

Analysis of Body Dimensions and Body Types for the Development of Size Specifications*

- Focused on 4~5 Year Olds in Busan -

Boo-Ja Shim**

Professor, Division of Fashion & Textile Studies, Dong-A University**

I. Research Objectives

According to the sophisticated subdivision and development of contemporary society, the weight of ready-made clothes by the clothing industry has become even greater. While the clothes for adults are partly tailor-made, those for babies and children are all but ready-made.

In addition, owing to the small number of kids in each family, expensive imported clothes are much favored. Compared with other markets, the market of children's clothes is very active because of the sharp competition in design, color, material and so forth.

Until the early 1990s, the domestic market was largely divided into the clothes for infants (age 0 to 5) and children (age 5 to 15). Age subdivision began to take place from 1993. Since 1996, therefore, product research and development have been pursued to make most of specialization and differentiation in the three fields of toddlers, infants, and children. At present, toddlers' clothes (height: 90~120cm) are most popular at home.¹⁾²⁾

Much improvement is seen in design, material and color owing to the reflection of customer demands. But, as far as size fitness goes, there is no systematic classification based on body types. That's why those not belonging to the standard somatotypes have difficulty finding suitable clothes for them.

The researcher recently held a questionnaire with mothers purchasing clothes for their 4~5 year old children. Their responses were about the confusion of various size systems, partial unfitness of clothes, and the uncomfortableness of slow repair. In other words, the problems with babies' and children's clothes are the purchase inconvenience related to size specifications.

Therefore, this research is an approach to minimizing such problems by securing

* This paper was supported by the Dong-A University Research Fund, in 2001.

highly fitting size standards in the Busan area. The following are objectives:

1. The physical measurement results of the 4 or 5 year olds residing in Busan are compared and analyzed by sex and age.
2. The body type characteristics of Busan's toddler are known by the comparison with national averages.
3. Main factors are revealed through the principle component factor analysis to get the information about body dimensions.
4. Problems are examined regarding the current size descriptions and standards for 4~5 year olds.
5. The basic divisions, "height-chest girth" for upper clothes and "height-waist girth" for lower clothes, are suggested as the fundamental data for new size specifications.

II. Research Methods

1. Subjects & Measurement Period

The subjects were 200 toddlers (age 4 to 5) of both sexes living in Busan. The measurement was held in 10 nurseries and kindergartens from May 1 to June 10, 2001. <Table 1> shows the age distribution of the subjects.

<Table 1> Age and sex distribution of the subjects.

Age \ Sex	Male(N)	Female(N)	Total(N)
4 Years	50	50	100
5 Years	50	50	100
Total	100	100	200

2. Measurement Instruments & Methods

Martin's measurement instruments were applied here. Five graduate students majoring in clothing science took part; two measuring the toddler subjects, two assisting them, and one taking records. The subjects were standing with their hands lowered, feet at 30° and heads to the front. The measurement items were 41, as shown in <Table 2>: 12 (height), 4 (breadth), 3 (depth), 7 (length), 11 (girth), and 4 (others).

<Table 2> Measurement items

Division	Measurement items
Height	1. Height 2. Cervical Height 3. Anterior Neck Height 4. Shoulder Height 5. Bust Point Height 6. Waist Height 7. Omphalion Height 8. Hip Height 9. Knee Height 10. Elbow Height 11. Wrist Height 12. Fingertip Height
Breadth	13. Shoulder Breadth 14. Bust Breadth 15. Waist Breadth 16. Hip Breadth
Depth	17. Bust Depth 18. Waist Depth 19. Hip Depth
Length	20. Shoulder Width 21. Front Width 22. Back Width 23. Waist Front Length 24. Back Length 25. Elbow Length 26. Sleeve Length
Girth	27. Neck Base Girth 28. Bust Girth 29. Waist Girth 30. Hip Girth 31. Thigh Girth 32. Knee Girth 33. Ankle Girth 34. Armscye Girth 35. Upperarm Girth 36. Wrist Girth 37. Hand Girth
Etc.	38. Weight 39. Shoulder Angle(R) 40. Shoulder Angle(L), 41. Upperarm Skinfold Thickness

3. Size Analysis

20 brands each in department stores and discount stores were investigated to find sizing methods and size dimensions. Based on preliminary examination, the most purchased items of T-shirts and cotton pants were selected.

4. Data Analysis

The data were statistically processed by SPSS/Win (ver 9.0) as follows:

- 1) The means and S.D. for each measurement were sought, while t-test was held to know significance by sex and age.
- 2) Mollison's relative deviation method was used to compare Busan's and national averages.
- 3) Main factors were revealed through factor analysis to get the condensed information about the body dimensions of Busan's toddlers.
- 4) Sizing methods with high frequency of the clothing industry were compared.
- 5) The basic size divisions, "height-bust girth" for upper clothes and "height-waist girth" for lower clothes, were compared.

III. Results & Discussion

1. Comparison of Measurements by Sex and Age

A. Height Items

<Table 3> sums up the results of means, S.D. and T-tests in height items. According

to this table, significance by age was seen. That is, the growth of age was accompanied by that of physical characteristics. However, no significance by sex was noticed.

