A Comparative Study on the Subjective Fabric Hand According to Gender for Winter Sleepwear Fabrics

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Abstract: The purpose of this study is to analyze the subjective fabric hand of sleepwear fabrics, and to assist in developing sleepwear fabrics that offer maximum comfort in wearing sensation. In general, the respondents noted that sleepwear fabrics made with polyester had better tactile sensation than those made with cotton, while satin weave fabrics felt better than plain weave fabrics. As regards the difference in fabric hand according to gender, female students responded with more receptiveness and sensitivity than male students in the category of woven fabric evaluation. As regards the same textile materials, the evaluations of female students and male students differed in fabric hand descriptors, particularly for the evaluation on cotton fabrics. Male students responded that both plain weave fabrics and satin weave fabrics were stiff while female students replied that satin weave fabrics had better tactile sensation.

Keywords: Subjective fabric hand, Gender, Sleepwear fabrics

Introduction

The need for the development of fabric of high sensitivity is being emphasized recently to promote comfort in wearing sensation. Wearing sensation is generally assessed from functional perspectives such as the thermal resistance of the fabric, its moisture absorbency and tactile sensation on the skin. However, expectations of conforming to social customs and relevant cultural aspects are also part of the wearing sensation [1].

Unlike outer wear, sleepwear is very personal and as it comes in direct contact with the skin, wearing sensation from a functional perspective is more critical. In particular, such subjective sensations as thermal sensation, humidity sensation and tactile sensation of the fabric greatly influence the consumers' decision to purchase a particular sleepwear.

The comfort sensation of a fabric, however, has multi-dimensional attributes and it is virtually impossible to quantify the comfort sensation through a single physical property. Accordingly, in order to promote the comfort sensation of the apparel, the concept of 'hand' is introduced to assess fabrics. The hand is the means for judging the essential features that decides the adequacy of usage and purpose of the fabric. The need for hand assessment of apparel fabric is escalating in order to improve quality and technology of textile products [2].

Recently, research is being conducted not only on the dynamic performance or the physical performance of the surface property of apparel fabric but also with diverse methods including sensory features on comprehensive elegance and quality through tactile sensation and visual inspection. In other words, the diverse physical performance of the fabric is crucial in determining the quality and external appearance of the fabric. In particular, the surface property of the fabric is acknowledged as having great impact on tactile sensation, the hand of the garment as well as on comfort sensation [3-5]. Moreover, considering that the predilection of consumers for a certain product changes according to the difference in social and cultural environment as well as its end use [6-8], it is essential to research the physical property in the development of the fabric as well as on the hand of the product and sensitivity assessment regarding how the final product makes the consumer feel. In other nations, there has been great deal of research on the objective evaluation of the physical property of apparel fabric as well as subjective sensory evaluation, the result of which has been compiled. In Korea, subjective sensory evaluation has been minimal, centering only on such outerwear as blouses and blue jeans [5,9-13], and on underwear [14]. Subjective evaluation on sleepwear has been virtually zero in Korea. Accordingly, by conducting sensory evaluation of Korean consumers regarding sleepwear fabric and identifying their preferences, it would be possible to develop sleepwear fabric with sensibility most favored by consumers.

This study aims to explore the subjective sensory level according to gender and to assist the development of sleepwear fabrics that can provide maximum comfort in wearing sensation. To this end, male and female college students, as sensory arbiters, assessed the tactile sensation of four types of winter sleepwear fabrics.

Research Method and Procedures

Characteristics of Sleepwear Fabrics

Among the winter sleepwear on the market, four types of fabrics most preferred by consumers were used as test fabrics. The features of the test fabrics are illustrated in Table 1.

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Table 1. Characteristics of test fabrics

Specimen	Fiber (100 %)	Fabric construction	Yarn count (end/pick)	Fabric count (end × pick/inch)	Thickness (mm)	Weight (g/cm²)
CP	cotton	plain weave	40/40Ne	110 × 84	0.26	4.41
CS	cotton	satin weave	35/55Ne	220 × 92	0.27	4.52
PP	polyester	plain weave	180/72d	172 × 92	0.25	5.18
PS	polyester	satin weave	95/54d	292 × 102	0.20	4.00

Measurement of Mechanical Properties of Fabrics

The mechanical properties of test fabrics were measured by using the Kawabata Evaluation System (KES)-FB [15]. The properties included tensile, bending, shearing, compression and surface properties.

