

An Investigation on Fitting Dummies for the Making of Women's Clothing in their 50s~60s

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Abstract: This study investigated the usage and product conditions of clothing companies and online dummy companies for the development of fitting dummy for South Korean women's wear in their 50s and 60s. These women-targeted apparel companies mainly used nude-sized torso type and torso crotch type made of FRP material. The frequency of use of the dummies was high, while the user satisfaction was moderate. Users expressed dissatisfaction with the inaccurate reflection of the body shape according to the KS sizing system and the measurements such as the front and back intercybe, upper arms, abdomen, crotch, and waist back length. Upon survey, 73.7% of the respondents answered that development of the dummy and the appropriate age for it is 50 to 54, and they preferred the torso crotch form. In the production of online dummy companies, the torso crotch type and torso type were most widely produced, and polyurethane, FRP, and recycled paper materials were used. The size of dummy was expressed in numerical type, and 6, 7, 8, 9, 10, 12, 14, 16, 18 and 44, 55, 66, 77, 88 were being produced. Even models of the same size had significant deviation, especially in the waist circumference. Also, there was no dummy reflecting 25%~75% center interval to the KS garment sizing standards of women in their 50s and 60s. Therefore, it is desperately necessary to develop a fitting dummy for KS clothing sizing system that reflect their body sizes and shapes.

Key words: Korean women in their 50s and 60s, fitting dummy, garments sizing system, body size, women's apparel

1. Introduction

As life expectancy has increased due to the development of medical science and technology and economic growth, Korea has entered an aged society.

According to the National Statistical Office, Elderly population in Korea is expected to increase to 46.4% in 2067(Statistics Korea, 2022), the aging process is accelerating as approximately 17 million baby boomers born between the late 1950s and early 1970s enter in their 50s and 60s. They are the generation which has led national economic development and social change in Korea, and penetrated the era of mass consumption. We call them the New Senior Generation(Kang, 2018). They pursue not only physical health but also youth looking. They pay attention to social trends, and actively invest and consume for themselves(Kim, 2017), so the elderly consumer market and various industries pay attention on them. In particular, women in their 50s~60s are more interested in clothing due to various social activities and role performance. They

also have a high desire for fashionable clothes that are suitable for their body type and not outdated(Chung, 2011). They are the late middle-age fashion market leader, and we should develop high-quality clothing to meet their demand. To develop apparel for them, it is necessary to examine the characteristics of their body types. The general characteristic of the body type of elderly people is an increasing intra-abdominal fat and a decreasing subcutaneous fat, a significant loss of muscle mass. It is the phenomenon of muscular obesity(World Health Organization, 2011). Muscle and bone density are less and body cell volume is reduced compared to young adults(Baumgartner, 2000). The late middle-age women in their 50s~60s are shorter than early middle-aged woman in their 40s, and their upper body shape is a wider and thicker. They have different body characteristics from the early middle-aged or elderly, and the change of their body shape is bigger than that of other age groups(Uh & Kim, 2019). Thus, in designing apparel for them, it is necessary to adapt and apply their body characteristics and activities but also consider and review the body dummies which is the base of production, confirm and evaluation.

Apparel manufacturers and fashion designers use fitting models or dummies to test the wearability, size, and visual appearance of garments(Zakaria, 2017). Fitting dummies used in the fashion practices are variously called as dress form, body form, nude form, mannequin, torso, and 인대, じんたい in the fashion practices (Yoon, 2016). It is designed variously depending on its use for pattern making, fitting and inspection, three-dimensional cutting,

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and display, and is manufactured with various materials(Chang, 2016). Considering the functionality of human motion, it is divided into the normal type for containing ease and the nude type for close to the size and shape of the human body without ease being calculated(Chang, 2009). The sizes of the dummies are usually based on general human body measurements, but there are slight differences depending on the brand or market characteristics.

Apparel companies are requesting dummies that are suitable for the Korean body type, but the domestic dummies currently being produced are not applying properly the KS women's Clothing size Standards and each manufacturer has a different sizing system (Song et al., 2004; Oh, 2016). In addition, due to the small business of model companies, research investment in Korean human body size and shapes is not done(Chang, 2016). Only the standard size of adult women and early middle-aged women in their mid-30s to mid-40s, are produced, and the body shape for women in their 50s and 60s has not yet been developed.

