(REFEREED RESEARCH)

DETERMINATION OF BODY-CLOTHING PATTERN FIT PROBLEMS IN MEN'S JACKET AND PATTERN PROPOSAL

ERKEK CEKETİNDE VÜCUT-GİYSİ KALIP UYUM PROBLEMLERİNİN BELİRLENMESİ VE KALIP ÖNERİSİ

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Received: 30.06.2015 Accepted: 25.08.2015

ABSTRACT

As an item of men's clothing, which is an important part of the ready-made clothing sector, the classic jacket is used by a large number of people. In order to give the body a good look, the jacket necessarily has to restrict several movements of the body. However, keeping this restriction at a minimum, allowing the individual to wear the jacket for longer periods during the day, and increasing comfort and efficiency requires designing the jacket in such a way that it fits the body and adapts to the wearer's movements. The aim of this research is to determine the problems experienced by men with classic jackets with regard to body fit and freedom of movement, and to design a classic men's jacket pattern fitting the body of men with body measurements Drop6/Size50 which ensures freedom of movement. This is an action research type of study. The research population is men with normal body characteristics living in Turkey. The research sample is comprised of the Drop6/Size50 customers of the store belonging to the company collaborating in the research, located in Ankara, in which most of the national transactions of the company take place. Frequency (f), percentage value (%) and arithmetic mean ($\overline{x}$) were used in the analysis of the quantitative data obtained in the research with the survey form. As a result of three experiments, a classic jacket pattern fitting the body and ensuring freedom of movement was obtained.

Keywords: Apparel, Men's Clothing, Clothing pattern, Clothing and body fit.

ÖZET

Hazır giyim sektöründe önemli bir yere sahip olan erkek giyiminde klasik giyimin bir parçası olan klasik ceket, oldukça büyük bir kitle tarafından kullanılmaktadır. Ceket, vücudu iyi gösterme işlevi nedeniyle vücudun bazı hareketlerini kısıtlamaktadır. Ancak bu kısıtlamanın minimum düzeyde olması, kişinin gün boyu daha uzun süre ceketi giymesi, rahat olması ve verimliliğinin artması için ceket kalıbının vücuda uygun ve hareket sınırlarına uygun olarak tasarlanması gerekmektedir. Araştırmanın amacı, erkeklerin mevcut kalıp sistemleriyle hazırlanıp üretilen erkek ceketinde vücuda uyum ve hareket rahatlığı bakımından yaşadıkları problemleri belirlemek ve 6Drop/50Beden vücut ölçülerine sahip erkeklerin vücuduna uygun ve vücudun hareket rahatlığını sağlayan klasik erkek ceket kalıbı tasarlamaktır. Bu araştırma, bir eylem araştırmasıdır. Araştırmanın evrenini, normal vücut özelliğine sahip Türkiye'de yaşayan erkekler oluşturmaktadır. Araştırma örneklemini ise, Ankara'da bulunan, araştırmanın birlikte yapıldığı firmanın Türkiye genelinde en çok satışının yapıldığı mağazasının 6Drop/50Beden müşterileri oluşturmaktadır. Araştırmada gözlem formu ile elde edilen nicel verilerin çözümlenmesinde frekans (f), yüzdelik değer (%) ve aritmetik ortalama ($\overline{x}$) uygulanmıştır. Üç deneme sonucunda vücuda uygun ve hareket rahatlığı sağlayan klasik ceket kalıbı elde edilmiştir.

Anahtar Kelimeler: Hazır Giyim, Erkek Giyimi, Giysi Kalıbı, Giysi ve Vücut Uyumu

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1. INTRODUCTION

In the ready-made clothing sector, men's clothing has an important place. Preferred by men who work in a formal work environment, classic clothing consists of two basic items, the jacket and the trousers. If the jacket has a comfortable fit, it appeals to a wider range of potential customers.

