



The Clothing Design for the Elderly Care

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Abstract. The physiological functions of the elderly will gradually degenerate with age, and their daily life will require special care as well. With the aging population around the globe, the elderly population has increased gradually, and the care of the elderly is getting more and more attention. More and more elderly people are living in nursing homes to acquire convenient care. By observing the care for elderly people, we can find that although the elderly can receive full care in nursing homes, they can also be exposed to occupational injuries.

Therefore, this study aims to explore and analyze the care-giving procedures to improve the care efficiency and quality of caregivers for the elderly living in nursing homes, and to reduce the pressure of care-giving, thus enhancing the autonomy of the elderly. By re-examining the methods of care for the elderly, we will start from improving the dressing problems encountered by the elderly and aim at improving the self-care of the elderly and reducing the work injuries suffered by the caregivers, thus improving the quality of life of the elderly and contributing to the issue of aging population around the globe in the future.

Keywords: Occupant injury · Elderly clothing · Ergonomics design · Nursing home dressing

1 Introduction

1.1 Background

In the global aging society, the care of the elderly has received more and more attention. However, domestic care personnel often suffer occupational injuries due to insufficient manpower and long working hours. Therefore, the main purpose of this study is to analyze the interaction between the care personnel and the elderly living in the nursing home, find the main causes of pain and injuries suffered by care personnel in the clothes-changing process through analysis and observation of the dressing procedure, and identify the inability of the elderly to perform dressing independently due to physiological deterioration. Taking the deterioration of the physiological function among the elderly as the starting point, this study attempts to understand the relationship between the physiological and psychological changes, the dressing process

and the care personnel and identify design parameters for the elderly care clothing from the interaction between the elderly and care personnel in the clothes-changing process.

According to 2010 Population and Housing Censuses by Directorate General of Budget Accounting and Statistics under the Executive Yuan, there are about 475,000 people who need the long-term care in Taiwan, of which the elderly account for 65.4%, but only half of them live together with their children. As population aging and childlessness have slightly reduced the traditional family function as a caregiver, the family type in Taiwan is moving towards becoming the nuclear family. The average number of family members is about 3, but it requires 2 to 3 or more people to provide care assistance for the more proper care. It is foreseeable that the long-term care has become an indispensable option in the future [1]. According to the national population statistics information published by Directorate General of Budget Accounting and Statistics under the Executive Yuan, the ratio of people aged 65 and over in long-term care and nursing institutions is 1.6%. The growth of institutional care has slowed down as the long-term care service is becoming more and more solid with the development of home and community care. According to the statistics of the Ministry of Health and Welfare, there were 1,048 long-term care and nursing institutions in Taiwan by the end of June 2014, including 1,023 long-term care institutions and 25 nursing institutions which could accommodate 58,000 people, showing a decrease by 1.7% compared to those numbers in 2009. The actual number of people institutionalized was 44,000, accounting for 1.6% of the population over 65 years old in Taiwan. In 2012, while the utilization rate of institutions taking care of senior citizens stricken by dementia reached about 90%, the utilization rate of other institutions was only about 60% to 70%.

1.2 Research Questions

Human aging has a significant degenerative effect on physiological functions. When the physiological functions of elderly are degenerating owing to normal aging with diseases striking at the same time, the human body function can be significantly degraded. When the body functions degenerate, the activity and performance of the physiological system will deteriorate. For example, the hearing and visual functions deteriorate, soft tissues (skins and blood vessels) become less elastic, or the cardiopulmonary function, physical strength and muscle strength decline. Physiological deterioration and mobility disorder may even cause disability in the elderly. The elderly encounter a variety of age-related physical changes from clothes-changing, including a weakened sense of balance, dizziness and joint degeneration [2]. With the gradual loss of the basic life skills and autonomy, many of the actions in the life of the elderly will be hindered and restricted. Either at home or in care institutions, aging will undoubtedly seriously affect their quality of life. Under the more serious circumstances, the daily activities of the elderly may even depend on the care personnel completely. The elderly show a clear dependence on the care personnel for clothes-changing. As of 1999, the Centers for Disease Control and Prevention (CDC) reported that only 13% of the elderly livings in nursing homes were able to take care of themselves in clothing-changing, and the number among the elderly who could take care of themselves in clothing-changing was declining [3]. 91% of the elderly dementia patients with the Alzheimer's disease need to rely on others to complete the act of clothes-changing.

