

## **Aging Well at Home: The Meaning and Implementation of Aging-in-Place Home Modifications**

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### **Abstract**

The US has an aging population and a low working population, with the share of elderly expected to increase to 22.3% by 2050. However, there will be only 2.1 workers per Social Security beneficiary in 2040. We need innovative solutions to address this problem. Our approach is supposed to focus on the entire society. According to statistics, 85.5% of eligible elderly people continue to live at home and 80.6% have implemented house renovations. This shows that house renovations reduce the risk of aging due to aging. To overcome obstacles caused by degradation and improve safety, the government is actively developing strategies to integrate multiple professional systems and services such as community medical care, social welfare, and construction equipment. This will help develop barrier-free and safe housing, which will support the elderly to continue living at home and maintain their health. This is conducive to overall community development, increasing positive social interaction among elderly families and reducing US medical expenditures. Aging-in-Place home modification involves making adjustments to a home to make it more convenient, safer, and more suitable for independent living. Home modification involves Barrier-Free, Universal Design, and ICF. Barrier-Free provides equal access to public buildings. Universal Design creates user-friendly products and environments. ICF holistically evaluates the physical and mental functions of older adults and their living environments to promote their well-being and daily activities. To ensure adequate housing and living conditions for the elderly, a multi-pronged approach must be taken. This starts with creating a simple, convenient, easy-to-use, and controllable living environment. This article demonstrates and fully explains the current situation of the society and living environment of the elderly in the United States, the necessity of home modification models for a welfare living environment adjustment, and the related technologies of home modification models for a welfare living environment adjustment. This serves as a reference for integrated service systems in local aging communities.

**Keywords:** Aging-in-Place; home modification; Barrier-Free; Universal Design; ICF; ADL; accessibility.

In the 1970s, American citizens began to prioritize community welfare. However, policies for the living environment were not always adequate. A comfortable and safe living environment is crucial for community life. In this paper, we will discuss the challenges faced by the elderly and the importance of improving their living environment and home accessibility.

## **I · Social Conditions and Home Living Environment of the Elderly**

### **〈1〉 The increasing trend of elderly population and elderly households**

The growing U.S. population after World WarII, including immigrants, is projected to from 330 million in 2022 to a peak at 370 million in 2080.<sup>1</sup>

The population of individuals aged 65 or older is expected to increase by 47%, from 58 million in 2022 to 82 million by 2050. Additionally, the proportion of the population aged 65 and older is projected to rise from 17.3% to 22.3%.<sup>2</sup>

The US is seeing a rise in the number of people aged 65 and above, mainly due to the baby boomer generation. This change is causing an increase in Social Security and Medicare spending, projected to go from 9.1% of GDP in 2023 to 11.5% in 2035.<sup>3</sup>

The median age of the U.S. population has increased from 30.0 to 38.9 between 1980 and 2022, making it the oldest it has ever been. As of 2022, one-third (17) of the states in the country have a median age above 40.<sup>4</sup>

Life expectancy is increasing, leading to more older people in society. By 2050, the life expectancy for both males and females is predicted to increase to 81.3 and 85.2, from 77.2 and 82.1 in 2022, respectively. This is due to lower infant, childhood, and early adult mortality rates.<sup>5</sup>

Life expectancy is increasing, which means there are more older people in society. The life expectancy for both males and females is expected to rise from 77.2 and 82.1 in 2022 to 81.3 and 85.2 by 2050 due to lower mortality rates.<sup>5</sup> Older Americans are living longer. Men aged 65 could expect to live another 18.8 years in 2022 and 20.5 years by 2050. Women aged 65 will gain an additional two years in remaining life expectancy between 2022 and 2050.<sup>2</sup>

The average size of U.S. households has been decreasing since 1960. There are 129.8 million households in the United States, with an average of 2.6 people per household. Around 41 million households are occupied by elderly individuals, with an increase in the number of older adults getting divorced, especially among women. Divorce rates have risen from 3% to 15% for women aged 65 and over and from 4% to 12% for men aged 65 and over.