Review of the former researches on the use of dummy is as follows: Park et al.(2006) studied the use of dummy to develop female dress forms for draping; Chung et al.(2006) investigated the use of dress form and the fitting model for silver women's apparel brands; Lee and Jang(2019) studied the status of dress forms for adult women. Although there are researches on dummy usage of clothing companies or the available model products, but there is no research that has examined the actual use of dummies by apparel companies targeting late middle-age women and product analysis of dummies on the on-line market. This study reviews and analyzes the dummy development and usage in the fashion market, and also presents the improvement suggestion of dummy by analysis of dummy production.

2. Methods

2.1. Data collection and analysis on the use of dummies in target clothing companies

To identify the use of body dummies in clothing companies targeting women in their 50s and 60s, this study conducted a survey from April to May 2021 of hands-on workers involved in pattern making and production. We visited 19 target clothing companies and their subcontractors that were selected based on 2014/2015 Korean fashion brand annual(2014) and responded to the survey. These companies include formal wear brands such as Daks Ladies, Escalier, and Ribbon, casual brands Free balance, Isae, Mademoiselle, and Melissa, designer character brands such as Doho, Fashion Story Jung Hun Jong, and Sysmax, sports brands Leedongsoo and Palms Springs, and subcontractors such as Anyone DM, B&B, Inseong, Jungwon, Lime, Pnus, and Time. The questionnaire was

developed with reference to previous studies(Chung et al., 2006; Cui et al., 2006), comprised of a total of 36 items on basic data, brand information, use and sizes of body dummies, frequency of use and satisfaction, and development of body dummies. Descriptive statistics and frequency analysis were conducted using SPSS 25.0.

2.2. Data collection and analysis on body dummies of Korean online malls

To collect data such as shapes and sizes of dummy products of domestic online shopping malls, a total of 81 body dummies domestically produced for apparel fitting and inspection by 8 manufacturers and sellers were collected through search of domestic online marketing business data from April to May 2021. These companies include Damannequin, Form21, Madamada, King mannequin, Kokodp, Kwangjenmq, Samsin mall, Shop&Mall. Shapes, Materials, and company selection of body dummies were classified with reference to Do and Choi(2016). After analyzing the types and materials as well as sizes of body dummies posted on the shopping mall's website, the size suitability was analyzed by comparing with the average of major circumference items of women aged 50~69 from 3D body-scan data of the 6th Size Korea(KATS, 2012). Descriptive statistics and frequency analysis were conducted using SPSS 25.0.

3. Results and discussion

3.1. Use of body dummies of target women's clothing companies

3.1.1. Data on respondents and clothing companies

Among the respondents from 19 clothing companies and subcontractors targeting South Korean women in their 50s and 60s, 42.1% were in their 60s or older with a long history of working in the industry for more than 30 years, followed by 30s(31.6%) and 50s(21.1%). Most of the brands were national brands(8, 42.1%), followed by designer brands(3, 15.8%) and subcontractors(6, 31.6%). For apparel production, some companies manufactured in-house(15.5%) or outsourced(18.8%) only, but most(13, 40.6%) did both, and six companies(18.8%) purchased finished goods and sold them with branded goods, mostly national brands.

3.1.2. Use and sizes of body dummies

The results of the survey on the usage and sizes of the dummy are shown in Table 1. The results of multiple responses on the type of dummies used in target clothing companies revealed that 11 companies(57.9%) used the torso crotch type, followed by 10 companies(52.6%) using the torso type, two(10.5%) also using the lower body type, and only 1(5.3%) using the whole body type.

Table 1. Usage of dummies

(unit: N(%))

Category	Brand	Designer's B		National B		Subcontractor		Etc.		Total	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Type (Multiple responses)	Whole body type	1	5.3	0	0.0	0	0.0	0	0.0	1	5.3
	Torso type	3	15.8	4	21.1	3	15.8	0	0.0	10	52.6
	Torso crotch type	0	0.0	4	21.1	6	31.6	1	5.3	11	57.9
	Lower body type	0	0.0	2	10.5	0	0.0	0	0.0	2	10.5
	Total	4	21.1	10	52.6	9	47.4	1	5.3	24	126.3
Production	Domestic ready-made	2	10.5	3	15.8	5	26.3	1	5.3	11	57.9
	Domestic order made	1	5.3	4	21.1	2	10.5	0	0.0	7	36.8
	Overseas ready-made	0	0.0	1	5.3	0	0.0	0	0.0	1	5.3
	Total	3	15.8	8	42.1	7	36.8	1	5.3	19	100.0
Price	10~30 million won	1	5.3	0	0.0	0	0.0	0	0.0	1	5.3
	30~50 million won	2	10.5	3	15.8	6	31.6	1	5.3	12	63.2
	50~100 million won	0	0.0	4	21.1	1	5.3	0	0.0	5	26.3
	100~300 million won	0	0.0	1	5.3	0	0.0	0	0.0	1	5.3
	Total	3	15.8	8	42.1	7	36.8	1	5.3	19	100.0
Size	55	2	10.5	3	15.8	4	21.1	0	0.0	9	47.4
	66	1	5.3	5	26.3	3	15.8	1	5.3	10	52.6
	Total	3	15.8	8	42.1	7	36.8	1	5.3	19	100.0
Material & Allowance	FRP, Nude type without allowance	2	10.5	6	31.6	6	31.6	1	5.3	15	78.9
	P.U, Wrapped Normal type with allowance	1	5.3	2	10.5	1	5.3	0	0.0	4	21.1
	Total	3	15.8	8	42.1	7	36.8	1	5.3	19	100.0

