Lateral Body Shapes of Males in Their 20s for the Development of Educational Dress Forms (Part 2)

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Abstract

The study with the subjects of 200 adult males in Busan in their 20s had a purpose of analyzing lateral body shapes to develop men's educational dress forms. The following are the conclusions:

1. Comparison of the Body Dimensions of Busan Male Adults in Their 20s and the 5th Survey of Korean Body Measurement
In the comparison of the Busan and national body dimensions by way of Mollison's relative deviation, all compared items were under the deviation of 0.7. Therefore, the sample of Busan male grown-ups is understood to represent the body shapes of the average Korean male adults in their 20s.

2. Results of Lateral Body Shape Classification
From factor analysis, seven factors were produced to explain 75.45% of all variables. Those 7 factors to compose lateral body shapes were hip prominence, back-neck sides, upper body's front-back depth, lateral upper body depth, hip-waist depth, front chest-waist depth, and hip and waist height.
Cluster analysis revealed four characteristic lateral body shapes. Type 1 with the appearance rate of 11.70%, named D, had the greatest upper chest angle and tanterior neck lower angle. The front side was more developed. Type 2 with 33.51%, named I, was generally long and slender. Type 3 with 24.47%, named d, had the biggest depth differences in hip-chest as well as more prominent back hip. Type 4 with 30.32%, named q, had the biggest dorsal upper angle and the tiniest chest upper angle as the back area was a little bent.

Key Words : Educational Male Dress Forms, lateral Body Shapes,
5th Korean physical dimensions, Mollison Relational Deviation Line

Ⅰ. Introduction

The domestic market of male clothes since the 1990s has shown the increase of new-generation male consumers who have different lifestyles and young fashion consciousness and want to actively express their unique personality.

In particular, following the autonomous trend of office uniforms and the 5-day-a-week work system of large companies, young males show more brilliant and detailed colors and coordination.

That's why we need diverse studies to reflect the needs of fashion-oriented customers, produce variously-designed goods and patterns in consideration of men's physical characteristics, and develop dress forms fitting ready-made sizes and body shapes. However, there have not been many systematic studies, especially focused on educational dress forms for patternmaking.

For the development of educational dress forms, front and lateral body shape classification is required to suggest representative body shapes. Jeong, Jae-Eun[1] and Seok, Hye-Jung[2] studied those male adults in their 20s-50s and 20s respectively for frontal and lateral body shape classification. Kim, Ku-Ja[3] researched lateral body shapes based on photographs, while Kim, Su-Hyeon & Lee, Jeong-Ran[4] investigated front body shapes. But these studies were mainly for the development of the clothing size system and pattern of jacket according body shapes, not that of dress forms.

As a result, this study is focused on 200 adult males in Busan in their 20s. Their lateral body shape characteristics were analyzed with the following aims:

1) Human body measurement is held to know the body shapes of male adults living in the Busan area.

2) The measurement results are compared with the data of the 5th survey of Korean body measurement (2004) to prove the properness of the samples in this study.

3) Factor analysis is used to reveal the composition factors of lateral body shapes.

4) Cluster analysis is utilized to classify lateral body shapes and understand their characteristics.

Ⅱ. Research Contents & Methods

1. Measurement Period & Subjects

From January 3 through February 28, 2005, body measurement was held in Busan for 200 male grown-ups aged 20 to 29. Their age distribution of the subjects is seen in ⟨Table 1⟩.

⟨Table 1⟩ Age distribution of the subjects

Age	Male (N)	Percent(%)
20-24 Years	113	56.5
25-29 Years	87	43.5
Total	200	100

2. Measurement Methods & Items

1) Direct Method

According to R. Martin's human body measurement method and the 5th survey of Korean body measurement (2004), methods and items were chosen. Both direct and indirect measurement were held. Direct measurement items were 17 (height), 13(depth), 28 (length), 14 (girth), and weight. The contents of 73 measurement items are shown in ⟨Table 2⟩.

2) Indirect Measurement

For the 2—dimensional information related with posture, indirect photography measurement was given. The background screen was black with white stripes, and the front—lateral feet were drawn at 30° in the measurement post. A digital camera was used, while ⟨Table 3⟩ shows the conditions of photography. Indirect measurement items were 12 (angle) and 18 (calculation) as seen in ⟨Table 4⟩and ⟨Fig. 1⟩. The vertical line at the half point of the foot length became the standard line.

⟨Table 2⟩ Direct measurement items

Division	Measurement items
Height (17 items)	Stature, Cervical Height, Anterior Neck Height, Lateral Neck Height, Acromion Height, Shoulder Height, Axilla Height, Scapula point Height, Inferior Thyroid Height, Chest Height, Bust Height, Waist Height, Waist(Omphalion) Height, Hip Height, Crotch Height, Gluteal Fold Height, Knee Height
Depth (13 items)	Inferior Thyroid Depth, Cervical Neck Depth, Anterior Neck Depth, Midaxilla(Front—Back) Depth, Axilla(Front—Back) Depth, Scapula point Depth, Chest Depth, Bust Depth, Waist Depth , Waist(Omphalion) Depth, Hip Depth 1, Gluteal Fold Depth, Armscye Depth
Length (28 items)	Waist Front Length, Waist Back Length, Waist Side Length , Waist(Omphalion) Front Length, Waist(Omphalion) Back Length, Anterior Neck — Lateral Shoulder Length, Lateral Shoulder(L)— Lateral Shoulder(R): Front, Lateral Shoulder(L)— Lateral Shoulder(R): Back, Bust point—Bust point, Acromion Length:Back, Shoulder Length, 1/2 Scapula point —Scapula point, Interscye:Front, Interscye:Back, Anterior Axilla Length , Posterior Axilla Length, Lateral Shoulder —Anterior Axilla Length, Lateral Shoulder —Posterior Axilla Length, Neck point—Bust point—Waistline Length, Neck Point —Waist Front Length, MidShoulder—Bust point—Waistline Length, Neck Point —Scapula point Length , Neck Point —Scapula point —Waistline Length, MidShoulder—Scapula point—Waistline Length, Neck Point —Waist Back Length, Axillary Level at Midspine, Arm Length, Waist to Hip Length
Circumference (14 items)	Inferior Thyroid Circumference, Cervical—Lateral Neck Circumference, Cervical—Anterior Neck Circumference, Neck Base Circumference, Chest Circumference, Bust Circumference, Waist Circumference, Waist(Omphalion) Circumference, Hip Circumference, Thigh Circumference, Armscye Circumference, Upper Arm Circumference, Elbow Circumference, Wrist Circumference
Etc. (1 items)	Weight

