

A Korean–American Comparative Study of 3D Scanned Female Anthropometric Data

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Abstract

The purpose of this research is to provide useable data for application in American and Korean apparel company. This data was developed by analyzing information of Korean and American body sizes obtained from "Size USA Project" and "Size Korea Project".

The Subjects were 6,306 American females and 1,988 Korean females over 18 years old. 30 measurements and 14 computed values were chosen that were considered critical in making garments. And descriptive analysis, percentile analysis and t-test were used as statistical methods for analyzing measurements and computed value between the two countries.

The results were as follows. It was determined that American women were larger and bigger than Korean women in all measurements and computed values, except for Shoulder Slope. Based on BMI values, we determined that American women had a distinct tendency towards being overweight.

Through the comparison of drop values (i.e. the difference between Hip and Bust Girths or Hip and Waist Girths), ratio values (i.e. waist height divided by height) and Body Mass Index (BMI) between the two countries, we determined that American women's figures were shapelier than Korean women's. American women had higher hip heights and longer leg lengths for their height compared to Korean woman. Furthermore, the back shapes of Korean women were flatter than American women and BMI values indicated American women were relatively more overweight than Korean women.

Key Words : 3D body scanning, anthropometric, body measurements, laser scanners, CAD

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Size USA measurement data were provided by [TC]². And Size Korea measurement data were provided by Korean Agency for Technology & Standards.

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I . Introduction

Traditionally, body size and shape has been viewed using ratios such as 36–26–36, which correspond to actual body measurements at the locations of bust–waist–hip. However, university researchers, apparel producers, and consumers are beginning to understand that the numbers themselves are not as important as the ratio between these numbers, and the body proportions they represent. Anthropometric research using body scan data provides information on consumer body sizes and shapes to designers and manufacturers to improve the fit of garments.¹⁾

Size USA Project (7/2002–9/2003), collected body measurement and demographic data of over 10,000 subjects were collected in 13 cities. Historically, almost all U.S. sizing surveys conducted were for the U.S. military for the purpose of sizing equipment and military apparel.²⁾ Except for Size USA survey, a comprehensive study of the size and shape distributions of the United States civilian population has never been done.³⁾

A few precedent researches about body sizes and shape analysis of American women were done by using this Size USA 3D scanned data since 2004. But until now, there were no researches about international comparative study between the U.S. and other country.

Korea also completed an international comparative study of body sizes and established several apparel sizing standards⁴⁾⁵⁾ in 2005 as a "Post Size Korea Study".⁶⁾ But the information was limited due to the lack of recent and up to date research data on body sizes.

In this paper, we analyzed 3D scanned anthropometric measurement data of 6306 American female adults 18 years old and more

from Size USA and 1988 Korean female adults 18 years old and more from Size Korea. We used various statistical methods such as, descriptive analysis, percentile analysis and t–test between the two countries' measurements. And we also analyzed drop values, ratios and for understanding of physical characteristics.

II . Methodology

The purpose of this study was to compare the body sizes and shapes of Korean females and American females.

The brief comparison of characteristics in Size USA and Size Korea was shown in <Table 1> and demographic distribution of the subjects in two countries was shown as <Table 2>.

30 measurements and 14 computed values were chosen that were considered critical in making garments. These measurements used in this paper showed in <Table 3>. These measurements were all standardized international measurements methods came from ISO⁷⁾⁸⁾⁹⁾¹⁰⁾, ASTM¹¹⁾¹²⁾¹³⁾¹⁴⁾¹⁵⁾ and KS.¹⁶⁾

The t–test between American & Korean females' main measurements by bust groups according to ASTM D 5585 were fulfilled because this research data, which is one of the initial steps to make a sizing conversion table between the two countries will contribute to the continuing effort to standardize import apparel sizing for the Korean market.