Most used dummies with removable upper arms. Designer brands used the torso type, and national brands used various types such as torso, torso crotch, and lower body types. Most companies(11, 57.9%) used domestic ready-made dummies, followed by 7 companies(36.8%) using domestic order-made dummies based on brand sizes. Many national brands used order-made dummies, and only one company(5.3%) used overseas ready-made dummies because they do not fit the body types of South Korean women. The price of domestic ready-made products was in from 300 thousand to 500 thousand won range, with the largest proportion (63.2%), and 15 companies(78.9%) were using the nude type without allowance made of fiber-reinforced plastic(FRP), followed by 4(21.1%) using the normal type with allowance made of polyurethane wrapped in fabric such as cotton or hemp. Many used the nude-type dummies since they have excellent molding and are easy to customize, and the smooth material makes it easier to put on or take off garments. This showed the same results as the former study by Chang(2016), who reported that dummies made of FRP were widely used to check the fit of clothes after making them.

Size 55(47.4%) and size 66(52.6%) dummies were used in almost same frequency. Designer brands and subcontractors were using size 55, while domestic national brands were mostly using size 66, which is closer to the body size dimension of women in

their 50s and 60s. The fact that clothing companies and subcontractors are using smaller size than the actual sizes of the women in their 50s and 60s, indicates that it is just for showing the fitting states of apparel rather than for sampling and inspection.

The results of calculating the means of size 55 and size 66 owned by clothing companies are reported in Table 2 and show a high frequency of use among the sizes of dummies in the whole body, torso, and torso crotch types. The average measurements of size 55 body dummies were as follows: bust circumference 85.1 cm, waist circumference 69.6 cm, hip circumference 90.1 cm, S.N.P to B.P 23.6 cm, S.N.P to waist level(through B.P) 39.4 cm, across back lateral shoulder width 36.4 cm, waist back length 37.5 cm. The average measurements of size 66 body dummies were: bust circumference 89.5 cm, waist circumference 70.3 cm, hip circumference 96.0 cm, S.N.P to B.P 24.7 cm, S.N.P to waist level(through B.P) 41.3 cm, across back lateral shoulder width 38.2 cm, waist back length 38.6 cm. There was a significant difference of body size among 344 women aged 50 to 69 according to 3D body-scan data of SizeKorea(2012). In particular, there was a significant gap in major circumferences. Their average body size were calculated as bust circumference of 96.1 cm, waist circumference of 86.7 cm, and hip circumference of 94.0 cm. Compared to this, the size 55 dummies showed significant differences of

Table 2. Average size comparison between target women and 55, 66 dummies (unit: cm)

Items	55 dummies (A)	66 dummies (B)	Age 50-69 (C)	A-C Deviation	B-C Deviation
Across back lateral shoulder width	36.4	38.2	38.5	-2.1	-0.3
Bust circumference	85.1	89.5	96.1	-11.0	-6.6
Waist circumference	69.6	70.3	86.7	-17.1	-16.4
Hip circumference	90.1	96.0	94.0	-3.9	2.0
Front interscye	32.0	34.6	34.6	-2.6	0.0
Back interscye	34.7	36.4	35.0	-0.3	1.4
S.N.P to waist level(through B.P)	39.4	41.3	42.3	-2.9	-1.0
Waist back length	37.5	38.6	40.5	-3.0	-1.9
S.N.P to bust-point	23.6	24.7	26.4	-2.8	-1.7
Bust-point breadth	16.3	18.8	18.9	-2.6	-0.1
Bust breadth	26.3	32.4	30.5	-4.2	1.9
Waist breadth	20.3	25.7	29.5	-9.2	-3.8
Hip breadth	28.9	35.2	34.1	-5.2	1.1
Bust depth	20.9	23.2	25.1	-4.2	-1.9
Waist depth	16.5	19.2	22.9	-6.4	-3.8
Hip depth	21.5	24.4	24.2	-2.7	0.2
Bust breadth/Bust depth	1.26	1.40	1.22	0.04	-0.10
Waist breadth/Waist depth	1.23	1.34	1.29	-0.06	-0.01
Hip breadth/Hip depth	1.34	1.44	1.41	-0.12	0.05

