Proceedings of ICADSS 2026 Symposium: Interpreting Culture: Context in Art, Literature, and Mass Media
DOI: 10.54254/2753-7064/2026.HT38134

Research on Design Strategies of Age-Friendly Home Seats from Physiological, Behavioral and Psychological Dimensions

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Abstract. China has entered a deep aging society, and home-based elderly care has become the mainstream elderly care model. Age-friendly seats, as the basic furniture frequently used by the elderly at home, their design level is directly related to the safety and comfort of the elderly group in their home life. At present, China's age-friendly seat market generally has problems such as insufficient human-machine dimension matching, weak safety protection design, redundant and complicated functions, excessive stacking of intelligent modules, prominent medical labels, and lack of psychological and humanistic care, which are difficult to fully meet the real home use demands of the elderly group. Taking home-based age-friendly seats as the research object, this paper analyzes the aging characteristics and differentiated use needs of the elderly from three dimensions: physiology, behavior and psychology. Based on this, with the core concepts of invisible aging-friendliness, minimalism and practicality, and modular adaptation, this paper constructs the design strategy of age-friendly seats from three dimensions: modeling, function and aesthetic humanity, giving consideration to the safety, comfort, practicality and home aesthetics of the product, and strengthening the humanistic psychological care for the elderly group. The research can provide theoretical reference for the refined and humanized research and development of home-based age-friendly seats, and has practical significance for improving the quality of home-based elderly care life.

Keywords: population aging; elderly seat design; age-friendly design; behavioral characteristics; psychological needs

1. Introduction

China's population aging process continues to advance, the total number of elderly population increases year by year, and deep aging has become the main feature of current population development. According to the latest population data released by the National Bureau of Statistics on January 19, 2026, the number of births in China in 2025 was 7.92 million, the birth rate dropped to 5.63‰, a decrease of 1.62 million compared with 2024; in the same period, the population aged 60 and above in China reached 323.38 million, accounting for 23.0% of the total population, of which 223.65 million were aged 65 and above, accounting for 15.9% [1].

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The deep aging of the population structure has made the elderly group's home-based health care and quality of life issues more and more valued by the society, and age-friendly design has gradually changed from traditional special supporting renovation to universal and basic people's livelihood needs. At present, various age-friendly products for the elderly's home life have been gradually popularized, including nursing beds, walking aids, home anti-slip handrails, special bathing chairs, etc., which have effectively improved the elderly's daily living conditions, and also fully reflected the practical significance and application necessity of carrying out optimal design of home-based age-friendly products.

In the home life scenario, seats are the basic furniture with the highest frequency of use and the widest coverage for the elderly. Their structural dimensions, safety performance and comfort level directly affect the elderly's sitting posture, activity ability and home life quality. However, from the current market product status, most age-friendly seats still have obvious design shortcomings. Existing products generally have problems such as mismatch between human body size and the physical characteristics of the elderly group, imperfect safety protection design, redundant function settings, complex operation logic, poor fabric touch and use experience, and mismatch between product pricing and actual adaptability, which are difficult to truly fit the real use scenarios and physiological and psychological needs of the elderly. Based on the above practical problems, this paper takes the optimal design of home-based age-friendly seats as the research core, combines the unique physiological functions, behavior habits and cognitive characteristics of the elderly group, and systematically discusses the theoretical basis and practical direction of the optimal design of age-friendly seats from multiple dimensions.

2. Physiological, behavioral and psychological characteristics of the elderly

The increase of age will bring continuous changes to the human body's physiological, behavioral and psychological states. These changes are generally irreversible, which directly change the real state and actual needs of the elderly in daily use of furniture, making the elderly's use feelings, functional requirements and aesthetic preferences for seats significantly different from those of young people. For this reason, the design of age-friendly seats cannot simply follow the general ergonomic parameters, but must comprehensively analyze the aging characteristics of the elderly group, and consider from the three dimensions of physiology, behavior and psychology, so as to solve the practical problems such as insufficient adaptability and poor use experience of traditional seats, and effectively improve the safety and comfort of elderly users.

2.1. Physiological characteristics of the elderly

Existing studies have pointed out that the decline of physiological functions is the core reason for the differentiation of the elderly's seat use needs, and changes in body structure and function will directly change their daily sitting posture and use habits [2]. At present, the design data of general seats are mostly based on the young and middle-aged population, which do not match the physical conditions of the elderly after aging, and it is difficult to take into account the comfort and safety of elderly users. The specific contradictions are mainly reflected in four aspects: musculoskeletal state, sensory function, body balance ability and body size changes.