<Table 1> Comparison of Size USA & Size Korea

	Size USA	Size Korea
Period	2002~2003	2003~2004
Scanner	[TC] ²	Cyberware
Software	Body Measurement System (Visual basic/C++/Open GL Graphics)	Editing S/W: RapidForm 2004 Measurement S/W: 3DM
Subjects	1) 6 age groups (18-25, 26-35, 36-45, 46-55, 56-65, 66+) 2) Female: 6,310 3) 4 ethnic groups (White, Black, Hispanic and Other) * Note: Asian subjects are included in Other.	1) 18~75 years old 2) Female: 1,988 * Note: Analyzed fixed ages only and adjusted age groups same to USA
Measurement variables	Over 140 automatic body measurements	205 total measured, includes 126 body measurements, 79 Foot/head measurements

<Table 2> Demographic distribution of the subjects

Age group	Korean		American									
			White		Black		Hispanic		Others		Group Total	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
18~25	463	23.3	707	1.2	293	4.6	271	4.3	266	4.2	1537	24.4
26~35	518	26.1	653	10.4	290	4.6	233	3.7	271	4.3	1447	22.9
36~45	382	19.2	686	10.9	268	4.2	176	2.8	210	3.3	1340	21.2
46~55	272	13.7	682	10.8	194	3.1	106	1.7	159	2.5	1141	18.1
56~65	194	9.8	413	6.5	54	.9	44	.7	94	1.5	605	9.6
66~	159	8.0	187	3.0	6	.1	8	.1	35	.6	236	3.7
Group Total	1988	100.0	3328	52.8	1105	17.5	838	13.3	1035	16.4	6306	100.0

III. Results

1. American/Korean analysis of the body sizes

The percentile values of America and Korean females were as <Table 4>. In most of the measurements, the means and each percentile of American females were bigger than Korean

females. And the measurement ranges of American females were wider than Korean females except for "Shoulder Slope".

<Table 5> was the results showing differences of body sizes between the two countries. All measurements except "Crotch Length Total" were different significantly between Americans and Koreans. All Heights measurement variables of

<Table 3> Measurements and Computed value were used

Measurements			Measurements
Girths	1. Bust Girth	Heights	16. Waist Height
	2. Waist Girth		17. Hip Height
	3. Hip Girth		18. Crotch Height
	4. Mid-Neck Girth		19. Knee Height
	5. Neck Base Girth		20. Ankle Height
	6. Armscye Girth	Lengths	21. Waist Length (Front)
	7. Elbow Girth		22. Waist Length (Back)
	8. Thigh, Max Girth		23. Cross-Back Width(Interscye Fold, Back)
	9. Thigh, Mid Girth		24. Cross-Chest Width(Interscye Fold, Front)
	10. Knee Girth		25. Arm Length (Shoulder to Wrist)
	11. Calf Girth		26. Arm Length (Center Back Neck to Wrist)
	12. Ankle Girth		27. Bust Point to Bust Point
	13. Total Crotch Length		28. Side Neck to Bust Point
Heights	14. Height	Others	29. Shoulder Slope(degree)
	15. Back Neck Point Height		30. Weight(Kg)
Computed values			Computed values
Drop Values	C1. Hip girth–Bust girth	Ratios	C8. Knee Height/Height
	C2. Hip girth –Waist girth		C9. Ankle Height/Height
	C3. Bust girth –Waist girth		C10. Waist Length Front/Height
Ratios	C4. Back Neck Point/Height		C11. Waist Length Back/Height
	C5. Waist Height/Height		C12. Waist/height
	C6. Hip Height/Height	C13. Hip /Height	
	C7. Crotch Height/Height	Index	C14. BMI

$$\text{BMI}=\text{weight(Kg)}/\text{height(m}^2\text{)}$$

American females were higher than those of Korean females. All Girth measurements of American females were bigger than those of Korean females. In case of Lengths measurements, American females' measurements were longer than Korean females' measurements. "Shoulder Slopes (degrees)" of American females is smaller than Korean females. We concluded American women had "risen shoulder" when compared with Korean women. In terms of weight, American females were also heavier than Korean females.

<Table 6> showed Korean Standard % values when American measurements were considered as 100%.

