〔報 文〕

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Comparison of Anthropometric Measurements of Oriental and Caucasian Females for Sizing Systems

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東洋과 西洋女子의 人體計測에 의한 치수의 比較

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國 文 抄 錄

研究의 目的은 衣類生産에 있어서 東洋(Oriental women)과 西洋女子(Caucasian women: U.S.A)의 人體計測에 의한 치수의 比較를 하였다. 研究資料는 東洋女子 100名과 西洋女子 970名의 資料로 比較하였다. 東洋女子의 人體計測値는 1981年 4月 日本에서 筆者에 의해 수집되고 西洋女子의 人體計測値는 1976年 11月부터 1977年 2月 美國(U.S.A. by the Quartermaster Corps of the United States Army)에서 人體計測을한 資料이다.

東洋과 西洋女子의 人體計測値 중에서 各各 32項目을 選出하여 比較된 것은 높이항목과 길이항목(height-related measurements; height and length), 나비항목(surface measurements; breadth and depth), 둘레항목(measurement of circumference)이다.

32項目을 平均値의 t-test로 東洋人과 西洋人을 比較한 結果, 모든 項目에서 $p<.001$ 水準에서 有意한 差를 보였다. 그 중에서 머리둘레, 목둘레, 손목둘레, 팔굼치둘레, 손바닥둘레의 項目에서는 東洋人이 西洋人에 比해서 큰 값을 나타냈다. 그 외에 27個 項目은 西洋人이 全部 높거나, 길거나, 또는 큰 값을 나타냈다. 標準偏差에서 보이는 바와 같이 西洋女子가 東洋女子보다 크고, 特히 높이항목, 길이항목(height-related measurements)이 더 높거나 길다.

이러한 結果로서 東洋과 西洋女子의 人種的인 側面에서, 多樣한 衣類生産에 있어서 고려해야 할 것같다. 이 東洋과 西洋女子의 人體計測比較에 重要한 要點을 두고 研究한 것은 衣類生産過程에 있어서, size 設定, 보다 美的인 design, 衣服構成을 위한 등등에 고려 되겠으나, 特히 美國과 같은 大量生産國에서 東洋과의 貿易(import or export)에 있어서 重要하게 고려가 될것이며, 나날이 發展하는 우리나라의 衣類貿易에도 고려 되리라 본다.

뒤에 recommendations for future research에서 말한 바와 같이 西洋과 韓國女子의 人體計測比較를 하여 우리나라의 衣類貿易(輸出)에 도움이 되었으면 한다.

I. INTRODUCTION

Apparel patterns vary among nations and populations, due to variations in bone structure as well as cultural differences For this reason, the design of clothing requires a knowledge of the human body and its dimension.

Apparel patterns are based on scientific measure ments. The measurement process, involving the multiple interrelationship of the body's dimensions, is difficult, and consequently, the data base for anthropometric measurements is very limited.

The measurements used have grown up in the industry, apparently chiefly by trial and error, based on measurements taken on a few women by various inaccurate procedures. To be satisfactory, garment and pattern sizing must be based on a practical and logical classification of body types. The chief problem in setting up a satisfactory set of body measurements for garment and pattern sizing is one of selecting the combination of measurements that in most clothing is related to the other dimensions of a woman's body.

In this research, differences in body configurations of selected samples of Oriental and American women were observed and compared, in order to identify the most important body measurements for apparel.

Anthropometric measurements were compared using a selected sample of 100 Oriental women and 970 Caucasian U.S. Army. women.

Ⅱ. REVIEW OF LITERATURE

History of Anthropometry: Anthropometric data on military personnel in the United Status have been collected for at least 100 years. Indeed, some data on the body sizes of soldiers in the Civil War are available. Large quantities of anthropometric data were collected during and after World War Ⅰ, and an extensive anthropometric survey was conducted by the U.S. Army in 1946 at the conclusion of World War Ⅱ.

In 1919 at the time of demobilization, 18 additional anthropometric measurements were obtained on approximately 100,000 troops under the direction of qualified anthropologists. A detailed statistical analysis of the findings by state, region, and national origin was prepared for the U.S. Army in 1921.

Anthropometric body-size informatio in the form of anthropometric data have been utilized in military research and development programs. Knowledge of body size and proportions is essential for the design, sizing, and tariffing of military clothing and personal equipment. Of even greater importance is the fact that anthropometric data are required as a basic input in the human engineering of military equipment systems.

Army women have been measured twice, in 1946 and 1977; Army men have been measured three times, in 1946, 1966, and 1977; and Army aviators have been measured three times, in 1959, 1967, and 1970. This considerable amount of anthropometric data accumulated on the U.S. Army population have been published in a large number of technical reports.

Ⅲ. METHODOLOGY

The purpose of the study is to make a comparison between the anthropometric measurements of Caucasian females and Oriental females.