One gets least tired and is most efficient when one can perform the movements required by one's task comfortably and without any strain (1). Therefore, like with all products to be designed, for clothing a three-dimensional fit is required between the body and the apparel so as to ensure a good ergonomic fit and freedom of movement (2). In order to ensure this fit, the human body and movements must be known well, the intended use of the garment must be taken into consideration, and the features of the materials used must be known (3). The body fit of the item is considered to be the most important factor in the decision stage of buying a piece of clothing. This could either reinforce or compromise the popularity of a brand (4).

The pattern is the first stage in the design of a garment the fits the body. The oldest known book about clothing patterns is the *Book of the Practice of Tailoring, Measuring and Marking Out* written by the Spaniard Juan de Alcega in 1580, in which the writer points out that since fabrics are very important in the 16th century, the pattern system is necessary in order for the dressmaker to be able to create the best apparel out of the minimum length of fabric(5). In clothing, the pattern refers to pieces prepared in accordance with the shape of the clothing and the measurements of the individual (6). Patterns for ready-made clothing are prepared for an idealized figure in accordance with standard size tables (7). The pattern is actually the schematized version of body dimensions that will create a three-dimensional form adapted to the human body (8). In ready-made clothing production, if the designers, pattern makers and producers have better knowledge about the anatomic structure of the population for whom the garment is being produced, the patterns prepared two-dimensionally will cover the three-dimensional body geometry better (9). Since the male body has straighter lines compared to the female body, even the smallest mistake in the cut or production is manifested more prominently. Therefore, since any change to be made on basic patterns will be evident immediately, more pains must be taken with patterns and production in men's clothing (10).

Many studies have been performed to develop patterns. The pattern developing process requires repeated creations of patterns in order to solve problems with body fit and production. In the 2012 study by McKinney, Bye and Labat, the hip curvatures of seven women with similar body build were used to create patterns for trousers. The participants then tried on the trousers made according to these patterns(11). In their 2014 study, Musilova and Nemcokova compared the measurements of various patterns. The shirt measurements of 200 Czech men were used to design a new shirt pattern(12). In the study conducted by Dongsheng and Qing titled "A Study On Clothing Pressure For Men's Suit Comfort Evaluation," experiments were conducted on mannequins made of six different materials in order to determine how much pressure the men's jacket applies on the body in the normal standing position. As a result of these experiments, the mannequin with plastic content proved to be most suitable for measuring pressure (13).

The pattern preparation stage is one of the design stages of the men's jacket, the most important element of classic clothing and a symbol of elegance in men's clothing. The aim of this research is to design a pattern for a classic men's jacket with a good fit that ensures freedom of movement, using different pattern systems and measurement tables at the preparation stage.

METHOD AND MATERIAL

This research is an action research conducted by the practitioners, based on solving the problems besetting the current practice and attempting a new practice.

In this research, the evaluations of the jackets that were tried on, as to their fit on the body and their conformity to body movements, were conducted by the researchers with the aid of survey forms, using calibrated tape measures and rulers.

The research population is men with Drop6/Size 50 body measurements and normal body characteristics, using classic style clothing and living in Turkey.

The fact that the company collaborating in the research reports the highest sales across Turkey in jackets in Drop6/Size50 shows that a larger number of people with measurements corresponding to Drop6/Size50 can be easily reached. Therefore, the research sample was comprised of people with the measurements corresponding to Drop6/Size50. The researchers collected data through immediate observation. Therefore, synthetic models were not used in measuring fitness of the men's jacket, but real persons were reached instead.

In determining the research sample, the "Criterion Sampling" method, allowing criteria to be created by the researcher or used from previously prepared list of criteria, was employed.

According to the Criterion Sampling Method, criteria created and used by the researchers in determining the research sample, taking expert opinion into consideration, are as follows:

- The research participants of the first experiment are customers of a total of seven stores located in Istanbul, Ankara and Izmir, belonging to the company that agreed to take part in the research
- The research participants of the second and third experiments are customers of the company store achieving the highest sales
- These customers have the measurements corresponding to Drop6/Size50,
- These customers prefer the classic clothing style.

In line with these criteria, the first experiment was performed with 60 customers, the second with 165 and the third with 133 customers.

The data for the first experiment were collected by having 60 men with the measurements corresponding to Drop6/

Size50 try on classic men's jackets made with Metric, Müller, Optikon and ITKIB pattern systems, and documenting the results with the aid of the survey form.

