The Classification and Measurement of Body Size in Jiangxi for the Application of Clothing Industry

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Abstract. 3D body scanner and Martin ruler were applied in this study. Total sampling number is 2000 Ranging from 1 to 75 years old based on the population distribution including north, middle and south area in Jiangxi. Specially, 562 women ranging from 13 to 22 years old were sampled for detailed analysis. 66 items were measured through 20 basic marked points. Descriptive statistic including concentrated trend and dispersive tend were calculated by using SPSS software for various area gender and age. The main body size parameters were obtained by PFA method and further analyzed by descriptive statistic method. The various foreign classification methods were referred and 6 kinds of the latest body size classification standards were built according to height, hipline, hip-bust-gap, bust-waist-gap and hip-waist-gap. An extended estimated sampling number 25,972 was found based on variation of measured items for overall study to build a Jiangxi body size database.

1. Preface
The database constructed by the body size measurement can be widely used in the clothing industry, the medical field, the automobile industry, the sports leisure industry, the household goods industry and all the machinery and equipment manufacturing industry which needs to be operated by the personnel. Therefore, the anthropometric survey and related research are open in 1980 [1-3]. Taking the garment design as an example, the body size database can be set up by the body size measurement. The size analysis and classification of the human body can be made and the prototype version of the garment is made. The size of the industrial sample.

2. Measuring Method
According to the proportion of the total population of the Ministry of the interior in July, 99, we draw up 17 sampling plans for age and distance in the following 99 tables. In this sample plan, the sampling plan is used in the sampling plan for the female population of 13~22 years old in the proportion of age and sex of each region, and sex of men and women. A total of 587 women sampled from 22 years old were more than 108 men. There is no complete maternal standard deviation for the sample size of women aged 13~22 years old. Therefore, it is impossible to use the equation (4) to calculate, so it is the principle that the sampling number of 13~14 years, 15~19 and 20~22 years old in each region is in accordance with the principle of normal distribution, so the number of enlarged sampling number of the 13~14 year old female population in the middle area is the smallest, and the enlarged sampling number of other regions and women of all ages is taken. According to the number of cases, and the central income, expand the sample number as shown in Table 1 of thick line region.
Table 1. A list of sampling program for the measurement of body size

| S | P | E | X | 0-4 | 5-9 | 10-15 | 16-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | total |
|---|---|---|---|-----|-----|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| N | M | 16 | 20 | 14  | 10  | 26     | 14    | 10    | 30    | 30    | 28    | 29    | 28    | 25    | 15    | 13    | 587   |
| W | 16 | 19 | 13  | 55  | 140  | 80     | 10    | 29    | 31    | 29    | 28    | 29    | 28    | 29    | 27    | 23    | 941   |
| M | M | 9  | 11  | 8   | 6   | 14     | 8     | 6     | 16    | 14    | 15    | 15    | 14    | 11    | 8     | 6     | 190   |
| W | 8  | 10 | 8   | 30  | 75   | 45     | 5     | 16    | 18    | 13    | 14    | 16    | 17    | 14    | 10    | 310   |
| M | 17 | 21 | 16  | 36  | 89   | 53     | 11    | 32    | 32    | 28    | 29    | 30    | 28    | 22    | 16    | 500   |
| W | 17 | 21 | 16  | 38  | 95   | 59     | 36    | 37    | 32    | 34    | 36    | 32    | 28    | 18    | 16    | 559   |
| S | M | 9  | 11  | 8   | 6   | 15     | 9     | 18    | 19    | 16    | 18    | 16    | 14    | 9     | 8     | 216   |
| W | 8  | 10 | 8   | 32  | 80   | 50     | 18    | 18    | 16    | 16    | 18    | 16    | 14    | 9     | 8     | 343   |
| M | 66 | 81 | 59  | 139 | 350  | 206    | 43    | 127   | 130   | 117   | 121   | 116   | 99    | 63    | 51    | 2000  |
| T | M | 34 | 42  | 30  | 22   | 55     | 31    | 22    | 64    | 65    | 58    | 61    | 58    | 49    | 31    | 24    | 760   |
| W | 32 | 39 | 29  | 117 | 295  | 175    | 21    | 63    | 65    | 59    | 60    | 58    | 50    | 32    | 27    | 1240  |

3. Somatotype Analysis

The main body size parameters extracted by principal component analysis, including four items such as height, chest circumference, waist circumference and hip circumference, are divided into 18 age classes over 0-75 years old, and the standard deviation of the average and average number of each size parameter is calculated respectively, that is, the standard error. The results are shown in Table 4 and table 5, and draw the polygonal map based on this statistic. The results are shown in figures 1 to 4.