〈Table 3〉 Photography equipment & conditions

Photography equipment & conditions	Specifications
Camera kind	Canon EOS 300D
Picture elements (possible)	6.5 (3,152 * 20,680)
Picture elements (recordable)	Medium/ Fine (2,048 * 1,360)
Photography distance	EV 0.5~1.8 (20℃, ISO 100)
Shutter speed	1/4,000~30 sec
Light measurement	35-frame SPC, TTL
Camera height	107cm
Camera distance	350cm

〈Table 4〉 Indirect measurement items

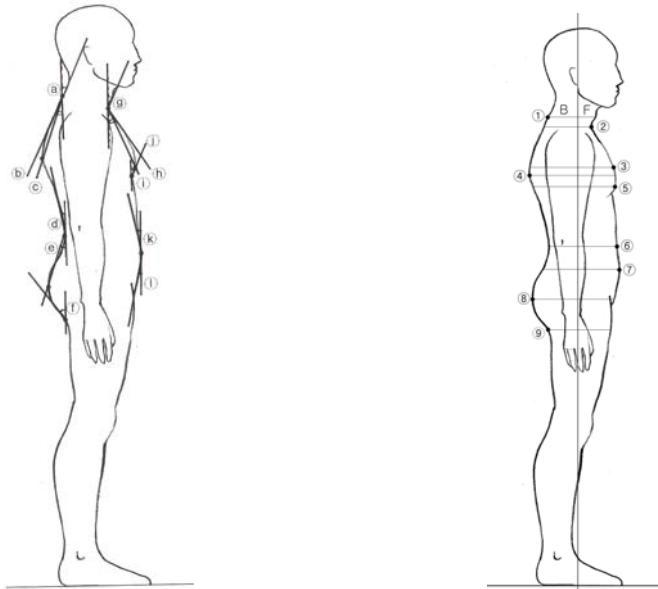| Division	Measurement items
Angle (12 items)	Cervical Upper Angle, Cervical lower Angle, Dorsal Upper Angle, Dorsal lower Angle, Hip Upper Angle, Hip lower Angle, Anterior Neck Upper Angle, Anterior Neck lower Angle, Chest Upper Angle, Chest lower Angle, Abdomen Upper Angle, Abdomen lower Angle
Calculation Items (18 items)	Hip Depth(Front)/Hip Depth(Back) Cervical Depth(Front)/Cervical Depth(Back) Waist Depth(Front)/Waist Depth(Back) Chest Depth(Front)/Waist Depth(Back) Hip Depth/Chest Depth − Waist Depth/Chest Depth Hip Depth/Chest Depth − Chest Depth/Chest Depth Scapula point Depth/Chest Depth − Bust Depth/Chest Depth Chest Depth/Chest Depth − Waist Depth/Chest Depth Scapula point Depth(Back)/Chest Depth − Hip Depth(Back)/Chest Depth Hip Depth(Back)/Chest Depth − Waist Depth(Back)/Chest Depth Hip Depth(Back)/Chest Depth − Scapula point Depth(Back)/Chest Depth Hip Depth(Back)/Chest Depth − Chest Depth(Back)/Chest Depth Chest Depth(Back)/Chest Depth − Cervical Depth(Back)/Chest Depth Waist Depth(Front)/Chest Depth − Chest Depth(Front)/Chest Depth Abdomen Depth(Front)/Chest Depth − Chest Depth(Front)/Chest Depth Waist Depth(Front)/Chest Depth − Hip Depth(Front)/Chest Depth Cervical Height/Cervical Height−Waist Height/Cervical Height Cervical Height/Cervical Height−Hip Height/Cervical Height

3. Data Processing

The data in the present study were processed by way of the SPSS/Win (ver 10.0).

1) Means and standard deviation were obtained, while Mollison's relative deviation method was utilized to compare the 5th survey of Korean body measurement (2004) and the measurements of Busan male adults.

2) Factor analysis was used to find the composition factors of lateral body shapes.

3) Cluster analysis was held to classify lateral body shapes with the factor analysis points as independent variables. One—way ANOVA and the Duncan test were given to understand the body shape characteristics.

ⓐ : Cervical Upper Angle
ⓑ : Cervical lower Angle
ⓒ : Dorsal Upper Angle
ⓓ : Dorsal lower Angle
ⓔ : Hip Upper Angle
ⓕ : Hip lower Angle
ⓖ : Anterior Neck Upper Angle
ⓗ : Anterior Neck lower Angle
ⓘ : Chest Upper Angle
ⓙ : Chest lower Angle
ⓚ : Abdomen Upper Angle
ⓛ : Abdomen lower Angle

① : Cervical Neck Depth
② : Anterior Neck Depth
③ : Chest Depth
④ : Scapula point Depth
⑤ : Bust Depth
⑥ : Waist Depth
⑦ : Waist(Omphalion) Depth
⑧ : Hip Depth
⑨ : Gluteal Fold Depth

〈Fig. 1〉 Indirect measurement Method

Ⅲ. Results & Review

1. Analysis of Human Body Measurement

1). Descriptive Analysis of Direct/ Indirect Measurements

〈Table 5〉 and 〈Table 6〉 talk about the means and standard deviation of the direct and indirect measurements.