Although the aging disorder does not make the elderly lose their autonomy in clothes-changing completely, they rely on others for assistance. Therefore, caring for the disabled elderly people will definitely cost a relatively large amount of manpower and money. Social costs for medical care, general care and social welfare can also pose a heavy burden.

Studies have shown that more than half of caregivers have problems with their shoulders, elbows, wrists and suffer from neck pains owing to their work [4]. As the elderly receive the long-term care, they can gradually lose their autonomy and heavily rely on the help of caregivers. Therefore, research shows that the issues concerning dressing have a negative impact on the elderly. The inability to dress on one's own and loss of autonomy have seriously affected the quality of life of the elderly [5]. Exploring the problems in the elderly clothes-changing, we find that the clothes worn by the elderly are tailored for the general public, but as the bones change from aging, shoulders and chests will shrink, so the clothes will become loose and unfit, and besides issues like loss of warmth and poor spirits, the existing design of clothes can also cause the problem of inconvenience in clothes-changing among the elderly. Based on the above viewpoints, it is of great value and contribution to explore the effects of physiological deterioration on clothes-changing and care personnel, find the best solution, and design a more comprehensive elderly care suit from the perspective of human factors.

2 Literature Review

2.1 The Influence of Clothes-Changing Care on Care Personnel

In addition to inconvenience in clothes-changing among the elderly, care personnel that assist the elderly clothes-changing can suffer great impacts as well. In general, a care worker usually needs to care for a number of elderly people at the same time. According to a study by Cohen-Mansfield et al. [6], a care worker may spend 4–9 min assisting an elder in clothes-changing. And the number of the elderly that the nursing home needs to care for is even larger. It can be seen that the clothes-changing care has virtually increased the workload of the care personnel and put pressure on the care personnel. In addition, due to long hours of work, excessive loads for handling, long-term repetitive movements, improper force applied, and poor posture can also lead to occupational injuries among the care personnel. According to a French study on musculoskeletal disorders among health care workers in 2014, among more than 2,000 participants, nearly half of them had neck pain and relevant problems [4]. In addition to neck pain, back pain is another pain often encountered by health care workers. From the record of compensation claimed by health care workers, it was found that the back injury is one of the top five occupational injuries in the nursing profession. Many studies between 1988 and 1990 even found that vertical and lateral movement were the main causes of serious injuries among the care personnel. Moving those being cared for has been identified to cause excessive stress on the spine [7]. According to a report in 2013 [8] even pointed out this high prevalence of such illness among female health care workers. The report showed that the smaller body size of women on average was the

reason why there was a high percentage of back pain among female health care workers, and moving patients could cause a greater physical impact. Therefore, the care personnel need to take into account the physical state of the elderly and efficiently complete the clothes-changing procedure when assisting the elderly clothes-changing. The care personnel have to assist the elderly clothes-changing in a stressful environment over a long time, which often causes muscle strain, soreness, posture damage and similar issues owing to improper force applied. Accumulation of the harm over the long term can cause a great harm to the care personnel. So, how to alleviate the pain and damage suffered by the care personnel from long-term assistance is an important question that must not be ignored.

2.2 Injuries of the Care Personnel

The care personnel must work in a high-pressure work environment for a long time, and the pressure on the psychological and physical levels is not to be underestimated. Interviews with care personnel working in the nursing home revealed that assisting the elderly bathing was the most difficult task in the care work, followed by assisting the elderly clothes-changing. The care personnel have suffered a lot of occupational injuries as they must avoid the strain and injuries on the hands and wrists of the elderly from direct use of force while assisting the elderly clothes-changing. Exploring the occupational injuries suffered by care personnel in the process of assisting the elderly clothes-changing, it is not difficult to find that many injuries are caused by the movement of hands, shoulders, the back and the waist during the clothes-changing process when they try to move the elderly, thus causing damage to their intervertebral disc (L5/S1). However, long-term accumulation of the harm has made more than half of the care personnel suffer from the neck pain, and the problems of waist injury and back pain are also very common. According to research, nearly 30% of the care personnel suffer from the lower back pain, which is even more serious among the more petite women.

