

Research on the Design Requirements of Aging-Friendly Furniture Based on the Physiological and Behavioral Characteristics of Elderly People in China Nursing Home

Zhang Yun¹ & Musdi Bin Hj Shanat¹

¹ Faculty of Applied and Creative Arts, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, MALAYSIA

Correspondence: Zhang Yun, Faculty of Applied and Creative Arts, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, MALAYSIA.

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Abstract

The aging of China's population and the growth of the elderly care industry have necessitated higher requirements for the design and research of aging-friendly furniture in nursing homes. However, current furniture manufacturers and designers do not adequately consider the unique characteristics of the elderly in nursing homes, resulting in a limited number of truly aging-friendly furniture products. Given the physiological and behavioral changes that occur with age, there is an urgent need for design to enhance interaction and communication between the elderly and their living furnishings. Therefore, it is crucial to develop and design aging-friendly furniture that aligns with the physiological and behavioral characteristics of the elderly population in nursing homes. This study aims to discover, investigate, develop, and focuses on design requirements for aging furniture in China nursing home.

Keywords: design requirements, aging-friendly furniture, physiological, behavioral

1. Introduction

Based on data from the Seventh National Population Census and the United Nations World Population Prospects 2022, an analysis of population aging trends in China reveals that the country is currently experiencing a rapid development of population aging, with this process expected to accelerate in the future, leading to an increasingly aged society (Dong, 2022). China officially entered an aged society in the year 2000. From 1982 to 2020, the proportion

of the elderly population aged 60 and above in China has drastically increased from 7.62 % to 18.7 %, accounting for a population of approximately 264,019,000. Similarly, the proportion of the elderly population aged 65 and above has risen significantly from 4.91% to 13.5%, with a population of approximately 190,635,000 (CNBS, 2019). According to the population projections in the United Nations World Population Prospects 2022, the number of individuals aged 60 and above in China is

expected to surpass 500 million by 2050, constituting 38.81% of the total population. Additionally, the proportion of the population aged 80 and above is projected to exceed 10 % (UN, 2022).

However, the investigation on the aging furniture for China nursing homes is still in the preliminary stage. The majority of furniture available in the market lacks an aging-friendly concept, and the exclusivity and market positioning of furniture for the elderly remain unclear and ambiguous. Most geriatric furniture functions similarly to furniture for young adults, and has not been designed from the perspective of older adults. Additionally, furniture manufacturers lack an understanding of the distinct requirements and desires of the elderly in nursing homes, resulting in existing furniture products that fail to meet the daily requirements of elderly consumers. These factors contribute to the background of the research conducted in this study.

2. Literature Review

2.1 *Physiological Characteristics of the Elderly in China Nursing Home*

China has extensive research findings concerning the design of aging, with the Healthy China 2030 Plan serving as the basis for the introduction of numerous novel concepts and measures. A considerable portion of scholars focus their research on the methods and strategies for designing products tailored to the elderly, drawing insights from an analysis of their lifestyle, physiological attributes, and cognitive psychological characteristics (Yin, 2007; Gong, 2014). Furthermore, He (2014) takes into account various factors such as the living environment, personal circumstances, psychological and behavioral traits, and functional requirements of the elderly population. By adhering to a people-centric design approach, He (2014) strives to create a living environment that is both aesthetically pleasing and comfortable for this specific demographic (Shi & Zhang, 2023). Fu and Zhang (2019) adopt an emotional design perspective, integrating the physiological and psychological characteristics of the elderly population. As a result, they propose the functional expression of emotions and design principles that cater to the requirements of elderly homes.

During the natural aging process of the elderly, their physiological functions and body shape

will undergo a series of degenerative changes. As a result, their ability to adapt to the spatial environment is reduced. These changes significantly affect their behavioral activities and daily life. In China, the decline in the ability of the elderly is primarily evident in the following aspects (Xie et al., 2023): a decrease in experience ability hinders the reception of physical and social environmental information, first leading to a decline in auditory and visual impairments, and subsequent gradual degradation of other sensory systems (Wang, 2008); decline in cognitive ability, manifested by a weakened ability to adapt to new environments, difficulty in identifying the changing surroundings, and challenges in forming cognitive maps; a decline in behavioral activity capacity, characterized by reduced flexibility in daily behavioral activities among the elderly, as well as a progressive decrease in muscle strength and control ability (Gao & Huang, 2006; Yuan, 2021); and the decline in adaptability is manifested in the elderly reduced sensitivity to temperature, humidity, and climate fluctuations, leading to weakened adaptability and increased vulnerability to health issues.