〈Table 5〉 Descriptives of Height, Dept, Length items

	Items	Mean	S.D.		Items	Mean	S.D.
H e i g h t (cm)	Stature	173.83	5.23	L e n g t h (cm)	Waist Front Length	33.28	1.72
	Cervical Height	147.28	4.87		Waist Back Length	40.10	2.24
	Anterior Neck Height	140.73	4.52		Waist Side Length	21.72	1.86
	Lateral Neck Height	146.22	4.69		Waist(Omphalion) Front Length	39.53	1.99
	Acromion Height	140.16	4.71		Waist(Omphalion) Back Length	45.96	2.11
	Shoulder Height	140.75	4.70		Anterior Neck – Lateral Shoulder Length	20.31	1.25
	Axilla Height	128.08	4.35		Lateral Shoulder(L)– Lateral Shoulder(R): Front	40.49	2.07
	Scapula point Height	127.91	4.45		Lateral Shoulder(L)– Lateral Shoulder(R): Back	43.95	2.44
	Inferior Thyroid Height	146.90	4.64		Bust point–Bust point	20.18	1.55
	Chest Height	130.15	4.33		Acromion Length:Back	44.46	2.46
	Bust Height	124.48	4.27		Shoulder Length	13.57	1.04
	Waist Height	109.17	4.02		1/2 Scapula point –Scapula point	8.85	1.27
	Waist(Omphalion) Height	102.57	3.88		Interscye:Front	35.82	2.09
	Hip Height	85.83	3.45		Interscye:Back	41.97	2.51
	Crotch Height	80.40	3.16		Anterior Axilla Length	37.93	3.03
	Gluteal Fold Height	76.86	3.09		Posterior Axilla Length	40.03	2.98
	Knee Height	45.28	1.99		Lateral Shoulder –Anterior Axilla Length	15.01	0.99
D e p t h (cm)	Inferior Thyroid Depth	12.00	0.78		Lateral Shoulder –Posterior Axilla Length	18.07	1.17
	Cervical Neck Depth	11.66	0.60		Neck point–Bust point–Waistline Length	41.62	1.88
	Anterior Neck Depth	14.37	0.96		Neck Point –Waist Front Length	42.47	1.86
	Midaxilla(Front–Back) Depth	11.36	0.96		MidShoulder–Bust point–Waistline Length	39.75	2.31
	Axilla(Front–Back) Depth	11.57	1.19		Neck Point –Scapula point Length	24.53	1.38
	Scapula point Depth	22.06	1.84		Neck Point –Scapula point –Waistline Length	44.76	3.74
	Chest Depth	21.55	1.68		MidShoulder–Scapula point–Waistline Length	42.38	1.94
	Bust Depth	21.92	2.05		Neck Point –Waist Back Length	45.30	2.01
	Waist Depth	20.78	2.33		Axillary Level at Midspine	19.19	1.45
	Waist(Omphalion) Depth	20.20	2.19		Arm Length	59.25	2.29
					Waist to Hip Length	23.49	2.12
	Hip Depth	23.88	1.93	Etc.	Weight(kg)	70.61	9.56
	Gluteal Fold Depth	18.63	2.05				
	Armscye Depth	12.05	0.92				

〈Table 6〉 Descriptives of Circumference, Angle, Calculation items

Items		Mean	S.D.	Items	Mean	S.D.
C i r c u m f e r e n c e (cm)	Inferior Thyroid Circumference	39.00	1.93	Hip Depth/Chest Depth − Waist Depth/Chest Depth	18.07	7.52
	Cervical−Lateral Neck Circumference	9.79	0.66			
	Cervical−Anterior Neck Circumference	21.70	1.03	Scapula point Depth/Chest Depth − Bust Depth/Chest Depth	1.76	4.31
	Neck Base Circumference	43.91	2.12			
	Chest Circumference	96.10	6.21	Chest Depth/Chest Depth − Waist Depth/Chest Depth	5.94	7.01
	Bust Circumference	92.47	6.66			
	Waist Circumference	78.79	6.52	Hip Depth(Back)/Chest Depth − Waist Depth(Back) /Chest Depth	18.85	7.45
	Waist(Omphalion) Circumference	81.24	7.43			
	Hip Circumference	95.90	5.44	Hip Depth(Back)/Chest Depth − Scapula point Depth(Back) /Chest Depth	2.59	8.36
	Thigh Circumference	59.28	6.25			
	Armscye Circumference	43.04	2.50	Hip Depth(Back)/Chest Depth − Chest Depth(Back) /Chest Depth	2.39	8.51
	Upper Arm Circumference	31.11	2.85			
	Elbow Circumference	28.97	1.96	Chest Depth(Back)/Chest Depth − Cervical Depth (Back)/Chest Depth	27.26	6.35
	Wrist Circumference	16.75	0.69			
A n g l e (°)	Cervical Upper Angle	15.62	6.4	Waist Depth(Front)/Chest Depth − Chest Depth(Front) /Chest Depth	10.64	7.31
	Cervical lower Angle	30.99	5.98			
	Dorsal Upper Angle	18.04	4.39	Abdomen Depth(Front)/Chest Depth − Chest Depth(Front) /Chest Depth	12.79	7.72
	Dorsal lower Angle	11.51	3.48			
	Hip Upper Angle	18.37	3.57	Waist Depth(Front)/Chest Depth − Hip Depth(Front) /Chest Depth	0.91	7.20
	Hip lower Angle	18.36	3.89			
	Anterior Neck Upper Angle	20.95	5.80			
	Anterior Neck lower Angle	30.10	6.54			
	Chest Upper Angle	19.66	4.90			
	Chest lower Angle	11.11	7.68			
	Abdomen Upper Angle	5.00	4.32			
	Abdomen lower Angle	4.10	4.42			