2.3 Considerations for the New Elderly Care Clothing

In addition to conforming to the wearer's physical conditions, the elderly clothing should be designed to keep warmth and optimal comfort throughout the body. It is best that the elderly avoid excessive and extreme muscle movements while wearing the clothes. At present, most studies on Care Clothing aim to explore the influence of clothing materials and heat dissipation on the elderly, but few studies have been done for improvement to the elderly clothes-changing. In addition, on the market, most clothes-changing accessories are designed to assist the elderly clothes-changing on their own, such as: sock wearing frames, sock wearing slippers, clothes-changing rods, etc. But such accessories are not that convenient in our daily life as they rarely take into account the actions of the elderly. This study will propose an improvement solution based on the interaction between the care personnel and the elderly clothes-changing. It will conduct research and discussion on how to reduce the difficulties faced by both parties and how to directly improve the clothing to facilitate clothes-wearing. Finally, it will propose a new design for the elderly care clothing. It is hoped that the



improvement to the Care Clothing design can reduce difficulties in the elderly clothes-changing and improve the efficiency of care.

Clothes-changing can take lots of time for both the elderly and the care personnel, so it can also impose a great burden on both parties. Therefore, in this research, it is hoped that through further understanding of the key factors influencing the clothes-changing and the entire changing process, we can design the new elderly care clothing, so that during the clothing-changing process, with the help of the care personnel, the autonomy of the elderly can be enhanced, and the chances of damage from clothes-changing to the elderly, such as the body pain and injuries from involuntary movement, can be reduced. From the perspective of the care personnel, the new design can also reduce the occupational burden on the bodies of the care personnel in the process of assisting the elderly clothes-changing, and increase the efficiency of the clothes-changing at the same time.

2.4 The Existing Elderly Clothing Designs and Textures

Clothes are meant to maintain the dignity of the wearer and make them feel comfortable [9]. At present, except for the clothing brought from the home, the clothing worn by the elderly in the nursing home is provided by the nursing home. However, the clothes provided by the nursing home are not designed for the elderly, so the elderly can face a certain degree of difficulty in clothes-changing on their own and they need help from the care personnel. In the process, the dignity and confidence of the elderly can be impacted. On the other hand, since the clothes are not designed for the care personnel, the care personnel are often injured while assisting the clothes-changing process (Table 1).

Table 1. Observation of the elderly clothing

Type	Illustration	Analysis
Coat	 <p style="text-align: center;">Front Rear</p>	<p>Features:</p> <ol style="list-style-type: none"> 1. Lycra 2. Open fronted 3. V neck 4. Oblique pocket 5. Adjustable sleeve <p>Advantage</p> <ol style="list-style-type: none"> 1. Easy for the neck move 2. Less joint movement when you put on and take off 3. Increase more comfort 4. Easy to take stuff from the pocket 5. Improve the process of hand movement
Pants	 <p style="text-align: center;">Front Rear</p>	<p>Features:</p> <ol style="list-style-type: none"> 1. Soft Elastic waistband 2. Velcro instead of zip 3. Oblique pocket 4. Plain <p>Advantage</p> <ol style="list-style-type: none"> 1. Enhance the comfort of users 2. Velcro is more easily than zip 3. Easy for use 4. Increase of adaptability 5. Breathable and durable

2.5 Advice for the Study on the Elderly Care Clothing

Existing research on the Elderly Care Clothing shows that the design of the Elderly Care Clothing varies according to the different changes from biological aging among males and females. Studies have shown [4] that explored the clothing for elderly women in nursing homes and rendered suggestions for improvement on such clothing. These suggestions include (1) Corrections to the size and fitness: smaller and wider clothes, large-area cuts to cope with changes. (2) Material requirements: soft and light materials with a smooth backside, easy to organize, no need for ironing, distinct, soft colors; materials with appropriate elasticity. (3) Functional requirements: extra-loose style, the beauty of the clothes when the wearer is in the sitting state, good warmth and good ventilation. (4) Easy to put on and take off: coat style, large opening or front opening, extra loose, deep-cut armholes and wide sleeves on the back, elastic materials, the front opening that can be closed with just one hand, no need to pull onto the head to wear clothes, no need to demand for the strength and precision while opening and closing the clothes with the hands and no big action required in the clothes-changing.