Subjective Sensory Assessment

Extraction of Fabric Hand Descriptors

The fabric hand descriptors were based on the sensory adjectives abstracted from a preceding study [12]. Fifteen subjects were asked to touch the test fabrics used in this experiment and were asked if they were able to extract similar sensory descriptors. They were also asked to freely write down any additional sensory adjectives that came to their minds. These responses were analyzed, and ten descriptors for sensory assessment were selected and the questionnaire was drafted.

Subjects

The subjects in this study were 20 male and 20 female university students in their early twenties, all of them healthy with similar physical conditions. As regards the physical characteristics of the subjects, the average height was 174.5 ± 4.7 cm for males and 161.8 ± 3.8 cm for females, while the average weight was 67.4 ± 6.2 kg for males and 52.8 ± 5.7 kg for females.

Test Method

The preliminary test and the actual test were conducted in November of 2001. The laboratory was adjusted to the temperature of 23 ± 1 °C, and relative humidity of 45 ± 3 % R.H., which is the average winter indoor environment in Korea.

The subjects were asked to freely touch and feel all of the four sleepwear fabrics of a certain size (20 × 20 cm). According to the designated assessment behavior such as touching with the hand the area that touches the skin or feeling the fabric with the arm, the subjects then made an assessment using a 7-point scale of 10 descriptors. The test was repeated twice for the same test fabric.

Data Analysis

The data were analyzed through the SPSS/WIN program using Mean (SD), t-test, ANOVA, and crosstab analysis.

Results and Discussion

Mechanical Properties of Fabrics

The mechanical properties of the four winter sleepwear fabrics by KES are shown in Table 2. Cotton fabrics (CP and CS) showed the higher value of B (bending rigidity), 2HB (hysteresis of bending moment), G (shear stiffness), 2HG (shear hysteresis), and 2HG5 (hysteresis of shear force) than polyester fabrics (PP and PS). It means that polyester fabrics were more easily deformable than cotton fabrics. Especially PS (Polyester Plain Weave) which was thinner and lighter than any other fabrics showed the lowest value of these properties.

Subjective Sensory Assessment of Sleepwear Fabrics

The three-way analysis variance (ANOVA) was used to find the interaction effect of fiber type, textile woven structure and gender on the subjective sensory assessment. But in all of the 10 evaluation descriptors, there were no interaction effect. For that reason, the one-way analysis variance was used to analyze the subjective sensory assessment of fiber type, textile woven structure and gender, respectively.

Comparison of Sleepwear Types

The result of the subjective sensory assessment on the four winter sleepwear fabrics on the market is indicated on Table 3.

Table 2. Mechanical properties of fabrics

	LT (−)	WT (gf · cm/cm²)	RT (%)	B (gf · cm²/cm)	2HB (gf · cm²/cm)	G (gf/cm)	2HG (gf/cm)	2HG5 (gf/cm)	LC (−)	RC (%)	MIU (−)	SMD (μm)
CP	0.63	14.98	41.87	0.04	0.05	0.93	1.77	2.86	0.36	33.49	0.18	0.97
CS	0.83	4.22	45.26	0.08	0.06	0.60	1.36	1.73	0.39	31.90	0.16	0.76
PP	0.85	5.20	51.11	0.02	0.03	0.36	0.36	0.71	0.33	58.78	0.19	0.82
PS	0.62	7.89	55.56	0.01	0.01	0.31	0.21	0.36	0.75	59.71	0.25	0.78

Table 3. Comparison of the subjective sensory assessment of sleepwear types

Evaluation descriptors	Fabric				
	CP	CS	PP	PS	F-value
Soft	3.40 a	4.44 b	5.16 c	6.41 d	105.2***
Thin	3.48 a	3.88 b	5.83 c	6.05 c	125.7***
Smooth	3.20 a	4.08 b	5.66 c	6.64 d	169.3***
Warm	4.88 b	5.14 b	3.35 a	3.39 a	37.0***
Dry	4.86 c	4.40 bc	4.10 b	3.49 a	11.6***
Light	4.08 a	4.51 a	5.16 b	5.75 c	21.8***
Loose	2.69 a	3.58 b	5.28 c	5.89 d	77.8***
Sheer	2.24 a	3.25 b	5.51 c	6.45 d	242.5***
Stiff	5.18 d	4.03 c	2.59 b	1.74 a	111.0***
Pleasant tactile sensation	3.94 a	4.89 b	5.13 b	6.39 c	57.1***

abcd: Means with the same letter are not significantly different (p<0.05).
***p < 0.001.