The middle column group is labeled vertically: C a l c u l a t i o n I t e m s

2) Comparison of the Body Dimensions
of Those in Their 20s in Busan
and the Nation

The data of the 5th survey of Korean body measurement (2004) and the body dimensions of the Busan male adults in their 20s were compared by using Mollison's relative deviation method in 30 items: 8 (height), 5 (depth), 6 (Circumference), 10 (length), and 1 (weight). The comparison results are summed up in ⟨Table 7⟩.

As the 5th survey of Korean body measurement (2004) divided the 20s into the first half and the second half, the same division was also made in Busan measurements. In height items, Busan values were ⟨ 0.7 , while the early 20s were closer to the national values. depth and Circumference items were ⟨ 0.7 , while the

Circumference items were even nearer to the national dimensions. Length items showed lower values than 0.7.

This finding is believed to have come from the different criteria of the waist line. The innermost of the right waist is the common criterion, while the central point between the lower rib and the hip hill can be another criterion of the waist line. The current study found that the second waist line was placed rather lower than the first one, bringing about different measurements.

In the present study, the location of the waist line was higher than the national standard. Generally speaking, however, as all the measured items were ⟨ 0.7 in Mollison values, the sample of Busan male grown-ups is understood to represent the body shapes of the average Korean male adults in their 20s.

⟨Table 7⟩ Comparison of the measurement in Busan and
the data of the 5th Korean physical dimensions(Size Korea)

Items		20-24 Y				Mollison value *	25-29 Y				Mollison value *
		Busan		Size Korea			Busan		Size Korea		
		Mean	S.D.	Mean	S.D.		Mean	S.D.	Mean	S.D.	
H e i g h t (cm)	Stature	173.49	5.20	173.8	5.83	−0.05	174.36	5.26	172.5	5.30	0.35
	Cervical Height	147.07	4.85	148.0	5.41	−0.17	147.64	4.93	147.0	5.03	0.12
	Acromion Height	139.90	4.68	140.3	5.27	−0.07	140.62	4.76	139.40	4.79	0.25
	Shoulder Height	140.48	4.68	141.3	5.25	−0.15	141.21	4.72	140.4	4.81	0.16
	Waist Height	108.96	3.92	107.5	4.42	0.33	109.52	4.19	106.5	4.48	0.67
	Waist(Omphalion) Height	102.39	3.82	102.5	4.20	−0.02	102.87	3.99	101.5	4.05	0.33
	Hip Height	85.58	3.38	85.5	3.85	0.02	86.24	3.62	84.4	3.55	0.51
	Crotch Height	80.23	3.15	79.9	3.75	0.08	80.67	3.18	78.9	3.54	0.5
D e p t h (cm)	Chest Depth	21.31	1.53	20.6	1.85	0.38	21.95	1.85	20.9	1.63	0.64
	Bust Depth	21.65	1.93	21.4	2.14	0.11	22.36	2.18	21.8	1.82	0.30
	Waist Depth	20.52	2.06	20.0	2.49	0.20	21.20	2.68	20.8	2.23	0.17
	Waist(Omphalion) Depth	19.95	1.97	19.7	2.36	0.10	20.64	2.47	21.4	2.13	0.11
	Hip Depth	23.64	1.90	23.8	2.17	−0.07	24.26	1.92	24.2	2.12	0.02

〈Table 7〉 continued

Items		20-24 Y				Mollison value *	25-29 Y				Mollison value *
		Busan		Size Korea			Busan		Size Korea		
		Mean	S.D.	Mean	S.D.		Mean	S.D.	Mean	S.D.	
C i r c u m f e r e n c e (cm)	Inferior Thyroid Circumference	36.80	1.73	37.1	1.97	−0.15	37.29	2.01	37.5	1.90	−0.11
	Chest Circumference	94.87	5.59	95.1	6.25	−0.03	98.09	6.66	96.4	5.50	0.30
	Bust Circumference	91.28	6.29	90.7	6.81	0.08	94.4	6.82	91.8	5.79	0.44
	Waist Circumference	77.87	5.88	77.7	7.45	0.02	80.29	7.24	79.4	6.52	0.13
	Waist(Omphalion) Circumference	80.09	6.81	79.7	7.78	0.05	83.1	8.03	81.3	6.80	0.26
	Hip Circumference	95.32	5.43	94.6	5.53	0.13	96.85	5.35	94.8	5.17	0.39
L e n g t h (cm)	Waist Front Length	33.25	1.70	34.8	2.28	−0.67	33.33	1.76	35	2.73	−0.61
	Waist(Omphalion) Front Length	39.40	1.93	40.2	2.08	−0.38	39.73	2.09	40.4	2.06	−0.34
	Waist Back Length	39.96	1.93	41.9	3.04	−0.63	40.33	2.66	42.2	2.76	−0.67
	Waist(Omphalion) Back Length	45.89	2.01	46.8	2.49	−0.36	46.08	2.28	47	2.41	−0.38
	Interscye:Front	35.44	1.95	36.6	1.94	−0.59	36.43	2.19	36.6	1.86	−0.09
	Interscye:Back	41.78	2.54	40.6	2.65	0.44	42.30	2.45	41	2.47	0.52
	Axillary Level at Midspine	19.02	1.41	19.1	2.04	−0.03	19.47	1.47	19.6	2.77	−0.04
	Shoulder Length	13.43	0.98	13.8	1.12	−0.33	13.79	1.10	13.8	1.19	−0.00
	Arm Length	59.10	2.41	58.3	2.7	0.29	59.50	2.08	57.9	2.50	0.64
Etc.	weight(kg)	69.24	8.95	69.5	10.2	−0.02	72.82	10.15	70.1	9.0	0.30