Consequently, more older women are living alone; by 2023, around 27% of women aged 65 to 74 will live alone. This percentage jumps to 39% for women aged 75 to 84 and 50% for women aged 85 and over. The trend towards single-person households is expected to continue in the future.<sup>6</sup>

### **〈2〉 A health insurance program, Medicare for the elderly and Medicaid for the people: Medicaid Coverage for Home Modifications**

In the past, elderly or disabled individuals were mainly cared for by family members. If no family members were available, the government or voluntary groups provided care through relief funds or workhouses. In 1965, the Medicare and Medicaid Act, also known as the Social Security Amendments, into law, established Medicare, a health insurance program for the elderly, and Medicaid, a health insurance program for people with limited income.<sup>7</sup>

Medicare is a health insurance program for seniors while Medicaid is a healthcare program for low-income individuals. Medicaid covers benefits not included in Medicare, such as nursing home care and personal care services. Medicaid can cover home modifications through a Home and Community Based Services (HCBS) Waiver, which aims to delay nursing home placement. These modifications can help seniors live in their own homes for as long as possible, and the state can provide more cost-effective care.<sup>8</sup>

- 〈3〉 The changes in living environments and increasing awareness towards elderly care over the years.

As we age, our physical functions decline and circumstances change. But most people want to continue living at home and in their community. If we become ill or disabled, we may need care services, but 85.8% of elderly people choose to receive care at home through the long-term care insurance system.

The NHATS study reports that the percentage of older adults living in community settings has increased from 80.5% in 2011 to 85.8% in 2021. The percentage in residential care settings other than nursing homes has declined from 7.6% in 2011 to 5.3% in 2021, and nursing homes' percentage has declined from 4.4% in 2011 to only 1.9% in 2021.<sup>9</sup>

To age well at home, seniors seek information about medical and nursing care, community welfare services, and easy-to-use tools. Providing adequate services that improve living conditions and create a comfortable environment can help seniors achieve their goals and enjoy their lives.

- 〈4〉 The impact of the self-independence life as the elderly household-keeping ratio and housing accessibility status

Elderly people spend more time at home as they age, and their living environment affects their ability to perform daily activities. Structural problems in housing that hinder their mobility are called barriers, and accessibility aims to remove them to maintain their quality of life. Recently, there has been a shift in direction to go a step further and prepare the home and environment to avoid creating obstacles from the outset (see III, 1).

Living independently is important for people to maintain their desired lifestyle as they age, and owning a home plays a key role in achieving this. As of the first quarter of 2023, the homeownership rate in the U.S. is 66%. The largest group of homeowners is over 65, with a ratio of 79.1%, which is high.<sup>12</sup>

Designing a house with consideration to the needs of elderly and physically disabled people can help minimize the need for human care by incorporating welfare

equipment. Approximately 13% of US households have members who use mobility-assistive devices, while 6% have at least one member who has difficulty accessing parts of their home due to a condition. Around 19% of US households include an individual with mobility-related disabilities who faces difficulty accessing their home or using spaces in their homes.<sup>11</sup>

Home modifications and assistive devices have helped older Americans maintain independence. The percentage of older adults with home modifications increased from 72.8% in 2011 to 80.6% in 2021.<sup>12</sup>

Creating affordable housing options that provide a comfortable, safe, and humane environment for the community is essential. This approach, known as community development for all ages, aims to make the community accessible to everyone.

## 〈 5 〉 Integration of Aging-in-Place Home Modification

Home modification refers to modifying or adjusting a home to make it more convenient, safer, and conducive to independent living. These changes may include removing any hazards that could lead to falls or injuries, as well as adding supportive features that improve a person's ability to participate in daily activities, self-care, or social engagement within the community.

It's important to consider the physical abilities and living needs of the elderly and disabled when ensuring appropriate housing and living conditions. Welfare equipment and housing structures must be evaluated and adapted accordingly. Effective coordination with family members and professionals is essential.

An integrated assessment of medicine, health, welfare, construction, welfare equipment, care services, and systems is necessary to improve the overall living environment and help users live independently.

As the baby boomer generation reaches retirement age and becomes eligible for welfare programs, community-based elderly care awareness has improved gradually, and joint efforts have been developed between the government and the community. This partnership between medical systems and insurance institutions has created new market opportunities.

To help elderly people live independently, we need to approach aging-in-place home modification holistically. This means considering their unique needs, evaluating their current living environment, and finding specific ways to improve it. Creating a simple and controllable living environment can enhance their lives and activities, and improve their overall quality of life.