2.2 *Behavioral Characteristics of the Elderly in China Nursing Home*

Chinese scholars initiated their research on the subject of environmental behavior using relevant theories at a relatively delayed stage. It was during the 1980s that these pertinent theories were first introduced to China and subsequently applied to architectural research (Zhang et al., 2020). Since the commencement of the 11th Five Year Plan, there has been an increasing focus among scholars on the development of elderly care facilities and the exploration of this topic from various perspectives. In essence, research based on the relevant theories of environmental behavior can be classified into two categories: one is the examination of behavioral patterns exhibited by the elderly, while the other is the examination of the intrinsic relationship between behavior and spatial environment (Gao, 2021).

The temporal occurrence, range of action, frequency, and extent of mobility of elderly individuals residing in nursing homes are distributed across different spatial levels and domains. The behavioral activities of the elderly have distinctive features. These include the periodic nature of their activity timing, as evidenced by differences in daily routines

between the elderly and younger individuals, characterized by reduced sleep duration and increased leisure time (He, 2020). Moreover, their activities display certain regularities and periodic patterns, with a significant emphasis on entertainment and physical fitness. Domain characteristics are apparent in the constraints imposed by various factors on the activity domains of the elderly. These factors encompass their social background, physiological and psychological attributes, behavioral habits, ethical beliefs, as well as the influence of their surroundings and location of activity (He, 2008). The elderly require a domain space that ensures safety and possesses a certain level of privacy, security, and distinctiveness. Social characteristics are characterized by a relatively stable target audience and a well-defined selection of communication methods.

2.3 Nursing Home Elderly Care Facilities Design

Regarding the design of living space facilities in nursing homes, it is crucial to summarize the principles derived from domestic and international cases, thoroughly analyze the functional space configuration of elderly facilities, explore the architectural components within indoor space (Liu et al., 2022), evaluate the spatial scale and functional configuration, assess the common furniture facilities and overall environment within the elderly space, and propose interior design principles (Cui & Chung, 2023). Additionally, research on the design of indoor public activity space facilities in nursing homes should encompass a comprehensive summary of the design aspects related to space function form, furniture and facility configuration, elements, and the resulting environmental ambiance. In 2018, the book *Housing for the Elderly* by Zhou et al. systematically summarized the design methodologies for aging facilities in terms of functional spaces such as bedrooms, living rooms, kitchens, and bathrooms, taking into account the physiological characteristics of the elderly. The book also provides a comprehensive overview of the layout characteristics and interior space design of elderly care facilities.

By synthesizing significant literature and monographs from different time periods, the primary findings of the analysis concentrate on corresponding examination and summation of conventional elderly care facilities and their design for the aging population. This consists the functional spatial arrangement of living

rooms, bathrooms, dining areas, and main entrances in such facilities. The study primarily centers on the aging design in relation to the psychological, physiological, and behavioral attributes of the elderly through the integration of aging product facilities (Shang Pengyue, 2020). It expounds and scrutinizes the independence, comfort, safety, and privacy experienced by the elderly within institutional settings. Additionally, it involves an analysis of the layout of aging equipment and facilities, as well as aging furniture products. Throughout this process, this study obtains crucial theoretical support, particularly in the context of the aging design of residential and public spaces within institutions, thereby offering a certain degree of inspiration and reference value.

3. Research Methods

This investigation uses questionnaires, interviews and other methodologies to examine the daily activities and Physiological requirements of the research subject. Moreover, this study analyses the physiological and behavioral attributes of the elderly population in China nursing homes, with the purpose of establishing a theoretical foundation for the design of aging-friendly furniture in such establishments and identifying the determinants of aging-friendly furniture design in nursing homes.

3.1 Questionnaire

Questionnaires represent a fundamental and crucial quantitative method for surveying the lifestyle of a specific population. They are also considered one of the primary instruments used to collect information during surveys (Martin & Haninton, 2012). Questionnaires help to standardize and streamline the data collection process, providing standardized phrasing of questions and a consistent procedure for their delivery. In the present study, a questionnaire survey is employed to examine the daily activities of the elderly population residing in certain China nursing homes.

The findings from each questionnaire survey were subsequently analyzed and summarized in order to provide valuable data references and evidence for the exploration of targeted design requirements of aging-friendly furniture.

