

# Research on Barrier-free Design of Bath Products for the Elderly\*

Yu Liu

South China University of Technology  
Guangzhou, China

Chao Yang

South China University of Technology  
Guangzhou, China

**Abstract**—The accelerated development of aging in China has made the elderly pay more and more attention to bath products. This article analyzes the problems in the design of bath products for the elderly in China, and combines the changes in the bathing style brought about by the changes in the physiological and psychological characteristics of the elderly. Based on the concept of barrier-free design, the design principles of bath products for the elderly are proposed from four aspects: safety, applicability, ease of use and development, so as to meet the real demands of the elderly for bath behavior and promote the vigorous development of the bath industry for the elderly.

**Keywords:** *the elderly, bath products, barrier-free design*

## I. INTRODUCTION

In August 2019, the National Bureau of Statistics issued the 20th Report of Series on the achievements of economic and social development in the 70th anniversary of the founding of the People's Republic of China. According to the report, it only took about 18 years for the age structure of China's population to move from the adult type to the elderly type, and the proportion of the population aged 65 and above reached 11.9% by 2018. It is estimated that in 2050, the total number of the elderly population will reach 487 million, accounting for 34.9% of the total population.

According to the definition of the World Health Organization, people aged 60 and above are identified as the elderly. With the acceleration of the aging of Chinese society, the pension concept of the elderly has changed. However, as a bath product to protect the daily cleaning and health care of the elderly in the house, it is often overlooked due to its high privacy.

## II. CURRENT SITUATION OF BATH PRODUCTS FOR THE ELDERLY IN CHINA

At present, health and health care is a national hot topic. All kinds of daily health care products for the elderly are

emerging in an endless stream, which constantly reminds us of the importance of the needs of China's elderly users and the huge consumption market for the elderly. In the aspect of bath products closest to health, no matter in the daily family, government pension institutions, real estate developers' apartments for the elderly and other places, except for some simple armrests and bath chairs, there are not too many bath products developed and designed for the elderly as an important group. However, the existing bath products do not fully consider the needs of the elderly for the amenity of life in the design, and many obstacles are in the operation of the products.

### A. Imperfect safety protection facilities

Due to the wet and slippery bathing environment, safety protection measures are very important in the bathing process for the elderly. However, according to the survey, many families with the elderly have installed shower chairs, which are used in combination with the existing bathrooms. Less than 10% of elderly families have accessible handrails. These installations of handrails in the bathroom also did not refer to the corresponding size recommendations, and most of them are free to install. It can be seen that the bathrooms of ordinary families with the elderly in China seldom undergo targeted transformation, and most of them lack corresponding safety protection measures. Even if there are simple protection measures, the installation of their facilities does not meet the specifications.

And the hidden dangers in common bath products are always threatening the safety of the elderly. According to the statistics of "NikkanGendai", about 4800 people died of accidental drowning in their bathtub in 2015, 90% of them were over 65 years old. This is precisely because the inner wall of the existing bathtub mostly adopts smooth modeling design, which does not eliminate the safety risk from the perspective of ergonomics. When using the bathtub, due to the weakening of the strength of the elderly's waist, abdomen, arms and legs, it is easy to encounter the problem of getting up in an emergency. There will be problems in and out of the bathtub. It is a very common accident for the elderly to have a fracture due to slipping in the bath.

---

\*Funds: This work was supported by the Guangdong Application-oriented Special Funds for Science and Technology R&D — "Key Technology Development and Industrial Application of New Generation Environmentally Friendly Brass Faucet" (No. 2016B090931002), and the Guangdong Special Funds for Public Welfare Research and Capacity Building — "Development of a new type of lead-free free-cutting silicon brass faucet material" (No. 2014A010105020).

### *B. Lack of human care*

Most of the existing design of safety protection facilities for bathing of a few elderly people still stays in solving the problem of growing from scratch, ignoring the psychological needs of the elderly, which is easy to cause poor experience in use. For example, the addition of safety armrest and safety chair is quite different from the family decoration style, and the strong industrial sense of modeling is easy to associate with hospitals, public toilets and other places, lacking psychological care for the elderly. Under the shower mode, a shower chair can effectively reduce the safety risk of the elderly when bathing. However, the selection, taking and use of the shower head, the position height of the shower head switch, and the way of water volume regulation are all relatively random, and there is no targeted design. However, due to the imperfection of product safety protection measures mentioned above, many families choose children or support workers to assist the elderly to complete bathing behavior, so as to avoid all kinds of potential safety hazards when using bathtubs. Although the starting point is for the safety of the elderly, the basic psychological needs of the elderly for life independence are ignored in the process of assistance, which increases the psychological burden of the elderly. Therefore, most of the existing products are only designed from the perspective of use function, lack the thinking about the unique bathing style of the elderly, and do not achieve "people-oriented" principle.

