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Research on the Design of the Elderly Wardrobe Based on Ergonomics

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Abstract. The elderly population of our country increases continuously, and the problem of aging population is becoming more and more serious. Based on the storage demand of the elderly, this paper analyses the problems existing in the use of the wardrobe by the elderly based on the ergonomics and the physiological, psychological and behavioural characteristics of the elderly. And from the perspective of safety, versatility and barrier-free design principles, the concepts of security, versatility and barrier-free design are used. It aims to improve the quality of life of the elderly by proposing a wardrobe design suitable for their elderly users.

1. Introduction

According to the latest population data released by the National Bureau of Statistics, by the end of 2018, China's population aged 60 and over was 249.49 million, accounting for 17.9% of the total population, of which the population aged 65 and over reached 166.58 million, accounting for 11.9% of the total population. Against the backdrop of China's upcoming aging population, China's elderly furniture is still in its infancy and has not yet formed a professional market and brand. Therefore, furniture suitable for the elderly will become a new consumption hotspot in China's future furniture market. The power of design will make life more secure and comfortable for older people.

2. Human factors analysis of the elderly

2.1 Physiological analysis

As we grow older, our body's physical function continues to decline, which has a certain degree of impact on our work and life. After entering the age of 65, the height of the elderly will shrink and the weight will continue to decline [1]. The bone content and muscle mass will decrease, and the tendons and ligaments will begin to shrink, which will directly affect the limb flexibility of the elderly [2]; arthritis, shoulder circumference The common diseases of the elderly such as inflammation and osteoporosis further reduce the activity of the limbs of the elderly.

2.2 Psychological analysis

When the elderly leave their jobs, they return to family life, social activities are gradually reduced, and the changes in social roles have also caused their lifestyles to change dramatically. There will be a huge gap in psychology, which may lead to some negative thoughts, often manifested as lack of Security, loneliness, sensitivity, etc. Affected by various factors, 421 families and two-child families have become the main form of modern family structure. As a result, more and more elderly people



living alone have emerged. Their life circle has shrunk and no one has taken care of them. This makes the elderly feel very lonely.

3. Research on the use of wardrobes for the elderly

3.1 Research purpose and content

This research mainly analyzes the human-computer interaction process between the elderly and the wardrobe through interviews and observations of the use of the wardrobe by the elderly; selects the typical behavior decomposition action, and analyzes the behavior patterns and ability obstacles of the elderly. Through the research on elderly users and wardrobe products, to understand the actual needs of elderly users and the pain points of products, the design scheme of aging wardrobes that meet the actual needs of elderly users is proposed.

3.2 Research objects and methods

The sample of this survey was determined to be male and female citizens aged 60 and over, who are basically able to live on their own and have the habit of using the wardrobe for storage. First of all, we visited 13 elderly people, observed and interviewed the elderly using the wardrobe, and also learned about the living habits, behavioral characteristics, and health status of the elderly. Followed by the questionnaire survey, based on the survey, interviews and observations of households, combined with the relevant information to produce a questionnaire, through the questionnaire to investigate the main problems of the use of wardrobes for the elderly.

3.3 Research results

A total of 500 questionnaires were distributed for the elderly and 381 valid questionnaires were collected. Interviews and observations of 13 elderly people. According to the results of this survey, the dissatisfaction rate of the elderly in using the wardrobe reached 89.6%. The reasons are inconvenient use of the wardrobe, insufficient storage space, and unreasonable space division. The problems frequently encountered by the elderly in using the wardrobe are shown in Table 1.

Table 1. Common problems in the process of using the wardrobe for the elderly.

Behavior	Common problems
store clothes	insufficient storage space, wardrobe partition is too high, need to squat down, etc.
try on clothes	clothing storage disorder, dark light, forget where the clothes are placed, no mirror in the bedroom, etc.
drying the quilt	The quilt is placed too high, making it very inconvenient to take and store, and it needs to be done with tools. It is difficult for the elderly to complete alone.

4. Design principles

4.1 Safety design principle

Security is the first element of human survival. The safety design principle of aged furniture is to design and analyze from the physical and mental safety level of the elderly, to the greatest extent avoid safety hazards. The design of the elderly wardrobe should fully consider the physiological characteristics of the elderly, and try to avoid letting the elderly do the laborious actions. For example, in the wardrobe design, the hanger automatic lifting system is used to assist the elderly, and the inconvenient parts of the wardrobe function module are adjusted to ensure that the elderly can safely use the wardrobe.