S.N.P: side neck point

-11.0 cm, -17.1 cm, and -3.9 cm, respectively, and size 66 dummies was -6.6 cm and -16.4 cm, and +2.0 cm, especially in waist circumference. Considering that the sizing systems for female adult's garments(KS K 0051), that requires fit, the nominal interval is sets to 3 cm according to major circumference sizes such as bust circumference and waist circumference, and the nominal interval for non-fit clothing is set to 5 cm, this was a deviation across several sizes. In the analysis of breadth and depth dimensions, the waist breadth of the 55 and 66 dummies showed a difference of -9.2 cm and -3.8 cm, respectively, and a difference of -6.4 cm and -3.8 cm in waist depth compared to the human body size. As a result of flattening, which represents the shape of the cross section, the flattening ratios of the target women's bust and waist were 1.22 and 1.29, respectively, which increased in the depth compared to the breadth, and hip flattening ratio of 1.41, which decreased in depth compared to the breadth as the hip muscle mass decreased. On the other hand, the bust and waist flattening ratios of the 66 dummy were 1.40 and 1.34, respectively, which were larger in breadth, indicating that the dummy were flatter than the human body, indicating a low fit, and the hip flattening ratio was 1.44, showing a flatness similar to the human body size. Therefore, it is considered that the size of the dummy used by the target consumer's brands inevitably raises issues with clothing fit. The need for a dummy that is suitable for the body size of these consumers has emerged

due to the low fit in the main circumference dimensions.

3.1.3. Size satisfaction and satisfaction with use of body dummies

The results of rating the size satisfaction, frequency of use, and satisfaction with use of the whole body, torso, or torso crotch type dummies on a 5-point Likert scale are reported in Table 3. Users were most dissatisfied with an abdominal area(3.00), back interscye (3.00), and front interscye(3.11), followed by bust-point level (3.22), bust area(3.22), upper-arms area(3.33), waist area(3.44), side neck point to waist level(3.44), and side waist to hip(3.50). Overall, body dummies failed to express the real body in areas where fat is accumulated such as the abdominal and waist area,

Table 3. Size satisfaction of dummies

Category	Score	Category	Score
Abdominal area	3.00	Side neck point to waist level	3.44
Back interscye	3.00	Side waist to hip	3.50
Front interscye	3.11	Hip area	3.56
Bust-point level	3.22	Arm length	3.60
Bust area	3.22	Waist back length	3.67
Upper-arms area	3.33	Shoulder area	3.67
Waist area	3.44	Crotch area	3.71
Frequency of use	4.46	Satisfaction with use	3.39

Table 4. Reasons for satisfaction and dissatisfaction with the use of dummies (unit: N(%))

Category	Reason for satisfaction		Reason for dissatisfaction	
	Frequency	%	Frequency	%
Size	8	40.0	8	40.0
Form	10	50.0	3	15.0
Convenience in use	13	65.0	1	5.0
Reflected KS standard	1	5.0	4	20.0
Standard body shape reflection	2	10.0	4	20.0
Etc.	0	0.0	1	5.0
Total (Multiple responses)	34	170.0	21	105.0

front/back interscye, bust area, and upper-arms area, while also failing to show the spreading and droopy bust-point level and the length of sagging hips. Users also highlighted that the side neck point to waist level of body dummies was shorter than the actual size used, and they were also dissatisfied with waist back length that must reflect the hunching of the back with age.

The frequency of using dummies was 4.46, and satisfaction with use was moderate at 3.39 compared to the high frequency of use, indicating that users were using dummies that are not particularly satisfactory.