There was significant difference in all of the 10 evaluation descriptors regarding the four types of sleepwear. The respondents noted that PS (Polyester Satin Weave) was the softest, thinnest, most smooth, loose and sheer while the CP (Cotton Plain Weave) was warm, dry and stiff. In the comprehensive evaluation of tactile sensation, which is the overall sensation, the respondents said that PS was the most outstanding, followed by PP (Polyester Plain Weave) and CS (Cotton Satin Weave). They responded that tactile sensation of the CP was not very pleasant.

While the actually measured thickness and subjective thickness were similar, there was a difference in the measured weight and subjective evaluation of the weight. In other words, the subjects noted that PS, which is the thinnest fabric, was the thinnest and that CP, which is the thickest, was the thickest. However, PP was the heaviest among the actually measured fabric but in the subjective assessment, they picked the CP to be the heaviest. Hence, we can assume that making a judgment as to the thickness is easier than that of the weight.

Comparison of Fabric and Structure

The evaluation results of the subjective sensation of the four type of winter sleepwear fabrics on the market according to the textile material and structure is illustrated in Table 4. In the evaluation of textile structure, there were significant differences on the sensory evaluation of the four types of fabrics. The respondents noted that PP and PS were softer, thinner, smoother, lighter, looser and sheerer than CP and CS while the cotton fabric was warmer, drier and stiffer. They responded that the polyester fabric had better tactile sensation than cotton fabric.

As regards sensation according to structure, the subjects evaluated that there are differences according to structure in

Table 4. Comparison of subjective sensory assessment according to sleepwear fabrics and structure

Evaluation descriptors	Fiber			Weave		
	Cotton	Polyester	t-value	Plain	Satin	t-value
Soft	3.92	5.79	-13.45***	4.28	5.43	-7.07***
Thin	3.68	5.94	-19.06***	4.65	4.96	-1.80
Smooth	3.64	6.15	-19.43***	4.43	5.36	-5.02***
Warm	5.01	3.37	10.48***	4.11	4.26	-0.82
Dry	4.63	3.79	4.89***	4.48	3.94	3.07**
Light	4.29	5.46	-7.16***	4.62	5.13	-2.97**
Loose	3.13	5.58	14.18***	3.98	4.73	-3.46**
Sheer	2.74	5.98	23.73***	3.88	4.85	-4.42***
Stiff	4.60	2.16	15.73***	3.88	2.88	5.03***
Pleasant tactile sensation	4.41	5.76	-9.13***	4.53	5.64	-7.22***

**p < 0.01, ***p < 0.001.

the 8 evaluation descriptors. They replied that CS and PS was softer, lighter, and smoother, looser and sheerer than CP and PP, that plain weave was drier and stiffer while the tactile sensation of satin weave was better. It could be surmised that the subjects were able to better distinguish the difference in textile material rather than the difference from the structure of fabric.

Subjective Sensory Assessment According to Gender

Overall Comparison

A test was conducted to determine whether there were any differences according to gender regarding the overall sensory assessment of sleepwear fabrics. As illustrated in Table 5, the evaluation on the sensation of stiffness received the lowest scores both from male and female university students. Terms that received high scores were 'smooth' (mean 4.89) for male students and 'pleasant tactile sensation' (5.34) for female students.

Table 5. Comparison according to gender

Evaluation descriptors	Male	Female	t-value
Soft	4.69	5.02	-1.95*
Thin	4.69	4.93	-1.37
Smooth	4.89	4.89	0.00
Warm	4.12	4.12	0.76
Dry	4.23	4.19	0.21
Light	4.71	5.04	-1.96*
Loose	4.31	4.41	-0.45
Sheer	4.23	4.49	-1.15
Stiff	3.74	3.03	3.51***
Pleasant tactile sensation	4.83	5.34	-3.11**

*p < 0.05, **p < 0.01, ***p < 0.001.

