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Comparison of Fabric Hand with Sensory Comfort for Knitted Clothes

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Abstract: Sensory comfort is an important criterion in buying decision of garments. Consumers try to judge wearing comfort by touching, rubbing and squeezing fabric with hand (Fabric Hand). Being subjective in nature, the effectiveness of 'fabric hand' is under question. In this study, a detailed approach has been adopted to compare 'fabric hand' with 'wearer's response' on comfort. Single jersey fabrics were made in 140 & 160 grams per square meters using cotton and poly-cotton blend yarns. One half of each of the four fabrics was bleached to white while the other was dyed. In addition, a part of each processed fabric was kept with normal finish while the second was applied with softener finish. For fabric hand evaluation, a group of male and female volunteers was trained as per AATCC evaluation procedure # 05. For sensory analysis, boxer shorts were prepared and the volunteers were asked to wear them for day long and record responses. The response variables smoothness, stiffness, roughness and tensile stretch and thickness were evaluated. It was concluded that fabric hand is economical and reliable, where modern equipment cannot be used. Also, female panelists were found better in subjective evaluation than males.

Keywords: Sensory comfort; fabric hand; knitted clothes

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1. Introduction

'Comfort' is one of the most important attribute of textile products, from consumer view point [1]. The first action that a buyer performs to evaluate the fabric is through the sense of touch. They often try to make decision regarding comfort parameter; softness, stiffness, roughness, and drape of the fabrics. The use of human senses in fabric evaluation is termed as sensory analysis [2]. There are qualitative and quantitative techniques to evaluate physical properties, related to comfort, of fabrics. The qualitative (descriptive) techniques, also known as sensory analysis, provide a perceived ranking of a variables of interest, like roughness, stiffness, thickness etc. This involves subjective opinion for relative grading of available fabrics or of a single fabric against a standard fabric. The quantitative techniques, on the other hand, provide magnitude of the variables of interest [3].

"Sensory Analysis" is the tactile sensation experienced by touching the fabric inner side with the body. It can be experienced by wearing garment for extended time which is time taking and destructive. However, as a quick measure, a common user tries to develop perception, about comfort of the garment, by treating fabric with hand which is termed as "Fabric Hand". Fabric hand is the sensation, experienced by touching, squeezing, rubbing and/or handling the fabric, with hand [4].

Since both are subjective (qualitative) in nature, the results may vary from person to person. In the pursuit of consistent and reliable results objective evaluation involves mechanical equipment. These provide a numerical value of variable of interest [3]. Fabric Assurance by Simple Testing, Fabric Touch Tester and Kawabata Evaluation System for fabrics are among the available equipment [5]. Objective evaluation does not require any experienced personal for evaluation and has higher consistency. Being subjective in nature, it may seem hard to develop consensus over sensory analysis yet it has its own significance as it involves humans who are also the end users of textile products [6].

A number of people have worked to evaluate fabrics using subjective techniques (sensory analysis) [3], [7]–[10]. Subjective assessment may vary depending upon different factors like human age, sensitivity of the evaluator, gender of panelist (evaluator), duration of touching, force applied during assessment, finger movement speed and skill. There is also a parallel or even bigger group who tried to evaluate fabric objectively, using different equipment [11]–[14]. Objective assessment does not ensure the full representation of the hand due to less involvement of human. But objective assessment provides quantified results. In addition, some researchers have performed both types of assessments (subjective and objective) in parallel and have tried to correlate their results [3], [15], [16].

It is apparent from the literature that objective evaluation provides basis to communicate the perceived value of fabric/clothing comfort parameters at commercial level. However, from end user view, there is still no substitute of subjective evaluation. A variety of different techniques exist for both subjective and objective evaluation of fabrics. The results of subjective techniques vary based on personal perception of individual while sensitivity of equipment is crucial to the objective evaluation. The effectiveness of subjective techniques has been compared against objective evaluation but there is certain gap to compare them against wearers perception of sensory comfort.

The present study focuses on to drive a relationship between fabric hand and wearer's perception of fabric comfort through sensory analysis. In addition, comparison was made between the fabric hand results, obtained from male and female evaluators. The research is significant as it provides insight on effectiveness of judging fabric comfort through hand which is most dominant in end user buying.

2. Materials and Methods

Two yarns, Cotton and Polyester-Cotton (PC) blend were used to make single jersey fabrics in 140 and 160 grams per square meter (GSM) in each. The obtained four fabrics were divided into two equal parts and one of each was bleached while the other was color dyed. Again from the eight samples half of each was normal finished (no softener) while the other was treated with silicon softener. In all sixteen samples were prepared for testing. Relevant factors and levels are given in Table 1. The detailed design of experiment (DOE) is provided in Annex A, Table A1.