## II 、 What perspectives are required for Aging-in-Place Home Modifications

### 〈 1 〉 The significance of the elderly's mobility for daily activities

Walking is an autonomous movement that humans repeat through a self-sustaining cycle of muscle contraction. It is triggered by the feeling of the heel touching the ground and the reaction force from the ground. This allows individuals to move around, maintain motor function, and perform daily activities. (Figure 1).<sup>13</sup>

Maintaining mobility is essential for carrying out daily activities such as bathing,

changing clothes, cooking, and commuting. It also improves the quality of life and social activities of the elderly. As we age, it's crucial to create an easily accessible environment for physiological mobility.

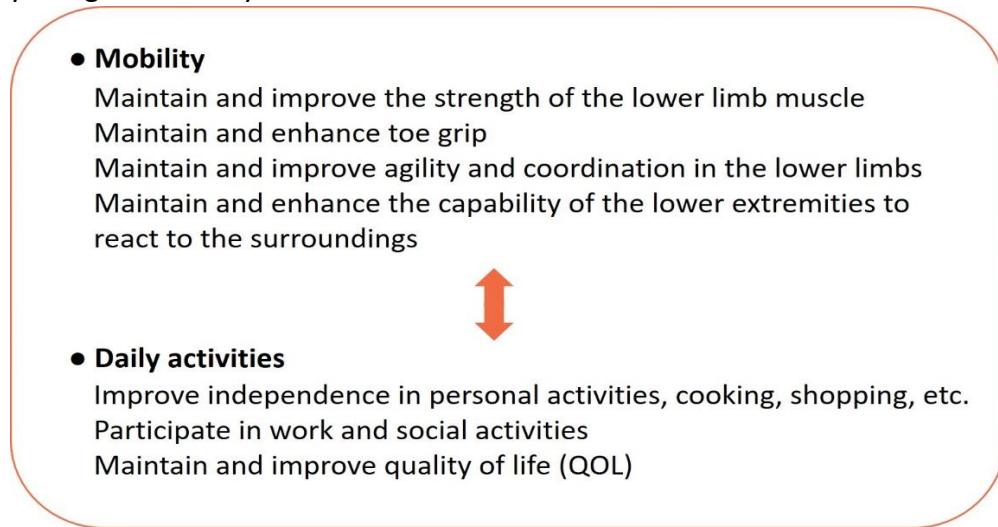


Figure 1 : The impact of getting up and walking on body functions and daily activities<sup>13</sup>

## 〈2〉 The Necessity of Aging-in-Place Home Modifications

### 1. To improve the mobility environment for the elderly

As we age, our physical strength gradually declines. This varies depending on lifestyle, occupation, and daily activities. Lower limb muscle strength declines to about half of what it was in our 20s by age 60. Balance function also significantly drops to around 30% of what it was in our 20s.<sup>14</sup>

As a result, even healthy elderly individuals cannot avoid a decline in physical function. Therefore, it is essential to improve the housing environment and the surrounding area to ensure that they can move around smoothly.

### 2. It is possible to make adjustments that cater to the specific needs of people with disabilities

As people age, they become more susceptible to diseases that affect their ability to move. During hospitalization, it's important to provide walking training and lifestyle guidance that considers the patient's ability to move at home. To achieve this, coordination among users, families, physical therapists, occupational therapists, architects, etc. is necessary.<sup>16</sup> It is important to consider if assistive devices like wheelchairs are necessary to aid in movement and the impact that modifications will have.

### 3. Improvements in mobility, motor function, and independence are directly related

Individuals with hemiplegia due to cerebrovascular disease can walk with crutches or leg braces if the floor surface is flat. However, walking at home can be challenging due to narrow spaces and obstacles. Modifying handrails and steps is important for supporting independent living. Renovating bathrooms is necessary to ensure safe movement. Careful planning and consideration of family requirements are crucial for

longer home stays after hospital discharge.

In other words, appropriate modifications will directly lead to improvements in ADL motor function and independence.

#### 4. Appropriately reducing the burden of care and establishing smooth interpersonal relationships

Proper modification of a home can not only make daily activities easier for the users but also help reduce the burden and stress on family caregivers. In particular, care for incontinence and bathing accounts for a significant portion of the nursing burden in terms of time. If the care is required for a shorter period, such as a month or two, the family may try to be involved. However, most cases of care can last for several years. Therefore, by making appropriate modifications to the home and adopting appropriate care practices, the burden of caregiving can be reduced. This can help enhance the trusting relationship between care recipients and their families. In other words, reducing the burden of care is one of the essential factors in supporting each other in long-term care.