3.2 Interview

Interviews serve as a fundamental research method that allows direct interaction between

the researcher and the participants (Marzuki, 2011; Martin & Hanington, 2012). Moreover, they are widely regarded as the most popular methodological tool in qualitative research. It is well established that interviews are indispensable for obtaining primary data. This study focuses on the design study of furniture suitable for the elderly, and the interviews were conducted to directly understand the requirements of the elderly group from their subjective perspective.

This study uses an open-ended interview format, with face-to-face communication as the main focus. The design of the interviews was divided into two parts. The first part of the interviews focused on interviews with experts, designers, manufacturers and relevant practitioners in the elderly care service industry, while the second part focused on interviews with groups of elderly people in nursing homes in different regions of China. The interviews lasted between 30 and 40 minutes for each interviewer, and were recorded through written notes and audio recordings, with the final results collated by the researcher. The interviews were recorded through written notes and audio recordings, followed by transcription of the interview transcripts, performed using Verbal Protocol Analysis (VPA), and analysis of the interview data using Nvivo12.

4. Data Collection and Analysis

This survey was conducted in December 2022 via the administration of questionnaires in the form of questionnaires employing the utilization of Question star, web links, and on-site paper

questionnaires for the self-completion of the survey in all provinces and cities across China, for the purpose of distributing the questionnaires and collecting data. Recovered questionnaires that met the necessary qualifications were treated as factual statistics. The target population for this questionnaire survey included elderly individuals staying in elder care facilities in the provinces of Jiangsu, Zhejiang, Hunan, Guangxi, and Guangzhou. A total of 1,200 questionnaires were distributed using both online and on-site methods, and the elderly who received the questionnaires completed them diligently and actively. Throughout the course of this survey, the distribution of questionnaires was facilitated via the utilization of the questionnaire link (<https://www.wjx.cn/vm/eUAtvsL.aspx#>), the online interview link (<https://www.wjx.cn/vm/eUAtvsL.aspx?interview=1>), and the WeChat.

4.1 Survey of Elder People's Interest in, Reasons for, Awareness of and Concerns About Aging-Friendly Furniture

According to the findings of the survey, a significant majority of the elderly, amounting to 80.17% have expressed interest in aging-friendly furniture, with 25.85% displaying a high level of interest. Conversely, 19.83% of the elderly population has indicated a lack of interest in aging-friendly furniture products. This attitude can be attributed to the older generation's inclination to resist unfamiliar products, thereby reflecting their mindset (Table 1).

Table 1. Frequency Analysis Results of Interest in Furniture Products

Topic	Categories	Frequency	Percentage (%)
Level of Interest in Aging-friendly Furniture Products	Not interested	204	19.83
	Interested	559	54.32
	Very interested	266	25.85
Total		1029	100.0

Within the scope of this research, the primary factors influencing older individuals' interest in aging-friendly furniture were identified as material, style, and safety. These elements accounted for 23.62%, 20.21% and 19.05% respectively, collectively exceeding 60%. Conversely, brand, price, and appearance played a relatively minor role, each accounting for

approximately 6% (Table 2).

Regarding familiarity with suitable furniture for the elderly, it is evident that only about 35% of the surveyed population possesses a basic understanding of such products. Furthermore, within this group, a mere 5.64% exhibit a high level of familiarity. The majority of individuals, however, remain largely uninformed about

these types of products. This lack of awareness can be attributed to the limited popularity of suitable furniture for the elderly (Table 3).

Table 2. Frequency Analysis Results of Reasons for Interest in Aging-friendly Furniture

Topic	Categories	Frequency	Percentage (%)
Reasons for Interest in Aging-friendly Furniture	Material	243	23.62
	Safety	196	19.05
	Style	208	20.21
	Price	67	6.51
	Function	60	5.83
	Appearance	58	5.64
	durability	64	6.22
	Brand	64	6.22
	Others	69	6.71
Total		1029	100.0

Table 3. Survey on Knowledge of Aging-friendly Furniture Frequency Analysis Results

Topic	Categories	Frequency	Percentage (%)
Knowledge (or familiarity) of aging-friendly furniture products	Not at all	73	7.09
	Know a little	247	24.00
	Know but not understand	278	27.02
	Basic understanding	303	29.45
	Strong understanding	58	5.64
	Others	70	6.80
Total		1029	100.0

In terms of concerns related to aging-friendly furniture, it is noteworthy that 348 individuals emphasized the importance of comfortable, accounting for 33.82%. Additionally, 280 respondents expressed a focus on convenient, constituting 27.21%. Furthermore, 219 individuals highlighted the significance of safety.