After entering the old age, the human body's muscle content and bone density will naturally decrease, the support strength of the waist, back and lower limbs will be significantly weakened, the flexibility of the main joints such as hip and knee will gradually decrease, and the overall support capacity of the musculoskeletal system will become worse. In a sitting state for a long time, the

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elderly's waist and back muscles are difficult to support the body weight for a long time, and they are prone to discomfort such as waist and back pain, limb stiffness, and physical fatigue. At the same time, it is difficult for the lower limbs to exert force, and the flexion and extension of the joints are limited, which makes basic actions such as standing up and sitting down laborious, and the difficulty of independent standing increases [3], which also intensifies the problem of long-term sedentary inactivity. In terms of sensory function, the elderly's vision gradually degenerates, the visual clarity and light adaptability decline, and they have higher requirements for the shape recognition, color contrast and structural visibility of the seat. At the same time, the skin tactile sensitivity decreases, and the perception of the hardness and softness of the contact surface and the uneven changes is not sensitive, so it is difficult to detect local compression and slight slip in the first time. Therefore, they have stricter use requirements for the seat fabric material, surface flatness and fit. From the perspective of body stability, the elderly's physical coordination and balance ability decline, the center of gravity is easy to deviate in the sitting state, and the body sway frequency is higher. If the seat support is insufficient and the anti-slip effect is poor, it is easy to cause potential safety hazards such as body sliding, seat tipping and even falling. In terms of body shape, affected by aging changes such as spinal curvature, vertebral compression and osteoporosis, most elderly people will have physical changes such as shorter height, forward leaning posture and slightly hunched back. Seats designed according to the size of ordinary adults are often unable to adapt to such special postures, which are likely to cause distorted sitting posture, suspended waist and back, and excessive local compression of limbs in the elderly, which will not only aggravate sedentary fatigue, but also intensify problems such as limb numbness and waist and back strain, which is not conducive to the health of the elderly.

2.2. Behavioral characteristics of the elderly

The continuous decline of physical functions will directly change the daily behavior patterns and furniture use habits of the elderly, making the behavioral characteristics of the elderly using seats significantly different from those of the young group [4], mainly reflected in the aspects of limb activity ability, use scenario scope, independent action level and function use preference. With the decline of limb strength and joint flexibility, the elderly's daily movements are generally slow, and the activity range and movement amplitude of behaviors such as standing up, sitting down, turning around and adjusting sitting posture are significantly reduced, and it is difficult to complete fast and large-scale limb transformation. Insufficient physical mobility makes the elderly rely heavily on the auxiliary support structure of the seat in the process of sitting posture conversion, and need to use the force parts of the seat to make up for their own insufficient force and reduce the difficulty of movement. From the perspective of use scenarios, the elderly's daily activity range is relatively fixed, mostly concentrated in the family space. Seats are mainly used for home scenarios such as living room rest, daily reading, watching TV, and short rest. A single seat often needs to take into account multiple daily use functions, which requires age-friendly seats to have good scenario adaptability and comprehensive practicality. In terms of independent action ability, with the deepening of aging, some elderly people's action ability continues to weaken, and gradually enter a semi-disabled state, unable to complete the actions of standing up and sitting down independently and smoothly, and need external assistance to complete basic behaviors, which requires the seat to set up reasonable auxiliary structures to provide support and assistance for elderly users with limited mobility. In terms of use preference, the elderly pay more attention to the practical use value of the product, have low acceptance of various complex and cumbersome functional designs, and generally

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prefer seat forms with simple structure, intuitive operation and easy to get started, and do not want to increase the burden of daily use due to cumbersome operation and complex functions.

2.3. Psychological characteristics of the elderly

Changes in physiological state and behavior habits will also synchronously affect the psychological state and cognitive style of the elderly, forming psychological needs with age-stage characteristics, which directly determine the elderly's use feelings, acceptance and long-term use willingness of seat products, and are important content of humanistic care in age-friendly design [5].

From the perspective of actual psychological needs, with the weakening of the elderly's self-protection ability, their awareness of risk prevention will continue to increase, and they will pay special attention to the safety performance of seats. Whether the seat structure is stable, whether the contact surface is anti-slip, and whether the support is uniform will directly affect the elderly's sense of security in use. Any unstable and slippery details will easily cause users to feel worried and uneasy. At the same time, the elderly generally have a strong sense of self-esteem, and are very resistant to being deliberately labeled as "vulnerable" and "disabled" groups. Some over-medicalized and overly prominent age-friendly designs on the market will make the elderly have negative emotions such as inferiority and resistance. Therefore, the design of age-friendly seats should weaken the special identification, realize the invisible age-friendly effect on the premise of ensuring practical functions, and fully respect the elderly's independent personality and self-worth. In terms of emotion and aesthetics, the elderly have a more peaceful and introverted aesthetic mentality, prefer design styles with soft tones, simple and generous shapes, and warm and natural texture, and have low acceptance of designs with fancy shapes, complicated decorations and exaggerated colors. At the same time, the elderly pay more attention to the comfort and sense of belonging in life in their later years, and hope that home products can bring a warm, fitting and relaxed use experience. The seat design needs to take into account both aesthetics and comfort to meet the user's emotional sustenance needs. In addition, the elderly's memory, understanding and learning ability will naturally decline. When faced with complex designs such as multi-button adjustment, hidden switches and multi-level functions, it is difficult for them to quickly master the use methods and remember the operation steps for a long time. They are prone to frustration and anxiety due to inability to use and inconvenient operation, and then are unwilling or afraid to use the product.