In particular, knee height had the lowest growth rate. This is agreeable to the findings of Choe, Young Hee (1980)³⁾. So, upper-body growth seems to be dominant at the ages of 4 and 5. In addition, for 5 year olds, big values were seen in height and shoulder height to reveal great individual differences.

<Table 3> t-test results of height items

(Unit: cm)

Item	Sex	4 Years		5 Years		t-test by Age	t-test by Sex	
		Mean	S.D.	Mean	S.D.		4 Years	5 Years
Height	M	102.03	4.31	110.91	5.59	-8.75 ***	1.91	0.96
	F	100.49	3.65	109.86	5.23	-10.33 ***		
Cervical Height	M	81.46	3.86	89.50	4.98	-8.88 ***	0.74	0.82
	F	80.89	3.65	88.71	4.61	-9.34 ***		
Anterior Neck Height	M	79.01	3.81	87.24	4.75	-9.40 ***	1.61	0.61
	F	77.89	3.07	86.67	4.48	-11.37 ***		
Shoulder Height	M	76.34	4.09	83.76	7.55	-6.00 ***	1.17	-0.69
	F	75.51	2.86	84.65	5.02	-11.11 ***		
Bust Point Height	M	70.78	3.70	77.88	4.45	-8.53 ***	1.57	1.31
	F	69.66	3.33	76.76	4.01	-9.58 ***		
Waist Height	M	58.35	3.22	65.24	4.51	-8.63 ***	-0.28	0.23
	F	58.38	2.84	65.04	3.87	-9.75 ***		
Omphalion Height	M	55.22	3.35	61.13	4.59	-7.22 ***	0.70	-1.34
	F	54.72	3.68	62.24	3.68	-10.16 ***		
Hip Height	M	46.47	3.62	52.11	4.27	-7.01 ***	0.75	-0.96
	F	45.91	3.87	52.83	3.15	-9.78 ***		
Knee Height	M	24.89	1.60	28.22	2.35	-8.16 ***	0.50	1.06
	F	24.72	1.81	27.74	2.18	-7.51 ***		
Elbow Height	M	58.38	3.19	64.56	3.94	-8.48 ***	0.85	0.44
	F	57.89	2.48	64.22	3.69	-10.00 ***		
Wrist Height	M	45.26	2.55	50.20	3.20	-8.40 ***	0.31	-0.49
	F	45.11	2.35	50.52	3.10	-9.76 ***		
Fingertip Height	M	34.43	2.47	38.19	2.56	-7.36 ***	1.05	-0.81
	F	33.94	2.12	38.23	2.62	-8.95 ***		

(*** : $p \leq .001$)

B. Length & Girth Items

<Table 4> indicates the results of means, S.D. and t-tests in length and girth items. According to this table, girls revealed significant changes in all items. As age increased, they had distinct growth. On the contrary, boys showed significant difference in all the items except front width, waist girth and ankle girth.

Clear growth was comparatively seen in sleeve length, elbow length, bust girth, hip girth and thigh girth. Measurements by sex were different in the items of waist front

length, back length and sleeve length. In general, boys had bigger values than girls.

<Table 4> t-test results of length and girth items

(Unit: cm)

Items	Sex	4 Years		5 Years		t-test by Age	t-test by Sex	
		Mean	S.D.	Mean	S.D.		4 Years	5 Years
Shoulder Width	M	26.81	1.78	28.62	1.94	-4.77 ***	0.22	0.08
	F	26.75	1.05	28.59	1.47	-7.16 ***		
Front Width	M	22.06	1.49	22.33	1.53	-0.88	2.48	-0.4
	F	21.22	1.82	22.34	1.29	-3.54 **		
Back Width	M	23.68	1.76	24.80	1.75	-3.16 *	1.40	0.65
	F	23.14	2.02	24.58	1.63	-3.91 ***		
Waist Front Length	M	21.67	1.78	22.98	1.77	-3.64 ***	4.3 ***	2.68 **
	F	20.22	1.52	22.18	1.14	-7.27 ***		
Back Length	M	23.97	1.58	24.87	1.50	-2.89 *	3.89 ***	2.54 *
	F	22.79	1.39	24.06	1.67	-4.10 ***		
Elbow Length	M	19.48	1.35	21.89	1.72	-7.67 ***	1.18	1.62
	F	19.20	0.96	21.38	1.36	-9.20 ***		
Sleeve Length	M	33.47	1.83	37.34	2.32	-9.01 **	3.22 **	3.63 **
	F	32.32	1.78	35.73	2.11	-8.70 **		
Neck Base Girth	M	28.73	1.39	29.82	1.30	-4.00 ***	1.28	-0.27
	F	28.31	1.79	29.92	2.26	-3.92 ***		
Bust Girth	M	54.77	2.61	57.79	2.49	-5.83 ***	1.55	-0.75
	F	54.04	1.97	58.18	2.74	-8.63 ***		
Waist Girth	M	51.08	3.07	52.21	2.45	-2.02	3.80 ***	0.50
	F	49.05	2.11	51.93	3.13	-5.36 ***		
Hip Girth	M	55.39	3.01	58.90	3.53	-5.26 ***	0.36	-0.45
	F	55.18	2.69	59.19	2.90	-7.12 ***		
Thigh Girth	M	30.68	1.89	32.68	2.73	-4.20 ***	-1.59	-2.94 *
	F	31.43	2.68	34.22	2.47	-5.40 ***		
Knee Girth	M	23.12	1.23	24.74	1.72	-5.32 ***	0.91	-0.71
	F	22.88	1.32	24.97	1.59	-7.12 ***		
Ankle Girth	M	15.10	0.74	15.58	1.13	-2.48	1.70	-1.50
	F	14.85	0.72	15.90	0.98	-6.06 ***		
Armscye Girth	M	23.95	1.28	25.78	1.75	-5.86 ***	0.60	0.66
	F	23.75	1.86	25.51	2.21	-4.29 ***		
Upperarm Girth	M	16.37	1.15	17.38	1.39	-3.90 ***	0.31	-0.86
	F	16.29	1.28	17.65	1.70	-4.47 ***		
Wrist Girth	M	11.50	0.87	11.89	0.84	-2.26	2.98 **	0.16
	F	11.03	0.66	11.86	0.90	-5.24 ***		
Hand Girth	M	15.70	0.87	16.40	1.01	-3.35 **	2.99 **	-0.87
	F	15.22	0.72	16.57	1.26	-6.45 **		