In the results of multiple responses about specific satisfaction and dissatisfaction factors of dummies being used, most respondents were satisfied with convenience in use(65.0%), followed by shape (50.0%) and size(40.0%). Most respondents were dissatisfied with size(40.0%), followed by the inaccurate reflection of the KS sizing standard(20.0%), an inaccurate reflection of the standard body type(20.0%), and form(15.0%). Reviewing the content of dissatisfaction, the worst dissatisfaction was with the size of the dummy, which was different from the body size of target women. It was analyzed that the size factor of the dummy affects the satisfaction with use(Table 4).

The results of the multiple response survey on the application of dummies are shown in Table 5. It is mainly used in the sample pattern and modification stage(94.7%), and is used for multiple purposes, including the inspection stage(36.8%), planning(15.8%), and product evaluation(15.8%), which showed the same results as previous studies by Cui et al.(2006). For sample development or fit

resolution priority methods in the quality control process, most companies(10, 52.6%) were checking and modifying dummies, fitting them on fit models, and modifying them again, followed by eight companies(42.1%) giving priority to dummies, and one(5.3%) giving priority to fit models.

In addition to the basic sample pattern and modification, and planning stages that form the basis of clothing production, it is necessary to create dummies that are frequently used not only in the development stage but also in accordance with the changes in the physical form and dimensions of the human body due to the aging process, specifically tailored to the areas that are affected. Furthermore, development should be carried out in compliance with KS clothing size specifications.

3.1.4. Direction for development of dummies

The survey results on the development of dummies for target consumers are reported in Table 6. A total of 14 companies(73.7%) responded that dummies are necessary, which suggests the need for the development of dummies targeting women in their 50s and 60s. Most responded that the base age for the development of body dummies must be 50~54(57.9%), followed by 55~59(31.6%), and two companies(10.5%) claimed that body dummies must be developed based on the age of 40s. This implies that the effort made by clothing companies targeting women in their 50s and 60s to make women look younger when manufacturing apparel is also reflected in the development of dummies. The results of multiple responses on the development form of dummies revealed that most

Table 5. Steps of application and reasons for using dummies (unit: N(%))

Application steps	Frequency	%	Fit solution	Frequency	
				Frequency	%
Sample patterns and modification	18	94.7	Dummy first	8	42.1
Inspection	7	36.8	Fitting model first	1	5.3
Planning	3	15.8	Wearing/modifying dummy after wearing a fitting model	10	52.6
Evaluation	3	15.8			
Sales exhibition	1	5.3			
Total (Multiple responses)	32	168.4	Total	19	100.0

preferred the torso crotch type(57.9%), followed by the torso type(47.4%) and the whole body type(21.0%), indicating the preference for multi-use forms to fit both tops and bottoms.

The survey results on the need for development and points to improve regarding dummies currently being used are as follows. Since energetic women in their 50s and 60s prefer with young appearance will be the major consumers of apparel in the aging society and continuously increase apparel consumption. According to these circumstances, body dummies must express the volume of front and back interscye, upper-arms, bust, and waist circumference due to the deposit of fat, as well as sagging breasts and hips, longer side neck point to waist level caused by obesity, and hunched shoulders. They can check the fit with these dummies that express the actual circumference measurements and forms of real human bodies. Many respondents also raised the need to develop dummies that can be enlarged or reduced so that they cover various sizes.

3.2. Product types and sizes of online dummy companies

3.2.1. Product types and materials of female dummies sold online

The types of female dummies sold online are classified into torso, torso crotch, lower body, and whole body types. The torso type was found to be 33(40.7%), 30 the torso crotch type(37.0%), 11 the whole body type(13.6%), and seven the lower body type (8.6%), with removable full arms or upper arms. Out of all products for fitting and inspection, 77.7% were torso crotch and

torso types, indicating that they were the most commonly produced types. This showed the same as in Lee and Jang's(2019) results.

The materials of body dummies were classified into smooth nude type FRP(Fiberglass Reinforced Plastic), flexible polyurethane used as infill, and recycled paper. Most dummies were made of polyurethane(71.6%), because they can be used for not only sampling and inspection but also planning or evaluation. Rigid urethane was mostly used for the body, while soft urethane was used for the removable arms. A total of 14.8% used recycled paper and 13.6% used FRP, indicating that the proportion of online sales of FRP, which is mainly used in actual clothing companies, was low.