In the course of the second experiment, data pertaining to the pattern which was designed as a result of the corrections resulting from the first experiment as well as the corrections made instantaneously during production were collected.

In the course of the third experiment, data pertaining to the pattern that was formed as a result of the corrections resulting from the second experiment and the corrections made during production were collected. In this experiment, 133 people with the measurements corresponding to Drop6/Size50 tried on the jackets made according to the re-corrected pattern at the same store.

In the analysis of the data, the data were tabulated and interpreted by performing statistical operations in the statistics packet program SPSS 14 (The Statistical Packet for The Social Sciences).

Frequency (f), **percentage value (%)** and **arithmetic mean ($\bar{x}$)** were used in the analysis of the data obtained in the research.

The research materials were produced in the measurements Drop 6/ Size 50, in accordance with the ready-made clothing made by the company collaborating in the research. In the production of the jackets, the model and fabric characteristics of the best-selling jackets of the company were taken into account. The jackets were made of black fabric of 70% cotton and 30% polyester, with standard lining, processed stiffening cloth, and shoulder pads. All jackets were made with classic lapels, two front buttons, four cuff buttons and pocket flaps, and without back slits.

FINDINGS AND DISCUSSIONS

Demographic Characteristics

Men constituting the sample group of the first experiment were aged between 19 and 46. Men constituting the sample group of the second experiment were aged between 27 and 47, and men constituting the sample group of the third experiment were aged between 21 and 44.

Men comprising the sample group of the first experiment were between 169cm and 186cm tall, averaging 178.5cm in height. Men constituting the sample group of the second experiment were between 174cm and179cm tall, with 177cm being the average, and men constituting the sample group of the third experiment were between 174cm to 179cm, averaging 177cm.

The weights of the men comprising the sample group of the first experiment ranged from 67kg to 89kg with 76kg being the average. Men constituting the sample group of the second experiment weighed between 65kg and 80kg, averaging 78kg, and men constituting the sample group of the third experiment weighed between 71kg and 79kg, with 77kg being the average.

Findings of the first experiment

In the first experiment of the research aiming to develop a classic jacket pattern fitting the male body structure, four different pattern systems were compared. The first experiment consists of four stages. In the first stage, basic measurements used to make the pattern in each system were compared. This comparison is given in Table 1. In the second stage, pattern crosschecks were performed. This stage is illustrated in figure 1. In pattern crosschecks, the median points of the body lines were set as fixed points in the front, back and side body parts. As the patterns are fixed on these points, the difference between them is seen more clearly. In the third stage, the trial jackets were evaluated as to the freedom of movement they allowed, and the results were presented. The four different movements included in the research, the most routine movements for the upper body, are shown in Table 2. In the table 3 addressing the freedom of movement, tensions and strains experienced on the body and sleeves of the jacket while performing the four movements are evaluated. In the fourth stage, the men's jackets prepared and produced with four different pattern systems in Drop6/Size50 were evaluated with regard to problems with body fit. The fit of the four different jackets, according to seven different widths and two different lengths on the male body.

Measurement Comparisons

Table 1. Comparison of Jacket Measurements Drop6/Size50 between Metric-Müller-Optikon- ITKIB Systems

Measurements	Metric	Müller	Optikon	Itkib
Length	176cm.	177cm.	176cm.	176cm.
Body	100cm.	100cm.	100cm.	100cm.
Waist circumference	82cm.	88cm.	94cm.	88cm.
Hip circumference	102cm.	104cm.	102cm.	102cm.
Sleeve length	62cm.	63cm.	63cm.	64cm.
Back length	44.6cm.	44cm.	43,5cm.	44cm.
Armscye depth	24.4cm.	25cm.	24,5cm.	25cm.
Hip drop length	21cm.	25cm.	22cm.	22cm.
Neck circumference	40cm.	43cm.	40,6cm	40cm.
Back collar width	9,5cm.	8cm.	9,1cm.	8,3cm.
Back width	20cm.	22cm.	21cm.	21cm.
Jacket length	76cm.	76cm	75,5cm.	76cm.