(* : $p \leq .05$, ** : $p \leq .01$ *** : $p \leq .001$)

C. Breadth, Depth and Other Items

<Table 5> depicts the results of means, S.D. and t-tests in breadth, depth and other items. According to this table, girls held evident growth in shoulder breadth and

hip breadth. In opposition, boys retained significant differences in shoulder breadth, bust breadth, hip breadth and hip depth. Noticeably, the subjects were inclined in the right shoulder angle. So, right posture is demanded right before schooling.

In sum, the 4~5 year olds in Busan showed clear growth differences by age rather than by sex. As sexual differences, boys were bigger in waist front length, back length and sleeve length.

<Table 5> T-test results of breadth and depth items

(Unit: cm)

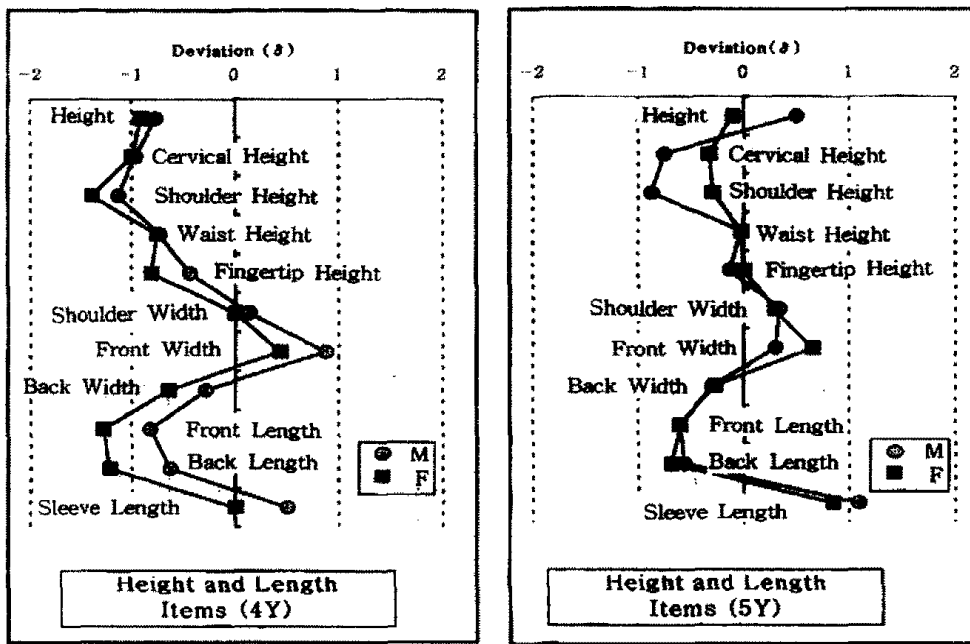
Items	Sex	4 Years		5 Years		T-test by Age	T-test by Sex	
		Mean	S.D.	Mean	S.D.		4 Years	5 Years
Shoulder Breadth	M	21.85	1.43	23.24	1.60	-4.51 ***	-0.30	0.26
	F	21.93	1.11	23.16	1.62	-4.38 ***		
Bust Breadth	M	17.20	1.15	18.14	1.35	-3.71 ***	-0.71	1.25
	F	17.35	0.97	17.83	1.11	-2.31		
Waist Breadth	M	16.24	1.18	16.76	1.35	-2.01	0.30	-0.05
	F	16.18	0.81	16.77	1.31	-2.70		
Hip Breadth	M	18.00	0.97	19.79	1.60	-6.61 ***	0.33	1.65
	F	17.93	1.09	19.29	1.41	-5.32 ***		
Bust Depth	M	11.85	0.92	12.17	1.03	-1.60	-0.31	0.02
	F	11.91	1.07	12.16	0.92	-1.25		
Waist Depth	M	11.94	0.95	12.17	1.23	-1.02	0.31	0.42
	F	11.88	0.96	12.07	1.05	-0.94		
Hip Depth	M	11.20	1.28	12.29	1.52	-3.80 ***	-3.73 ***	-1.56
	F	12.15	1.21	12.77	1.57	-2.23		
Weight	M	16.45	2.10	19.29	2.66	-5.83 ***	2.48	0.59
	F	15.55	1.41	18.95	2.94	-7.32 ***		
Shoulder Angle(R)	M	21.71	4.52	21.19	3.30	0.64	-0.27	0.51
	F	21.92	2.91	20.86	3.32	1.69		
Shoulder Angle(L)	M	21.19	3.64	19.43	4.07	2.25	1.43	1.39
	F	20.12	3.72	18.40	3.30	2.44		
Upperarm Skinfold Thickness	M	11.76	1.65	12.92	2.15	-3.00 *	-1.57	-0.31
	F	12.28	1.66	13.06	2.30	-1.93		