In case Korean Standard % values were higher than those of American, each value was highlighted. Korean women's value was higher than American in shoulder slope measurement. But most values of American females were higher than Korean females. According to analysis of standard values of American vs. Korean females, Korean women had smaller

<Table 4> American/Korean Percentile analysis of Measurements

unit: cm, Kg, °

Measurements	Country	Mean	%tile 05	%tile 25	%tile 50	%tile 75	%tile 95	Range*
Bust Girth	U.S.	103.67	85.84	94.28	101.82	111.27	127.83	41.99
	Korea	90.20	78.80	84.40	89.30	95.18	104.52	25.72
Waist Girth	U.S.	87.40	69.61	77.20	84.85	95.04	114.11	44.50
	Korea	76.87	63.19	69.20	75.40	83.30	95.40	32.22
Hip Girth	U.S.	109.61	93.18	100.62	107.30	116.00	134.58	41.40
	Korea	93.58	85.70	89.90	93.40	96.70	102.90	17.20
Mid Neck Girth	U.S.	35.77	31.22	33.21	35.14	37.70	42.46	11.24
	Korea	32.74	28.60	30.80	32.40	34.50	37.60	9.00
Neck Base Girth	U.S.	38.32	33.95	35.97	37.86	40.14	44.33	10.38
	Korea	37.69	33.39	35.60	37.60	39.60	42.50	9.12
Armscye Girth	U.S.	42.27	35.31	38.77	41.70	45.19	51.16	15.85
	Korea	35.27	30.70	32.90	35.00	37.30	40.70	10.00
Elbow Girth	U.S.	26.39	22.40	24.22	25.86	27.96	32.12	9.72
	Korea	23.16	19.60	21.70	23.20	24.60	26.82	7.22
Thigh Max Girth	U.S.	62.52	52.60	57.25	61.31	66.48	76.81	24.21
	Korea	55.44	48.40	52.30	55.20	58.20	63.40	15.00
Thigh Mid Girth	U.S.	51.26	43.01	46.87	50.14	54.51	63.52	20.51
	Korea	49.44	43.20	46.70	49.20	51.90	56.20	13.00
Knee Girth	U.S.	39.06	34.06	36.48	38.47	41.04	46.11	12.05
	Korea	35.16	30.89	33.40	35.10	36.90	39.40	8.52
Calf Girth	U.S.	38.14	32.82	35.36	37.62	40.21	45.54	12.73
	Korea	34.09	29.60	32.20	34.00	35.90	38.72	9.12
Ankle Girth	U.S.	25.58	22.60	24.03	25.18	26.65	30.11	7.51
	Korea	23.57	20.20	22.20	23.50	25.00	27.10	6.90
Crotch Length Total	U.S.	72.40	60.09	66.55	71.23	76.73	89.82	29.73
	Korea	72.17	65.20	69.20	72.20	75.00	79.30	14.10
Height	U.S.	162.74	151.55	157.91	163.01	166.83	174.47	22.92
	Korea	157.37	147.66	153.40	157.30	161.30	167.40	19.74
Back Neck Point Height	U.S.	139.85	129.52	135.43	139.79	144.05	150.28	20.76
	Korea	132.71	124.00	129.10	132.60	136.20	141.70	17.70
Waist Height	U.S.	100.29	90.67	96.13	100.23	104.36	110.44	19.76
	Korea	96.94	89.00	93.50	97.00	100.20	105.00	16.00
Hip Height	U.S.	81.37	71.13	76.47	80.77	85.87	93.61	22.48
	Korea	75.61	69.10	72.90	75.50	78.30	82.40	13.30
Crotch Height	U.S.	73.42	65.74	70.20	73.34	76.58	81.36	15.62
	Korea	70.02	63.90	67.40	69.90	72.50	76.40	12.50
Knee Height	U.S.	44.31	39.67	42.41	44.34	46.20	49.15	9.48
	Korea	40.22	36.90	38.80	40.20	41.60	43.70	6.80
Ankle Height	U.S.	6.98	5.26	6.27	7.02	7.52	8.52	3.26
	Korea	5.31	4.50	4.90	5.30	5.70	6.20	1.70