### *C. Insufficient integrity of bath products*

Compared with neighboring Japan, China seldom adopts the overall bath design. Especially in the old houses where the elderly live, the integrated toilet is still used, that is to say, a space needs to meet the toilet, bath, wash and wash functions at the same time. Taking 85 square meters of living room as an example, the area of the toilet is generally 3-5 m<sup>2</sup>. Due to the many functions in the toilet, a variety of products gather. If the bathing space for the elderly is not transformed from the perspective of integrity, it will undoubtedly increase the space tension. Due to different brands, functions and styles, the existing bath products are difficult to match and systematically solve the physical and psychological needs of the elderly. Therefore, in addition to the basic problems such as floor anti-skid, dry and wet separation, indoor ventilation and lighting, the integrity of bath products needs to be improved to ensure the good user experience of the elderly in the bath process.

At present, many problems of bath products for the elderly in China are mainly caused by the lack of understanding of the elderly. Therefore, it is necessary to fully grasp the changes of physiological and psychological characteristics of the elderly in order to better carry out barrier-free design of bath products.

## III. PHYSIOLOGICAL CHARACTERISTICS OF THE ELDERLY

### *A. Decline of body function*

With the growth of age, human body function began to decline, mainly manifested in the continuous atrophy of

bones and muscles, as well as the decline of exercise ability caused by various diseases. First of all, people's height in the old age is about 2.7% shorter than that in the young age. Not only that, osteoporosis and fracture are also common problems of the elderly. The elderly are more likely to be damaged in the sudden load-bearing and impact.

Secondly, if the aging of bones is not enough to promote the change of bathing products for the elderly, the degradation of muscle elasticity, endurance, explosive force, flexion and extension caused by muscle atrophy of the elderly has a significant impact on their daily life, including bathing behavior. For example, the aging of the muscles and nerves of fingers and poor control ability make the elderly unable to complete fine operation activities in the process of bathing. The strength of arms and legs is weakened, and the body cannot be given enough support when lying down or sitting up. At the same time, the degradation of the strength of legs leads to slower speed and shorter step length, and the posture cannot be adjusted quickly in case of emergency.

Third, in addition to the aging and wear of daily skeletal muscles, chronic and acute diseases are also eroding the physical functions of the elderly. Some diseases controlled or more stable in the ordinary daily may be caused by bathing. For example, too long bathing time is easy to lead to fatigue of the elderly, resulting in heart ischemia and hypoxia; too high bathing water temperature may cause the blood pressure to rise, leading to cardiovascular and cerebrovascular diseases; too large temperature difference inside and outside the bathing room, the elderly are easy to catch cold, resulting in reduced immunity and inducing other diseases.

### *B. Decreased perception*

Perceptual ability refers to the ability to obtain the light, color, sound, taste, force, cold, heat, pain and other feelings of things through the sense organs such as vision, hearing and touch. It is an important ability for people to understand the world and receive information. With the increase of age, the perceptual organs weaken in different levels, which lead to the overall decline of perceptual ability. In terms of vision, the ability of retina to distinguish image of the elderly is declining with the increase of age. For example, the raised weather bar on the bathroom floor may be easy to avoid for young and middle-aged users, but it may be a great potential safety hazard for the elderly. Elderly people are often tripped in the bathroom at home. In terms of hearing, the sensitivity to sound is reduced, and some young people feel that normal volume is not easy to be heard by the elderly. In tactile sense, the sensitivity to cold and heat is low, the ability to distinguish texture and surface is weakened, and the risk of catching cold, scalding or disease is easy to occur.

It can be seen that a series of problems caused by the decline of body function and perception ability have a hidden danger to the bathing behavior of the elderly. The elderly bear a greater safety risk than the young when using these products alone.

#### IV. PSYCHOLOGICAL CHARACTERISTICS OF THE ELDERLY

A person's mental health determines his quality of life. The formation of the psychological characteristics of the elderly is more complex and diverse than the physiological characteristics. For many elderly people, the transformation of social identity, the distance of their children and the decline of their physical functions will have great influences on their psychology. According to the investigation, the psychological characteristics of the elderly, including cognitive decline and sensitive emotional characteristics, have an important impact on bathing behavior.