(* : $p \leq .05$, *** : $p \leq .001$)

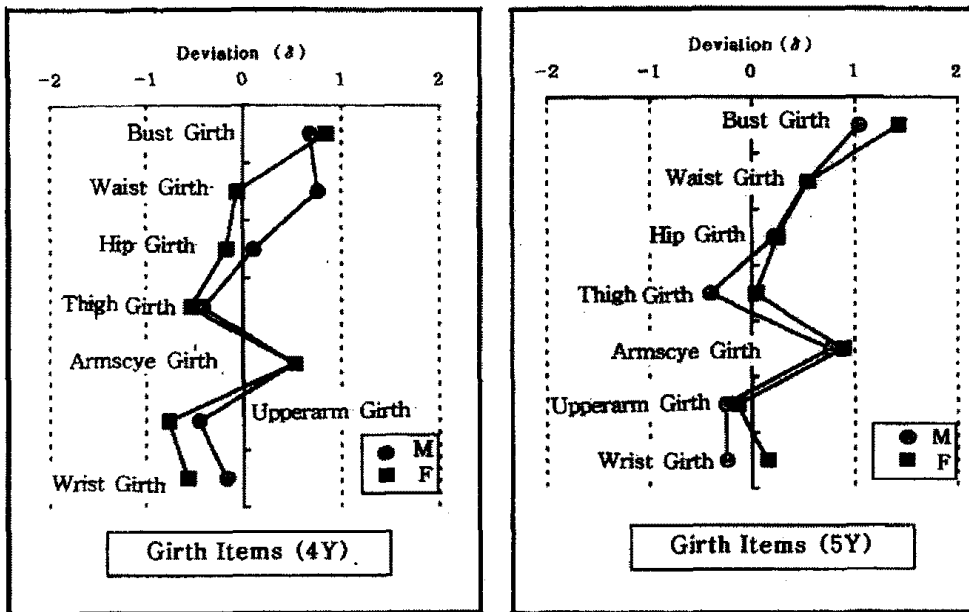
2. Comparison with National Means

According to Mollison's relative deviation method

All 25 items were compared with national average suggested in the Korean Physical Standard Report (1997). The results are expressed in <Fig. 1>, <Fig. 2> and <Fig. 3>.

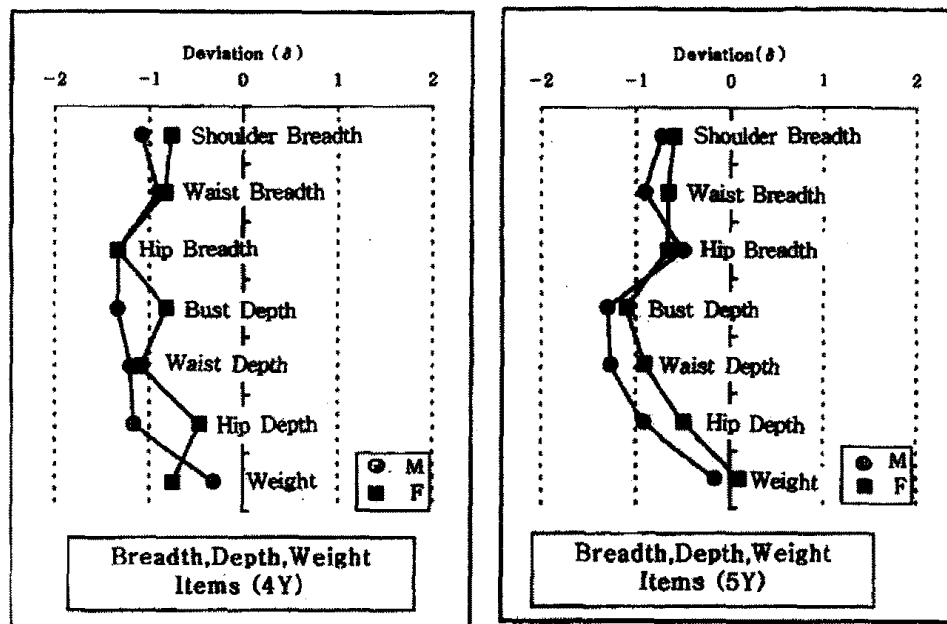


<Fig. 1> Comparison of height and length items
(Base line : National average)



<Fig. 2> Comparison of girth items
(Base line : National average)

According to <Fig. 1>, Busan's 4 year olds were bigger in front width with the error range within 1δ . They were smaller ($\geq 1\delta$) in shoulder height, front length and back length. For 5 year olds, Busan's toddlers outnumbered national averages in shoulder width, front width and sleeve length.