#### 5. To improve safety

Modifying a home by installing handrails, adjusting non-slip floors, and eliminating steps can be very helpful for people with unstable mobility and caregivers who assist them. These changes ensure easy and safe movement, especially for unsteady users who are more likely to lose balance and fall. Modifying the home not only improves safety but also gives users a sense of security.

Modifying homes can make daily tasks easier and safer. Tasks such as entering and exiting the home, bathing, grooming, transferring to the toilet, walking, and moving in and out of bed were perceived to be easier after the modifications.<sup>15</sup>

#### 6. Maintaining individuals' independent living activities and dignity

Home improvements can significantly improve the lives of individuals with disabilities, enabling them to move around in a wheelchair or use assistive devices such as walkers. This allows them to perform personal activities such as going to the toilet or using bathroom facilities when needed, promoting mental independence and maintaining dignity. Moreover, home renovations can provide psychological support not only to the individuals but also to their families. Relationships with family members, relatives, neighbors, and friends who live with them can be maintained, just as before.

### III 、 Relevant Implementation for aging-in-place Home Modifications

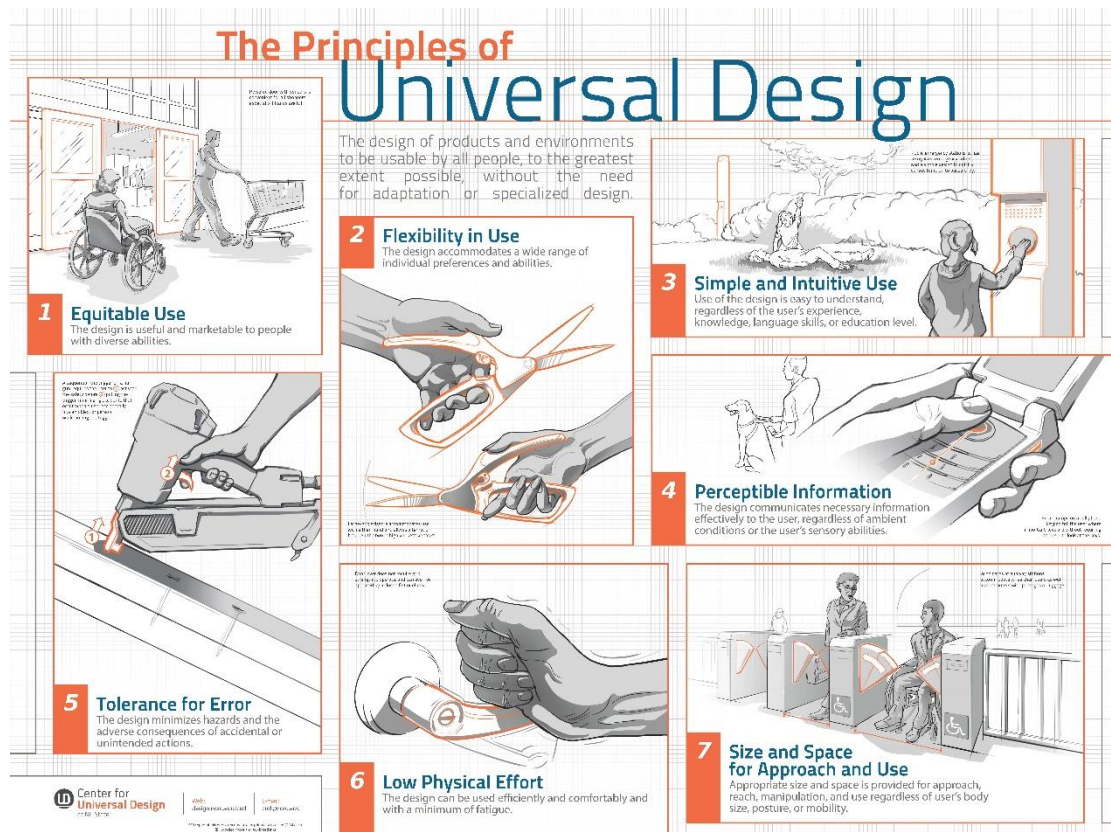
- 〈1〉 Based on the concepts of Barrier-free Design, Accessible Design, and Universal Design for the basic concepts behind various types of support for elderly home modification (Perspectives in Social Equal Participation)

Barrier-free living emerged in the 1960s when a large number of people in the U.S. military became disabled after the Vietnam War. To improve the quality of life for people with disabilities and the elderly, the federal government passed the Housing Act,

which pooled resources for this purpose. In 1974, the United Nations Expert Meeting on the Living Environment for Disabled Persons, entitled "Barrier-free Design," sparked the global spread of this movement.