Table 6. Comparison of sensations by textile component according to gender

Evaluation descriptors	Cotton			Polyester		
	Male	Female	t-value	Male	Female	t-value
Soft	3.70	4.14	-2.26*	5.68	5.90	-1.14
Thin	3.48	3.88	-2.14*	5.90	5.98	-0.52
Smooth	3.60	3.68	-0.36	6.19	6.11	0.48
Warm	5.10	4.91	1.06	3.41	3.33	0.33
Dry	4.78	4.49	1.35	3.69	3.90	-0.79
Light	4.03	4.56	-2.37*	5.39	5.53	-0.59
Loose	3.08	3.19	-0.48	5.54	5.63	-0.34
Sheer	2.58	2.91	-1.63	5.89	6.08	-1.06
Stiff	5.08	4.13	4.23***	2.40	1.93	2.40*
Pleasant tactile sensation	4.13	4.70	-2.73**	5.54	5.98	-2.20*

$*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Table 7. Comparison of sensation by textile structure according to gender

Evaluation descriptors	Plain weave			Satin weave		
	Male	Female	t-value	Male	Female	t-value
Soft	4.21	4.35	-0.58	5.16	5.69	-2.38
Thin	4.51	4.79	-1.13	4.86	5.06	-0.80
Smooth	4.46	4.40	0.24	5.33	5.39	-0.23
Warm	4.22	4.00	0.95	4.29	4.24	0.18
Dry	4.51	4.45	0.26	3.95	3.94	0.04
Light	4.49	4.75	-1.09	4.93	5.34	-1.67
Loose	3.93	4.04	-0.36	4.69	4.78	-0.28
Sheer	3.76	3.99	-0.71	4.70	5.00	-0.96
Stiff	4.24	3.53	2.59***	3.24	2.53	2.56**
Pleasant tactile sensation	4.43	4.64	-0.99	5.24	6.04	-3.79***

$**p < 0.01$, $***p < 0.001$.

There were significant differences according to gender in the four terms among the 10 evaluation terms. Among the sensations with a high preference level of four points, female students gave higher scores than the male students for the terms of soft, light and pleasant tactile sensation. Among the sensations with a low preference level, meanwhile, the female students gave low scores to the term stiff. This supports the earlier study result [14,16] that in the description of fabric hand, the responses of males were closer to the midpoints of the scale than the females, which represents the fact that females responded more delicately and sensitively than males in fabric assessment.

By Textile Component and Structure

Table 6 shows the comparison result of textile components through the assessment of sensations of winter sleepwear fabrics according to gender. Male subjects responded that although cotton fabric sleepwear gave a warm, stiff and dry feeling, it is not sheer whereas they noted polyester sleepwear to be smooth, thin, sheer and soft. On the other hand, female students responded that cotton fabric is warm with a pleasant tactile sensation, light but not sheer, while they assessed polyester fabric to be smooth, sheer, soft with a pleasant tactile sensation.

As seen here, subjective sensation according to the textile fabric displayed significant differences according to gender. Assessment of the cotton fabric illustrates that there are significant differences according to gender in the five terms among the 10 assessment terms. Among the fabric hand descriptors with a high preference level, female students gave higher scores than male students in the category of light and pleasant tactile sensation whereas male students gave higher scores in the sensation of stiffness. As regards the sensation of softness, male students gave negative assessments whereas female students gave positive assessments. In the

sensation of softness, male students gave negative assessments while in the sensation of thinness, female students gave slightly more positive assessments than male students.

Next, in the assessment of polyester fabric, differences were shown only in the two terms among the ten evaluation terms according to gender. In the assessment of pleasant tactile sensation, female students gave a more positive response than male students while in the sensation of stiffness, female students gave a more negative response.

As seen here, there are differences in sensations among the evaluation by male students and female students even for the same textile fabric. In particular, there were major differences in subjective sensation according to gender regarding fabrics made of cotton.

Illustrated in Table 7 is the result of comparison by structure on the evaluation of sensations on winter sleepwear. As regards plain weave fabrics, differences according to gender were found only in the term of stiff whereas in the satin weave fabrics, differences were found in the two evaluation terms of stiff and pleasant tactile sensation. In other words, male students were more likely to respond that both plain weave and satin weave fabrics were stiff while female students showed more inclination to respond that satin weave fabrics had more pleasant tactile sensation than male students. As a result, regardless of structure, male students responded sensitively to stiffness while female students responded sensitively to the comprehensive sensation of pleasant tactile sensation regarding satin weave fabrics.