The table shows that the waist circumference is the same in the Müller and ITKIB pattern systems, but narrower in the Metric pattern system, whereas it is wider in the Optikon pattern system. The back width is the same in the Optikon and ITKIB pattern systems, wider in the Müller pattern system, and narrower in the Metric pattern system.

Comparison of Jacket Patterns between Metric-Müller-Optikon- ITKIB Systems

On each piece of the men's jacket patterns prepared with four (4) different systems, the middle point of the body line was crossed with the grain line. The differences between them are presented in Figure 1.

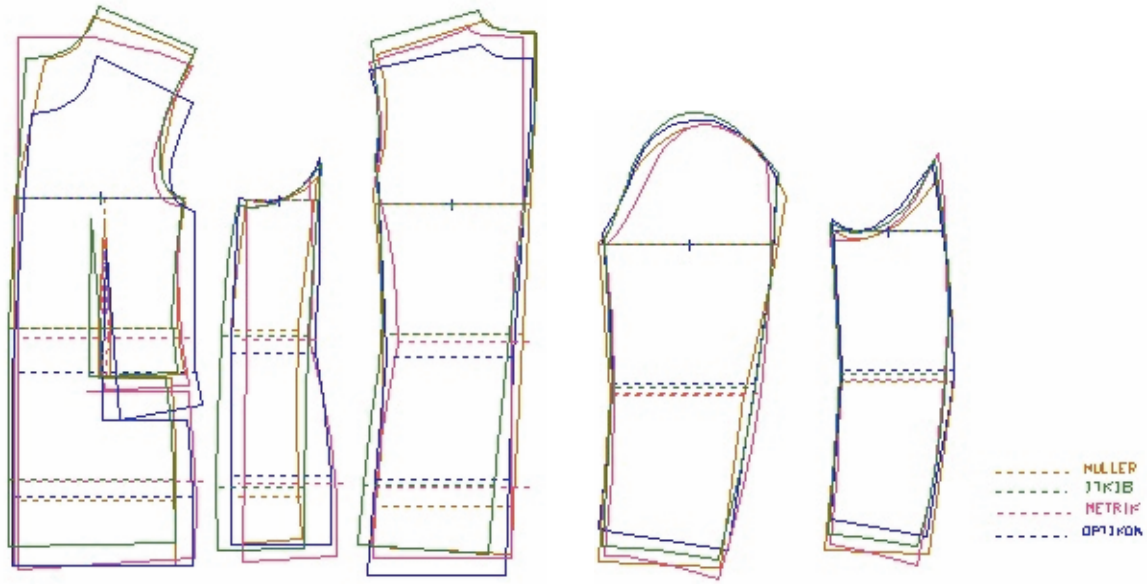


Figure 1. Comparison of Jacket Patterns between Metric-Müller-Optikon- ITKIB Systems

In terms of jacket pattern stages, Müller, Optikon and ITKIB pattern systems are worked on from right to left, while the Metric pattern system is worked on from left to right.

Figure 1 shows that the waistline and hipline on the middle back of the jacket prepared with the ITKIB system are cut more closely to the body compared to other systems. An analysis of back part shoulder measurements shows that the Müller pattern system has the widest shoulders. In the back part, the waist is widest in the Müller pattern system, and is cut most closely in the Metric pattern system. In the ITKIB pattern system, the middle back shows more of a slanting line compared to other pattern systems, and armhole depth and hip drop measurements are also different. The figure also shows, as was also noticed during production, that the lengths of the back and side parts of the Metric and Optikon pattern systems did not match the front body parts. Therefore, they were shortened by 1 cm at the hem.