Procedure

Anthropometric measurements were compared using average measurements of 100 Oriental women and 970 Caucasian women. The Caucasian data were collected between November 1976 and February 1977 at four U.S. Army installations. For the Oriental women's data, 100 Oriental female, ages 19~24, were Selected as a convenience sample in Tokyo, Japan, in the spring of 1981, were measured for height-related measurements, breadth and depth measurements, surface measurements, and circumferences. All subjects wore brassieres and panties and were positioned on the platform of the anthropometer; no shoes or slippers were worn. As the first step in the measuring procedure, certain marks were placed with a skin pencil on the body of the subject.

The neck base was determined by cervical, laterial neck root point, and suprasternale points.

The armscye was marked by the acromion

(shoulder point), the armscye anterior and posterior, and underarm midpoint. The body measurements were marked by the thelion (bust-point), waist level, olecranon (rediale), iliospinale anterius (iliac crest), patella (tibial), and lateral malleolus.

The procedures described here are for the right side of the body only. Regarding the actual measurement techniques, some observations should noted. For example, the American women were measured on Kneecap height. Tibial height was taken for the Oriental women's body measurements. Though measured in the same knee area, the kneecap height is different from tibial height by approximately 4 cm. The 8.48 cm. difference is due to different measurement techniques. These kinds of artifact differences must be recognized, and corrections must be made. Moreover, it is important to identify exactly which place is to be measured. The following differences should be noted in the measuring procedure:

Measurements	Caucasians	Orientals
Kneecap height	Kneecap height	Tibial height
Sleeve length	Sleeve outseam with straight arm	Sleeve outseam with curved arm
Biceps circumference	Flexed	Relaxed
Elbow circumference	Flexed	Relaxed

Measurements were classified according to the measuring instrument used. An *anthropometer* was used to obtain heightrelated measurements. Breadth and depth measurements were taken with a *beam caliper*, while a tape measure made all the surface and circumference measurements. Figures illustrate each of the measurement processes which are grouped as follows: first, the subjects, wearing panties and brassieres, were weighed on spring scales. Weight was recorded to the nearest kilogram. Next, the investigator positioned the subjects and made all of the measurements.

Ⅳ. STATISTICAL ANALYSIS AND FINDINGS

Average measurements of Oriential and Caucasian U.S. Army women derived as shown in Table 1.

Analysis Comparing the Samples on Selected Variables

The comparison of the Oriential measurements with the Caucasian measurements from the U.S. Army study was carried out using t-test on the respective means of the 32 measurements that were judged to be comparable by virtue of their location on the body:

—Weight
—Stature
—Shoulder Height
—Axilla Height
—Bustpoint Height
—Waist Height
—Crotch Height
—Knee line Height
—Chest Breadth
—Waist Breadth
—Hip Breadth
—Bust Depth
—Waist Depth
—Waist Back Length
—Waist Front Length
—Sleeve Length
—Shoulder Length
—Interscye Back
—Interscye Front
—Crotch Length
—Bust Circumference
—Waist Circumference
—Hip Circumfererence
—Neck Circumference
—Armscye Circumference
—Biceps Circumference
—Elbow Circumference
—Wrist Circumference
—Upper Thigh Circumference
—Head Circumference
—Hand Circumference
—Foot Length

Statistical values for the anthropometric data

Table 1. Table of Means and Stand ardDeviations for Significant Body Measurements by Race

No. Variable	Race: Caucasian n=970 $\bar{X}$	Caucasian n=970 S.D.[a]	Oriental n=100 $\bar{X}$	Oriental n=100 S.D.[a]	t-value[b]
1. Weight	59.91	8.36	49.92	4.84	32.23***
2. Stature	163.23	6.42	157.20	4.71	23.33***
3. Shoulder height	133.62	5.96	126.38	4.56	26.81***
4. Axilla height	123.32	5.52	115.83	4.36	28.81***
5. Bustpoint height	118.23	5.55	111.14	4.30	27.27***
6. Waist height	101.35	5.07	94.85	3.74	27.08***
7. Crotch height	75.91	4.16	96.25	3.37	30.27***
8. Knee height	47.68	2.55	39.20	2.13	49.88***
9. Chest breadth	28.27	1.78	26.22	1.28	14.64***
10. Waist breadth	25.61	2.41	22.30	1.12	19.47***
11. Hip breadth	35.53	2.38	31.85	1.34	21.65***
12. Bust depth	22.92	2.15	20.55	1.40	14.81***
13. Waist depth	18.14	2.11	16.85	1.22	8.06***
14. Waist back length	41.05	2.60	38.85	1.81	12.94***
15. Waist front length	36.89	2.57	32.90	1.96	23.47***
16. Sleeve length	53.44	2.82	52.10	1.98	7.44***
17. Shoulder length	14.99	1.05	13.54	.78	13.18***
18. Interscyte back	37.80	2.31	34.30	1.66	21.88***
19. Interscye front	33.08	1.71	31.36	1.37	12.29***
20. Crotch length	73.45	5.24	66.85	3.82	26.40***
21. Bust circumference	88.30	6.22	82.09	3.95	23.00***
22. Waist circumference	70.80	6.71	62.86	3.61	28.36***
23. Hip circumference	95.67	6.13	89.75	3.39	22.77***
24. Neck circumference	32.24	1.53	36.95	1.28	−36.23***
25. Armscye circumference	37.50	2.36	36.78	1.73	4.24***
26. Biceps circumference	26.76	2.24	26.25	1.69	3.19***
27. Elbow circumference	25.88	1.57	27.86	1.70	−14.14***
28. Wrist circumference	14.66	.67	16.12	1.58	−5.41***
29. Upper thigh circumference	56.79	4.43	51.78	2.76	21.78***
30. Head circumference	54.68	1.50	56.34	1.81	−11.86***
31. Hand circumference	18.36	.82	20.12	.89	−17.60***
32. Foot length	24.14	1.15	23.14	1.01	8.33***