The standard scale used in constructing buildings fails to meet the needs of disabled people and others. This results in various life constraints for them. To ensure their right to use public buildings, the Fair Housing Act and Americans with Disabilities Act were passed. These laws view buildings and transportation systems as common social assets and establish barrier-free environments.<sup>16</sup>

In the late 1970s, Ronald L. Mace, an American architect and product designer who used a wheelchair, noticed the issue of barrier-free housing and proposed the concept of "universal design". He believed that design should not vary based on age, ability, or gender and that products and environments should be designed to meet the needs of all users, regardless of their abilities, at little or no extra cost. This is how practical and attractive products can be created to cater to everyone. Mace actively implemented the concept of adaptability by following seven principles (see Figure 2) to address the changing needs of occupants over time. For example, coat racks and counters can be adjusted to suit different heights, and sink cabinets can be easily removed for wheelchair users or other seated tasks. This is what universal design is all about.



(Figure 2) : The seven principles of universal design which outline the performance that universal design should achieve and provide guidance for creators to follow when making decisions.<sup>17</sup>

Universal design is defined as follows. "The design of products and environments

to be usable by all people, to the greatest extent possible, without the need for specialized design.”<sup>17</sup>

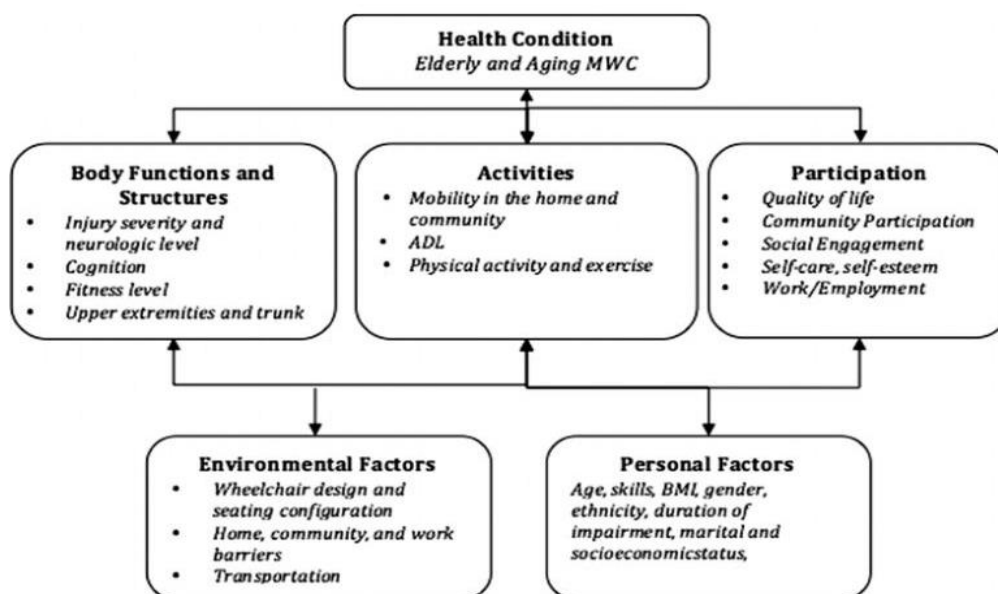
Universal design aims to create products and environments that cater to everyone's needs. However, it is important to consider the needs of each individual and create designs that integrate those needs. It's not possible to create a product that meets everyone's diverse needs, so users should be given options to choose what suits them best. The term "to the greatest extent possible" indicates progress step by step towards achieving universal design. Universal design aims to create an environment that prevents barriers from occurring in the first place. It promotes equal participation for people with diverse abilities. However, we must share the values of universal design throughout society. This way, we can create a world where everyone can participate equally without discrimination.

〈2〉 International Classification of Function and Health (ICF) for elderly home modification (Perspectives in Rehabilitation)

1、 Overview of ICF

Multifaceted considerations on a global scale are important in determining how human disability is understood, and in 2001 the General Conference adopted the International Classification of Function and Health (ICF)。

ICF focuses on the three levels of "Body Functions and Structures," "Activities," and "Participation" and considers health status such as "Environmental Factors" and "Personal Factors" as surrounding background factors to view people's health from multiple perspectives. Daily living functioning and disability. It consists of personal factors and health conditions, which are all interrelated.<sup>18</sup> (figure 3)



(Figure 3): ICF model as applied to elderly and aging manual wheelchair (MWC) users. ICF indicates the International Classification of Functioning and Health, Disability, MWC, ADL, BMI, and body mass index.<sup>17</sup>



"Body Functions and Structures" refers to areas such as brain and organ functions and limb movement functions at the level of mental and spiritual functions and life functions. Negative analysis. For example, in a person who has had a stroke, we would learn about problems such as motor paralysis and sensory impairment in one side of the upper and lower limbs, but on the other hand, we would also learn how much mobility the muscle tone would improve with the use of orthotics. We view changes in mental and physical functioning positively.

