Ergonomics-Based Clothing Structure Design for Elderly People

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Abstract. This research takes Guangdong and Jiangxi in southern China as examples for actual investigation. The actual measurement of the body shape data of the elderly over 65 years of age, the area where the changes in the body shape of the elderly are inferred, and the integration of the data of the elderly body in the form of graphs and tables; through the recording of the color and shape of the clothing worn by the measured subjects on that day, the psychological needs of their clothing colors are analyzed, and their clothing shape graphs are integrated to determine the clothing shape preferred by the elderly. By combining the characteristics of the elderly's body form, we drew up the dress style and structure diagram to fit the elderly, and provided data reference and shape suggestion for making the dress style more suitable for the elderly in South China.

Keywords: Ergonomics · The elderly · Clothing Structure · Somatic Data

1 Introduction

Advances in medical technology have contributed to the continuous extension of the average life span of human beings and the increasing number of the elderly over 65 years old, making "aging of population" one of the inevitable trends of the present era. The 7th Nationwide Census in China will begin on November 1, 2020, and it has been ten years since the 6th Nationwide Census. The 6th Nationwide Census in 2010 showed that the total population of China was 1.37 billion people as of that time [1]. All along, China's continuous adjustments to its population structure policies have deeply affected the age ratio of the Chinese population, so the continuous increase of the elderly population is an inevitable trend in history. Guangdong Province is one of the more developed provinces in southern China, attracting a large number of young people from other regions and constantly changing the proportion of the population of Guangdong Province. The census data in 2010 showed that the number of elderly people aged 65 and above in Guangdong Province reached 7,086,000, accounting for 6.79% of the permanent population in Guangdong Province [2]. Jiangxi Province and Guangdong Province are contiguous, according to the population data released by the Jiangxi Provincial Bureau of Statistics in 2016, as of the end of 2015, Jiangxi Province's population of 65 years old and above accounted for 9.44% of the total population, increased by 0.32% compared to 2014, and the province's aging degree continued to deepen [3].

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The transformation of human clothing from loose garment culture to fitting garment culture is the result of the continuous improvement of human clothing structure. The emergence of ergonomics makes the focus of clothing improvement constantly shift from decorative purpose to functional purpose. Unlike young people, the clothes of the elderly pay more attention to the laws of ergonomics while pursuing beauty and comfort. For the elderly with declining body functions, the demand for clothing is more focused on shifting from aesthetics to comfort. Clothing ergonomics is a discipline comprehensively analyzing human body structure, psychological preferences and other issues with the methods of anthropometry, psychology and physiology. The application of ergonomic principles to clothing is conducive to designing more scientific clothes, and is of great theoretical significance to the structural improvement of clothing.

Somatic data is the basis for the combination of clothing design and ergonomics. China conducted a nationwide survey of body dimensions of adults in the 1980s, and later released "GB10000-88 Body Dimensions of Chinese Adults" became China's basic body dimension data [4]. With the continuous expansion of the elderly market, the existing standard clothing sizes cannot meet the consumer market of the elderly and the lack of physical data for the elderly also shows the necessity of somatic data measurement. While the value of the elderly population continues to rise, the consumer demand of the elderly population increases, and more and more attention is paid to functional products serving the elderly. This research combines ergonomics and clothing design, and uses surveying as the starting point to explore the relationship between the physical characteristics of the elderly and the clothing structure, and provide references for designing clothing products that better meet the needs and needs of the elderly.

2 Research Methods

2.1 Human Body Measurement

Determine the Measurement Subjects. In Jiangxi and Guangdong provinces in southern China, 60 elderly people who are capable of taking care of themselves and over the age of 65 were randomly selected as the measurement subjects. The measurement period was from December 2020 to January 2021.

Measurement Methods and Instruments. The manual measurement method was used to collect data from the measurement subjects. When the measurement was taken, the measurement subjects wore a single piece of close-fitting clothing, kept their bodies standing straight, with their feet close together and their eyes looking forward, and their arms hanging naturally with their palms facing the inside of their bodies. The measuring tools included: soft tape measure, steel tape measure, height and weight measuring instrument, data recorder, etc.

Measurement Items. We measured 10 items, including height, weight, neck circumference, shoulder width, abdominal circumference, hip circumference, arm length, arm lift angle, arm spread angle, and bending ability. In the measurement items, its starting point is to determine the shape of the elderly and whether they have trouble putting on and taking off clothing, which can make the design of the top clothing shape of the elderly as the target of measurement.