[a] estimated from the sum of 32 variables
[b] statistically different from significant at
*** p-value<.001

are show in Table 1. Presented there are the number of individuals measured (N), the arithmetic mean or average value for the measurement (Mean) on the 32 variables of interest, the standard deviation(S.D.), and the two-tail significance (P) derived according to the t-test procedure.

The Oriental mean was subtracted from the Caucasian mean; i.e., positive t values indicated a larger mean for Americans.

Statistical Findings

An interesting observation in the data is that, in general, the standard deviations for the Caucasian women were larger than those for the Oriental women. The Caucasian women are not only heavier or taller on the average than Oriental women, but more variable in their weight, stature, waist height, crotch height, and crotch length, etc. The one noteworthy exception to the finding of larger Caucasian means was found among the head, hand, and wrist circumferences along with neck and elbow circumferences of the Orientals. The Oriental means are significantly greater than the Caucasian means, as the negative signs on these respective t-values indicate in Table. The variability, however, describing these circumferences is greater for the Caucasian women, thus demonstrating consistency in this trend.

Results indicated also that the height-related measurements and surface measurements of the Caucasian women were greater than the Oriental women's measurements. Similarly, those circumferences usually considered most crucial for apparel pattern development are significantly greater among the Caucasian women.

Caucasian women are larger than Oriental females in bust, waist, and hip circumference. Similarly, Caucasian women are longer than the Oriental women on the body surface measurements of crotch length, waist back length, waist front length, shoulder length, interscye, back and interscyte, front.

Interpreting the findings of the negative t-test values for certain circumference comparisons, as noted above, is less straightforward. Head, hands, and wrists all represent bony or skeletal body segments. Even the neck circumference is influenced by the size and density of bony growth, because the spinous processes actually from the framework on which the muscular and other tissues that make up the neck column are overlaid. The interpretation of this finding would appear to be related, then, to the idea that the Oriental women's sample demonstrates a bony body structure that surpasses that of the Caucasian women's sample in circumferential size, but not in length of particular segments. That is, although the Caucasian women were found to exhibit significantly longer bony segments, as shown by measurements like crotch height, acromion to elbow length, and waist back length, the bredth-related measurements of conspicuously bony segments like head circumference, hand and wrist circumferences, and even neck circumference, indicate clearly the greater size of the Oriental women's sample.

An explanation of this finding is clearly beyond the scope of this study. The inference is obvious, however, that this finding, if replicated, has implication for the design and sizing of headgear and coverings in a crosscultural context.

V. SUMMARY AND CONCLUSIONS

U.S. Army anthropometry survey studies across 30 years have indicated slight increases in the body size of U.S. Army female personnel. The body sizes of Army women measured in 1946 and 1977 were compared. Cross-cultural surveys and comparison studies have not been reported in the literature of either anthropometry or fashion design in helpful ways. This study is an attempt to add to the knowledge of both fields. Perhaps the information presented here will be useful to persons engaged in clothing and accessory export businesses.

Statistical results indicated that measurements for the Caucasian women are significantly larger than those of the Oriental women, except for head, neck, hand, wrist and elbow circumferences. However, variability is greater for the Caucasian women's body measurements. This finding indicates that the Caucasian women represented a much less homogeneous population than was true of the sample of Oriental women. Oriental women are

perhaps more similar in their body build since the variability in the measurements of the Oriental women was less than that of the Caucasian women.

Caucasian women were measured on 69 variables of anthropometric measurements. This research measured 47 variables for Oriental women of anthropometric measurements. The 47 variables selected are those deemed the most useful of all measurements for apparel design and production. These variables were also selected to be compatible with certain of the 69 U.S. Army variables for the sake of comparison.

This study was undertaken in order to provide measurements which could be used for improving the fit of women's patterns and garments. This study could be important for manufacturers wishing to refine their knowledge base for reasons of apparel export to the Orient.

Recommendations for Future Research

Based on this study' the following recommendations are made for future research. It would be useful to make a comparison of anthropometric data collected by U.S. Army Natick Research and Development Command with Oriental data collected by Oriental Government agencies in conutries such as Korea or Japan. It may also be of benefit to compare Oriental and Caucasian anthropometric data by age groups.

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