3.2.2. Comparison of the sizes of dummies and the body measurements of target women

The results of examining the sizes and measurements of dummies sold online are reported in Table 7. The sizes of female dummies were mostly indicated in numbers, such as 6, 7, 8, 9, 10, 12, 14, 16, 18 or 44, 55, 66, 77, and 88. Upper body dummies mostly specified 'bust circumference-waist circumference-hip circumference', and the across back lateral shoulder width and total length were specified as additional dimensions. Lower body dummies specified 'waist circumference-hip circumference', and thigh circumference, inseam, and total length as additional information. Whole body type dummies specified 'bust circumference-waist circumference-hip circumference' along with across back lateral shoulder width, total length, and arm length.

The sizes were not specified uniformly among the companies, and the widest variation was for waist circumference. Looking at the size 8, the bust circumference was 81.3~85.0 cm, showing a deviation of 3.7 cm, the waist circumference was 58.5~62.0 cm, 3.5 cm, and the hip circumference was 89.0~91.0 cm. Size 9 made by dummy companies have the bust circumference of 86.4~87.0 cm showing a variation of 0.6 cm, the waist circumference of 62.0~65.5 cm showing a variation of 3.5 cm, and the hip circumference of 91.0~93.0 cm showing a variation of 2.0 cm. In the case of size 55, the bust circumference was 81.0~86.0 cm, with a deviation of 5.0 cm, the waist circumference of 62.0~66.0 cm, and the hip circumference of 89.0~91.5 cm, with a deviation of 4.0 cm and 1.5 cm, respectively. Size 66, the bust circumference ranged from 85.0 to 88.5 cm, with a deviation of 3.5 cm, the waist circumference of 67.0~68.0 cm, a deviation of 1.0 cm, and the hip circumference of 90.0~94.0 cm, a deviation of 4.0 cm. And size 12 have the bust circumference of 91.4~93.0 cm showing a variation of 1.6 cm, waist circumference of 64.5~73.0 cm showing a variation of 8.5 cm, and the hip circumference of 94.0~99.0 cm showing a variation of 5.0 cm, indicating that the widest variation was for waist circumference.

Table 6. Development of body dummies (unit: N(%))

Category		Frequency	%
Necessity	Yes	14	73.7
	No	5	26.3
	Total	19	100.0
Basic age	45~50	2	10.5
	50~54	11	57.9
	55~59	6	31.6
	Total	19	100.0
Development form (Multiple responses)	Torso Crotch	11	57.9
	Torso	9	47.4
	Full body	4	21.0
	Lower body	2	10.5
	Total	26	136.8
Improvements (Multiple responses)	Size	9	42.8
	Posture	5	23.8
	Baseline related	2	9.5
	Detachable accessories	1	4.8
	No	4	19.0
Total	21	110.0	

Table 7. Distribution of dummy sizes according to KS sizing systems

(unit: cm)

Size	Bust C.		Waist C.		Hip C.		Across back lateral shoulder W.		KS (B/W/H)	KS Top body	KS Lower body
	Range	Aver.	Range	Aver.	Range	Aver.	Range	Aver.			
8	81.3~85.0	84.6	58.5~62.0	59.9	89.0~91.0	88.9	34.5~35.0	36.2	85/61/91	85-91-155(160)	.
9	86.4~87.0	86.4	62.0~65.5	63.5	91.0~93.0	91.7	36.0~37.0	36.8	85/64/91	85-91-155(160)	64-91
10	84.0~91.0	88.4	63.5~70.0	65.8	92.7~96.5	94.0	37.0~38.0	37.9	88/67/94	.	.
12	91.4~93.0	92.6	64.5~73.0	66.5	94.0~99.0	94.3	38.0	38.0	91/67/94	91-94-150	.
14	96.0~96.5	96.2	69.9~70.0	69.9	96.5~98.0	97.0	39.0	39.0	97/70/97	97-97-150	.
16	99.0~99.1	99.1	73.6~73.7	73.7	99.0~99.1	99.1	40.0	40.0	100/73/100	.	.
18	102.0~103.0	102.3	78.0~78.7	78.2	105.0~105.4	105.1	40.0	40.0	103/79/106	.	.
55	81.0~86.0	82.9	62.0~66.0	63.6	89.0~91.5	89.9	35.0~41.0	38.0	82/64/88	82-88-155(160)	64-88
66	85.0~88.5	86.2	67.0~68.0	66.9	90.0~94.0	93.2	38.5~42.0	39.8	85/67/94	.	.
77	88.0~91.0	89.0	70.0~72.5	70.3	96.0~97.0	96.5	38.5~42.5	40.8	88/70/97	.	70-97
88	93.0~94.0	93.2	73.5~76.0	74.2	99.0~104.0	102.3	39.5~44.0	41.8	94/73/103	.	.