4.2 Universal design principles

Universal design focuses on the special needs of the elderly while also paying attention to the needs of the young and middle-aged population; paying attention to the needs of the elderly at the age of 60, but also taking into account the needs of the elderly aged 80 or older. In addition to the elderly, the use of elderly wardrobes may also include family members, caregivers and housekeeping personnel. Therefore, it is impossible to metaphysically classify the design of the elderly wardrobe and the design of the ordinary wardrobe. Generally, furniture has a longer life than general industrial products. Older people may experience changes in physical function and living ability during the life of the furniture. Therefore, the design of the elderly wardrobe should also be designed for potential needs, so that the wardrobe can be adjusted as needed.

4.3 Accessibility design principles

Accessibility design is one of the main principles of elderly wardrobe design. The decline in motor function, sensory function and cognitive function of the elderly, resulting in audio-visual disorders, behavioral disorders, and disturbances of consciousness. The design of the elderly wardrobe is based on the study of the behavior, consciousness and movement of the elderly, making it a safe and convenient bedroom storage space for the elderly.

5.The design of aging wardrobe

5.1 The size design

Wardrobes are an important storage space for the elderly. If the size of the wardrobe is not suitable, it will cause inconvenience to the elderly. The overall size of the wardrobe is mainly determined by the size of the storage item and the size of the human body[3]. Therefore, the size of the aging wardrobe should be determined according to the size of the stored items and the size of the human body. The GB/T 3327-2016 "Main dimensions of furniture cabinets" [4] stipulates that the internal depth of the wardrobe should not be lower than 530mm, the height of long clothes is not less than 1400 mm, and the height of hanging short clothes is not less than 900 mm.

5.1.1 Height dimension. The bedroom and living room are the most frequent spaces in the home and are the place where large furniture is concentrated. The height of the residential floor, especially the height of the bedroom, has certain constraints and restrictions on the height of the wardrobe. In order to ensure the basic use requirements, according to the GB50096-2011 "Residential Design Code", the indoor net height of the bedroom and living room should not be lower than 2.40 m, and the local net height should not be lower than 2.10 m[5].

5.1.2 Depth dimension. According to the provisions of GB/T 3327-2016 "Main Sizes of Furniture Cabinets" and the common sizes of hanging and stacking clothes, according to the actual situation of the elderly using the wardrobe, the depth dimension of the old wardrobe is initially set to 550mm.

5.1.3 Width. There is currently no uniform standard for the width of the wardrobe, which is mainly limited by the width of the wall in the bedroom. In "Research on the Modular Design Method of Composite Wardrobe for Mass Customization", Dr. Lee rounded and normalized the width dimension data of 40 bedroom custom closets and positioned the size difference to 400. Then, according to the common size of the internal functional parts of the wardrobe, the width of the single door wardrobe of the artificial board and the solid wood composite wardrobe is determined to be 400 mm, and the width of the double door wardrobe is determined to be 800 mm. Finally, we can use a modular combination to match the 1200 mm, 1600 mm, 2000 mm wide composite wardrobe.

5.2 Functional space design

The internal functional space division of the aging wardrobe should be based on the principle of

clothing classification and storage, while taking care of the behavioral characteristics of the elderly group. We chose the two typical behaviors of drying quilt and trying clothes to decompose the action (as shown in Table 2) in order to be closer to the actual needs of the elderly.

5.2.1 Change the position where the quilt is stored. The top of the closet as the bedding storage area is the most common practice for wardrobe partitioning (as shown in Figure 1), but it will be more difficult for the elderly to use. From the action decomposition of Table 2, we can know that if the elderly want to take the bedding in the closet to the balcony to dry, it takes about 9 steps. However, most elderly people suffer from osteoporosis, so standing in a chair and taking a bedding is very dangerous for the elderly. If the elderly are required to complete this behavior alone, the difficulty coefficient and the risk factor are increased. We moved the position where the quilt was stored down to 0-600mm, which required space for squatting, and also designed a locker with pulley for the bedding. After adjustment, the action decomposition steps of the elderly quilt are reduced to 5 steps, and the dangerous action is cleverly avoided.

5.2.2 Application of liftable clothes rail. The top space of the covered wardrobe can be used to lift the clothes rail, and the hanging storage space is added in the wardrobe to reduce the stacking storage space. This form of design will guide older people to hang clothes for storage. Firstly, it can intuitively show the storage location of clothes to the elderly and solve the problem that the elderly forget the storage location due to poor memory. Second, a lot of clothes hang up space than stack less, the same size of space hanging can store more clothes than stack, increase the storage space of the wardrobe. Third, hanging and putting can better keep the wardrobe tidy, solve the problem of easy to mess up the wardrobe when storage clothes. In addition, clothes such as underwear and socks that are not suitable for hanging, drawers and stacking areas are also provided for storage.