2.2 Clothing Record

Since the measurement time was winter in China, the subjects of the human data measurement wore coats in their daily life. The jacket worn by the subjects on that day was the measurement target, and they measured and recorded the shape of the jacket. During the measurement, the subjects' jackets were spread flat on a flat area with the lapels aligned and the sleeve cages stretched to their natural state, where the collars were folded to the wearing state, and the data were recorded with a soft tape measure.

3 Data Collection

3.1 Anthropometric Measurements

Sixty elderly women aged 65 years or older with self-care ability were randomly selected in South China, and the measurement sites were elderly activity centers where the elderly gathered. The age distribution of the measurement subjects is shown in Fig. 1, and the majority of the sample were women aged between 70 and 74 years old.

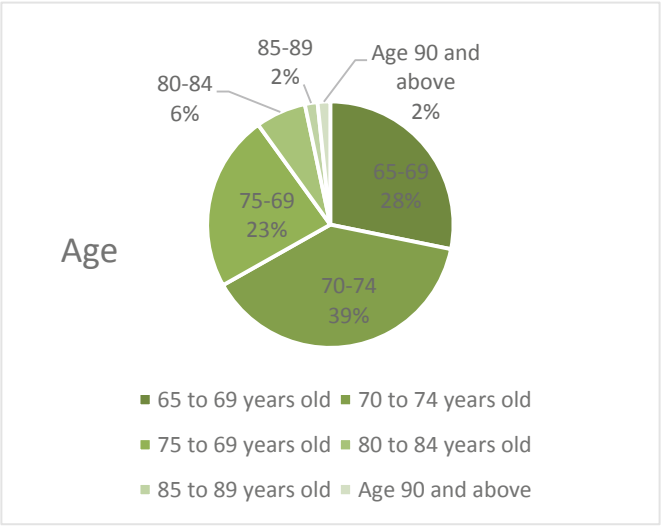

Fig. 1. Age distribution of measurement subjects

The height distribution of the measured samples is shown in Fig. 2, and 48% of the elderly women were between 150 and 154 cm in height. The lowest height of the measurement sample was 135 cm and the highest was 164 cm. Different from young people, the physical characteristics of the elderly will change with age, such as cartilage elasticity decline, muscle atrophy, deterioration of exercise ability, etc. [5].

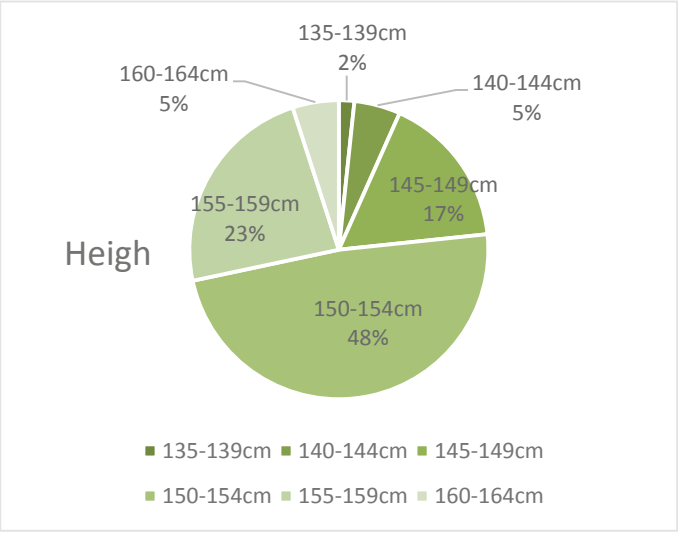

Fig. 2. The height data of the measurement subjects

As shown in Fig. 3, the distribution of the weight data of the randomly selected measurement samples spanned a large distribution range of 30–74 kg, among which, the number of people weighing in the range of 60–65 kg and 40–45 kg was higher. It was observed that the height of subjects weighing 60–65 kg was higher overall than that of subjects weighing 40–45 kg.

As shown in Fig. 4, the data of shoulder width of the random sample spanned a wide range, with the narrowest shoulder width of 37 cm and the widest shoulder width of 46 cm among the 60 measured subjects. Analysis of the dispersion of shoulder width showed that the overall trend of shoulder width and height of the measured samples was positive.

Neck circumference is the key data to determine the structure of the neck circumference of the upper garment. As shown in Fig. 5, the neck circumference of the measured subjects spanned 12 cm, with a more scattered distribution, and the 31–33 cm interval accounted for more, and the overall trend was positively proportional to the shoulder width.