<Fig. 3> Comparison of breadth and depth items
(Base line : National average)

As <Fig. 2> shows, for 4 year olds, bigger values were seen in chest girth and armscye girth, and smaller values in thigh girth, upper-arm girth and wrist girth, all within 1δ . Busan's 5 year olds had greater values in all items but upper-arm length, and the item with the difference more than 1δ was bust girth.

As seen in <Fig. 3>, Busan's toddlers had smaller values in breadth and depth items. The difference more than 1δ for 4 year olds was noticed in hip breadth (male/female), waist depth (male/female), bust depth (male) and hip depth (male). For 5 year old boys, the difference above 1δ appeared in bust depth, waist depth and hip depth.

In short, 4 year olds in Busan had smaller values in shoulder height (M/F), hip breadth (M/F), bust depth (M), waist depth (M), hip depth (M), front length (F) and back length (F). For 5 year olds, sleeve length (M) and bust girth (M/F) were greater, while bust depth (M) and waist depth (M) were smaller. Therefore, 4 or 5-year-old boys in Busan turned out to have slim depth and long sleeves. In particular, 4-year-old girls had shorter upper body, and 5-year-old girls showed bigger bust girth.

3. Body Type Factors for Busan's 4~5 Year Olds

As clear growth differences not by sex but by age were seen, factor analysis was made for each of the 41 measurement items. <Table 6> and <Table 7> carry the results.

Seven factors were drawn for the 4 year olds in Busan, contributing by 72.82%. They were 1) body growth, 2) obesity, 3) length and girth, 4) breadth, 5) depth, 6) shoulder and chest and 7) shoulder angle factors.

<Table 6> Factors composing body types (4 years)

Items	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7
Anterior Neck Height	0.91	0.08	0.19	0.07	0.11	0.16	0.03
Height	0.89	0.17	0.21	0.19	0.02	0.17	-0.01
Cervical Height	0.89	0.17	0.15	0.22	0.09	0.11	-0.07
Shoulder Height	0.87	0.01	0.17	0.07	0.21	0.15	0.02
Elbow Height	0.82	0.11	0.29	0.07	0.20	0.16	-0.14
Wrist Height	0.81	0.20	0.12	0.29	0.01	0.01	-0.15
Omphalion Heigh	0.75	-0.09	0.20	-0.19	0.36	0.16	0.08
Bust Point Height	0.75	0.32	0.16	0.21	-0.03	-0.04	0.04
Fingertip Height	0.74	0.18	0.17	0.24	-0.02	-0.07	-0.16
Waist Height	0.72	0.11	0.07	0.36	0.18	0.11	-0.76
Hip Height	0.68	-0.25	0.13	-0.17	0.38	0.20	0.01
Knee Height	0.68	0.44	-0.04	-0.02	-0.04	0.14	0.17
Sleeve Length	0.65	0.13	0.25	0.16	-0.03	0.48	0.15
Hip Breadth	0.54	0.40	0.25	0.32	-0.05	0.09	0.06
Elbow Length	0.51	0.26	0.12	0.19	-0.07	0.39	0.13
Weight	0.5	0.39	0.42	0.38	0.21	0.39	-0.03
Upperarm Skinfold Thickness	0.14	0.80	0.09	0.02	0.20	0.10	0.06
Upperarm Girth	0.11	0.65	0.32	0.10	0.25	0.24	0.08
Armscye Girth	0.30	0.58	0.12	-0.03	0.09	0.32	-0.16
Hip Girth	0.50	0.52	0.19	0.28	0.18	0.38	-0.16
Wrist Girth	0.13	0.49	0.47	-0.01	0.11	0.15	0.16
Waist Front Length	0.34	0.15	0.74	0.08	-0.14	-0.01	-0.09
Back Length	0.33	-0.07	0.72	0.09	-0.12	0.19	-0.05
Waist Girth	0.08	0.18	0.58	0.37	0.21	0.46	0.09
Ankle Girth	0.31	0.23	0.54	0.26	0.39	0.03	0.11
Hand Girth	0.40	0.33	0.53	0.18	0.21	0.07	0.25
Knee Girth	0.32	0.23	0.46	0.20	0.44	-0.14	0.14
Bust Breadth	0.18	-0.20	0.09	0.73	0.09	0.19	0.06
Shoulder Breadth	0.34	0.04	0.08	0.66	0.27	0.16	0.02
Waist Breadth	0.11	0.26	0.11	0.58	0.03	0.28	0.36
Thigh Girth	0.19	0.32	0.09	0.53	0.36	-0.07	-0.21
Front Width	0.24	0.07	0.19	0.38	0.25	0.02	0.38
Bust Depth	0.22	0.10	-0.05	0.09	0.66	0.09	0.02
Waist Depth	0.01	-0.08	0.09	0.38	0.62	0.29	-0.07
Hip Depth	-0.02	0.35	-0.04	0.21	0.61	0.08	-0.22
Neck Base Girth	0.08	0.32	0.35	0.05	0.46	0.43	0.14
Back Width	0.15	0.15	0.13	0.14	0.17	0.63	-0.10
Shoulder Width	0.32	0.31	-0.07	0.20	0.15	0.63	0.08
ust Girth	0.38	0.26	0.25	0.38	0.22	0.45	-0.09
Shoulder Angle(R)	0.01	0.11	-0.01	0.13	0.05	-0.17	0.84
Shoulder Angle(L)	-0.17	-0.08	0.04	-0.07	-0.05	0.13	0.82
Factor	body growth	obesity	length and girth	breadth	depth	shoulder and chest	shoulder angle
Eigen Values	17.73	4.44	2.45	2.05	1.67	1.58	1.37
% of Variance	41.2	10.34	5.71	4.77	3.88	3.67	3.2
Cumulative (%)	41.2	51.5	57.2	62	65.94	69.62	72.82