The water content in the body of an elderly male can decrease from 80% in infancy to 50–60%, and after 65 years old, EMG function of the elderly can significantly degenerate, and the sensitivity to external stimuli can be reduced [10]. The size of the clothes and the appropriate correction: The back area should be increased, because the body can lean forward. The height can be reduced because the water in the cartilage tissue of the spine can be reduced as well. The height can be reduced by 2.5 cm every 5 years after the age of 50, and after the age of 75, the height can reduced by 5 cm every 5 years. The fabric of the shoulder part should be reduced; the size around the pelvis should be increased; the fabric of the front piece will be adjusted: the ratio between the width and the depth of the chest will be reduced. Material requirements: Soft fabrics are preferred.

3 Methods

3.1 Design Planning

The new elderly care clothing research shall take into account the decline in autonomy of the elderly owing to biological aging and the burden of care personnel while assisting the elderly clothes-changing process. Therefore, the new elderly care clothing design must consider the physiological state of the elderly, and aim to improve the autonomy of the elderly and reduce the burden on care personnel while they assist the elderly clothes-changing process. Through evaluations based on observations and interviews, we can find the new elderly care clothing design that can effectively help the elderly improve their autonomy.

3.2 Design Process

Through Literature Review and Expert Interview, this study mainly focuses on the interaction between the elderly and the care personnel, the use of the elderly body parts,

the autonomy of the elderly, and the injury rate among health care workers to propose the new care clothing design (Fig. 1).

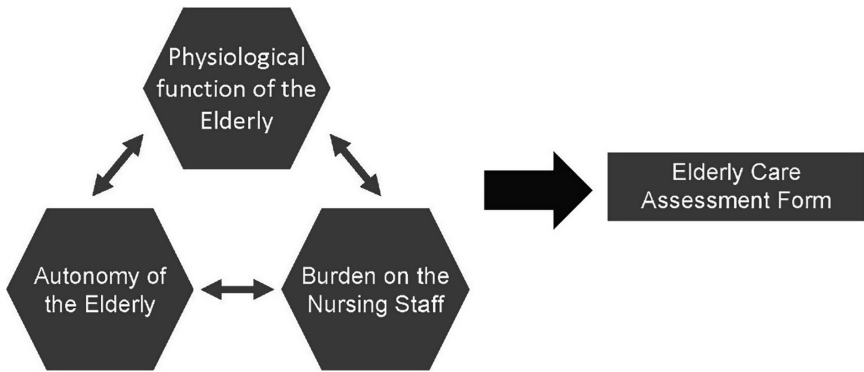


Fig. 1. Architectural diagram

3.3 Autonomy of the Elderly-the Elderly Clothes-Changing Quality and Habit Observation Interview

Through observation of the elderly in this interview, the inconvenience and habits of the elderly in the dressing process were discussed to provide a reference for the future development of the new elderly care clothing. The items for observation include the actual dressing conditions among the elderly, clothes-changing habits and physical phenomena, and interactions of the wearer and care personnel with the clothing. This study uses the most direct way to understand and analyze the use conditions, clothes-changing habits and personal preferences. The interview was conducted with the generally healthy elderly, and preliminary interviews were conducted with 10 elders. The interview questions included the family life, health status, clothes-changing habits, normal wear, cold-weather wear, laundry ways, exercise habits, preferred ways to open and close the clothes, and operations of the shoes and zippers, as shown by the elderly clothes-changing operations in Fig. 2.