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Table 1. Factors and Levels

		Levels		Total specimen
Factors	Material Content	Cotton (100%)	Polyester/Cotton (60/40)	16
	Areal Density	140 GSM	160 GSM	
	Processing	Bleaching	Dyeing	
	Softener Finish	0 g/l	20 g/l	

A renowned vertically integrated knitted textile & apparel manufacturer of Pakistan was engaged in present research work. They developed fabric in mentioned GSM, using both material contents in yarn count Ne = 30S. The TPI (turns per inch) for 100% cotton and PC yarns were 20.5 and 19 respectively. The prepared fabrics were processed according the mentioned routes and were also finished according to the design of experiment. Obtained fabrics were marked for identification and consequent future use in the study. For fabric hand evaluation, specimens were prepared according to American Association of Textile Chemists and Colorist (AATCC) Evaluation Procedure (EP) # 05. Similarly, for wearing comfort responses, boxer shorts were prepared according to the commercial size sets in 34 and 36 waist sizes because all the volunteers who took part in the study had one of the mentioned two sizes.

In all twelve volunteers, including males and females, took part in the present study. All the panelists were 21 to 23 years old. They were trained for eight weeks with two hours training session per week, according to AATCC EP#05. The prepared specimens were provided to individual panelists in random order and in separate locations so that they must record their own response. The panelists were asked to evaluate five different physical properties of the fabric namely smoothness, thickness, stiffness, tensile stretch and roughness. The responses were recorded on a scale of 0 to 5 with a division of 0.5. Where 1 meant to be best and 5 was worst. The individual respondents performed hand evaluation as per standard method AATCC EP#05. The results were ranked comparatively, out of sixteen, using following Equation 1.

$$\text{Comparative Rank} = \frac{\text{Average score}}{5} \times 16 \quad (1)$$

For recording responses of wearing comfort, volunteers were asked to wear the sewn garments for day long and record their responses accordingly. Same approach was adopted to rank the wearing comfort responses.

3. Results and Discussions

The results of fabric hand evaluation were compared to wearing comfort of the garments. All five response variables were compared for analysis. In addition, the correlation matrices were drawn to check the nature of relation between two responses, as shown in Figure 1. (a), (b), (c), (d), (e).

In all the graphs X-axis represents the number of specimen from one to sixteen and Y-axis represent respective comparative ranking of specimens for mentioned response variable. The individual graphs and further correlation matrix of each physical parameter show that there is a significant positive correlation between fabric hand and wearer's evaluation of sensory comfort. Particularly, the correlation is highly positive in case of evaluating thickness, tensile stretch and

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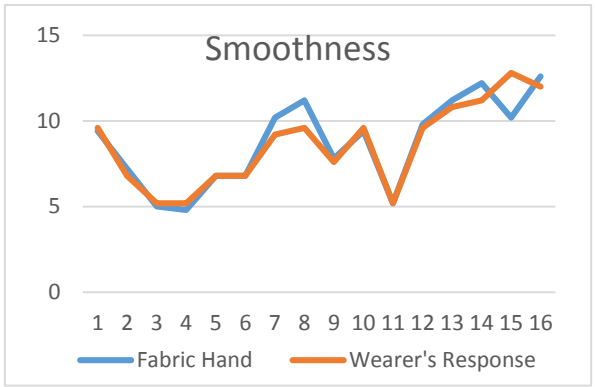
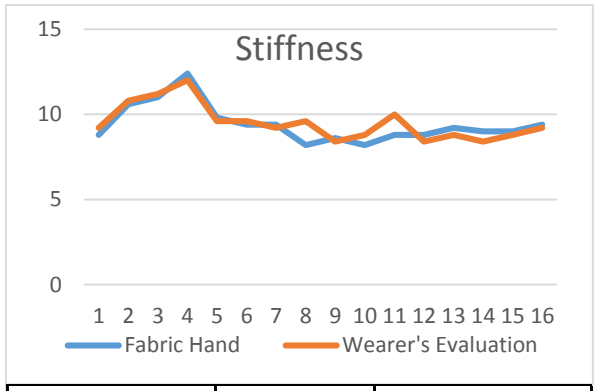
smoothness. It is enough of the evidence to say that no matter there are technological advancements in measuring fabric comfort parameter, yet fabric hand is economical and effective way of fabric evaluation.