<Table 7> Factors composing body types (5 years)

Items	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7
Anterior Neck Height	0.91	0.21	0.16	0.14	0.06	0.15	0.06
Height	0.89	0.24	0.20	0.12	0.11	0.13	0.15
Cervical Height	0.89	0.25	0.17	0.14	0.07	0.15	0.14
Waist Height	0.87	0.15	0.19	-0.07	0.00	0.13	0.09
Knee Height	0.85	0.17	-0.01	0.07	0.18	0.00	0.23
Wrist Height	0.85	0.32	0.22	0.05	0.03	0.04	0.05
Hip Height	0.83	0.16	-0.07	0.14	-0.03	0.23	0.03
Elbow Height	0.80	0.30	0.09	0.20	-0.10	-0.03	0.10
Fingertip Height	0.79	0.29	0.29	-0.05	0.01	0.11	0.06
Bust Point Height	0.79	0.24	0.07	0.09	0.12	0.31	0.12
Omphalion Height	0.78	0.30	0.18	0.09	0.01	-0.18	-0.03
Sleeve Length	0.78	0.04	0.17	0.17	-0.03	0.07	0.29
Elbow Length	0.73	0.21	0.08	0.33	-0.05	0.02	0.07
Shoulder Height	0.62	0.26	0.29	0.12	-0.04	-0.37	-0.03
Weight	0.60	0.59	0.37	0.17	0.13	0.17	0.08
Hip Breadth	0.59	0.32	0.51	0.20	0.20	0.02	0.28
Armscye Girth	0.52	0.31	0.49	0.18	0.15	0.21	0.00
Shoulder Breadth	0.50	0.21	0.28	0.27	0.17	0.32	0.40
Waist Girth	0.21	0.83	0.03	0.13	-0.15	0.04	0.22
Neck Base Girth	0.37	0.71	0.22	0.12	0.30	-0.03	0.09
Hip Depth	0.22	0.71	0.18	-0.01	0.26	-0.03	0.11
Bust Girth	0.31	0.70	0.02	0.23	-0.29	0.22	0.12
Waist Breadth	0.33	0.67	0.16	0.07	0.16	-0.09	0.35
Upperarm Skinfold Thickness	0.15	0.65	0.29	-0.37	-0.06	0.12	0.04
Ankle Girth	0.48	0.64	0.15	0.18	-0.15	0.20	0.05
Upperarm Girth	0.30	0.60	0.57	0.03	0.24	0.18	0.08
Thigh Girth	0.45	0.59	0.33	0.15	-0.04	0.16	-0.07
Wrist Girth	0.42	0.58	0.36	0.24	0.22	0.14	0.09
Knee Girth	0.52	0.56	0.26	0.27	-0.01	0.26	-0.07
Hip Girth	0.50	0.56	0.31	0.09	-0.22	0.21	0.04
Hand Girth	0.43	0.53	0.19	0.40	0.21	0.09	-0.08
Bust Depth	0.19	0.24	0.76	0.07	-0.07	0.00	0.13
Waist Depth	0.02	0.51	0.61	-0.13	0.09	-0.08	0.07
Back Length	0.25	0.09	0.03	0.78	0.10	0.00	0.10
Waist Front Length	0.32	0.16	0.42	0.42	0.24	0.03	-0.05
Shoulder Angle(R)	0.11	0.04	-0.02	-0.02	0.89	-0.02	-0.16
Shoulder Angle(L)	-0.04	-0.02	0.06	0.03	0.77	-0.04	0.27
Front Width	0.25	0.20	0.06	0.01	-0.10	0.81	0.06
Back Width	0.36	0.43	0.07	-0.03	-0.09	-0.02	0.53
Bust Breadth	0.39	0.24	0.39	0.17	0.02	0.19	0.47
Shoulder Width	0.38	0.27	0.15	0.42	0.13	0.32	0.45
Factor	body growth	obesity	depth	upper-body length	shoulder angle	front width	shoulder and chest
Eigen Values	22.68	4.12	2.41	1.55	1.18	1.11	1.02
% of Variance	52.76	9.58	5.61	3.62	2.74	2.58	2.37
Cumulative (%)	52.76	62.34	67.95	71.58	74.32	76.91	79.29

Also, seven factors were derived for the 5 year olds in Busan, accumulatively contributing by 79.29%. They were 1) body growth, 2) obesity, 3) depth, 4) upper-body length, 5) shoulder angle, 6) front width and 7) shoulder and chest factors.