Table 2. Decomposition of the action steps of the elderly using the wardrobe.

Behavior	Adjust	Action decomposition step
drying the quilt	before	stand on a chair—take a quilt—Stand on the floor—place the quilt—drying the quilt—take a quilt—stand on a chair—stand on a chair—put it in the closet—put the chair in position
	after	drag out the quilt box—drag it to the balcony—drying the quilt—take a quilt—put the box in position
trying on clothes	before	looking for a dress—get dressed—go to the room with the mirror—look in the mirror—return to bedroom—take off clothes—put the clothes in position
	after	pull down the adjustable hanger—take clothes—get dressed—open the mirror—look in the mirror—take off clothes—put the clothes in position

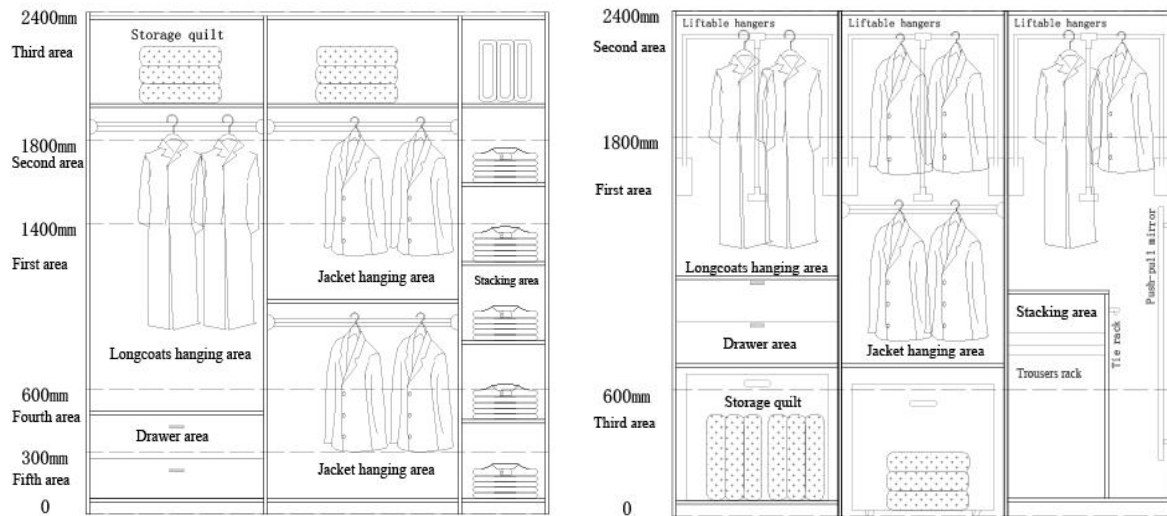


Figure 1. The common function modules of the wardrobe and the function modules of the wardrobe after adjustment for aging.

5.3 Detail design

More attention should be paid to details in the design of the wardrobe suitable for aging, so as to provide the elderly users with more intimate experience in vision, hearing and touch. According to the survey results, the elderly can't see when looking for things in the closet because the light is too dark. Therefore, we can install the sensor light in the closet. Second, placing a mirror inside the closet makes it easier for the elderly to use. Choose hydraulic buffer hinge, can avoid because drawer and move a door to close quickly and clip a hand, reduce wallop while still can accomplish mute. During the life of the furniture, you may experience changes in the physical function and living ability of the elderly. Considering the possibility of using a wheelchair in the future, leave a space of about 200mm in the bottom of the wardrobe and about 320mm in height to accommodate the wheelchair pedal. Even if the elderly use a wheelchair, it is easy to operate.

6. Conclusion

Many problems encountered by elderly users in the use of the wardrobe have greatly affected their experience. Reasonably adjust the functional partition of the wardrobe from the ergonomic point of view. Use the liftable hangers and increase the proportion of hanging storage to guide the storage habits of elderly users using the wardrobe. Propose targeted solutions such as insufficient storage space, inconvenient things, and confusion. With the continuous improvement of China's aging population, the demand for professional and aging furniture is also growing. This is an opportunity and a challenge, and it has placed higher demands on the market and practitioners. Only the practitioners of the furniture industry understand the actual needs of elderly users, solve problems in a targeted manner, and be people-oriented in order to gain a foothold in the elderly furniture market.

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