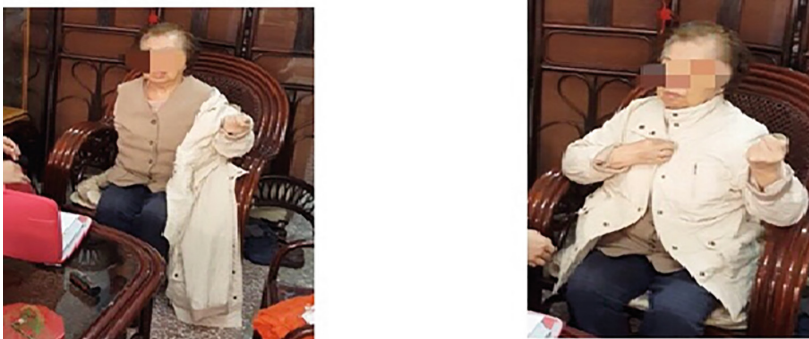


Fig. 2. The elderly clothes-changing operations

3.4 Physiological Function of the Elderly-Expert Interview

This study has conducted 3 Expert Interviews to inquire about the daily work conditions of the care personnel, the difficulties and inconveniences in the process of assisting the elderly clothes-changing, and the injuries and pains caused by the work. And the Expert Interviews also asked for improvements and suggestions that could be used in the future as the basis for developing the new elderly care clothing.

Content of the 1st Expert Interview about Elderly Care:

- The law stipulates that one care worker can only care for 15 elders at most, but with the insufficient manpower in the actual situation, one care worker can care for more than 15 people at the same time, which indicates that a shortage of human resources can also cause lots of physical burden on the care personnel. Daily routines include dressing, bathing, pain testing, dispensing medications, etc., and dressing is usually done on the bed, as is for wheelchair-bound patients. Experts believe that the Velcro fastener is designed for the caregiver, as it is rapidly convenient to use, while the use of buttons can promote autonomy and hand movement for the elderly.

Content of the 2nd Expert Interview about Elderly Care:

- A nurse can take care of 44 to 56 elders, and there can be 6 care workers subordinate to the nurse to be in charge of 7 to 10 elders each. Common illnesses among care personnel include the knee and hand arthritis, and their clothing can cause their bodies to suffer from temperature loss, poor blood circulation and dry skin. The elderly need to do exercise in their daily activities, such as the detailed movement of the hands or the stretching of the limbs, but they also must avoid falls or cramps during exercise.

Meanwhile, time and efficiency are also some other important matters that must be considered. As care personnel needs to care for several elders that suffer from muscle losses and slow motions at the same time, it often adds up the difficulty in wearing clothes and takes a lot of time for them to do so, which often affects their breakfast time in the care center. So, improvements need to be made to make the care personnel more effectively assist the elderly clothes-changing process and reduce the burden and time pressure as well. Experts suggest the physiological conditions of the elderly and some mechanisms for warmth-keeping should be taken into account.

Content of the 3rd Expert Interview about Elderly Care:

- When the care personnel take care of the elderly, the prolonged lifting and use of the hands while helping the elderly wear the clothes can easily cause a pain in the shoulder blade, and they may also suffer from a waist injury from the act of moving the elderly. When the care personnel are helping the elderly wear the clothes, the elderly will be asked to raise their arms so as to help them to put on their clothes. If any limb is injured, the clothes shall be put on the injured limb first, so that the elderly that can still move can buckle up the buttons on their own. Meanwhile, the zipper may be too small for the elderly to wear the clothes. The elderly clothing shall be able to open from the front, and it shall be flexible with large buttons to avoid damage caused by the large angle of the stretching arm. The Velcro fastener

will be suitable for the elderly, but it can be accidentally pulled open when the elderly are lifting arms or moving around.

From the 3 Expert Interviews, it is known that: (1) the care personnel do need efficiently effective dressing solutions. (2) The elderly are less mobile and they require an easier way to change clothes. (3) The elderly clothing must be able to keep warmth and fit the physiological conditions of the elderly (Table 2).