Relationship between Subjective Sensory Assessment and Mechanical Properties

The correlation between subjective sensory assessment and mechanical properties is shown in Table 8. Softness was positively correlated with the tensile property (RT), the compression property (LC) and the surface property (MIU),

Table 8. Correlation coefficients between subjective sensory assessment and mechanical property

	Soft	Thin	Smooth	Warm	Dry	Light	Loose	Sheer	Stiff
LT	0.11	0.48	0.20	−0.23	−0.06	0.20	0.17	−0.03	0.06
WT	−0.30	−0.51	−0.31	0.31	0.25	−0.15	−0.20	0.08	0.06
RT	0.66*	0.55	0.69*	−0.19	−0.52	0.54	0.78**	0.44	−0.52
B	0.14	0.21	0.04	−0.13	−0.27	0.18	−0.08	−0.01	0.07
2HB	−0.47	−0.40	−0.69*	0.41	0.58*	−0.22	−0.54	−0.40	0.71**
G	−0.68*	−0.82**	−0.86**	0.25	0.66*	−0.63*	−0.81**	−0.52	0.63**
2HG	−0.72**	−0.79**	−0.88**	0.30	0.60*	−0.68*	−0.93***	−0.63*	0.65*
2HG5	−0.72**	−0.79**	−0.87**	0.29	0.67*	−0.62*	−0.83**	−0.53	0.63*
LC	0.65*	0.24	0.59*	−0.24	−0.55	0.19	0.31	0.37	−0.46
RC	0.34	0.38	0.63*	−0.41	−0.44	0.19	0.71**	0.18	−0.50
MIU	0.59*	0.32	0.67*	−0.06	−0.63*	0.35	0.64*	0.44	−0.66*
SMD	−0.58*	−0.65*	−0.48	0.26	0.24	−0.24	−0.24	−0.21	0.10

* $p<0.05$, ** $p<0.01$, *** $p<0.001$.

and negatively with the shear properties (G, 2HG, 2HG5) and the surface property (SMD). Thickness was negatively correlated with the G, 2HG, 2HG5 and SMD. Smoothness was positively correlated with RT, the compression properties (LC, RC) and MIU, and negatively with the 2HB, G, 2HG and 2HG5. Dryness and stiffness were positively correlated with the 2HB, G, 2HG and 2HG5, and negatively with MIU. Lightness and looseness were negatively correlated with the shear properties (G, 2HG, 2HG5). But warmth had no any correlation with all the mechanical properties. Therefore, the shear properties were showed as the important ones in assessing subjective sensation of winter sleepwear fabrics.

Summary and Conclusion

This study was conducted to assist in the development of sleepwear fabrics that considers the sensitivity favored by the consumers. The subjects in this study were male and female university students who assessed the tactile sensitivity of four types of winter sleepwear fabrics. Sense of preference in purchase was explored, comparison and analysis regarding the sensibility difference and preference sensibility of fabrics were made according to gender.

1. In the assessment of sleepwear fabrics by textile components, most responded that polyester fabrics had better tactile sensation than cotton fabrics. As to the sensation according to the structure of sleepwear fabrics, most responded the tactile sensation of satin weave fabrics to be more pleasant.

2. Concerning the sensibility difference regarding sleepwear fabrics according to gender, female students responded more delicately and sensitively than male students in textile assessment. In particular, male students reacted more sensitively to the sensation of stiffness while female students responded more sensitively to thickness, flexibility and tactile sensation.

3. Comparison result of differences in textile components

according to gender found variations in fabric hand descriptors in the assessment of male and female students as to the same textile material. In particular, in the assessment of materials made with cotton fabric, there were significant differences in sensation according to gender. Sensation in sleepwear structure according to gender showed significant variation by parts. Male students responded that both plain weave and satin weave fabrics were stiff while female students said that satin weave fabrics had more pleasant tactile sensation.

4. There were partially significant correlations between mechanical properties and the subjective hand evaluation. The shear properties were shown as the important ones in assessing subjective sensation of winter sleepwear fabrics.

Results of this study showed dissimilarity in subjective sensation regarding winter sleepwear fabrics according to gender. As a result, sleepwear manufacturers should take such factors into consideration and produce differentiated sleepwear for couples that reflect the sensibility of fabric.

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