"Activities" refers to activities related to an individual's standard of living. It helps you understand how to carry out activities of daily living, such as eating, washing, cleaning, and shopping.

"Participation" refers to interaction with society in daily life. For example, we know about social-level activities such as kindergarten, compulsory education, higher education enrollment, etc., as well as employment, neighborhood committee activities, leisure activities, maintenance of family life, etc.

Background factors include "Environmental Factors" and "Personal Factors," among which environmental factors have a significant impact on daily life functions such as "Body Functions and Structures," "activity," and "participation," and their diseases. External environmental factors include the natural environment, such as house structure and daily necessities; natural environment, such as terrain and climate; humanistic environment, such as family and friendship, nursing service system and health measures, etc. If these environmental factors are in place, the ability to perform daily activities and physical functions will also develop in a positive direction. Conversely, environmental factors such as lack of primary caregivers, toilets, and house structures with many steps may limit activity and participation. Personal factors are background factors related to the individual, such as age, gender, lifestyle, etc.

When thinking about daily functioning and disability, we tend to focus on the negative aspects of illness and trauma. However, at ICF we value finding positive interactions. For example, the support of a home helper, home improvements, and the appropriate use of lower limb orthotics can improve a person's ability to walk and lead a more active independent life at home.

In addition, the ICF structural model and its concepts are applicable not only to the medical field, but also to professional fields such as social welfare, education, architecture, and vocational fields, as well as administrative agencies and users with disabilities, and its content can also be used by patients, their families and caregivers by support.<sup>19</sup>

## 2、 The impact of home modification on ICF

Being able to move freely around the home can lead to improved quality of life activities, not just a certain level of independent physical activity. For example, if users develop hobbies such as playing chess, listening to music, or cooking, they become more active and take the first step toward self-actualization. Home improvement provides the basis for improving the quality of life and stimulating activities to achieve this goal. Once a person is able to actively perform activities of daily living at home, the next step is to move outside. In particular, transforming the area from the entrance to

the main door means creating an environment that encourages interaction within the home with the outside world, such as participating in local events, shopping, going out with friends, or going to work. The ability of each person to participate in society on a personal level, such as through volunteering.

Let me take a specific example to illustrate the relationship between home modification and ICF. (figure 4)