* Note: Range=Percentile 95-Percentile 05

<Table 4> Continued

unit: cm, Kg, °

Measurements	Country	Mean	%tile 05	%tile 25	%tile 50	%tile 75	%tile 95	Range*
Waist Length _F	U.S.	37.57	31.28	34.68	37.13	40.11	45.24	13.96
	Korea	32.38	29.00	30.80	32.30	33.90	36.20	7.20
Waist Length _B	U.S.	44.01	39.22	42.02	43.93	45.91	49.04	9.82
	Korea	38.41	35.10	36.93	38.30	39.90	41.92	6.82
Cross Back Width	U.S.	36.75	31.25	34.22	36.39	38.87	43.40	12.15
	Korea	35.34	31.60	33.70	35.20	36.80	39.52	7.92
Cross Chest Width	U.S.	37.75	29.73	34.73	37.64	40.74	45.90	16.18
	Korea	33.79	30.40	32.30	33.70	35.10	37.60	7.20
Arm Length (Shoulder to Wrist)	U.S.	53.54	47.31	51.07	53.47	55.98	59.83	12.53
	Korea	50.77	47.00	49.10	50.70	52.40	54.60	7.60
Arm Length (CB Neck to Wrist)	U.S.	72.64	65.39	69.70	72.55	75.48	80.05	14.65
	Korea	71.38	66.60	69.40	71.30	73.30	76.30	9.70
Bust Pt to Bust Pt	U.S.	21.04	17.37	19.47	20.85	22.36	25.51	8.14
	Korea	15.62	13.40	14.60	15.60	16.50	18.10	4.70
Side Neck to Bust Pt	U.S.	27.97	23.53	25.89	27.69	29.81	33.47	9.94
	Korea	26.24	22.70	24.50	26.10	27.70	30.50	7.80
Shoulder Slope (degrees)	U.S.	21.22	14.97	18.64	21.26	23.83	27.27	12.31
	Korea	24.68	18.00	22.00	25.00	27.00	31.00	13.00
Weight (Kg)	U.S.	70.57	48.98	58.50	66.66	78.91	104.76	55.78
	Korea	56.32	44.50	51.00	55.50	61.00	71.00	26.50

* Note: Range=Percentile 95–Percentile 05

<Table 5> American/Korean differences of the body sizes ¹⁷⁾

unit: cm, Kg, °

Measurements	US		Korean		t	Sig.
	Mean	S.D.	Mean	S.D.		
Bust Girth	103.67	12.85	89.88	9.45	44.12	0.000
Waist Girth	87.40	13.83	76.60	10.87	31.40	0.000
Hip Girth	109.61	12.75	93.01	9.02	54.33	0.000
Mid–Neck Girth	35.77	3.51	32.62	3.35	35.15	0.000
Neck Base Girth	38.32	3.21	37.55	3.62	7.86	0.000
Armscye Girth	42.27	5.11	35.14	3.73	57.64	0.000
Elbow Girth	26.39	3.20	23.16	2.19	41.88	0.000
Thigh Max Girth	62.52	7.49	55.24	5.65	39.73	0.000
Thigh Mid Girth	51.26	6.35	49.27	5.04	11.95	0.000
Knee Girth	39.06	3.80	35.04	3.40	42.37	0.000
Calf Girth	38.14	4.00	33.97	3.45	41.95	0.000
Ankle Girth	25.58	2.31	23.49	2.49	34.39	0.000
Crotch Length Total	72.40	9.02	71.92	6.05	1.09	0.277
Height	162.74	6.98	156.42	13.57	30.81	0.000

<Table 5> Continued

unit: cm, Kg, °

Measurements	US		Korean		t	Sig.
	Mean	S.D.	Mean	S.D.		
Back Neck Point Height	139.85	6.37	131.91	11.58	45.02	0.000
Waist Height	100.29	6.00	96.36	8.94	22.58	0.000
Hip Height	81.37	6.81	75.15	7.10	35.68	0.000
Crotch Height	73.42	4.77	69.59	6.66	28.85	0.000
Knee Height	44.31	3.04	39.97	3.75	55.78	0.000
Ankle Height	6.98	1.00	5.28	0.68	70.73	0.000
Waist Length Front	37.57	4.23	32.27	2.91	52.33	0.000
Waist Length Back	44.01	2.99	38.28	3.14	77.11	0.000
Cross Back Width	36.75	3.72	35.22	3.18	15.86	0.000
Cross Chest Width	37.75	4.94	33.66	3.08	34.49	0.000
Arm Length(Shoulder to Wrist)	53.54	3.86	50.59	3.82	30.11	0.000
Arm Length CB Neck to Wrist	72.64	4.47	71.13	5.13	11.79	0.000
Bust Pt to Bust Pt	21.04	2.41	15.56	1.69	95.14	0.000
Side Neck to Bust Point	27.97	3.03	26.15	2.83	23.29	0.000
Shoulder Slope(degrees)	21.22	3.75	24.68	4.12	-34.95	0.000
Weight(Kg)	70.57	17.43	56.32	7.88	35.30	0.000