* Mollison value = (Mean of Busan− Mean of Size Korea)/ Std. Deviation of Size Korea

2. Classification of Lateral Body Shapes

1) Composition Factors of Body Shapes

Principle components and the Varimax orthogonal rotation solution were used for factor analysis. This analysis was made several times because it was hard to produce clear factors owing to the overlapped and complicated characteristics.

Seok, Hye-Jung[2] and Gwon, Yeong-Ja[5] found the difficulty of classifying by shapes owing to the easy tendency of classifying by the size of human body including fatness. As a result, 7 factors explaining the concepts of angles(4), calculation items of height and depth(14) were produced. 〈Table 8〉 shows the final 7 factors with the cumulative % of 75.45.

Factor 1 showed the load 〉 0.7 in hip depth(back) − chest depth(back), hip depth(back) − waist depth(back), scapula point depth(back) − hip depth(back), and hip depth(front)/hip depth(back). This factor related with hip projection had the Eigen value of 3.36 and the cumulative % of 16.82.

Factor 2 was 〉 0.6 in chest depth(back) − cervical depth(back), dorsal upper angle, chest upper angle and anterior neck lower angle. This factor related with the lateral shapes of the back and the neck had the Eigen value of 3.04 and the cumulative % of 32.05.

Factor 3 was 〉 0.7 in waist depth(front)/waist depth(back), chest depth(front)/waist depth(back), and cervical depth(front)/cervical depth(back). Related with the ratios of the upper body's front−back depth, this third factor had the Eigen

value of 2.38 and the cumulative % of 43.96.

Factor 4 revealed 〉 0.6 in hip depth − chest depth, chest depth − waist depth, and dorsal lower angle. Related with the lateral upper body, therefore, this 4th factor was 2.04 (Eigen value) and 54.17 (cumulative %).

Factor 5 was 〉 0.9 in the items of the hip−waist depth difference and showed 1.57 (Eigen value) and 62.03 (cumulative %).

Factor 6 was the load 〉 0.9 in the difference items of the front waist−chest depth, having 1.51 (Eigen value) and 69.60 (cumulative %).

Factor 7 was 〉 0.7 in the difference items of cervical height − waist height and cervical height − hip height. Thus, related with waist and hip height, the 7th factor was 1.17 (Eigen value) and 75.45 (cumulative %).

〈Table 8〉 Factor analysis results of lateral body shapes

Contents of Factor	Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Hip Projection	Hip Depth(Back)/Chest Depth − Chest Depth(Back)/Chest Depth	−.852	−.006	.232	−.193	.009	−.280	−.002
	Hip Depth(Back)/Chest Depth − Waist Depth(Back)/Chest Depth	−.828	−.002	.245	.181	.268	.290	.000
	Scapula point Depth(Back)/Chest Depth − Hip Depth(Back)/Chest Depth	.820	−.007	−.005	.223	.001	.158	.002
	Hip Depth(Front)/Hip Depth(Back)	.728	.008	.473	−.211	.181	.002	.001
Lateral Shapes of the Back and the Neck	Chest Depth(Back)/Chest Depth − Cervical Depth(Back)/Chest Depth	.108	.833	−.002	.001	−.005	.121	−.000
	Dorsal Upper Angle	−.001	.822	.006	.004	−.002	−.173	−.157
	Chest Upper Angle	.005	−.755	.007	.008	−.416	.003	−.009
	Anterior Neck lower Angle	.007	−.650	.008	.007	−.335	−.166	−.146
Ratios of the Upper Body's Front−Back Depth	Waist Depth(Front)/Waist Depth(Back)	−.002	−.168	.887	.102	.004	.302	−.000
	Chest Depth(Front)/Waist Depth(Back)	−.144	−.196	.882	−.001	−.002	−.329	−.000
	Cervical Depth(Front)/Cervical Depth(Back)	−.008	.260	.769	−.001	−.000	−.211	−.000
Lateral Upper Body Depth Difference	Hip Depth/Chest Depth − Chest Depth/Chest Depth	−.008	.008	.002	−.823	.407	.170	−.003
	Chest Depth/Chest Depth − Waist Depth/Chest Depth	−.002	.004	.005	.819	.420	−.223	.004
	Dorsal lower Angle	.114	.007	−.001	.611	.009	.318	−.244

〈Table 8〉 continued

Contents of Factor	Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Hip–Waist Depth Difference	Hip Depth/Chest Depth − Waist Depth/Chest Depth	−.103	.134	.005	.002	.917	−.007	.002
Front Waist–Chest Depth Difference	Waist Depth(Front)/Chest Depth − Chest Depth(Front)/Chest Depth	.155	.005	−.155	−.179	−.008	.911	−.001
Waist and Hip Height	Cervical Height/Cervical Height − Waist /Cervical Height	.003	−.002	.003	.191	.136	.009	.829
	Cervical Height/Cervical Height − Hip /Cervical Height	.002	.004	−.004	−.219	−.009	−.122	.719
Eigen value		3.365	3.047	2.382	2.041	1.572	1.513	1.170
% of Variance		16.82	15.23	11.90	10.20	7.86	7.56	5.85
Cumulative %		16.82	32.05	43.96	54.17	62.03	69.60	75.45

2) Body Shape Classification According to the Results of Factor Analysis

With the 7 factors above as independent variables, cluster analysis was held to classify lateral body shapes. The Squared Euclidean Distance method was used to measure similarity, while Ward's method was employed to reveal 4 types. 〈Table 9〉 shows the results of ANOVA analysis.