Table 2. Table of the interview content

The influence of elder	1. Action show
	2. Keep warm
	3. Degenerative joint
	4. Degree in bed
	5. Do some easy actions
The influence of care attendant	1. Time-consuming
	2. Joint disease
	3. Lack of manpower
Notes	1. Velcro is convenience but danger
	2. Big buckle can improve hand movement
	3. Clothes need more elasticity
	4. Open fronted can avoid hand-lift
	5. It's not suitable for elder cause the zip is too tiny

Through the advice provided by this Expert Interview, we can learn about the deficiencies in the existing Elderly Clothing to enhance the autonomy among the elderly and help avoid harms to the care personnel when they are assisting the elderly clothes-changing process. As the Literature Review has clearly defined the direction of this study, the Expert Interview also provides a preliminary understanding of the current needs of the elderly and the care personnel for the Elderly Clothing and the way to increase their autonomy. And from the preliminary interviews, we can learn that the elderly clothing must enhance the autonomy of the elderly and reduce injuries suffered by the care personnel while assisting the clothes-changing process, so that we can revise subjects of this study, formulate experiment details in this study, and establish the basis and references for the design of the new elderly care clothing.

3.5 Burden on the Nursing Staff-Data Collection and User Observation

Through the Expert Interview, we can understand that in the process of assisting the elderly clothes-changing, the care personnel will try to let the elderly perform some simple actions to achieve the effect of rehabilitation, such as: lifting the legs, lifting the waist, etc. In the process of dressing, the care personnel will dress the injured limb first before dressing the normal limbs. In the process of undressing, it is quite the opposite of dressing; the normal limbs will be undressed first before the injured limb can be dressed, mainly to avoid movement of the injured limb and/or unnecessary harms.

In the choice of the clothes style, the upper outer garment of the front open type is preferred, but considering that the winter weather is relatively cold, and the front open type has a poor warming effect, the loose (larger by 2 scales) and elastic general sweater can be a better choice. And the pants with the elastic band is preferred. In the choice of clothing materials, the breathable, elastic fabric with a low coefficient of friction, such as the cotton fabric, is a better choice, and materials like the denim shall be avoided (Fig. 3).

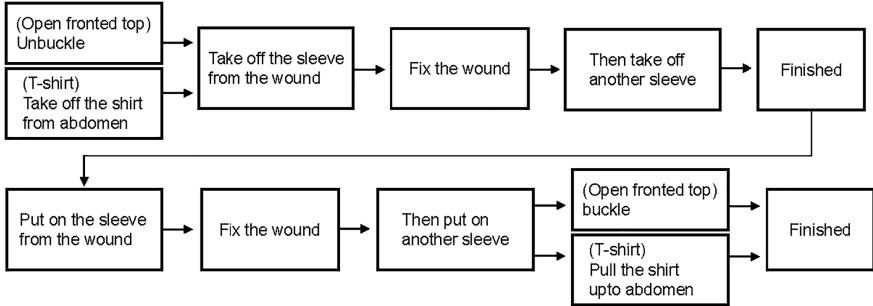


Fig. 3. Steps in the clothes-changing process under observation

Field observation shows that the caregiver uses Rescue Anne during practice and as a prop in the caregiver license exam. The angle of the elbow in this process of changing clothes is not possible for the elderly with arthritis. There is much needed to be improved (Fig. 4).



Fig. 4. The procedure of dressing CPR Annie (A to I)

Figure 5 shows how the caregiver dresses the elderly. In picture A and B, the caregiver uses rescue Anne as a prop in simulation. In Picture C and D, the caregiver dresses a real person. You can see the difference in the angle of the elbow.



Fig. 5. The procedure of dressing CPR Annie (the top part) and patients (the bottom part)

3.6 The Focus Group Methodology

The implementation process is for the designer with the relevant background to elaborate the current situation of dressing among the elderly, in hope to:

- address the reduced flexibility of the elderly, simplify the clothes-changing methods and increase autonomy of the elderly.
- reduce repeated damage to the care personnel in the process of assisting the elderly clothes-changing (Fig. 6).



Fig. 6. Discussion in the focus group

3.7 Design Simulation After Concept Comparison

Through On-Site Observation, Expert Interview and Literature Review, parameters to be considered can be established for the new elderly care clothing to develop a systematic evaluation scale for relevant needs, design model development recommendations, and establish the Mind Map model for the proposed design (Fig. 7).

