Modernization of the Physical Features of Korean

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Abstract
Accurate statistics on body features classified by country, age and gender are important notably in multiracial societies. Indeed such statistics allow defining the average virtual individual shape for each class, consequently to recognize the growing importance of some of them, and to recognize the changes occurring with the passing of time. These changes, though sometimes manifest, seem not to be recognized or reflected in the industry or by the manufacturer until new statistics are made public or profit has declined. Therefore, the statistics are becoming more and more of a necessity to the whole manufacturing community. Moreover, all of the products that people use or wear in everyday life should be designed by considering the users’ anthropometric features for best fit and function. To this end, anthropometric data collections and comparison are conducted both on a domestic and global level.

This paper deals with secular trend of height spanning 1979 to 2010 and also morphological growth patterns for Korean. It also investigates the comparison of the growth pattern between male and female based on the anthropometric data samples of KATS taken from the 1979 to 2010 surveys. The great rates of change in height occurred during 1979 - 1997 with 2-3 cm increase in both sexes at each surveys. After 1997 the rate of height increasing is remained within less then 1cm till 2010 survey. This pattern is consistent with recent Korean cultural emphasis on health and physical fitness according to the economic development. The causes of the observed trends, insofar as they have been identified, are related to cultural processes.

Key words: Anthropometry, clothing, morphology, growth.

Introduction
Anthropometric data collection, including three-dimensional information, together with comparison of these data among countries are becoming necessary tools for the entire manufacturing community [1]. However, if anthropometric data are necessary, raw data themselves are insufficient to apply to pattern grading and size compositions according to design variations for the producer. The data must be controlled to enhance their validity for product applications. In the clothing industry, there is a critical problem of minimizing the number of sizes to be defined while maximizing their cover rates, in an attempt to strive for more rationalized production methods. Anthropometric surveys devised by each country attempt to fulfill the requirements of the manufacturers, providing them with data and tools, and allowing them to face both the internal and export markets [2].

Thus, in Korea, the first national anthropometry survey was conducted in 1979 by a Korean Government division, the Korean Agency for Technology and Standard [3]. At the time, data were collected concerning 17,000 sample individuals residing in various parts of the country aged between six and fifty. A total number of 117 measurement dimensions were taken using calipers and tape measures. Thanks to these data, the KATS established 46 items defining Korean standards concerning clothing, furniture, desks and chairs. Forty-one of them (KSK 0035 to KSK 0096) were associated with the size designations of men's wear, women's wear, brassieres, socks, etc. Following this survey, the Korean government has been presenting a national anthropometric survey every 5 or 6 years. The surveys of 1986, 1992, 1997, 2003 and 2010 were performed according to the following sequence: the surveys were performed with the traditional measurement method (2D) using an anthropometer, somatometer, caliper and tape measure. The 3-D body scan data collection (Body Line Scanner, Hamamatsu Co.) method (3D) was also adopted for the 2003 and 2010 surveys. All body dimensions were measured with the method defined by the ISO [4] [5].

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on the anthropometric data samples of KATS taken between the 1979 and 2010 surveys.

**Methods**

The anthropometric data of Korean measured in 1997 (KATS, 1997) and the data collected from 2003 and 2010 [6] [7] as well as the women’s data measured from 2003-2004 [8] which was conducted on 360 adult females between the ages of 20 and 60 were analysed in this section to obtain information on Korean women’s physical features. The 2004 data, generated by direct traditional measurement, sliding gauge measurement and 3D body scanner measurement, consisted of anthropometric data of 140 women in their twenties and of 220 middle-aged women.

The anthropometric data included stature, 3 girth dimensions (bust girth, waist girth and hip girth), 5 breadth dimensions (inter-bust point breadth, chest breadth, waist breadth, hip breadth and acromion to acromion breadth), 4 depth dimensions (chest depth, waist depth, abdominal depth and hip depth), 3 height dimensions (waist height, crotch height and hip height) and span, which were analyzed to indicate body shape and body proportion [9].

3D modeling data, body silhouette data of the mid-sagittal plane, front median line, form front and form side views measured by the sliding gauge, and index values calculated from the differences between bust-waist, bust-hip girth and waist-hip girth measurements, were used as elements for body shape and proportion comparison. Data on size and annual growth changes of measurements of subjects aged from 0 to 60 years were used to clarify the tendency of maturation in body size.

The 3D standard body shape of men and women in their twenties obtained from 2010 KATS photos[7] are presented to define Korean’s morphological features.

**Results**

1. **The comparison of the body size changes**

The changes of body height in subjects from 6 to 20 years illustrated in Figure 1. Figure 1(a) is an example showing a secular change in mean height of female and male subjects’ samples taken between 1979 to 2010 aged from 6 to 20 years. In Korea, like many other countries, the mean height has been increasing in last several decades. In such countries anthropometric data will be outdated sooner or later. The information on the speed of the secular change in height in last several decades is useful to judge if the database is still representing the intended target population or to judge how long the latest database will serve as the reference data [10]. As shown in Figure 1(a), the mean height value of 18 years women is 155.7cm in 1979, 156.2cm in 1986, 160cm in 1997, 160.2cm in 2003, and 160cm in the 2010 data. The mean height value of 18 years men is 166.8cm in 1979, 167.9cm in 1986, 171.8cm in 1997, 172.9cm in 2003, and 172.9cm in the 2010 data as shown Figure 1(b). As shown in Figures 1 (a) and (b), compared to 1979 data, the mean height of 1997 and 2010 for both sexes increased about 4cm to 5cm. The mean height of both adults remains almost the same in the surveys of 1997 and 2010. However, the mean height of girls aged from 8-9 years increased about 1-2cm from 1997 to 2010 which shows the early fast maturing somatotype. Also, the mean height of girls aged from 8-9 years increased 7-8cm in last several decades from 1986 to 1997 [11] [12].