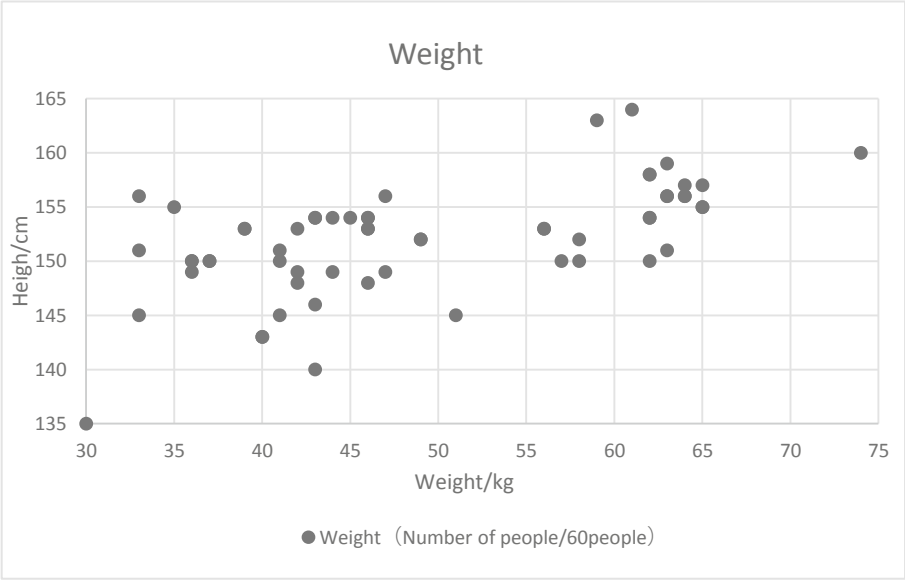

Fig. 3. Distribution of body weight of female elderly

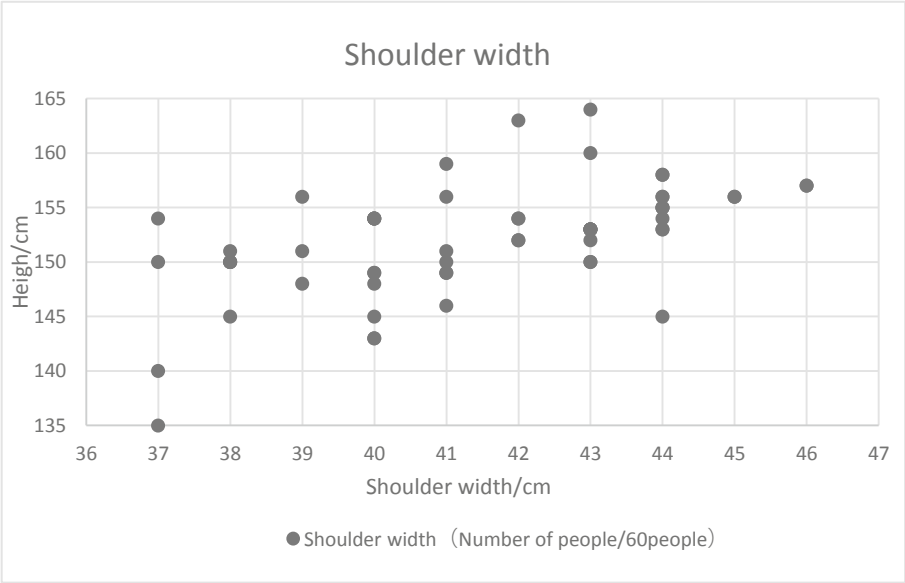

Fig. 4. Distribution of shoulder width in female elderly.