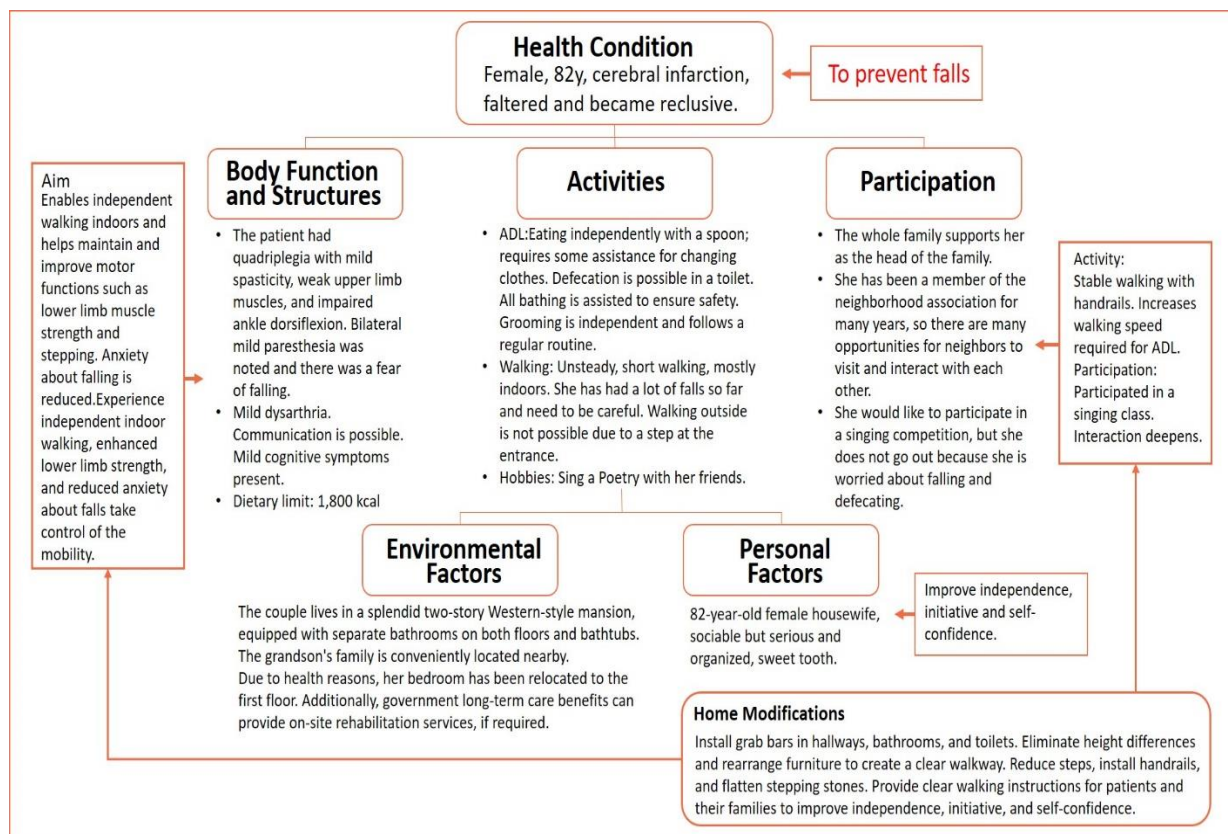


Figure 4: The correlation between home modifications and the International Classification of Functioning, Disability, and Health (ICF) in patients with cerebral infarction. Organized by the practical case.

2021, an 82-year-old female with cerebral infarction. She faltered and her lifestyle gradually became reclusive. She faltered and her lifestyle gradually became reclusive.

We believed that the multi-structure of the house would restrict functional functions and daily activities, so we made modifications to the house, such as installing handrails in corridors and bathrooms, changing the floor height of steps and thresholds, rearranging furniture, etc. We also provide families with guidance on what to look for when walking with assistance and how to participate in activities of daily living. As a result, in terms of "Body Functions and Structures", the elders can walk independently using handrails, improve lower limb muscle strength and walking and other motor functions, and reduce the fear of falling by eliminating steps. In terms of "Activities", steps in the corridor were removed to ensure a safe flow to the bathroom and improve the mobility required to perform ADL. "Participation" requires the assistance of family members. The passage from the entrance to the main door has been smoothed, making

it easier to go out and participate in singing classes.

In this way, home modification involves all aspects of ICF, from the "Body Functions and Structures," "Activities," and "Participation," to the environment and personal factors of the elderly who are disabled due to illness and worried about their health, to consider and improve their daily life function.

#### IV - Conclusion and Discussion

〈1〉 The country is experiencing an unprecedented impact of an aging population and a low working population. This has led to changes in the lives of the elderly, their families, communities, and the government medical system. To address this issue, there is a trend toward reform and innovation for the aging society. Home modification for the elderly is one of the strategies being developed. The approach should be focused on society as a whole, supporting the independent living of the elderly. A comprehensive assessment of medical care, health, welfare, architecture, welfare equipment, care services, and systems should be conducted. A multi-pronged approach should be adopted, starting with creating a simple and controlled living environment.

The US population is aging rapidly, with the proportion of elderly people predicted to increase from 17.3% in 2022 to 22.3% in 2050. By 2080, the total population, including immigrants, is expected to peak at 370 million. The number of teenagers and working-age adults is decreasing, which means fewer workers supporting each Social Security beneficiary. By 2040, each beneficiary will have only 2.1 workers. The divorce rate among the elderly is high, ranging from 12 to 15%. By 2023, over 27% of elderly women will live alone, and the trend of single elderly families is expected to continue.

The U.S. healthcare system has been dominated by Medicare and Medicaid programs since 1965. Medicaid covers nursing home care and has a Home and Community Based Waiver Program that enables seniors to stay in their homes by covering home modifications like stair lifts and wheelchair ramps. This program is cost-effective and delays nursing home placement, benefiting both seniors and the state.