* The part of this table was cited from the original paper of Yi, Kyong-Hwa, et. al. in 2007¹⁷⁾

<Table 6> Standard values of American females vs. Korean females

Unit: %

Measurements	US	Korean	Measurements	US	Korean
Bust Girth	100.0	86.7	Waist Height	100.0	96.1
Waist Girth	100.0	87.6	Hip Height	100.0	92.4
Hip Girth	100.0	84.9	Crotch Height	100.0	94.8
Mid-Neck Girth	100.0	91.2	Knee Height	100.0	90.2
Neck Base Girth	100.0	98.0	Ankle Height	100.0	75.6
Armscye Girth	100.0	83.1	Waist Length Front	100.0	85.9
Elbow Girth	100.0	87.8	Waist Length Back	100.0	87.0
Thigh Max Girth	100.0	88.4	Cross Back Width	100.0	95.8
Thigh Mid Girth	100.0	96.1	Cross Chest Width	100.0	89.2
Knee Girth	100.0	89.7	Shoulder Slope(degrees)	100.0	116.3
Calf Girth	100.0	89.1	Weight	100.0	79.8
Ankle Girth	100.0	91.8	Arm Length(Shoulder to Wrist)	100.0	94.5
Crotch Length Total	100.0	99.3	Arm Length(CB Neck to Wrist)	100.0	97.9
Height	100.0	96.1	Bust Pt to Bust Pt	100.0	74.0
Back Neck Point Height	100.0	94.3	Side Neck to Bust Point	100.0	93.5

girths, shorter heights and lengths, "sagged shoulders" compared with American women. Korean women's hip sizes were respectively smaller than American because hip values were the most low among the girth measurements. And Korean women's "Hip Height" was lower than American according to standard values. It has also been determined from <Table 6>.

1) Korean women's weight was 79.8% of American women's value, we can verify American women's obesity, 2) Korean women were lower than American women in the distance of "Bust Point to Bust Point". Namely, we can presume the possibility that American women had "wider and larger breast" compared with Korean women.

2. American/Korean differences Analysis of drop values, ratios and BMI

When we compared the measurements between two groups and more, drop values, ratios and indices are very useful to understand the characteristics of body shapes. In this paper, Drop values such as "Hip Girth–Bust Girth", "Hip Girth–Waist Girth", "Bust Girth–waist Girth" were computed and analyzed. In case of ratios, main Height measurements for "Height" were computed and analyzed for understanding the proportion of body heights. BMI was used to verify degree of obesity. Body mass index (BMI) is a measurement of bodyfat based on height and weight that applies to both adult men and women

The computed measurements' percentile values of America and Korean females were as <Table 7>. All computed measurements except for "Waist Height/Height", the mean and each percentile value of American women were bigger

or higher than Korean women. In case of range value which means range from percentile 05 to percentile 95.

Table 8 was the results showing differences of "Drop Values", Body ratios and BMI between the two countries. All Drop Values of American women were bigger than those of Korean women. These results intimated American women's "Hip Girths" and "Bust Girths" were large compared "Waist Girths". These also showed American women's body figures were more curved than Korean women. When "Hip Girth–Bust Girth" of American women were compared to 『ISO/TR 10652 : 1991』, the mean drop value of American women's was just same as the mean drop value of "body type M" by ISO. But the mean drop value of Korean women's was close to the drop value of "body type H" by ISO.

According to other Height ratios by Height, "Back Neck Point Height", "Hip Height", "Crotch Height", "Knee Height", "Ankle Height" of Americans were statistically different from those of Koreans. But in case of "Waist Height/Height", there was no significant difference between the two countries. In summary, we concluded American women had slightly short head length, risen hips and long leg length for their height compared Korean woman.