Conversely, artistic emerged as a relatively insignificant concern for the elderly, comprising only 8.65%. This stark contrast to the “appearance first” mindset observed in modern young people underscores the elderly prioritization of practicality (Table 4).

Table 4. Survey on Concerns about Aging-friendly Furniture Frequency Analysis Results

Topic	Categories	Frequency	Percentage (%)
Aspect of aging-friendly furniture are important to you.	Artistic	89	8.65
	Safety	219	21.28
	Comfortable	348	33.82
	Convenient	280	27.21
	Others	93	9.04
Total		1029	100.0

Given that the elderly constitute a distinct demographic, their interests and preferences in

furniture differ significantly from those of younger individuals. Notably, age plays a crucial role in shaping the requirements and requirements of the elderly regarding furniture. Moreover, variations can be observed between elderly individuals with underlying health conditions and those who are generally healthy. Therefore, the design of aging-friendly furniture should align with the overall demands of the elderly population in order to cater to their unique requirements.

4.2 Survey of Color, Material and Style Selection

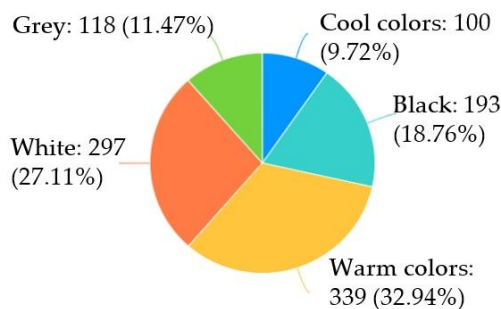


Figure 1. Results of Survey on Color Choices of Elderly

Color Selection. In relation to the selection of aging-friendly furniture colors, it is evident that elderly individuals possess a pronounced inclination towards warm colors. In addition, older people have a distinct preference for white, presumably because older people usually believe that white symbolizes cleanliness and

tidiness (Figure 1).

Material Selection. Regarding the choice of materials for aging-friendly furniture, a substantial percentage of the population, namely over 37%, expressed a preference for solid wood and MDF chipboard. Conversely, plastic, finish made from rattan, and finish made from bamboo garnered considerably less popularity, accounting for 27.6%, 26.46%, and 25.46% respectively (Figure 2).

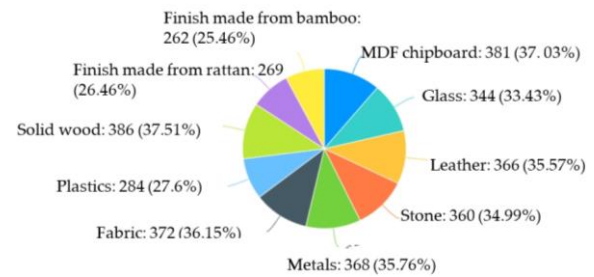


Figure 2. Survey Results for Elderly' Material Choices

Furniture Styles for the Elderly. With regard to the selection of furniture styles for the elderly, the Chinese style holds a distinct allure for the older generation, encompassing more than 42.08% of the total share, which significantly surpasses other styles at approximately 7% (Table 5). From this data, it becomes evident that Chinese elderly individuals gravitate towards a traditional Chinese living environment.

Table 5. Surveys on Style Choices in Frequency Analysis Results

Topic	Categories	Frequency	Percentage (%)
Style of aging-friendly furniture preference	American style	70	6.80
	Minimalist style	76	7.39
	Fashion style	71	6.90
	Retro style	90	8.75
	European style	60	5.83
	Chinese style	433	42.08
	Affordable luxury style	70	6.80
	Natural style	84	8.16
	Others	75	7.29
Total		1029	100.0

4.3 Survey of Furniture for the Elderly Improvement Area

From the research data depicted in table 4.6, it is discernible that the size of furniture holds

utmost importance for the elderly, as evidenced by 632 senior citizens who firmly believe that this matter necessitates urgent improvement in the present scenario. Subsequently, habits emerge as a key aspect, garnering a support rate

of 45.87%, which underscores the imperative need for a profound comprehension of the elderly' way of life to facilitate the creation of more refined furniture products that cater to their specific requirements.