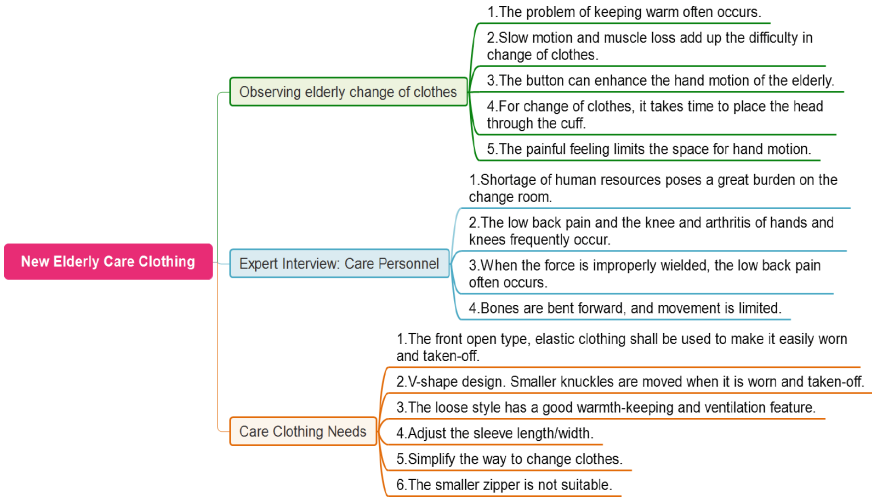


Fig. 7. Mind map of the new elderly care clothing

Introduction We will discuss the feasibility of each scheme and figure out the weights of each part based on their respective importance, such as: easiness to put on/take off the clothes, the cuff width, the front opening design and the button design, in order to conduct the objective conception and design based on relevant needs, evaluate all ideas, and use the ideas with higher scores to make drawings.

The design of the cuff style: The clothes-changing process often creates difficulties in making the hand pass through the cuff, so adding a zipper to the cuff can assist dressing and make it complete faster (Figs. 8 and 9).

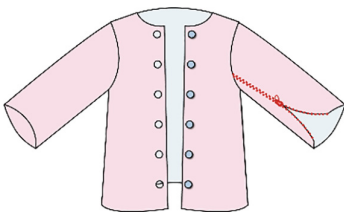


Fig. 8. Cuff design A

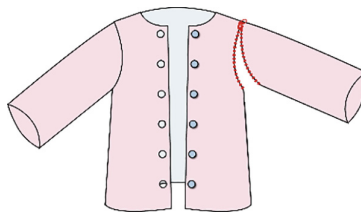


Fig. 9. Cuff design B

- (1) Two-Section Cuff Design: The elderly can autonomously find the cuff for clothes-changing. As the cuff can be detached, the elderly can take it off or put it on autonomously for more ventilation and warmth (Fig. 10).

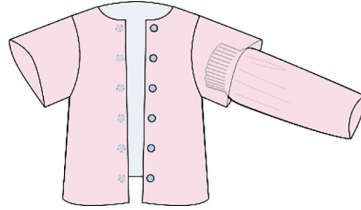


Fig. 10. Cuff design C

- (2) Automatic Alignment: The design of the large neck opening can assist put-on or take-off of the clothes. The adjustment of the cuff can make the process of clothes-changing faster. The front buckle has a magnet in the middle to assist the clothing alignment, and the different styles of the buttons can help the elders get used to it and avoid mistakes (Fig. 11).



Fig. 11. Automatic alignment

4 Conclusion

From the interview, it is known that the elderly have indeed faced much inconvenience in clothes-changing. Therefore, we can further discuss relevant inconveniences and observe relevant advantages of preferable clothing among the elderly. The new elderly care clothing design in this study aims to enhance the autonomy of the elderly. By exploring the decline in the physiological function, the care personnel can understand the harms suffered by the elderly during the clothes-changing process and develop the new elderly care clothing to immediately provide external assistance, as this can not only increase the autonomy of the elderly in the clothes-changing process, but also reduce the harm suffered by the care personnel in the process of assisting the elderly clothes-changing.

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