W.: Width, C.: Circumference, B/W/H: Bust/Waist/Hip circumference

According to KS sizing system for female adult's garments, for tops that require fit, three measurements of 'bust circumference-hip circumference-stature' are indicated, and two measurements of 'waist circumference-hip circumference' are indicated for bottoms. Converting the average measurements of dummies into the KS sizing system, size 8, 9, and 55 are included in the sizing systems for adult women's garments(KS K 0051), and size 12, 14, and 77 appeared to be included in the sizing systems for elderly women's garments(KS K 0055), but other sizes did not correspond to the KS clothing sizing systems.

Comparing the average size for each size with the gray shaded section that shows a high distribution rate in the sizing standards for women's garments(KS K 0051, KS K 0055), size 8 and size 9 were equivalent to 85-91-155(160) of KS K 0051. Size 55 corresponds to 82-88-155(160) of KS K 0051, and size 12 and size 14 were equivalent to 91-94-150 and 97-97-150 of KS K 0055, respectively. There was a difference of 0.1~8.5 cm in the sizing system among online dummy companies even with the same size dummies. It is the same results as the former study of Lee and Jang(2019). Furthermore, it has been recognized as an urgent matter to standardize dummy sizes based on KS clothing size criteria, as it is anticipated that consumers may face inconvenience when selecting dummy products, having to individually verify detailed dimension information from each company in order to choose the appropriate size.

To examine how well the dummies sold online reflect the body measurements of women in their 50s and 60s, this study applied the KS sizing system for women's garments to the measurements of dummies and compared the results. The results to examine the 25~75% interval of the major circumference items of women aged 50 to 69 among 3D data of KATS(2012) and the circumference measurements of 81 dummies sold in the market are reported in Table 8.

Of a total of 344 women aged 50~69, 116 are included in the median 25~75% interval for bust circumference, waist circumference, and hip circumference. Frequent intervals were 91-82-91, 91(94)-85-91, 94-88-91, 94-85-94, and 97-88-94(97) in the order of bust circumference-waist circumference-hip circumference, but the body dummies failed to cover the distribution of frequent intervals by the KS sizing system for women in their 50s and 60s. There were dummies within the median 25~75% interval for the bust circumferences such as the 91 cm, 94 cm, 97 cm interval and 25~75% interval for hip circumference such as the 91 cm, 94 cm, 97 cm interval from the 3D data for women in their 50s and 60s by KATS(2012). However, the waist circumference of dummies was smaller than that of target women, and thus there were no dummies included in the median 25~75% interval for waist circumference such as the 82 cm, 85 cm, 88 cm, 91 cm interval. To cover the body sizes of women in their 50s and 60s, it is therefore necessary to customize the dummies according to the standard sizes of apparel brands or purchase ready-made products according to the measurements of bust circumference and hip circumference and then adjust the waist circumference with cotton or gauze. These results are consistent those of Lee and Jang(2019). As such, there is a low production rate of online body dummies that can cover the sizes of South Korean women in their 50s and 60s, and these body dummies fail to properly reflect the body size and are thus not suitable for use in apparel production. Therefore, for pattern making and inspection, there is an urgent need to develop suitable body dummies that reflect 3D body measurements and body types.

Conclusions

As basic research to develop body dummies for South Korean women in their 50s and 60s, this study analyzed the use of body dummies in South Korean clothing companies and subcontractors

Table 8. Distribution of frequent intervals between online sales dummies and KS sizing system

Hip C.	Waist C.	Bust Circumference									Total N(%)
		79	82	85	88	91	94	97	100	103	
85	64		1(1.2)	1(1.2)							2(2.5)
88	61	4(4.9)	11(13.6)	2(2.5)							17(21.0)
	64	1(1.2)									1(1.2)
91	61		1(1.2)	4(4.9)							5(6.2)
	64		5(6.2)	6(7.4)							11(13.6)
	67			2(2.5)	1(1.2)						3(3.7)
	70										0(0.0)
	73										0(0.0)
	76										0(0.0)
	79										0(0.0)
	82										0(0.0)
	85										0(0.0)
	88										0(0.0)
91										0(0.0)	
94	64			6(7.4)	1(1.2)	3(3.7)	2(2.5)				12(14.8)
	67			5(6.2)	2(2.5)	1(1.2)	2(2.5)				10(12.3)
	70										0(0.0)
	73										0(0.0)
	76										0(0.0)
	79										0(0.0)
	82										0(0.0)
	85										0(0.0)
	88										0(0.0)
	91										0(0.0)
97	67					1(1.2)					1(1.2)
	70				3(3.7)	3(3.7)			3(3.7)		9(11.1)
	73							1(1.2)			1(1.2)
	76										0(0.0)
	79										0(0.0)
	82										0(0.0)
	85										0(0.0)
	88										0(0.0)
	91										0(0.0)
	100	73						1(1.2)		3(3.7)	4(4.9)
103	73						1(1.2)			1(1.2)	
	76						1(1.2)			1(1.2)	
106	79								3(3.7)	3(3.7)	
Total		5(6.2)	18(22.2)	26(32.1)	7(8.6)	8(9.9)	8(9.9)	3(3.7)	3(3.7)	3(3.7)	81(100.0)