〈Table 9〉 One-way ANOVA results of lateral body shapes

Contents of Factor	Items	Group 1 (N=22)	Group 2 (N=63)	Group 3 (N=46)	Group 4 (N=57)	F-value
Hip Projection	Hip Depth(Back)/Chest Depth − Chest Depth(Back)/Chest Depth	3.61 b	1.04 bc	7.44 a	−.079 c	8.64***
	Hip Depth(Back)/Chest Depth − Waist Depth(Back)/Chest Depth	18.53 ab	18.58 ab	20.59 a	16.63 b	2.06*
	Scapula point Depth(Back)/Chest Depth − Hip Depth(Back)/Chest Depth	−.2.57a	−0.15 a	−8.12 b	−1.34 a	6.37*
	Hip Depth(Front)/Hip Depth(Back)	85.83 a	75.74 b	67.72 b	65.68 b	5.58*

〈Table 9〉 continued

Contents of Factor	Items	Group 1 (N=22)	Group 2 (N=63)	Group 3 (N=46)	Group 4 (N=57)	F-value
Lateral Shapes of the Back and the Neck	Chest Depth(Back)/Chest Depth − Cervical Depth(Back)/Chest Depth	23.16 c	23.60 c	26.81 b	31.07 a	24.74***
	Dorsal Upper Angle	15.61 c	16.00 c	18.13 b	21.22 a	23.55***
	Chest Upper Angle	25.65 a	19.92 b	19.08 bc	17.49 c	20.47***
	Anterior Neck lower Angle	36.77 a	30.50 b	29.18 bc	27.65 c	12.44***
Ratios of the Upper Body's Front−Back Depth	Waist Depth(Front)/Waist Depth(Back)	153.75 a	103.60 b	104.22 b	90.52 b	11.33***
	Chest Depth(Front)/Waist Depth(Back)	86.95 a	59.02 bc	66.34 b	48.05 c	13.33***
	Cervical Depth(Front)/ Cervical Depth(Back)	124.25 a	44.50 b	56.97 b	67.18 b	3.92*
Lateral Upper Body Depth Difference	Hip Depth/Chest Depth − Chest Depth/Chest Depth	10.22 ab	10.19 ab	12.89 a	9.55 b	2.51*
	Chest Depth/Chest Depth − Waist Depth/Chest Depth	−1.64 c	7.32 a	1.28 b	3.23 b	14.64***
	Dorsal lower Angle	10.72 b	12.32 a	9.54 b	12.78 a	9.72***
Hip−Waist Depth Difference	Hip Depth/Chest Depth − Waist Depth/Chest Depth	8.58 c	17.75 a	14.17 b	12.78 b	16.64***
Front Waist−Chest Depth Difference	Waist Depth(Front)/Chest Depth − Chest Depth(Front)/Chest Depth	11.72 ab	8.30 b	8.62 b	12.33 a	3.64*
Waist and Hip Height	Cervical Height/Cervical Height − Waist /Cervical Height	25.00 b	25.94 a	26.21 a	25.27 b	15.85***
	Cervical Height/Cervical Height − Hip /Cervical Height	40.99 c	41.59 b	42.76 a	41.41 b	28.57***

*:p<.05, **:p<.01, ***:p<.001, The alphabets indicate the groups with some significance in the Duncan test (a>b>c).

Based on body shape classification by August (Lee Sun−Won et al. 2002),[17] body shape characteristics were known and each body shape was named in alphabets.

Type 1 showed the appearance rate of 11.70%. The lower and dorsal upper angle were small,

but chest upper angle and anterior neck lower angle were the greatest. The front depth was bigger than back depth in such parts as chest, waist, and hip. This body shape was named "D" as the front side was protruding and more developed.

Type 2 appeared 33.51%. The dorsal upper angle was small, while the front chest-waist depth difference and the back hip-chest depth difference were small. This body shape was named "l."

Type 3 was 24.47%. The biggest depth differences were shown in hip-chest, back hip-waist, and back hip-chest. This body shape was named "d" as the hip area was developed with more prominent back hip depth.

Type 4 was 30.32%. The back hip-waist depth difference was the smallest, while the back chest-cervical neck depth difference was the biggest. The dorsal upper angle was the greatest, but chest upper angle was the tiniest. This body shape was named "q" as the back area was a little bent. Picture 1 shows the lateral sides of each body shape.