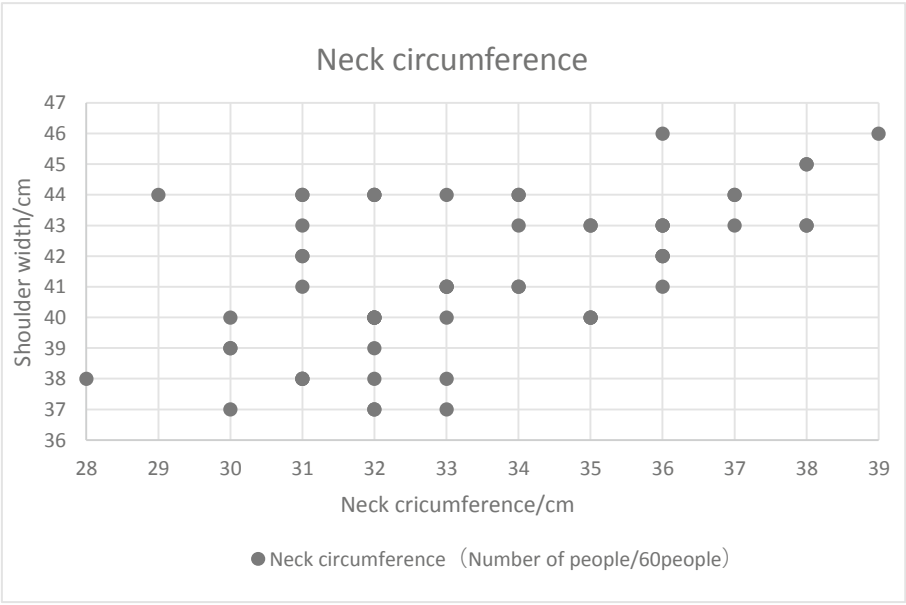

Fig. 5. Distribution of neck circumference of female elderly

As shown in Fig. 6, the abdominal circumference and weight of the measured subjects, showed an obvious positive relationship. 75–80 cm abdominal circumference data accounted for 28% of the total measured samples, accounting for a relatively heavy weight. The smallest of their abdominal circumference data was 63 cm, spanning 41 cm.

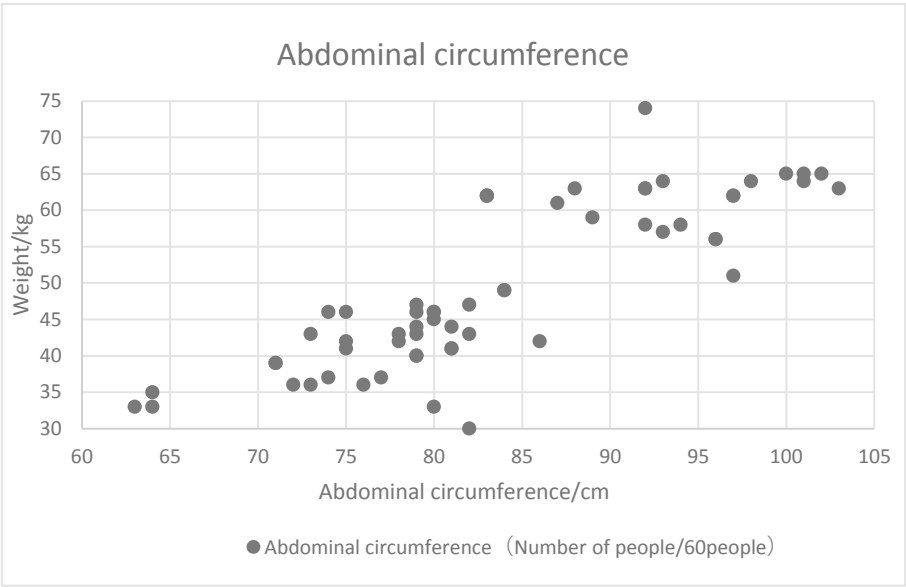

Fig. 6. Distribution of abdominal circumference in female elderly

As shown in Fig. 7, the hip circumference of the measurement subjects was distributed between 78–108 cm, with a relatively even distribution and a small difference in the percentage of each interval. Overall, hip circumference showed a positive relationship with body weight.