The height size measurement and analysis of male and female age groups showed that the growth and development period showed an increase in the growth and development period. For men, the height slowed obviously at the age of 20~22, and the slow decline after 50-54 years of age showed that the growth period of the female was faster than that of the male, so the height of the height was faster than that of the male. After the age of 15~19, the growth rate slowed down and showed a slow decline after 50~54 years old.

The measurement and analysis of the chest circumference of male and female age groups increased with age in the growth and development period in terms of chest circumference. As for men, the growth slowed down until the age of 15~19, but still slowly increased with age, and slowed down after 40-45 years of age; as far as women were concerned, the increase was increased after the age of 13~14. Amplitude is slowing down, but it still increases slowly with age, and it decreases slightly after 65~69 years old.

![Figure 1. Line chart of male and female height in various age levels](image-url)
Figure 2. Line chart of male and female bust in various age levels

The measurement and analysis of the waist circumference of men and women on the waist circumference of the waist circumference, in terms of the waist circumference, the non-gender waist circumference increased significantly as the age increased in the growth and development period, and no longer increased after 40-44 years of age, and the variation became larger. As far as women were concerned, the period of 13–22 was stable and unchanged after the age of 23–24. Increase and increase gradually.

The hip circumference of men and women on the hip circumference of the hip circumference, in terms of hip circumference, the non-sex hip circumference increased with age in the growth and development period. As for men, it increased to the maximum value at the age of 30–34, and then gradually decreased, and increased slightly at the age of 0–64. As for women, the period of age was stable and unchanged at the age of 30–3, at the age of 15–29. After the age of 4 with the increase of age slightly increase, until 65–69 years old began to decrease.

Figure 3. Line chart of male and female waist in various age levels

Figure 4. Line chart of male and female hip in various age levels

The number of sample samples was expanded to estimate the three types of men's wear, women's wear and children's wear. Each type was divided into 5, 5 and 4 according to age, and the standard deviation of measurement parameters of each type was calculated respectively, and the maximum sampling number of the items was calculated according to the equation (4). In the following table 6, the maximum estimated sampling number for men's wear is 10256, the maximum estimated sample
number for women's wear is 6564, and the maximum estimated sampling number for children's wear is 9152, and the total number of estimated samples of all types is 25972.

This study is the first to measure the size of the people of all ages in China. The measurement results can be used as an important reference material for long-term tracking of the change of people's Somatotype in the future.

Table 2. Estimated sampling number of various groups

| Classification | Classification level | Age moment (years) | Estimated number of samples |
|----------------|----------------------|--------------------|----------------------------|
| Men            | Juvenile dress       | 13–15              | 2214                       |
|                | Teenage clothes      | 16–22              | 1522                       |
|                | Less gentry          | 23–35              | 1426                       |
|                | Maturing clothes     | 36–65              | 3147                       |
|                | Silver hair          | Over 66            | 1947                       |
|                | Subtotal             |                    | 10256                      |
| Ladies         | Juvenile dress       | 13–22              | 1039                       |
|                | Teenage clothes      | 23–30              | 1083                       |
|                | Less gentry          | 31–45              | 1119                       |
|                | Maturing clothes     | 45–65              | 1569                       |
|                | Silver hair          | Over 66            | 1754                       |
|                | Subtotal             |                    | 6564                       |
| Children       | Baby                 | 1–4                | 2913                       |
|                | Young children       | 5–9                | 2403                       |
|                | Little boy           | 10–12              | 1961                       |
|                | Little girl          | 10–12              | 1875                       |
|                | Subtotal             |                    | 9152                       |
|                | Total                |                    | 25972                      |

4. Classification of Somatotype

In this study, 4 main parameters of height, chest circumference, waist circumference and hip circumference were extracted by factor analysis, and 7 parameters such as hip circumference, chest waist circumference and hip waist circumference were calculated as the basis for the classification of body shape. The following table 8 shows the concentration trend, the dispersion trend and the percentile of the 7 classification parameters, in which the percentile presents a total of 50%, 84.13%, 15.87%, 93.32%, 6.68%, 97.720%, 2.28%, 99.87% and 0.13% percentiles respectively of four digits, + 1.0S (standard deviation), + 15.87%, 15.87%, 15.87%, 93.32%, 6.68%, 97.720%, 2.28%, 2.28%, 99.87%, and the percentiles respectively. The parameter values, with the coefficient of skewness and kurtosis, must be within + 30 and the maximum deviation of the normal distribution must be less than 0.1. As a decision, the distribution of the sampling results of this study is a normal distribution. Body shape and size classification of this research, which is set according to the distribution of the sampling data. Various classification methods are described as follows:

4.1. The Classification of Three Points Method of Height

The median height of 159cm is normal height, and the normal height is 1.5 times the standard deviation. 152cm is short height, and the normal height plus 1.5 times standard deviation (168cm) is the long body height. According to this, the range of the body distance is drawn up as shown in Table 3.