As people age, their abilities decline, leading to changes in lifestyle and relationships. It is crucial to provide appropriate services that improve their living conditions and create a comfortable and familiar environment that allows them to feel at ease. The living environment of elderly individuals has a significant impact on their ability to perform daily activities, and it is essential to consider their living environment to maintain their quality of life. Assistive devices such as walkers and home modifications have enabled older Americans to maintain their independence. It is essential to create affordable housing options that provide a comfortable, safe, and humane environment for the community. Home modification involves adjusting a home to make it more convenient, safer, and suitable for independent living. To ensure appropriate housing and living conditions for the elderly and disabled, it's crucial to consider their physical abilities and living needs. Improving their living environment requires an integrated assessment of medicine, health, welfare, construction, welfare equipment, care services, and systems. Community-based elderly care awareness has

improved, and joint efforts have been developed between the government and the community to promote value-oriented elderly services. Aging-in-place home modification should be approached from a holistic social perspective and evaluated based on the users' current problems and life goals. Supporting the elderly to live independently requires a multi-faceted approach, starting with creating a simple and controllable living environment.

- 〈2〉 As we age, it becomes increasingly important to have an easily accessible environment that allows us to perform daily activities with ease. This is especially true for the elderly, who require mobility to perform household chores, shop, commute, and socialize. Physical mobility is a crucial aspect that directly impacts their quality of life, enhancing intellectual, daily life, and social activities. Therefore, it is imperative to consider perspectives on Aging-in-Place Home Modifications that prioritize accessibility and support physical mobility.

The Necessity of Aging-in-Place Home Modifications is summarized as follows:

1. As individuals grow older, their physical strength and balance tend to decline gradually, which can make it challenging for them to move around. Even those who are in good health may experience a decline in physical function. Hence, it is essential to improve the housing environment and the surrounding area to ensure that elderly individuals can move around easily and safely.
2. As people age, they may experience motor dysfunction due to various diseases. In such cases, providing them with walking training and lifestyle guidance is crucial. This requires coordination among various stakeholders to identify the problem, determine the appropriate indoor mobility solution, and make necessary adjustments. Assistive devices like wheelchairs should also be considered.
3. Individuals with hemiplegia due to cerebrovascular disease may face mobility and independence issues while moving around their homes. Renovating indoor spaces and assistive devices is necessary to increase mobility and prevent accidents. Careful planning and consideration of the user's behavior and family requirements can lead to improved motor function and independence in ADL.
4. Making changes to a home can be a great way to reduce the burden of care on family caregivers, as well as establish better relationships between caregivers and care recipients. By making appropriate modifications to the home, daily activities can become easier for care recipients. Incontinence and bathing care can be particularly time-consuming and stressful for caregivers. While family members may be able to help out for shorter periods, most cases of care last for several years. By adopting effective care practices and making suitable changes to the home, the burden of caregiving can be reduced, improving trust and communication between care recipients and their families. In the long run, reducing the burden of care is crucial for supporting each other in caregiving.
5. Home modification is crucial for people with unstable mobility and their caregivers. Installing handrails, eliminating steps, and adjusting non-slip floors are necessary steps to ensure easy and safe movement, reduce difficulty levels, and increase safety. Unsteady users are more likely to fall and suffer from fractures or

accidental death, making it imperative to renovate your home to prevent such incidents. By making the necessary changes, you not only improve safety but also give users a sense of security and enhance their ability to perform daily tasks with ease.

6. Making certain improvements to the home environment is crucial for enhancing the quality of life of people with disabilities. These renovations enable them to use assistive tools, move around comfortably, and perform personal tasks independently and with dignity. Moreover, home renovations play a significant role in providing psychological support to both individuals and their families, allowing them to maintain their relationships with loved ones, neighbors, and friends.
- 〈3〉 There are three main methods to approach home modifications for aging-in-place: barrier-free, universal design, and the International Classification of Function and Health (ICF). It's crucial to establish barrier-free environments and ensure the feasibility of buildings, and the Fair Housing Act and Americans with Disabilities Act guarantee equal access to public buildings. Universal design is essential to creating user-friendly products and environments that are accessible to everyone without the need for specialized design. The ICF framework is a powerful tool that helps understand disability on a global scale, emphasizing environmental and personal factors that influence health. It's essential to consider home modifications seriously as they can significantly improve quality of life and stimulate various activities, leading to higher levels of independent physical activity and self-actualization. We must embrace the concept of aging in place and make necessary changes to our homes to support our future selves.

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