##### A. Cognitive decline

Cognitive ability refers to the ability of human brain to process, store and extract information. It is an important psychological condition for people to complete their activities successfully. The ability of memory, thinking and learning are all regarded as cognitive ability. With the increase of age, theoretically, people's life experience should be more and more rich, and their ability to analyze and judge things should be constantly improved. However, in real life, the elderly often use products, especially when operating new products, there will be various kinds of unsmooth situations, making people feel frustrated. The reason of this situation is that the old people's memory is declining, their learning ability is decreasing and their habitual thinking is strong. With the increase of age, memory will gradually decline, so the elderly are prone to memory disorder when receiving and processing external information. In addition, some diseases, such as Alzheimer's disease, can cause obvious cognitive dysfunction in the elderly.

Not only that, the learning ability of the elderly will also decrease with age. On the one hand, it is due to the lack of interest and motivation in learning new things. On the other hand, due to the weakening of their sports ability, perception ability and memory, the difficulty of learning new things and new products is greatly increased, and it is easy to produce negative emotions such as frustration in the learning process and further lose the motivation for learning.

With the rapid development of science and technology and the continuous change of thinking mode, the time for the elderly to receive new ideas and new things is also increasing. Therefore, the thinking of the elderly is easy to form a stereotype, not flexible. The ability of the elderly to learn new things is relatively weak. With rich experience, the elderly is capable of analyzing and dealing with known or similar problems.

##### B. Ignoring emotional needs

The old people's leisurely retirement life has formed a great contrast with the previous busy work situation. Due to busy work, the children have gradually reduced their attention to the old people. The death of relatives, spouses, friends of the same age, the social interaction of the elderly is less, making the old people more likely to have lonely, sad, melancholy mood. The body function weakens, the activity ability loses gradually, and the old people will stay at home

most of the time, which is easy to make them question themselves in terms of self-worth. At the same time, the decline of cognitive ability makes them easily have frustration when using the product. And some families will also neglect the elderly's need for self-care and self-reliance due to excessive care. Therefore, the elderly are more likely to have negative emotions, and it is difficult to relax themselves.

#### V. BARRIER-FREE DESIGN PRINCIPLES OF BATH PRODUCTS FOR THE ELDERLY

As early as 1974, the United Nations Organization put forward the concept of barrier-free design, which emphasized that the design of all public spaces and all kinds of facilities and equipment must take into account the needs of children, the elderly and the disabled. And then, they can live as safe, convenient and comfortable as ordinary people, building a harmonious society full of love and care. When designing barrier-free bath products for the elderly, the following principles should be followed on the basis of fully considering the special physical and mental characteristics of the elderly and the current situation of bath products in China.

##### A. Safety principle

Barrier-free bath products must first conform to the safety principle in the design. In the modeling design, it is required to avoid the use of sharp, angular and other elements, and adopt the form of circular with arc to reduce bumps, abrasions and other accidents, so that bath products can bring the elderly a sense of psychological safety. In the process of bathing, the elderly are prone to fall down due to the slippery ground and lack of support due to the shift of center of gravity and direction of body movement, resulting in fracture and even life-threatening. Especially, the elderly need to step into the bathtub with one leg, which is very easy to cause accidents. Therefore, in the barrier-free design of bath products for the elderly, it is necessary to make full use of the strength of design to protect the safety of the elderly and minimize the negative results caused by mis-operation or accidental actions. American designers have designed a side-opening bathtub to facilitate the access of the elderly (Fig. 1). The seat in the bathtub can ensure that the head of the bather is always above the level. The inside of the bathtub is equipped with a handle, which is convenient for the elderly to get up and ensures the safety of the elderly. The bathtub is also equipped with spa massage function, which can effectively treat joint pain, arthritis, sciatica, sleep disorders and other diseases, so that the elderly can sit in the bathtub safely and comfortably.



Fig. 1. Walk in tubs.