From BMI, we also concluded American women reached overweight category. The mean value of Americans' BMI showed 0.27 which indicates "Overweight category" while the mean value of Koreans' BMI showed below 0.25 which means "Normal weight".

In addition "Waist Girth/Height" and "Hip Girth/Height" showed the relative obesity of American women for Korean women. We also verified that American women's obesity tendency in these two values.

<Table 7> American/Korean Percentile analysis of Measurements

Computed values	Country	Mean	%tile 05	%tile 25	%tile 50	%tile 75	%tile 95	Range*
Hip Girth – Bust Girth	U.S.	5.94	-4.88	1.56	5.83	10.14	16.98	21.86
	Korea	3.14	-7.60	-0.50	4.20	7.70	12.40	20.00
Hip Girth – Waist Girth	U.S.	22.21	12.14	18.13	22.34	26.25	32.17	20.03
	Korea	16.41	0.90	11.80	18.40	22.90	27.30	26.40
Bust Girth – Waist Girth	U.S.	16.27	8.34	13.13	16.35	19.45	24.09	15.76
	Korea	13.33	5.98	10.80	13.80	16.00	19.30	13.32
Back Neck Point Height/Height	U.S.	0.86	0.84	0.85	0.86	0.87	0.87	0.03
	Korea	0.84	0.83	0.84	0.84	0.85	0.85	0.02
Waist Height/Height	U.S.	0.62	0.58	0.60	0.62	0.63	0.65	0.07
	Korea	0.62	0.59	0.61	0.62	0.62	0.64	0.04
Hip Height/Height	U.S.	0.50	0.45	0.47	0.49	0.53	0.56	0.11
	Korea	0.48	0.46	0.47	0.48	0.49	0.50	0.04
Crotch Height/Height	U.S.	0.45	0.42	0.44	0.45	0.46	0.48	0.05
	Korea	0.44	0.42	0.44	0.44	0.45	0.47	0.04
Knee Height/Height	U.S.	0.27	0.26	0.27	0.27	0.28	0.29	0.03
	Korea	0.26	0.24	0.25	0.26	0.26	0.27	0.02
Ankle Height/Height	U.S.	0.04	0.03	0.04	0.04	0.05	0.05	0.02
	Korea	0.03	0.03	0.03	0.03	0.04	0.04	0.01
Waist Length Front/Height	U.S.	0.23	0.19	0.21	0.23	0.25	0.28	0.09
	Korea	0.21	0.18	0.20	0.20	0.22	0.23	0.05
Waist Length Back/Height	U.S.	0.27	0.24	0.26	0.27	0.28	0.30	0.05
	Korea	0.24	0.22	0.23	0.24	0.25	0.27	0.04
Waist Girth/height	U.S.	0.54	0.43	0.47	0.52	0.59	0.70	0.27
	Korea	0.49	0.39	0.43	0.48	0.53	0.63	0.23
Hip Girth /Height	U.S.	0.67	0.57	0.62	0.66	0.72	0.83	0.25
	Korea	0.60	0.54	0.57	0.59	0.62	0.66	0.12
BMI	U.S.	0.27	0.19	0.22	0.25	0.30	0.39	0.20
	Korea	0.23	0.18	0.20	0.22	0.25	0.29	0.11

* Note: Range=value of Percentile 95- value of Percentile 05

IV. Conclusion and Implication

This research is to provide feasible data for application in American and Korean apparel company which are related to apparel manufacturing and designing. This data was developed by analyzing information on Korean

and American body sizes obtained from "Size USA Project" and "Size Korea Project".

The conclusions of this research were as follows.