4.2. The Classification of Five Points Method of Height

The median height of 159cm was the normal height, the standard deviation of normal height was 1 times the standard deviation 154cm was medium height, the normal height minus 2 times standard difference was 149cm short height, the normal height plus 1 times standard deviation (165cm) was
high, and the normal height plus two times the standard deviation 17lcm was the height, and the height range range was determined according to this, as shown in table 4 as follows:

| Type   | Average height(cm) | Height arrange(cm) |
|--------|--------------------|--------------------|
| Short  | 152                | 149-155            |
| Medium | 159                | 156-164            |
| Long   | 178                | 164-171            |

4.3. Taxonomy According to Hip Circumference
The median 89cm of the hip circumference is A, the hip circumference is smaller than A 5cm (84cm) is Y, the hip circumference is larger than A size 5cm (94cm) for AB, and the hip circumference is larger than that of B type. The size of the hip circumference is divided into 4 types according to the size of the hip circumference, as shown in Table 5 as follows:

| Type  | Definition                                   | Bust(cm) | Waist circumference(cm) | Hip circumference(cm) |
|-------|---------------------------------------------|----------|--------------------------|-----------------------|
| A     | The average figure of the highest probability| 82       | 64                       | 89                    |
| Y     | The hip circumference is smaller than the A size 5cm | ---- | ---- | 84 |
| AB    | Hip circumference is larger than A 5cm      | ----     | ----                     | 94                    |
| B     | Hip circumference is larger than A 10cm     | ----     | ----                     | 99                    |

4.4. Taxonomy by Buttocks and Chest Circumference
The median of hip circumference (7cm) was M, the median of hip circumference and the standard deviation of 1.5 times (14cm) were 1.5 times the standard deviation (0cm) of A somatotype (0cm) as H, and the size of gluteus chest circumference was divided into 3 types, as shown in the following table.

| Type | Differential average of gluteus thorax(cm) | Differential range of buttock(cm) |
|------|-------------------------------------------|----------------------------------|
| A    | 14                                        | >10                              |
| M    | 7                                         | 3~10                             |
| H    | 0                                         | <3                               |

4.5. Taxonomy According to the Circumference of the Chest and Waist
The median of the middle and lumbar circumference (17cm) was A, and the standard deviation of the median difference of 1 times the median of the chest and waist circumference (13cm) was 2 times the
standard deviation of B body and waist circumference, 9cm was C somatotype, and 1.5 times the standard deviation of the chest and waist circumference and 1.5 times the standard difference 22cm was Y, and the size of the chest and waist circumference was divided into 4 types, as shown in the following table 7.

| Table 7. The classification method of 4 scales based on bust-waist-gap |
|-----------------------------|------------------|-------------------|
| Type | Mean circumference of chest and waist(cm) | Chest and waist circumference range(cm) |
|-----|---------------------------------|----------------------------------|
| Y   | 22                              | 19~28                            |
| A   | 17                              | 15~19                            |
| B   | 13                              | 11~15                            |
| C   | 9                               | 5~11                             |

5. Conclusion

A total of 760 men and 1240 women were measured in 2000 age groups, including height, length, width, thickness and circumference, and the results of height, chest circumference, waist circumference and hip circumference showed that male height, chest circumference, waist circumference and hip circumference were growing. The increase in height at the age of 20-22 was obviously slowed down, while the size of chest circumference slowed down at the age of 15~19 and decreased slowly at the age of 40~45; the waist circumference increased to the maximum at the age of 40-44, and slightly decreased after 60-64 years of age; the hip circumference increased to the maximum value at the age of 30~34, and then gradually decreased. In the female part, the height, waist circumference and hip circumference of the female were added at the age of 15~19, but the height slowed obviously after the age of 50~54, and slowed down at the age of the age of 13~14, and the increase in the chest circumference began to slow down after the age of 13~14, and the waist circumference appeared at the age of 13~22. After the age of 23, the hip circumference showed a steady trend. The hip circumference was stable during the age of 15~29. After 30 years of age, it slowly increased with the age of 65~69 and began to slow down gradually.

According to the 587 female body sizes of the actual sample, according to the 4 main size parameters of height, chest circumference, waist circumference and hip circumference, and the classification standards of the body shape of each country, 6 kinds of national standard of female body type are drawn up. 3 points are divided into 3 categories (S, R, L), and 5 points to distinguish the high score of the body (S, M, R, T, H), and according to the standard. There are 4 kinds of hip circumference (A, Y, AB, B). There are 3 classes (A, M, H), 4 classes (Y, A, B, C) and 4 difference according to the waist and waist.

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7. References

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