experience when maneuvering in the following areas. Liv... = Electrical points (numbers, type, position, height, reach) [Extremely difficult]

11-e Based on your response...

Please select the design factors that affect your experienced accessibility. Select all factors that apply. *Click on the image for more information.*

Living/ Dining: Electrical points (numbers, type, position, height, reach)

- ☐ Number of Electrical points (1)
- ☐ Position/ height to reach (2)
- ☐ Operating type (rocker/ toggle/ push/ soft touch/ turning) (4)
- ☐ Other: Please specify (3) _____

Display This Question:

If Please select the spaces that have universal design elements in your home = Patio

12-a

Please select the accessibility level you experience when maneuvering in the following areas. **Patio:**

	Extremely easy (1)	Somewhat easy (2)	Neutral (3)	Somewhat difficult (4)	Extremely difficult (6)
Accessible entrance (1)	○	○	○	○	○
Pathways and space to turn around (2)	○	○	○	○	○
Layout/ Furniture arrangement (position, height, reach etc.) (6)	○	○	○	○	○
Electrical points (numbers, type, position, height, reach) (8)	○	○	○	○	○
Other, please specify (7)	○	○	○	○	○

Display This Question:

If Please select the spaces that have universal design elements in your home = Backyard

13-a Please select the accessibility level you experience when maneuvering in the following areas.

Backyard:

	Extremely easy (1)	Somewhat easy (2)	Neutral (3)	Somewhat difficult (4)	Extremely difficult (6)
Accessible entrance (1)	○	○	○	○	○
Pathways and space to turn around (2)	○	○	○	○	○
Ramp/ stair (8)	○	○	○	○	○
Seater for rest (9)	○	○	○	○	○
Other, please specify (7)	○	○	○	○	○

Display This Question:

If Please select the spaces that have universal design elements in your home = Other

14-a Please select the accessibility level you experience when maneuvering in the following areas.

Other:

	Extremely easy (1)	Somewhat easy (2)	Neutral (3)	Somewhat difficult (4)	Extremely difficult (6)
Accessible entrance (1)	○	○	○	○	○
Pathways and space to turn around (2)	○	○	○	○	○
Layout/ Furniture arrangement (position, height, reach etc.) (6)	○	○	○	○	○
Electrical points (numbers, type, position, height, reach) (8)	○	○	○	○	○
Other, please specify (7)	○	○	○	○	○

End of Block: Section 3: Accessibility Experience