### B. Applicability

As mentioned above, the physiological characteristics of the elderly are constantly changing with the increase of age. Therefore, how to improve the applicability of bath products for the elderly should be considered from the perspective of the degradation of physical function and the change of body size. For example, the elderly's leg function is reduced, and it is difficult to squat and get up. The height of the sitting surface of the bath chair should not be about 430mm for the ordinary chair, but about 500mm for the wheelchair. Considering the degradation of the elderly's physical function, the elderly care institutions in Kanagawa, Japan, have carefully designed bathtubs and supporting safety handrails according to the scale of the elderly. The height of the special bathtub is slightly higher than that of the ordinary bathtub, reaching about 500mm, and the length of the bathtub is 1500mm, which is suitable for the elderly to enter the bathtub. Two horizontal handrails of 600mm and 900mm high are installed inside the bathtub.

The form of the water outlet controller should also be convenient for the elderly to use. At present, the common controller needs to adjust the water flow and the water temperature at the same time, which is a task requiring fine control for the elderly. Due to the poor flexibility of the elderly's movements, especially the elderly with Parkinson's disease, it is easy to be scalded or frozen when adjusting the water temperature. Therefore, it is a good choice to adopt water-saving flow, which can control the water temperature alone or prefabricate the water temperature.

### C. Ease of use

Due to the physiological and psychological characteristics, the elderly are easy to have difficulties in learning complex products and have a certain sense of resistance and fear. Therefore, in the barrier-free design of bath products, it is necessary to follow the principle of ease of use. The interface is simple, the operation is simple, and the function is stable. This can not only help the elderly to reduce the adaptation time of new products, improve the operation efficiency, but also reduce safety risks and increase the satisfaction of older people in the use of the product. For example, the barrier-free bathtub designed by a German designer can be raised and lowered. When the old people sit in the bathtub, they can enjoy the bath by raising the edge of the bathtub and adding water. After bathing, they can leave the bathtub by waiting for the water to run out and lowering the edge. The height of the sitting surface of the bathtub is also designed as the height of the ordinary wheelchair, which is easy to operate and convenient for the elderly under the condition of ensuring the use.

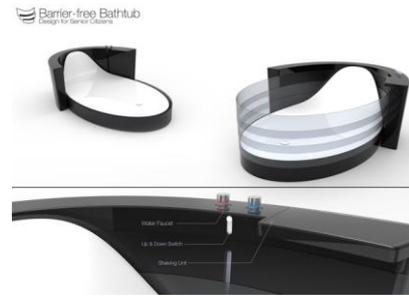


Fig. 2. Barrier Free Bathtub.

### D. Development

As a durable consumer product with a long service life in the home, the function development of elderly bath products should be fully considered in barrier-free design. When new functional requirements appear, it can improve the bathing experience of the elderly through simple transformation. According to the research of happiness, it can improve the happiness of the elderly by enhancing their sense of control over daily life. A bath product that can be adjusted according to the physical condition of the elderly can ensure the smooth progress of bathing behavior of the elderly, and help to protect the independence and self-esteem of the elderly. When the physical condition of the elderly needs the assistance of auxiliary personnel or nursing staff, the developable bath products can also meet their use needs by replacing parts.

## VI. CONCLUSION

A Bath product, as a relatively private product type, is also an important factor to measure the overall quality of life of a society. The research on the aging problem in China is still in its infancy, and the physiological and psychological characteristics of the elderly have not been reflected in the bath product design. It is hoped that through the barrier-free design concept, a new design attempt will be made for the bath products for the elderly from the four aspects of safety, applicability, ease of use and development. They will no longer be a cold product, but a humanized product with emotion and temperature, so as to eliminate the physical and psychological barriers of the elderly, help them enjoy the pleasure of bathing, and improve their happiness index, and ensure a safe, convenient and comfortable modern living environment for the elderly.

## REFERENCES

- [1] Wang Yimin, Jiang Han. Product Design Principles Based on Stages of the Aged Groups [J]. Packaging Engineering, 2011, 32 (6): 120-122. (in Chinese)
- [2] Sun Yuan. Bathroom Space Design Based on Universal Design Concept [D]. Dalian: Dalian University of Technology, 2008. (in Chinese)
- [3] Zhang Rupan. Research on Urban Sanitary Facility System for the Elderly [D]. Wuxi: Jiangnan University, 2008. (in Chinese)

- [4] Zhang Hua, Li Linman. Emotional Design of Barrier-free Sanitary Products for the Elderly [J]. *Packaging Engineering*, 2019, 40 (22): 148-152. (in Chinese)
- [5] Li Cuiyu, Dong Yanqing. Innovative Design of Sanitary Products Based on the Needs of Urban Elderly Living Alone [J]. *Packaging Engineering*, 2019, 40 (16): 145-150. (in Chinese)