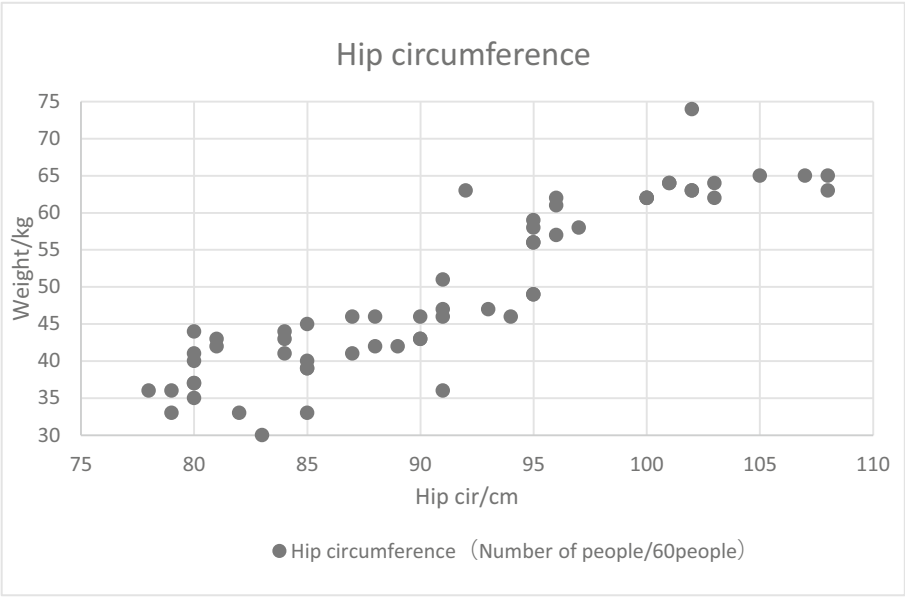

Fig. 7. Distribution of hip circumference in female elderly

As shown in Fig. 8, the arm lengths of the measurement samples were mainly in the range of 47–55 cm, and the arm lengths were centered at 50 cm and extended up and down with a span of 14 cm.

As shown in Fig. 9, the angle at which the measured subjects were able to open their arms when they were horizontal to their bodies and the angle at which they raised their arms high and up was recorded. Ninety-eight percent of the randomly selected female elderly were able to open and lift their arms without difficulty.

The bending ability of the subjects was recorded, and the standard was whether the arms could reach the ground when the subjects bent over. As shown in Fig. 10, the majority of female elderly with self-care ability could reach the ground when they bent over.

