Analysis of Lower Body Characteristics of Korean Women Using 3D Body Scan Data

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Keywords: 3D body scanning, body shape, body size, Korea

Introduction: The 3D body scanning technology has allowed anthropometric study to become more efficient. Recently many apparel researchers have adopted the technology to conduct body shape and size studies to develop better sizing standards and well-fitting garments for apparel industry (Chen, LaBat, & Bye, 2010; Lee, Istook, Nam, & Park, 2007). As the apparel industry is becoming more globalized, understanding body characteristics of Asian consumers will allow apparel brands to be more successful in Asian markets. The purpose of this research was to analyze the lower body characteristics of Korean women from 20s to 50s using 3D body scan data. The research questions were: 1) to compare the differences in anthropometric data between age groups, 2) to identify factors affecting Korean women's lower body shape, 3) to classify lower body shape of Korean women, and 4) to analyze the relationship between age group and lower body shape classification.

Method: The data were selected from the database of 5th Size Korea, the Korean national anthropometric survey using 3D body scanner conducted in 2004. A total of 1154 female participants aged 20 to 59 with normal BMI was selected. The age distribution included 36.22% of the participants in 20s, 34.23% in 30s, 17.24% in 40s, and 12.31% in 50s. A total of 28 lower body measurements in circumference, height, length, width and depth categories, determined to be useful for lower garment development was selected. To minimize the influence of height differences on the age group comparison, the indices of body measurements were used in statistical analysis; 28 body measurements were divided by each participant's height and then multiplied by 100. Descriptive statistics, chi-square test, factor analysis, cluster analysis, one-way ANOVA, and Duncan's post-hoc test were conducted.

Results and discussion: RQ 1: One-way ANOVA was performed to compare the body measurement differences between the four age groups. Significant differences were found in the indices of all 28 body measurements ($p<.05$). In the circumference, depth and breadth categories, waist and abdominal related measurements increased in higher age groups, but the indices of hip, thigh, and knee related measurements decreased in higher age groups. The results indicated that as women become older, their waist and abdominal areas become larger and their hip and leg areas become thinner. In the height category, the indices of almost all the measurements increased in younger age groups. The result indicated that younger Korean women have smaller upper body to lower body ratio and older Korean women have larger upper body to lower body ratio.

RQ 2: In order to identify factors that explain Korean women's lower body shape and to classify body shape, a principle component factor analysis was performed on the 28 body measurements, using the Varimax Rotating Method. The result revealed four factors to be optimal factor number (factor loading: 475 or greater, cumulative % = 77.31 %). The four factors

were labeled as Waist and Abdominal Circumference factor, Hip Height factor, Leg Circumference factor, and Hip and Crotch Length factor.

RQ 3: A cluster analysis was performed using the four factors as independent variables to classify body shape, and four clusters were identified to be optimal. Each cluster was named based on the results from one-way ANOVA and Duncan's multiple range test ($p<.05$). Cluster 4 was the largest cluster with 61.6% of participants, and the other three clusters represented similar number of participants; Cluster 1 represented 10.4% of the participants, Cluster 2 represented 12.4%, and Cluster 3 represented 16.1%. Cluster 1 had higher mean scores on Waist and Abdominal Circumference factor. Therefore it was labeled as Large Size Waist and Abdomen type. Cluster 2 had lower mean scores in Waist and Abdominal Circumference factor and Leg Circumference factor, and had high mean scores on Hip Height factor. Therefore it was labeled as Small Size Lower Body with High Hip type. Cluster 3 had higher mean scores in Leg Circumference factor; and Hip and Crotch Length factor. Therefore it was labeled as Large Size Leg with Long Hip Length type. Cluster 4 had medium mean scores in Waist and Abdominal Circumference factor and had higher mean scores in Hip Height factor. Therefore it was labeled as Medium Size Lower Body with High Hip Type.

RQ 4: Chi-square statists were conducted to determine the relationship between the age groups and the four cluster groups, and significant differences existed ($\chi^2=262.01$, $df=9$, $p<.01$). Cluster 1, Large Size Waist and Abdomen type, was seen most frequently among women in 50s with 42.3% distribution; the distribution had a small increase from 0.5% to 14.1% from the age group 20s to 40s. Therefore it was a typical body type of Korean women in their 50s. Cluster 2, Small Size Lower Body with High Hip type, was a common body type that was seen by 10% to 15% of Korean women across all age groups. Cluster 3, Large Size Leg with Long Hip Length type, was seen more frequently in older age groups of women in 40s and 50 than in younger age groups of women in 20s and 30s. Therefore, it was a typical body type of Korean women in their 40s and 50s. Cluster 4, Medium Size Lower Body with High Hip Type, was seen more frequently in younger age groups of women in 20s and 30s and it had lower distribution in older age groups. Therefore, it was a typical body type of Korean women in their 20s and 30s.

Conclusion: This study showed that the most commonly represented lower body type among Korean women was a medium size body with high hip type. The comparisons between the age groups revealed that body characteristic of Korean women differs according to the age groups. Most notable differences were that the older women had significantly larger waist and abdominal areas than the younger women did. Some changes could be seen related to leg circumference size; older women had a tendency to have thinner leg area than the younger women did. The body characteristics of Korean women and the differences between their age groups should be applied to the apparel products targeted to Korean market.

References:

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