Table 6. Findings on Areas of Improvement in Aging-friendly Furniture

Topic	Categories	Frequency	Percentage (%)
Furniture for the Elderly Improvement Area	Styling	400	38.87
	Size	632	61.42
	Habits	472	45.87
	Sturdy	333	32.36
	Auxiliary functions	343	33.33
	Others	118	11.47
Total		1029	100.0

5. Discussion

5.1 User Requirement Analysis

The results obtained from the collection and analysis of data using a combination of literature review, questionnaires and interviews, along with other mixed research methods, demonstrate that the design and development of aging-friendly furniture for nursing homes are primarily focused on meeting the requirements of the elderly. The ultimate objective is to fulfill the comprehensive requirements of the users and make necessary trade-offs and compromises based on these requirements.

Throughout our investigation and research, we have discovered that aging leads to significant physiological, psychological, behavioral, and cognitive changes in older individuals. These transformations have a profound impact on the elderly's ability to perceive, assess, and handle matters in the external world. Consequently, the requirements of the elderly in nursing homes are multidimensional. Furthermore, variations in age, standard of living, educational level, and income result in diverse requirements among different individuals or groups of older individuals. These requirements encompass not only physiological and behavioral aspects but also psychological, safety, living environment, spiritual, and emotional requirements that arise from daily activities and rest periods in nursing homes.

5.2 Physical Requirements of the Elderly in China Nursing Homes

The elderly constitute a distinctive group, and their physiological characteristics mainly manifest in the decline of various bodily functions, such as the sensory system, nervous system, memory, cognition, immune system, muscle strength, and bone density. As individuals age naturally, their physiological functions undergo a series of degenerative changes, along with a reduced ability to adapt to the spatial environment. This decline is also evident in the processing of information, movement, and cognition. First and foremost, there is a decline in perceptual ability, which is primarily observed in visual, auditory, tactile, and olfactory senses, further affecting cognitive abilities related to the spatial environment. Secondly, physical mobility and dexterity diminish. Older individuals experience weakened muscle strength and diminished control, which hampers their ability to perform daily activities.

Therefore, special attention must be given to the physiological requirements of the elderly during the furniture design process for nursing homes. Only when these requirements are adequately addressed can the furniture in nursing homes exhibit the fundamental characteristics of aging and contribute to the overall well-being of the elderly.

5.3 Behavioral Requirements of the Elderly in China Nursing Homes

The decline in the ability to participate in behavioral activities among older individuals can be attributed to the effects of aging. This

decline is evident in the decreased adaptability of daily behavioral activities demonstrated by older individuals. Simultaneously, the sensory perception of the elderly undergoes transformations, and their cognitive abilities and judgment also diminish. These transformations ultimately result in a slowing of their actions, delayed reactions, and uncoordinated movements, leading to potential safety hazards such as collisions with furniture, cuts, tripping, and falls.

Consequently, when designing furniture, it is imperative to consider the living behavior and thinking style of the elderly. This necessitates meeting the higher requirements of the elderly residing in nursing homes in terms of their behavioral capabilities. It also underscores the concentrated demand for furniture designs that cater to the functional utility requirements of the elderly, including ease of learning, ease of operation, and the physical comfort and satisfaction derived from the usage process. The fundamental requirement for designing aging-friendly furniture lies in enhancing the auxiliary function of the furniture. This entails employing ergonomic principles specific to the elderly to ensure more appropriate sizing and enhanced comfort in furniture usage. Simultaneously, it is crucial to eliminate any "obstacles" that hinder the fulfilment of their behavioral requirements, thereby facilitating the engagement of the elderly in their desired activities.

5.4 Psychological Requirements of the Elderly in China Nursing Homes

In nursing homes, older individuals encounter a gradual deterioration in their physical and mental well-being, financial independence, social connections, power dynamics, and life confidence as they age. These changes significantly impact the lives of the elderly, often leading to psychological distress. Drawing from Maslow's theory, psychological well-being is predicated on the fulfilment of basic human requirements. Conversely, the absence of these requirements can contribute to mental illness. Consequently, for the elderly residing in nursing homes for extended durations, their scope of social interaction becomes limited, and their living environment becomes more homogenous. This, in turn, gives rise to a series of psychological requirements that are more pressing compared to the general elderly population.

The psychological characteristics observed in the elderly residing in nursing homes are a result of their own physiological factors as well as the external social environment. These characteristics are evident in their diminished sense of psychological security, decreased adaptability, feelings of loss and inferiority, as well as their experience of loneliness and emptiness. The sense of psychological security is attributed to the decline in their physical functions, making them more susceptible to perceiving insecurity in their environment and fearing a lack of assistance from caregivers during emergencies. The weakening of their adaptability stems from their apprehension of falling ill and encountering new environments, leading to a reluctance to engage with strangers and ultimately disengaging from society. The feelings of loss, inferiority complex, loneliness, and emptiness can be attributed to reduced social interactions and the change in social roles following retirement, which significantly impacts the lives of elderly individuals. Moreover, the decline in their physical well-being and the lack of care from their children further exacerbate these phenomena. Consequently, when designing appropriate furniture for the elderly in nursing homes, it is crucial to prioritize their psychological requirements.