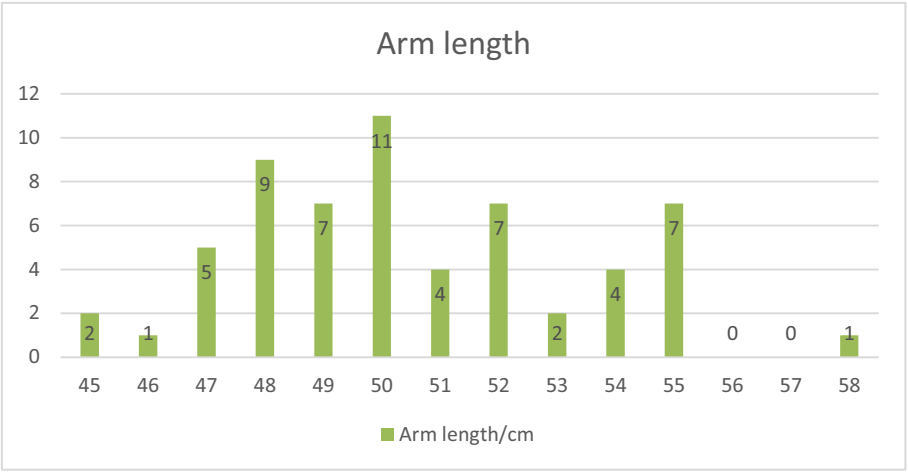

Fig. 8. Distribution of arm length of female elderly

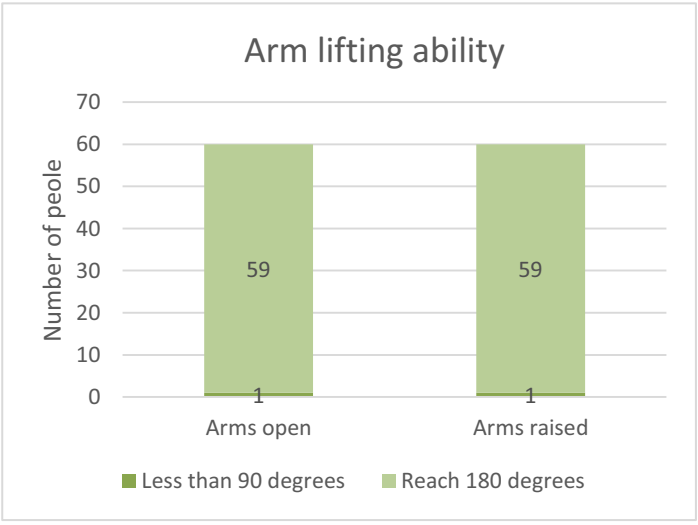

Fig. 9. Arm spread angle of female elderly number of people

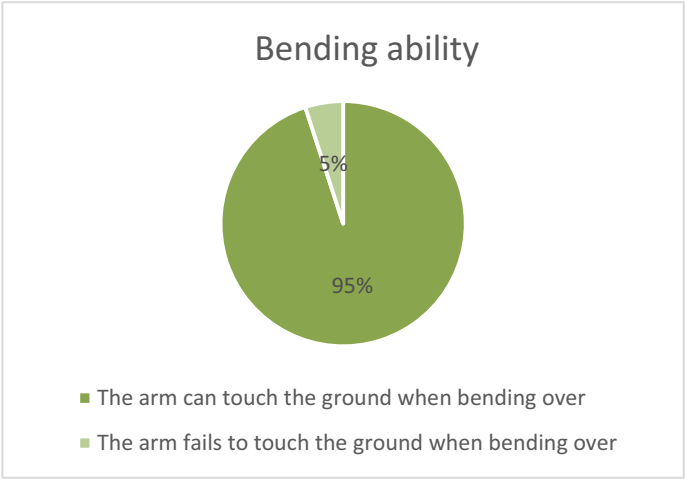

Fig. 10. Bending ability of elderly women

3.2 Dress Form Records

According to the survey, there are fewer sizes available for the elderly [6]. By measuring the coats worn by the subjects on that day and drawing the coat structure diagram, it is not difficult to find that the repetition rate is high. The elderly clothing market has been in a downturn, the main reason is that clothing cannot meet the needs of the elderly [7]. Among the tops measured in this survey, the four top structure diagrams with the highest repetition rate were selected. Figure 11 shows the overlapping images of the four top structure diagrams, and Fig. 12a, b, c, d shows the form structure diagrams of the four tops.