□ Distribution of dummies, □ Distribution of target women, ■ Intervals over 5%

targeting such women as well as the current state of domestically produced body dummies currently sold online in South Korea, identified the size fit by comparing with the actual body measurements of such women, and explored solutions for

problems in body dummies sold in the market. The following results were derived.

First, the results of examining fitting dummies used by clothing companies and subcontractors targeting women in their 50s and

60s revealed that many dummies used by the production team were the nude torso crotch type(57.9%) and torso type(52.6%) and there were more companies using domestic ready-made products(57.9%) than companies using custom-made products(36.8%). The nude type(78.9%) without allowance made of FRP material was used much more than the normal type(21.1%) with allowance made of polyurethane wrapped in fabric such as cotton or hemp. This was determined to be because the smooth material makes it easy to put on and take off the clothes to check the fit and allows for long-term use. The use of a size 66 dummy(52.6%) was higher than that of a size 55(47.4%), and there was a difference between size 66 dummy and the average size of the major circumference of women in their 50s and 60s, especially in terms of waist circumference. In particular, the variation in waist circumference was large at -16.4 cm, raising the problem of clothing fit as a dummy used in clothing companies targeting women so it is necessary to increase the suitability of the dummy by reflecting changes in body size and body shape.

There was a high frequency of use such as in sample pattern modification, inspection, planning, and evaluation, whereas the satisfaction with use was moderate. This dissatisfaction was mostly due to the size and form of the dummies, especially the inaccurate reflection of the standard body type and the lack of consistency with the KS sizing system.

Regarding the development of dummies, 73.7% of the respondents mentioned the necessity, and the appropriate age range for the dummy development was 50 to 54 years old(57.9%), and most preferred the torso crotch type. In response to these demands from clothing companies, the development of a highly satisfactory fitting dummy for making clothing for women in their 50s and 60s should proceed.

Second, in the product survey of online companies' dummies, torso type(40.7%) and torso crotch type(37.0%) were the most produced, and polyurethane(71.9%), recycled paper(14.8%) and FRP(13.6%) materials were used. The sizes of the dummy is expressed in numerical type, sizes 6, 7, 8, 9, 10, 12, 14, 16, 18 and sizes 44, 55, 66, 77, and 88 were produced. Upper body and lower body dummies specified the 'bust circumference-waist circumference-hip circumference' and 'waist circumference-hip circumference.' There was a variation of 0.1~8.5 cm in major circumference items among companies even when the dummy was the same size. In particular, there was a wide variation of waist circumference measurements and no consistent intervals between sizes. In addition, the size comparison between body dummies and actual women aged 50 to 69 revealed that dummies failed to cover the body types at the 25~75% interval for major circumference items of the KS sizing system, and there were no dummies including the 25~75% interval for waist circumference. This indicates that there

is an urgent need to standardize dummy according to the human body sizes and shapes of Korean women in their 50s and 60s. Moreover, it is necessary to increase awareness of the KS clothing size standards among those working in clothing production, and it appears that Korean dummy manufacturers need to have educational sessions to follow the KS rules.

As above, through the analysis of the dummy status of women's clothing companies in their 50s and 60s and dummy companies, it is expected that it will be difficult to produce well-fitting clothing because the size and shape of the current commercial dummies do not reflect the body type of Korean women in their 50s and 60s. Therefore, by collecting the requests of the working team, developing it as a dummy that meets the KS sizing systems for women's garments and reflects the actual human body shape of target women, whose body shape changes greatly according to the aging process, it will be possible to provide better clothing suitability for these women. Accordingly, based on this study, the follow-up study will use 3D body-scan data of Korean women in their 50s and 60s to identify their KS clothing sizing system, derive representative body types, and develop a dummy suitable for target women.

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