5.5 Security Requirements of the Elderly in China Nursing Homes

When it comes to furniture design, safety is of utmost importance. This is particularly true for the elderly, as the safety of their living environment is their most fundamental requirement, serving as the foundation for aging-friendly design principles. The principle of safety revolves around the personal health and well-being of the elderly, encompassing aspects such as the safety and accessibility of their activity, rest, and recreational areas. It is imperative to pay close attention to the safety of the elderly within the confines of nursing homes, to prevent physical and behavioral harm resulting from poorly designed furniture and other factors. To ensure this, one must consider the overall interior space and the furniture products within it, providing the elderly with protection, surveillance, accessibility, and other functional services.

Furthermore, safety extends beyond the physiological and behavioral sense of security experienced while using furniture. It also

encompasses the psychological and emotional sense of security that aging-friendly furniture provides to the elderly. Consequently, when designing furniture for the elderly, safety entails not only incorporating reasonable human-machine dimensions and scientific interaction design to minimize the risk of injury, but also selecting harmonious colors and comfortable materials to enhance the elderly's psychological sense of security and comfort.

5.6 Spiritual and Cultural Requirements of the Elderly in China Nursing Homes

Recreational hobbies are in high demand among the elderly in China, as each individual has varying interests and preferences such as playing cards, chess, dancing, musical instruments, reading, and gardening. The spiritual requirements of older adults in nursing homes primarily revolve around public activities and interpersonal interactions that both fulfil their own requirements and meet the requirements of others. The intergroup requirements of the elderly differ from self-realization requirements, with intergroup interactions being reciprocal and self-realization being one-sided. Nevertheless, both forms contribute to meeting the spiritual requirements of the elderly. Hence, nursing home furniture design should consider this aspect, incorporating spaces for public activities and communication, as well as exclusive furniture and facilities.

5.7 Emotional Requirements of the Elderly in China Nursing Homes

The emotional and inclusive design of products holds great significance for seniors residing in nursing homes. This is basically due to their heightened sense of insecurity and frequent experiences of loneliness. Furniture, which serves as a constant companion for the elderly, serves as the primary means of establishing emotional connections between them and the outside world. It facilitates the transmission of emotions between the elderly and others. The development of emotional design necessitates a thorough understanding of the psychological requirements of the elderly residing in nursing homes. This understanding requires a deep comprehension of the physiological and psychological characteristics of the elderly, as well as an insight into their emotional desires. It is essential to discern the inner longings, pursuits, and recollections of the elderly. Only

by doing so can one effectively approach the design process from the perspective of the elderly, considering every detail and ultimately improving the functionality and emotional value of nursing home furniture to enhance the quality of life of the elderly. Hence, the design of furniture for the elderly must prioritize their emotional requirements and mental state. It should strive to meet their expectations by utilizing product semantics that evoke positivity, such as a sunny and active design, thereby eliminating their feelings of social isolation.

6. Summarize

In conclusion, addressing the requirements of elderly users in nursing homes constitutes the most crucial starting point for designing furniture that caters to the aging population. The understanding of user requirements plays a pivotal role in determining the relevance and success of aging-friendly furniture design.

Designers must not only study the design of aging-friendly furniture products but also conduct a comprehensive assessment and analysis of the requirements of elderly users in nursing homes. Simultaneously, it is imperative to delve into the physiological and behavioral characteristics of the elderly in nursing homes and gain insights into their attitudes, aesthetic interests, habits, emotional demands, as well as physiological and behavioral traits. Subsequently, by analyzing and identifying the "pain points" of the elderly users' requirements, one can carefully develop effective responses through aging-friendly furniture design. Moreover, innovative design solutions are required to address these "pain points" and enhance the quality of life and happiness index of the elderly through furniture products.

It is also necessary to take into account the interplay between individual and group dynamics among special users, in addition to studying the physiological and behavioral requirements of older users. From this perspective, incorporating the requirements of older users into the design of furniture products entails the pursuit of optimal equilibrium between the factors influencing the product and the impact of older users.

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