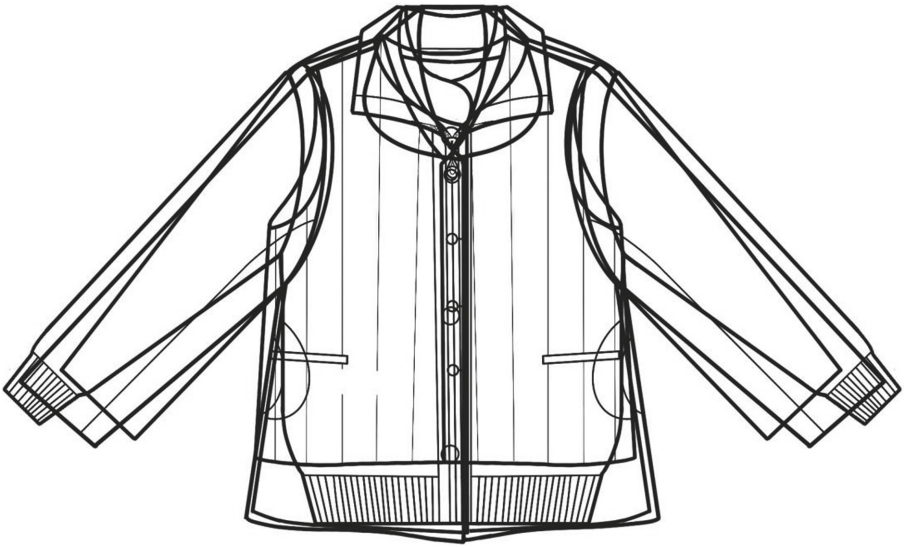

Fig. 11. Overlapping diagrams of four types of tops

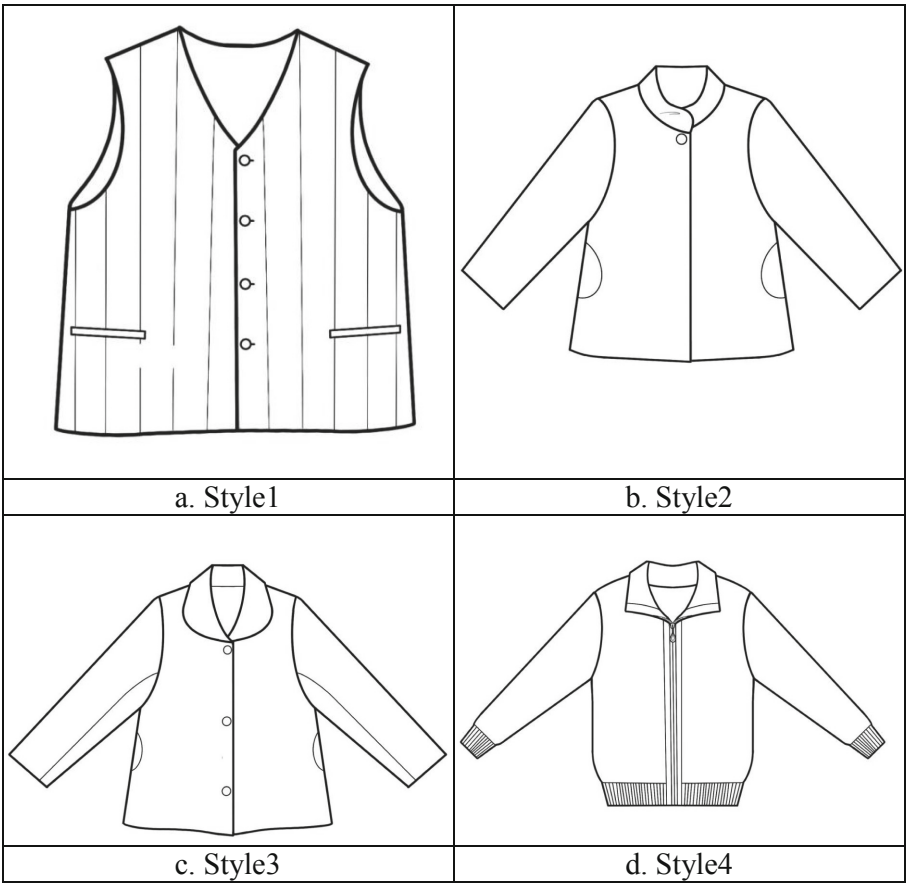

Fig. 12. Top-shaped drawing

4 Analysis and Discussion

4.1 Body Shape

The data of hip circumference, abdominal circumference and shoulder width of the sample were measured, and their distribution spanned a wide range, with hip circumference ranging from 78–108 cm; abdominal circumference ranging from 63–103 cm; the data of shoulder width ranging from 37–46 cm, and the length of the arms mainly distributed between 47–55 cm. It is not difficult to observe that the shoulder width of women over 65 years old is similar to that of ordinary adult women, while the abdominal circumference is large, showing a pattern of small upper and wide lower. The weight and shoulder width of elderly women are proportional to their height; neck circumference is related to shoulder width; abdominal circumference and hip circumference are proportional to their weight; arm lifting and spreading ability is better, and they can complete the normal dressing and undressing process.

In order to adapt to the physical characteristics of the elderly, in the design of tops, the amount of the abdomen of the dress should first be appropriately increased to accommodate the abdominal circumference of elderly women, unlike adult women, the abdominal circumference of the elderly is generally larger. In the design of the top structure, the waist province can be reduced or eliminated. Secondly, the size should be increased appropriately to enrich the clothing choices of elderly women with different shapes. Furthermore, the neck circumference data of female elderly is more scattered and proportional to the shoulder width, and the collar circumference of the apparel in the market should take into account the factor that the neck circumference data of the elderly spans a wide range.

4.2 Analysis of Upper Garment Shape

Since the measurement period was from December to January, it was winter in southern China and the temperature of the region was around 10–16°. Older people wear more clothes in daily life. According to the actual observed clothing worn by the measurement subjects, it was found that their coats were mainly tweed coats and knitted woolen sweaters. They wore fewer light and warm down coats as well as cotton coats for the elderly. Woolen fabric is the fabric that grows with the elderly as opposed to light and thin down clothing. The weight distribution of older adults spans a wide range. According to the size of the tops worn by the measured sample subjects, they, however, did not have a significant span change, in which the top structure as a whole showed a loose and fat characteristic, and the thin elderly people chose mostly jackets of more generous size for their own body.