2. **The comparison of the growth pattern in both sexes**

Total body height is clearly of primary importance for all growing children for clothes-fitting purposes, and this has been recognized in many national standards [13] [14]. In the body development features of the population group represented by the height, girl subjects are shown to grow upward rapidly during the height range 104-135 cm (approximately 4-10 years). The growth pattern shows the same tendency between the 1997 and 2010 data (See figures 2 and 3).

![Fig.1. Secular trend of height in groups of Korean male and female.](image)

![Fig.2. Secular trend of height in groups of Korean male and female from 1997 data set.](image)
Fig.3. Secular trend of height in groups of Korean male and female from 2010 data set.

Upwards from the height value of 134 cm, a choice of two or more values in girth dimensions can be provided for a better garment fit, as in the following extract from Figure 4. Increasing annual growth in bust, waist and hip girth, with 3.80cm, 3.11cm and 3.70cm respectively at age 9-10 (with height of 134 cm) corresponds to female child-adult transformation in body shape. There have been increases in growth rates in the more recent period compared to 1986, and there is a definite trend toward earlier maturation and greater total body build. A number of studies have been carried out on the growth stages of puberty [15] [16]. These reports showed that the puberty stages for boys appear at the age 9.1 to 12.5 years, while girls reaches the stages as early as 10.0 years. The growth stages are highly correlated to height growth as shown in Figure 4.

Fig.4. Growth rate in measurements of Korean female.

The size changes of height, bust girth, waist girth and hip girth measurements, which present body development features and annual growth changes of measurements by age 6-20 years in the Korean female, are shown in Figures 4 and 5.

At age 6, the values of height, bust girth, waist girth and hip girth are, 118.9 cm, 60.2 cm, 52.4cm and 62.4 cm, The growth rates of these dimensions are respectively 74.3%, 72.0%, 74.9%, 67.6% of the adult size. Each year, height increases 4-6 cm between the ages of 6 and 12 years, and 2-4 cm per year in other girth dimensions (bust and hip) for subjects aged from 12 to 15 years.

On average, maturity of growth in height is reached at the age of 18-19 years for males and 16-17 years for females.

Fig.5. Size changes of measurements in Korean women.

3. Body proportion

Body proportion is critical for manufacture of body fitting clothes. The proportion ratio index of body height dimension corresponding to height should be taken into consideration when designing good product construction systems. Five body dimensions, namely total body height, eye height, shoulder height, fingertips height, span and maximum shoulder breadth, are considered to be very important parameters for well-fitted balanced design and functionality. The results show 0.93, 0.81, 0.38, 0.99 and 0.26 times the height in eye height, shoulder height, fingertip height, span and maximum shoulder breadth, respectively. These values can be used to make work space and accessories design in order to predict the body length of each part [2].

4. The distribution of drop value in women

Figure 6 suggests the drop value between bust girth and hip girth based on the data of women body dimension taken in 2010(N=2,978). The drop values are concentrated in the range from 6 to 9 cm which approximately represent 40% cover rate of women. Data are divided into three zones corresponding to different body types of Korean women. The three body shapes range in descriptive titles from N (regular), H (slim hips) and A (broad hips) are as follows: Type N, whose drop value ranges from 6 cm to 10 cm, can be defined as the standard type for Korean women. Women who have a drop value between 10cm and 16cm belong to type A. This type indicates that she has a well-developed hip compared to that of Type H (drop value of -1 cm ~ 6 cm reflects a woman with a well-developed bust and slim hips).
5. Standard body type of Korean in twenties

Figures 5 and 7 are showing the change of mean values for height, bust, waist and hip of men and women aged from 6 to 20. The means of height, bust, waist and hip are respectively, 173.2cm, 93.0cm, 78.4cm and 94.3cm at 19 years in women, and respectively 160.2cm, 83.6cm, 69.3cm and 92.8cm at 19 years in men. These sizes can be regarded as the standard young adult female body shape in Korea as shown (Photos from “Size Korea 2010”).

6. 3D body silhouette

Figure 8 shows an example of body shape modeling of Korean women in their twenties using body size data plotting. This sort of figure realizes a comparison of existing shapes with the desired virtual ones (i.e. a well-proportioned body figure in which height corresponds to 8 times the height of the head) considered as a harmonious body shape by a given or targeted population.

Conclusions

As shown in the survey results, small differences in body proportions at birth are continuously multiplied by differential growth rates up until maturity, after which body shape changes are influenced by age, quality and quantity of food intake, exercise and social conditions. With advancing age, waist girth shows a considerable rise in subjects in their thirties. Hip girth and the overall body weight also show a sharp increase in subjects in their thirties.

References