As a result of the factor analysis, the first factor was growth factors of height, sleeve length, weight and hip breadth. The second factor was fatness factors including skinfold thickness, hip girth and upper arm girth. So, the items having much to do with infantile clothes were found to be height, sleeve length and hip girth.

4. Size Descriptions & Standards of the Clothing Industry

A. Size Descriptions

According to KS K 0050 and KS K 0051 concerning children's clothes, chest girth and waist girth corresponding to height can be diversely described as S, M and L. But the children's clothes in the domestic market tended to use one dimension of bust girth and waist girth corresponding to height. Also, each clothing company used different type of clothing designation. The examined results are seen in <Table 8>.

<Table 8> Type of clothing designation

Item	Type of clothing designation	Size code	Frequency (%)
upper clothes	Year	5	8(20)
	Height	110	5(12.5)
	Height(Year)	110(5)	1(2.5)
	Bust	55	3(7.5)
	Bust-Height	55-110	8(20)
	Bust(Height)	55(110)	3(7.5)
	Bust(Year)	55(5)	2(5)
	Bust-Height(Year)	55-110(5)	10(25)
Total			40(100)
lower clothes	Year	5	3(7.5)
	Height	110	2(5)
	Waist	52	1(2.5)
	Height-Waist	110-52	16(40)
	Waist-Height(Year)	52-110(5)	18(45)
	Total		

As this table shows, the clothing firms used "Bust-Height (Year)" (25%) and "Bust-Height" and "Year"(20%) for upper clothes, and "Waist-Height (Age)" (45%) and "Height-Waist" (40%) for lower clothes. In addition, various descriptions existed for upper clothes.

In fact, most companies described ages, too, while most mothers were likely to be ignorant of the body sizes of their children. In a research with the clothing

companies, Lee, Ji Yeoun⁴⁾ reported that ages need to be written in the clothes for toddlers age 3 to 6. Therefore, even though there is no recommendation in the KS, age description might help customers with the choice of clothing products.

B. Comparison of Basic Body Dimensions

In the KS, children's clothes belong to infants' clothes (age up to 4; KS K 0052-1999), men's clothes (KS K 0050-1999) and women's clothes (KS K 0051-1999). They also include ages 4~10 and height 105~140cm for boys' clothes, and ages 4~9 and height 105~135cm for girls' clothes. So, for the toddlers age 4, their clothes can be both infants' clothes and children's clothes.

In fact, however, most firms produce children's clothes aiming at age 5 or above. The mother of a 4 year old also has a tendency not to buy the kid's clothes at the corner of infantile clothes. So, the division of infants' clothes and children's clothes designated by the KS does not correspond to the practice in reality.

Body dimensions matching children's clothes are height and bust girth (upper clothes) as well as height and waist girth (lower clothes). The basic body dimensions of children's clothes in the market are shown in <Table 9> and <Table 10>.

<Table 9> Distribution of Height-Bust size (upper clothes)

Bust(cm) Height(cm)	Target Year	54	55	57	58	59	60	62	65	66	Total (%)
110	5 Years	2(5.6)	30(83)	1(2.8)	1(2.8)		2(5.6)				36(100)
120	7 Years				14(38.9)	2(5.6)	17(47.2)	1(2.7)	1(2.7)	1(2.7)	36(100)

* 4 firms were not described height and Bust

<Table 10> Distribution of Height-Waist size (lower clothes)

Waist(cm) Height(cm)	Target Year	50	52	53	54	55	56	57	58	Total (%)
110	5 Years	1(2.6)	2(5.3)	3(7.9)	29(76.3)	3(7.9)				38(100)
120	7 Years		1(2.6)		1(2.6)	2(5.3)	27(71.1)	3(7.9)	4(10.5)	38(100)

* 2 firms were not described height and waist

Frequent upper-clothes dimensions (height-bust) for 5 and 7 year olds in the clothing industry were 110-55 (83%) and 120-60 (47.2%) respectively. Lower-clothes counterparts (height-waist) for 5 and 7 year olds were each 110-54 (76.3%) and 120-56 (71.1%). Compared with actual production sizes, there were no firms producing the dimensions of 4 year olds, 105-54-51 (height-waist girth-bust).

5. Distribution of Upper & Lower clothes Dimensions

In order to choose size specifications with high coverage, <Table 11> and <Table 12> were made to reveal the distribution of upper and lower clothes dimensions based on the standards of KS K 0051 and K 0050 (1999).