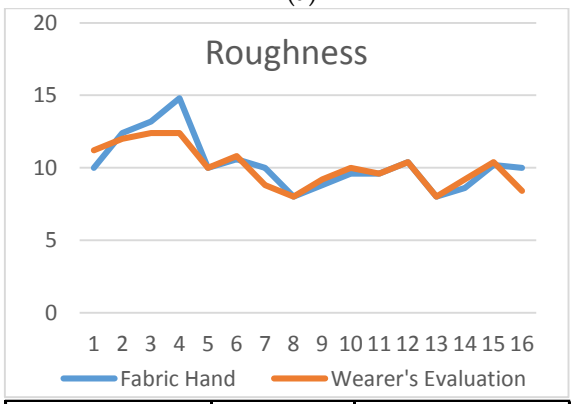
	F/Hand	*W/ Evaluation*
F/Hand	1	
W/ Evaluation	0.936283	1

(a)



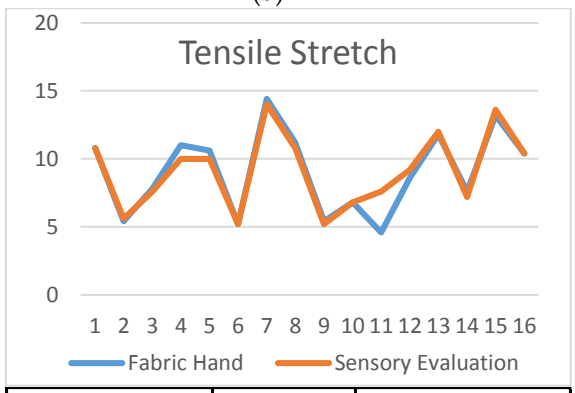
	F/Hand	*W/Evaluation*
F/Hand	1	
W/Evaluation	0.8576705	1

(b)



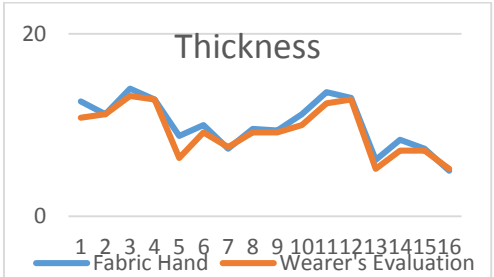
	F/Hand	*W/Evaluation*
F/Hand	1	
W/Evaluation	0.876227	1

(c)



	F/Hand	*W/Evaluation*
F/Hand	1	
W/Evaluation	0.958906	1

(d)



	F/Hand	*W/Evaluation*
F/Hand	1	
W/Evaluation	0.962343	1

(e)

Figure 1. Comparison of Fabric Hand Evaluation with Wearer's Evaluation for: (a) Smoothness; (b) Stiffness; (c) Roughness; (d) Tensile Stretch; (e) Thickness

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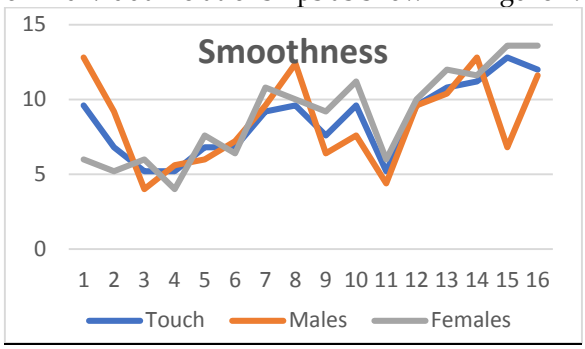
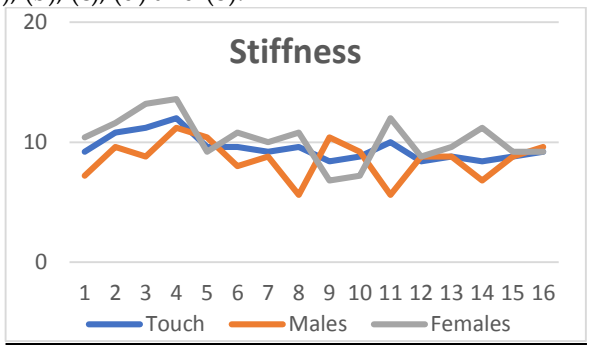
Further investigation was done to analyze responses of male and female panelists. Both of the fabric hand evaluation results, by male and female, were drawn against the wearer's responses, mentioned with "Touch" in the graph legends. Also correlation matrix was obtained to embark light on individual relationships as shown in Figure 2. (a), (b), (c), (d) and (e).