3. Research on design strategies of age-friendly seats based on physiological, behavioral and psychological perspectives

3.1. Physiological adaptation: size module optimization and safety material support

The modeling design needs to fully consider the physiological characteristics of the elderly such as musculoskeletal degeneration, decreased body balance ability and tactile sensory decline, adapt to their behavior characteristics of small movement range and slow action rhythm, pursue simplicity and restraint as a whole, and abandon complicated and redundant external decorations [6]. All exposed corners of the seat are rounded and passivated to avoid sharp edges and corners, eliminate the risk of bumping during standing up, sitting down and turning around; reduce unnecessary protruding components to prevent hooking clothes, and build a safety foundation from the appearance level.

The seat size cannot directly copy the general furniture parameters for young and middle-aged people, and must face up to the physical status of the elderly such as spinal degeneration, forward

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leaning and hunched posture, and insufficient lower limb muscle strength. The standard seat height of 42-44cm and the large seat depth of ordinary civilian seats are not suitable for the elderly group, which are easy to cause body sinking, suspended waist and back, and increase the risk of falling during sitting-stand conversion. Therefore, the key parameters such as seat height, seat depth, armrest height and backrest inclination should be optimized based on the body shape characteristics of the elderly in China, and a certain range of adjustable adaptation should be realized relying on the modular structure to cover the elderly with different physical states of self-care and semi-self-care. The backrest can be set with a zoned support structure to effectively support the waist and back, relieve the waist and back soreness and limb fatigue caused by the elderly sitting for a long time, and improve the body strain caused by distorted sitting posture.

Material selection also serves the two goals of safety and comfort. The elderly's skin tactile sensitivity decreases, and it is difficult to detect local compression and slip in time. The contact surface of the seat cushion and backrest should be made of fabric with warm touch, breathable and skin-friendly; the internal filler should not blindly pursue too soft texture, excessive sinking will aggravate the burden on the knee joint, and it is necessary to select a filling material with moderate hardness and softness and good pressure dispersion performance to reduce local body compression. The seat frame is made of high-strength and stable materials, and the base is equipped with anti-slip accessories to prevent potential hazards such as seat sliding and tipping when the elderly's center of gravity shifts in a sitting position; at the same time, taking into account the long-term home use scenario, the fabric is made of wear-resistant and anti-aging materials to prolong the service life of the product.

3.2. Behavioral adaptation: minimalist operation and barrier-free assistance

The functional design should fit the elderly's behavior habits of limited mobility and resistance to complex operations, put an end to the blind stacking of intelligence, take barrier-free safety as the core, and achieve practical functions and simple and easy-to-understand operation logic. In the barrier-free safety design, fully respond to the elderly's real pain point of difficulty in exerting force when standing up and sitting down, set up armrest force structures with comfortable grip and reasonable position, provide external support for sitting posture conversion, and reduce the burden on lower limb joints and muscles; for semi-disabled elderly, a lightweight standing auxiliary structure can be configured, but the driving logic needs to be simplified. The seat cushion increases reasonable anti-slip performance to avoid the elderly's body slipping when sitting and lying; the overall structure is stable and firm, reducing shaking and loosening, reducing the risk of home falls, and eliminating the elderly's safety concerns in use from the functional level.

The adjustment mechanism implements the modular adjustable idea, giving priority to the adjustment of core dimensions such as seat height and backrest inclination, to adapt to diverse home scenarios such as watching TV, reading and resting. The adjusting components abandon hidden buttons and multi-level complex operations, and priority is given to physical control methods such as knobs and levers with high recognition, to adapt to the cognitive characteristics of the elderly's memory and understanding decline, and reduce the cost of learning and memory. Intelligence adheres to the principle of moderation, does not stack unnecessary monitoring and interconnection functions, only retains rigid demand modules such as standing assistance, and minimizes the dependence on network and power supply; if electronic adjustment components are configured, the buttons are made in large size and high color contrast to adapt to the physiological status of the elderly's vision degradation. At the same time, taking into account the needs of home maintenance, the fabric and components that can be disassembled and washed are adopted to facilitate daily

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wiping and cleaning, reduce the cleaning burden of the elderly and their caregivers, and further optimize the comprehensive use experience in the home scenario.