| D type | l type | d type | q type |
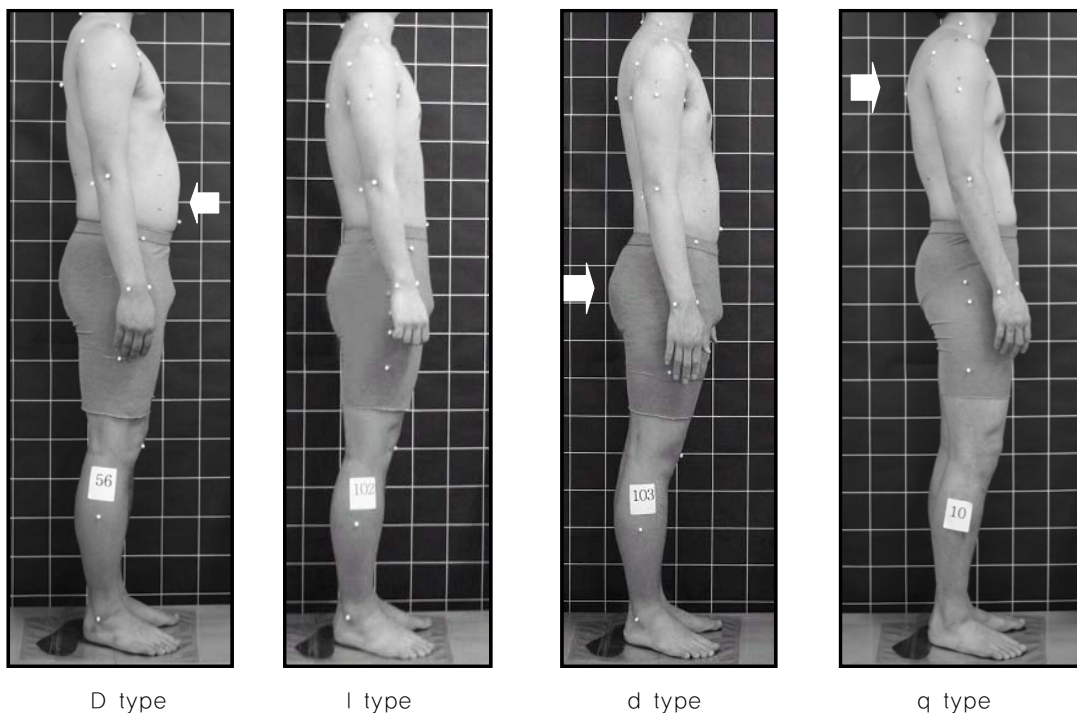
〈Picture 1〉 Typical pictures of 4 body shape

3) Data of Body Measurement According to Body Shape Classification

The comparison results of data body measurement according to body shape are shown in 〈Table 10〉.

〈Table 10〉 Data of body measurement according to body shapes

Items		D type (11.7%)		I type (33.51%)		d type (24.47%)		q type (30.32%)		F value
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	
Height (cm)	Stature	173.89	4.68	172.82	5.13	173.27	5.12	175.12	4.98	2.265
	Cervical Height	147.83ab	4.70	146.19b	4.83	146.82ab	4.54	148.71a	4.70	3.101*
	Anterior Neck Height	141.75b	4.21	139.91d	4.40	140.01c	4.32	141.93a	4.49	2.969*
	Lateral Neck Height	146.98ab	4.49	145.34b	4.58	145.54ab	4.44	147.51a	4.55	2.887*
	Acromion Height	141.38a	4.31	139.17b	4.59	139.53ab	4.49	141.35a	4.62	3.117*
	Shoulder Height	141.96a	4.34	139.75b	4.55	140.11ab	4.41	141.92a	4.65	3.123*
	Axilla Height	128.78	4.07	127.39	4.32	127.35	4.16	129.19	4.27	2.512
	Scapula point Height	128.38ab	4.10	127.00b	4.45	127.34ab	4.27	129.22a	4.21	3.047*
	Inferior Thyroid Height	147.46	4.45	146.15	4.73	146.26	4.28	148.14	4.46	2.434
	Chest Height	131.40a	4.02	129.40b	4.29	129.38b	4.07	131.28ab	4.25	3.192*
	Bust Height	125.36a	4.15	123.80b	4.11	123.35b	3.70	125.56a	4.28	3.426*
	Waist Height	110.17a	4.08	107.93b	3.62	108.23b	3.71	110.78a	3.60	7.485***
	Waist(Omphalion) Height	102.79ab	3.67	101.84b	4.07	101.63b	3.42	103.94a	3.26	4.565**
	Hip Height	87.23a	3.35	85.39b	3.31	84.02c	2.80	87.11a	2.84	10.585***
	Crotch Height	81.22a	3.16	79.86b	2.93	79.22b	2.97	81.66a	2.85	7.205***
	Gluteal Fold Height	77.85a	2.70	76.46b	3.00	75.40b	2.77	78.07a	2.86	8.622***
Depth (cm)	Cervical Neck Depth	11.87a	0.77	11.50b	0.54	11.58b	0.55	11.83a	0.59	4.255**
	Anterior Neck Depth	14.82a	1.04	13.89b	0.75	14.27b	0.86	14.82a	0.92	13.609***
	Chest Depth	23.00a	2.02	20.88c	1.54	21.38b	1.21	21.90b	1.54	11.722***
	Scapula point Depth	23.73a	2.18	21.17c	1.64	22.12b	1.41	22.41b	1.59	14.552***
	Bust Depth	23.94a	2.32	20.98c	1.85	21.96b	1.54	22.18b	1.77	14.963***
	Waist Depth	23.40a	2.95	19.27c	1.70	21.10b	1.86	21.17b	1.76	27.252***
	Waist(Omphalion) Depth	22.66a	2.94	18.85c	1.48	20.58b	1.88	20.47b	1.67	25.001***
	Hip Depth	25.32a	2.29	22.96c	1.71	24.10c	1.46	23.96b	1.84	10.658***
	Gluteal Fold Depth, Armscye Depth	20.59a	2.93	17.62a	1.68	18.71ab	1.38	18.92b	1.85	14.808***
Length (cm)	Waist Front Length	33.86a	1.99	33.58a	1.76	33.25ab	1.58	32.71b	1.55	3.715*
	Waist Back Length	40.06	3.46	40.09	2.27	39.92	1.76	40.18	2.04	.118
	Waist Side Length	21.70	1.55	22.19	1.95	21.48	1.64	21.41	1.92	2.168
	Waist(Omphalion) Front Length	40.62a	2.56	39.32b	1.61	39.80ab	2.04	39.04b	1.83	4.144**
	Waist(Omphalion) Back Length	45.79ab	2.02	45.36b	2.06	46.43a	2.05	46.28ab	2.10	3.067*
	Acromion Length:Back	44.77ab	2.43	43.76b	2.09	44.71ab	2.22	45.06a	2.85	3.193*
	Shoulder Length	13.75	1.25	13.51	1.03	13.51	1.00	13.62	1.01	.360