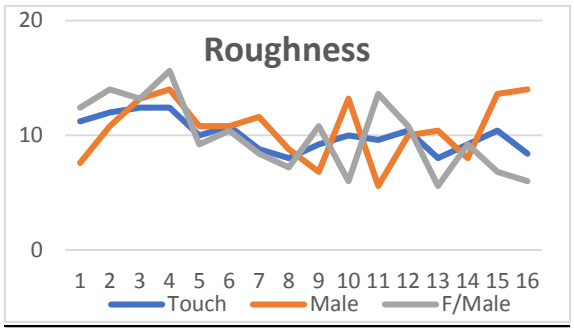
	Touch	Males	Females
Touch	1		
Males	0.688	1	
Females	0.894	0.436	1

(a)



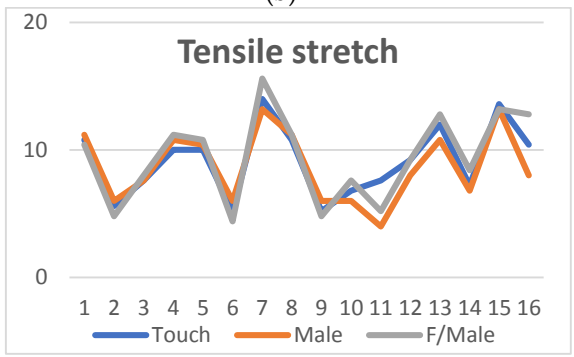
	Touch	Males	Females
Touch	1		
Males	0.2198	1	
Females	0.81	-0.2215	1

(b)



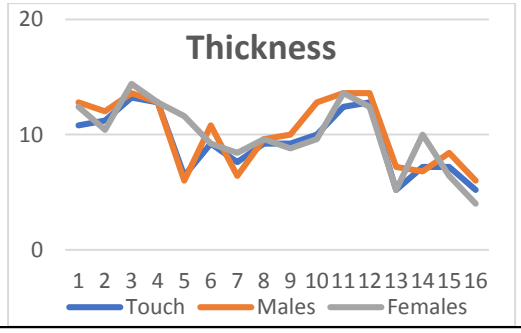
	Touch	Male	F/Male
Touch	1		
Male	0.2924	1	
F/Male	0.766	-0.22064	1

(c)



	Touch	Male	F/Male
Touch	1		
Male	0.9046	1	
F/Male	0.9521	0.8826	1

(d)



	Touch	Males	Females
Touch	1		
Males	0.9394	1	
Females	0.8413	0.7124	1

(e)

Figure 2. Comparison of Fabric Hand Evaluation of Male and Female Panelists with Wearer's Evaluation for: (a) Smoothness; (b) Stiffness; (c) Roughness; (d) Tensile Stretch; (e) Thickness

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It is important to note, from graphical representations, there are very weak correlations in the hand evaluation results of males and females for smoothness and even negative correlations for roughness and stiffness. It indicates that the average scores of male and female evaluators for smoothness, roughness and stiffness were far different. However, there were good positive correlations between hand evaluation of male and females for thickness and slightly strong for tensile stretch. From the individual responses, female panelists responses had strong positive correlation to wearer's evaluation (touch).

Hand evaluations of males were weekly correlated to wearer's response on roughness and stiffness. While strong positive correlation was observed in case of tensile stretch and thickness; smoothness was also positively correlated. In addition to the above, it was further analyzed that overall weak correlations existed in hand evaluation and wearer's evaluation in case of judging stiffness for PC blended yarns and dyed fabrics. Male evaluators were mainly deceived while evaluating roughness and stiffness of normal finish (no softener), dyed fabrics and PC yarn content. Similarly, female panelists remained unable to match wearer's perception of comfort in judging stiffness of dyed fabrics only while for other responses they had a good positive to strong positive correlations. The possible causes of strong positive correlations between female hand evaluations and wearer's perception perhaps can be explained by understanding skin structure. This might be because of the fact that female skin is thinner than male skin which might enhance functioning of underlying receptor cells. Further investigation, therefore, may be conducted in this direction.

4. Conclusions

It was concluded from study findings, that overall fabric hand evaluation and wearer's evaluation had strong positive correlation. Therefore, 'fabric hand' can be used confidently to evaluate wearing comfort of the fabric and garments. However, some weak correlations were found in the evaluation of fabric stiffness. Further analysis revealed that 'fabric hand' by female panelists had strong positive correlation with wearer's response which proofs that females can better evaluate fabric hand as compared to men and reason might exist in skin structure difference of females and males which requires further investigation. The study findings shall provide basis to use hand evaluation confidently where sophisticated equipment cannot be employed.

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