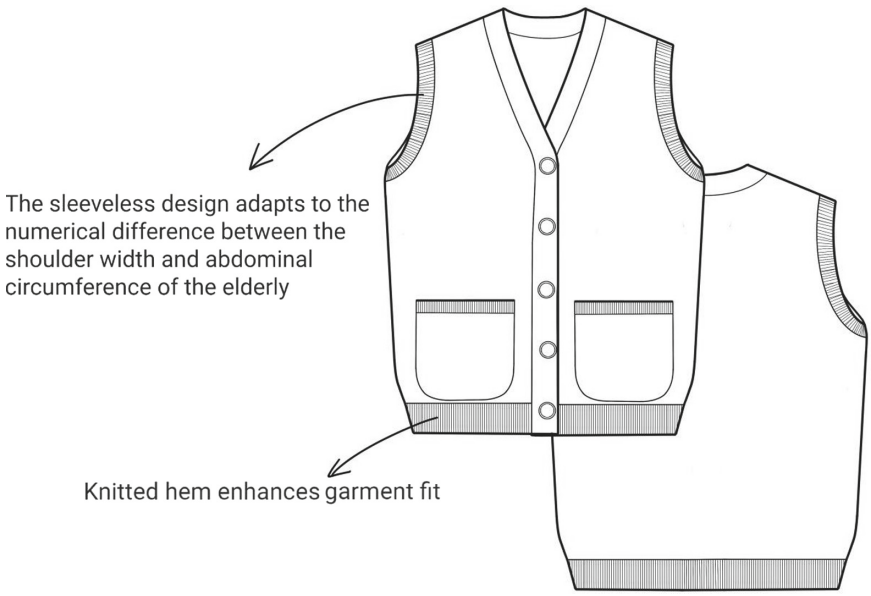

Fig. 13. Knitted vest

4.3 Top Style Design

Scheme 1. As shown in Fig. 13, the knitted undershirt style can better solve the problem of the ratio of shoulder width to waist circumference of the elderly, effectively increase the activity of the abdomen of the elderly, and the tightened cuffs and hem, effectively prevent wind more warm.

Scheme 2. According to the measurement results, the elderly have a large arm span, so the movable detachable cuff structure can flexibly change the sleeve length and increase the fit of the garment. As shown in Fig. 14, the double zipper design of the placket increases the movement of the abdomen and helps to reduce the accumulation of wrinkles produced by the garment when the elderly are in a sitting position.

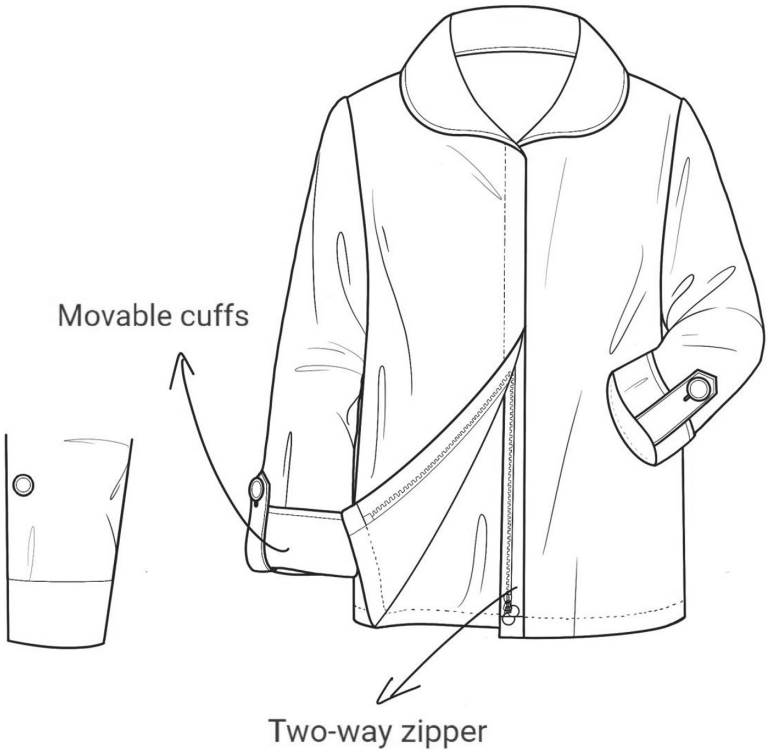

Fig. 14. Woolen jacket

5 Summary

In this study, manual measurement method was uses. In this study, the actual body data of 60 elderly women over 65 years old in South China were measured using the manual measurement method, and it was concluded that the form data of elderly women spanned a wide range, as well as the distribution of each data such as height, shoulder width, neck circumference, abdominal circumference and hip circumference was scattered within each interval. The observation method and manual measurement method were used to measure the daily wear of the elderly, and the four top styles with the highest repetition rate were mapped. It is proposed that (1) older women in South China are used to wearing familiar fabrics that grow up with them, such as wool and tweed; (2) the design of older people's clothing should pay more attention to the span of their sizes. Finally, a brief discussion on the body shape and psychological needs of dresses of older women in South China was made, and two top structure design suggestions were put forward in the hope of providing data reference for the senior citizens' apparel market.

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