〈Table 10〉 continued

Items		D type (11.7%) Mean	S.D.	I type (33.51%) Mean	S.D.	d type (24.47%) Mean	S.D.	q type (30.32%) Mean	S.D.	F value
L e n g t h (cm)	Interscye:Front,	37.25a	2.58	35.19b	1.69	35.96b	2.11	35.74b	1.94	5.962***
	Interscye:Back	42.50a	3.20	41.19b	2.04	42.04ab	2.24	42.65a	2.82	3.777*
	Neck point–Bust point–Waistline Length	42.31	2.15	41.78	1.97	41.58	1.76	41.19	1.73	2.138
	Neck Point –Scapula point –Waistline Length	44.13	1.76	45.28	5.99	44.32	1.79	44.74	1.92	.789
	Waist to Hip Length	23.03b	2.20	22.88b	1.81	24.58a	1.85	23.53b	1.98	7.425***
C i r c u m f e r e n c e (cm)	Inferior Thyroid Circumference	39.66a	2.44	38.23b	1.68	39.25a	1.69	39.57a	1.91	6.491***
	Chest Circumference	101.34a	7.06	93.28c	5.49	96.36b	5.00	96.92b	5.83	11.787***
	Bust Circumference	99.06a	7.28	89.28c	5.82	92.50b	5.12	93.20b	5.97	15.577***
	Waist Circumference	86.08a	8.03	75.12c	4.60	79.16b	5.45	79.78b	5.24	23.008***
	Waist(Omphalion) Circumference	88.97a	10.05	77.11c	5.25	82.03b	6.10	81.84b	5.75	20.186***
	Hip Circumference	100.53a	6.28	93.20c	4.57	97.12b	4.06	96.10b	5.45	13.547***
A n g l e (°)	Cervical Upper Angle	13.59	5.53	16.23	6.20	14.41	5.53	15.92	7.19	1.478
	Cervical lower Angle	30.04b	4.20	28.98b	5.57	30.92ab	4.61	33.03a	7.02	5.155**
	Dorsal Upper Angle	15.61c	2.71	16.00c	3.83	18.13b	2.47	21.22a	4.59	23.558***
	Dorsal lower Angle	10.72b	4.71	12.32a	2.95	9.54b	2.41	12.78a	3.73	9.723***
	Hip Upper Angle	18.00	3.39	18.40	3.62	18.35	3.46	18.42	3.70	.084
	Hip lower Angle	19.20	3.60	17.85	3.37	19.18	3.89	18.14	4.02	1.541
	Anterior Neck Upper Angle	17.86b	5.66	21.73a	4.93	19.11b	5.71	22.45a	5.68	5.949***
	Anterior Neck lower Angle	36.77a	6.78	30.50b	6.46	29.18bc	5.63	27.65c	5.59	12.448***
	Chest Upper Angle	25.65a	4.21	19.92b	4.50	19.08bc	4.13	17.49c	3.86	20.479***
	Chest lower Angle	10.87	9.52	9.78	5.99	13.08	8.50	11.32	7.05	.643
	Abdomen Upper Angle	3.06	3.04	4.94	4.23	468	452	5.85	4.70	2.268
	Abdomen lower Angle	7.09a	3.19	2.49c	4.24	3.98bc	4.57	4.73b	4.30	7.103***
Etc. (kg)	Weight	78.73a	11.97	65.63c	7.17	71.48b	7.10	72.15b	9.52	14.399***

*:p〈.05, **:p〈.01, ***:p〈.001, The alphabets indicate the groups with some significance
in the Duncan test (a〉b〉c).

Ⅳ. Conclusions

The present study with the subjects of 200 adult males in Busan in their 20s had a purpose of analyzing lateral body shapes to develop men's educational dress forms. The following are the conclusions:

1. Comparison of the Body Dimensions of Busan Male Adults in Their 20s and the 5th Survey of Korean Body Measurement

In the comparison of the Busan and national body dimensions by way of Mollison's relative deviation, all the 30 compared items were under the deviation of 0.7 Therefore, the sample of Busan male grown-ups is understood to represent the body shapes of the average Korean male adults in their 20s.

2. Results of Lateral Body Shape Classification

1) From factor analysis, seven factors were produced to explain 75.45% of all variables. Those 7 factors to compose lateral body shapes were hip prominence, back-neck sides, upper body's front-back depth, lateral upper body, hip-waist depth, front chest-waist depth, and hip and waist height.

2) Cluster analysis revealed four characteristic lateral body shapes. Type 1 with the appearance rate of 11.70%, named D, had the greatest upper chest angle and tanterior neck lower angle. The front side was more developed. Type 2 with 33.51%, named I, was generally long and slender.

Type 3 with 24.47%, named d, had the biggest depth differences in hip-chest as well as more prominent back hip. Type 4 with 30.32%, named q, had the biggest dorsal upper angle and the tiniest chest upper angle as the back area was a little bent.

In the following studies to come, front body shapes will be added in order to make representative body shapes for the continuous research into the production of educational dress forms. The final dress forms will be utilized not just for the patternmaking education for men's clothes but also for the work of fitting and testing to help improve size fitness of male consumers.

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