3.3. Psychological adaptation: invisible age-friendliness and humanistic care

The aesthetic design of age-friendly seats focuses on solving the industry pain point of excessive medical labels of current products, responding to the elderly's self-esteem needs, aesthetic preferences and emotional belonging, and realizing the design goal of invisible age-friendliness. Some age-friendly seats on the market have too prominent medical device features, which are likely to make the elderly have the psychological suggestion of being specially treated, and then breed inferiority and resistance, reducing product acceptance. Therefore, in the appearance design, the "elderly care device" attribute of the product should be weakened, the age-friendly functions such as assistance and adjustment should be internally hidden, so that the appearance of the seat is as close as possible to that of ordinary civilian furniture, integrate into the overall home environment on the premise of ensuring all age-friendly performances, maintain the elderly's independent personality and self-esteem, and improve their psychological acceptance and long-term use willingness.

At the visual aesthetic level, it fits the elderly's peaceful and introverted aesthetic psychology, the overall shape is simple and generous, and fancy and complicated decorative elements are avoided; the color priority is given to low-saturation, warm and soft tones, and moderate color contrast is added to key positions such as armrests and operation buttons, taking into account recognition, and avoiding copying the color scheme of nursing devices. Age-friendly design should not only stay at the physiological and functional levels, but also pay attention to the spiritual and emotional needs of the elderly. In addition to meeting the basic functions of sitting and leaning, the seat needs to create a relaxed and warm home atmosphere, and bring a sense of belonging and psychological security to the user. Humanistic care should be implemented into the appearance, color and overall style, breaking the design limitation of valuing hardware over psychology, making age-friendly seats not only furniture that ensures safety and comfort, but also home products that carry emotional experience, and truly completing the multi-dimensional comprehensive adaptation of physiology, behavior and psychology.

4. Conclusion

Based on the background of China's deep aging society, this paper takes home-based age-friendly seats as the research object, cuts in from the three dimensions of the elderly group's physiological functions, behavior habits and cognitive psychology, systematically sorts out their differentiated use needs, and puts forward the design strategy of home-based age-friendly seats for home scenarios combined with the domestic and foreign industry status and research progress.

The research shows that the elderly's demand for seats is not a single-dimensional physiological adaptation problem, but the result of the interaction of three factors: physiology, behavior and psychology. The degeneration of musculoskeletal system, the decline of sensory function, the decrease of balance ability and the change of body shape fundamentally determine that general furniture parameters are difficult to adapt to the elderly; the limited movement range, diverse home scenarios, differentiated independent action ability and instinctive rejection of complex operations further require seats to return to minimalism and practicality in function setting and interaction logic; while the safety demands, self-esteem consciousness, introverted aesthetic preferences and natural decline of cognitive ability make the product's appearance and use experience equally important. The three are interrelated and together constitute the complete basis for the design of age-

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friendly seats. However, most of the existing researches and products focus on the hardware transformation at the physiological and functional levels, and the care for the psychological dimension is obviously insufficient, which is also an important reason why many age-friendly seats are difficult to be truly accepted by the elderly.

In response to the above problems, this paper puts forward the design concept centered on invisible age-friendliness, minimalism and practicality, and modular adaptation, and constructs strategies from three levels: modeling, function and aesthetics. In terms of modeling, based on the optimization of key parameters such as seat height, seat depth, armrest height and backrest inclination of the elderly in China, the modular structure is used to cover different physical states such as self-care and semi-self-care. At the same time, the safety and comfort are considered through the selection of rounding and passivation, anti-slip base and skin-friendly and breathable materials; in terms of function, based on barrier-free safety, the auxiliary support for sitting-stand conversion is strengthened, modular flexible adjustment is implemented, moderate intelligence is adhered to simplify the operation logic, and the needs of easy-to-clean home maintenance are considered; in terms of aesthetics, the medical device attribute is weakened through internal hidden functions and home-style appearance design, the elderly's independent personality and self-esteem are maintained, and the humanistic care is carried with soft and introverted visual language and warm and relaxed use experience, and finally the multi-dimensional collaborative adaptation of physiology, behavior and psychology is realized.

It should be pointed out that limited by the research conditions, the design strategy proposed in this paper is still at the theoretical level, and the physical prototype trial production and elderly user measurement and verification have not been carried out. The optimization range of various parameters and the actual effectiveness of functional modules need to be further verified through ergonomic experiments and user experience tests; at the same time, the research is mainly oriented to the urban home elderly group, and the coverage of urban-rural living environment differences, different regional living habits and extreme use scenarios of disabled elderly groups is insufficient. Subsequent research can iterate the prototype based on this strategy framework, combined with means such as pressure distribution test, electromyography analysis and motion capture, and expand the sample scope, including elderly users with different self-care levels and different living conditions for long-term follow-up verification, so as to provide a more solid empirical support for the refined and humanized research and development of home-based age-friendly furniture, and promote the continuous deepening of age-friendly design from functional adaptation to whole-person care.

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