First, we determined that American female measurements such as heights, weight, lengths, circumferences and drop values(except for Shoulder

<Table 8> Standard values of Korean females vs. American females in computed values

Computed values	US		Korean		US (%)	Korean (%)
	Mean	S.D.	Mean	S.D.		
Hip Girth–Bust Girth	5.94	6.55	3.13	11.19	100	52.7
Hip Girth –Waist Girth	22.21	6.06	16.41	12.22	100	73.9
Bust Girth –Waist Girth	16.27	4.85	13.28	4.09	100	81.6
Back Neck Point Height/Height	0.86	0.01	0.84	0.01	100	97.7
Waist Height/Height	0.62	0.02	0.62	0.01	100	100.0
Hip Height/Height	0.50	0.04	0.48	0.01	100	96.0
Crotch Height/Height	0.45	0.02	0.44	0.01	100	97.8
Knee Height/Height	0.27	0.01	0.26	0.01	100	96.3
Ankle Height/Height	0.04	0.01	0.03	0.00	100	75.0
Waist Length Front/Height	0.23	0.03	0.21	0.01	100	91.3
Waist Length Back/Height	0.27	0.02	0.24	0.01	100	88.9
Waist Girth/height	0.54	0.09	0.49	0.07	100	90.7
Hip Girth /Height	0.67	0.08	0.60	0.04	100	89.6
BMI	0.27	0.06	0.23	0.03	100	85.2

Slope) were significantly larger than Korean female measurements. Using the BMI, we determined that American women had a distinct tendency towards being overweight.

Second, from the results of drops and ratios comparison between the two countries, we determined that (1) American women's body figures were more curved than Korean women; (2) American women had slightly shorter head lengths, higher hip heights, and longer leg lengths for their height compared to Korean woman; (3) Korean women's back shapes were flatter than American women and (4) BMI values indicated American women were more overweight than Korean women.

In conclusion, we could determine that American female measurements such as heights, weight, lengths, circumferences and drop values except for "Shoulder Slope" were significantly larger than Korean female measurements. And we can verify American women had a distinct tendency towards obesity.

Reference

- 1) *CAESAR uses latest laser technology*, Retrieved 2012. 9. 27, from <http://www.sae.org/technicalcommittees/caelaser.htm>.
- 2) US Army Natick Research, Development and Engineering Center(1989), *1988 Anthropometric Survey of U.S. Army Personnel: Methods and Summary Statistics*, US Army.
- 3) [TC]²(2004), *The National Sizing Survey, Women: Body Measurements and Data Analysis Reports on the U.S. Population*, [TC]² Cary, NC, USA.
- 4) KS K 0050(2009), *Sizing Systems for Elderly Women's Garments*, Seoul, KSA, Korea.
- 5) KS K 0051(2009), *Sizing Systems for Female Adult's Garments*, KSA, Seoul, Korea.
- 6) Korean Agency for Technology & Standards (2004), *The 5th Size Korea Survey Final Report*. KATS Gwacheon, Korea.
- 7) ISO 3637(1990), *Size designation of clothes*

- *Women's and girls' Outwear Garments*, ISO: Geneva, Switzerland.
- 8) ISO 7250(1996), *Basic Human Body Measurements for Technological Design*, ISO: Geneva, Switzerland.
- 9) ISO 8559(1989), *Garment Construction and Anthropometric Surveys – Body Dimensions*, ISO: Geneva, Switzerland.
- 10) ISO TR 10652(1991), *Standard Sizing Systems for Clothes*, ISO: Geneva, Switzerland.
- 11) ASTM D 5219(1999), *Standard Terminology Relating to Body Dimension for Apparel Sizing*, ASTM International, West Conshohocken, PA.
- 12) ASTM D 5585(1995), *Standard Tables of Body Measurements for Adult Female Misses Figure Type, Size 2 to 20*, ASTM International, West Conshohocken, PA.
- 13) ASTM D 7022(2004), *Standard Terminology Relating to Apparel*, ASTM International, West Conshohocken, PA.
- 14) ASTM D 5586(1995), *Standard Tables of Body Measurements for Women Aged 55 and Older(All Figure Types)*, ASTM International, West Conshohocken, PA.
- 15) PS 42–70(1970), *Body Measurements for the Sizing of Women's Patterns and Apparel*, ASTM International, West Conshohocken, PA.
- 16) KS K 7003(2004), *Garment Construction and Anthropometric Surveys–Body Dimensions*, KSA, Seoul, Korea.
- 17) Yi Kyonghwa, et. al(2007), "Comparative Analysis of Korean and American Body Sizes & Shapes using 3D Scanned Anthropometric Data, *Journal of Korean Society of Clothing & Textiles*, 31(6), pp.891–901.

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