<Table 11> Distribution of Height-Bust size

Height(cm) \ Bust(cm)		Bust(cm)									Total (%)	
		48	50	52	54	56	58	60	62	64		66
4 Y	90	1(1.0)	1(1.0)	1(1.0)								3(3.1)
	95	1(1.0)	1(1.0)	17(17.5)	14(14.4)	4(4.1)						37(38.1)
	100		5(5.2)	5(5.2)	16(16.5)	10(10.3)	3(3.1)					39(40.2)
	105				6(6.2)	7(7.2)	4(4.1)					17(17.5)
	110						1(1.0)					1(1.0)
	Total(%)	2(2.1)	7(7.2)	23(23.7)	36(37.1)	21(21.6)	8(8.2)					97(100)
5 Y	100			2(2.0)	3(3.0)	5(5.1)	2(2.0)					12(12.1)
	105			2(2.0)	10(10.1)	13(14.1)	10(10.1)	7(7.1)	3(3.0)			46(46.5)
	110				2(2.0)	6(6.1)	10(10.1)	2(2.0)				20(20.2)
	115					6(6.1)	4(4.0)	4(4.0)	2(2.0)	1(1.0)	1(1.0)	14(14.1)
	120					3(3.0)	4(4.0)	4(4.0)				7(7.1)
	Total(%)			4(4.0)	15(15.2)	25(25.3)	31(31.3)	17(17.2)	5(5.1)	1(1.0)	1(1.0)	99(100)

<Table 12> Distribution of Height-Waist size

Height(cm) \ Waist(cm)		Waist(cm)								Total (%)
		44	46	48	50	52	54	56	58	
4Y (N=100)	90		2	2						4
	95	1	6	13	13	4				37
	100	1	10	10	4	10	2	2		39
	105		2	2	3	5	3	3		18
	110					2				2
	Total(%)	2	20	27	20	21	5	5		100
5Y (N=100)	100	1		3	2	6				12
	105	2	2	5	18	9	8	1	1	46
	110		1	2	6	5	4	2		20
	115					8	3	2	1	14
	120					2	4	2		8
	Total(%)	3	3	10	26	30	19	7	2	100

In consideration of the clothing firms' productivity and sales economy, those units with the frequency of above 5% for 4 and 5 year olds were chosen: 8 each (height-bust), and 7 each (height-waist).

The "height-bust" unit with the highest frequency for 4 year olds in the Busan area was 100-54, and the "height-waist" units were 95-48 and 95-50. For 5 year olds, the upper-clothes unit was 105-56 and the lower-clothes unit was 105-50.

IV. Conclusions

This study held 1-D measurements of 200 toddlers residing in Busan in order to provide some basic data for size specifications of toddlers age 4 and 5. The following conclusions were made:

1. The 4~5 year olds in Busan showed distinct growth differences by age rather than by sex. As sexual differences, boys were bigger than girls in waist front length, back length and sleeve length.

2. Compared with national averages, boys (age 4~5) in Busan turned out to have slim depth and long sleeves. Also, 4-year-old girls had shorter upper body, and 5-year-old girls showed bigger bust girth.

3. As the physical characteristics of Busan's toddlers, seven factors were drawn for the 4 year olds in Busan: 1) body growth, 2) obesity, 3) length and girth, 4) breadth, 5) depth, 6) shoulder and chest, and 7) shoulder angle.

For 5 year olds in Busan, seven factors were derived: 1) body growth, 2) fatness, 3) depth, 4) upper-body length, 5) shoulder angle, 6) front width, and 7) shoulder and chest.

4. The clothing firms, producing clothes for toddlers age 4~5, mostly used "chest-height (year)" (25%) and "bust-height", "year" (20%) for upper clothes, and "waist-height (year)" (45%) and "height-waist" (40%) for lower clothes.

5. The "height-bust" unit with the highest frequency for 4 year olds in the Busan region was 100-54, and the "height-waist" units were 95-48 and 95-50. For 5 year olds, the upper-clothes dimension unit was 105-56 and the lower-clothes unit was 105-50.

In sum, for the toddlers age 4, their clothes are at the borderline of infants' clothes and children's clothes. In fact, most firms produce children's clothes aiming at age 5 or above. Also, the mother of a 4 year old has a tendency not to buy the kid's clothes at the corner of infantile clothes. Therefore, the age division of infants' clothes [0 to 4 according to the KS] may well be changed.

Reference

- 1) Fashionbiz (2002). *Textile Journal*, 5, co, p.246.
- 2) Park, Chan mee (1997). *Classification of the Somatotype and Development of the Dress Forms for Pre-School Children's Clothing Construction*, Han Yang University doctor's thesis.
- 3) Choe Young Hee, Lee Sun Weon (1980). A Study on Sizing Systems for infant's Clothing, *Journal of the Korean Home Economics Association*, 18(4).
- 4) Lee Ji Yeoun(1999). *A Study on Sizing Systems for Children's Clothing*, Yonsei University, master's thesis.
- 5) Choe Change Ae, Park Jung Soon (1992), An Analysis on Anthropometry of Infant for Clothing Construction, *Journal of the Korean Home Economics Association*, 30(4).
- 6) Jeon Eun Kyung (1992). *Analysis of Body Type and Development of Dress Form for children's Clothing Construction*, Yonsei University doctor's thesis.
- 7) Park Chan Mee, Suh Mi A (1998). Development of the Dress Forms for Pre-School Children's Clothing Construction, *Journal of the Korean Society of Clothing and Textiles*, 6(3).
- 8) Korean Standards Association (1999). *Sizing systems for infant's garments* (KS K 0052).
- 9) Korean Standards Association (1999). *Sizing systems for men's and boy's garments* (KS K 0050).
- 10) Korean Standards Association (1999). *Sizing systems for Women's and girl's garments* (KS K 0051).