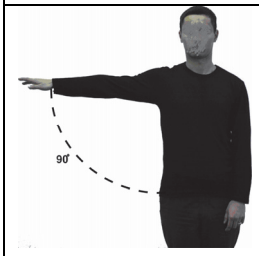
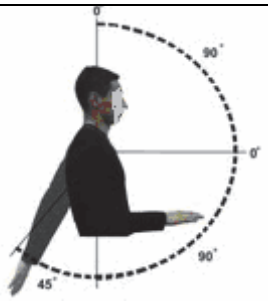
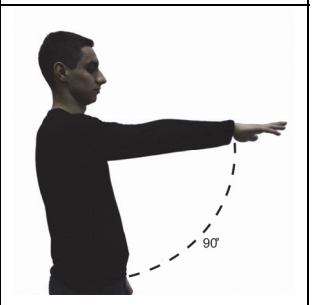
The Müller pattern system was seen to be the pattern where the side body part had the narrowest and straightest lines. In the Metric pattern system, on the other hand, the waist is cut closely to the body, the waist circumference being quite narrow.

In the Metric pattern system, the front body part extends towards the front hem, and there is no scalloped out neck hole. In the Optikon pattern system, the front body part is shorter compared to both the back body part and to the other pattern systems. In the patterns compared, the front and side darts in the front body parts are seen to be at different heights.

The figure shows that the pattern with the narrowest forearm elbow part is the Müller pattern system. The narrowest arm biceps part is also found in the Müller pattern system. Arm biceps lengths are also seen to greatly differ from each other. An examination of sleeve lengths shows that the Optikon pattern system has the shortest sleeve. However, a glance at the measurements table shows that it is the same as the Müller pattern system. This is because the Optikon pattern is made by shortening the sleeve by 2cm during pattern preparation.

The patterns with the narrowest forearm elbow part are the Metric and ITKIB pattern system. The same patterns also had straighter back arm parts. This prevents or minimizes bulges between the biceps and elbow line.

Table 2. Movements Used In Jacket Trials

Movement 1	Movement 2	Movement 3	Movement 4
			
Abduction - Extending the arm sideward by 90°	Flexion - Bringing the arm to front by 145° (holding the tie)	Flexion and Extension	Flexion Extending the arm from the shoulder to the front by 90°

Problems experienced by men with regard to freedom of movement in the first experiment when they tried on the jackets prepared with four different systems

In movement 1, strain occurred around the chest since the front body part of the jacket of the pattern prepared with the Metric pattern system was too narrow for 66.8% of the participants. Although the back width fit only 11.9% of the participants, the front body part was wider and compensated for the narrow back part, so that only 66.8% of the participants experienced strain in the side seams and body seams. Strain around the armhole and tension under the arm was reported in movement 1, since the shoulders and the biceps section were too narrow. Since the sleeve length was too short for the participants in normal standing position, the sleeve length was also too short for all participants in movement 1.

With the jacket of the pattern prepared with the Müller pattern system, participants for whom the back and front body parts were too narrow (38.3%) experienced strain in the side seams, tension around the chest and strain in the body seams. Since the sleeve length was too short for the participants in normal conditions, that sleeve length was also too short for all participants in movement 1.

Since the biceps part was too narrow in the jacket of the pattern prepared with the Optikon pattern system, tension occurred around the armhole and armpit. Since the sleeve length was too short for the participants and the arm was extended from the shoulder outwards at a 90° angle in movement 1, that movement proved this sleeve to be too short for all participants as well.

In the jacket of the pattern prepared by ITKIB, tension around the armhole and armpit was evident, since the biceps part was too narrow. Participants for whom the front body and back parts were too narrow experienced strain in the body of the jacket in movement 1.

In movement 2, in the jacket of the pattern prepared with the Metric pattern system tension around the chest and strain in the body seams were experienced by the participants (50%) for whom the front body part was too narrow by 10-20 mm. Although the back width fit only 11.9% of the participants, the front body part was wider and compensated for the narrow back part, so that only 66.8% of the participants experienced strain in the side seams. Tension around the armhole and armpit was observed in movement 2, since the shoulder and biceps parts were too narrow. Since the sleeve length was too short for the participants in normal standing position and movement 2 was an elbow movement, the sleeve length was also too short for all participants in movement 2.

With the jacket of the pattern prepared with the Müller pattern system, participants for whom the back and front body parts were too narrow (38.3%) experienced strain in the side seams, tension around the chest and strain in the body seams. During the research, the sleeves turned out to be too short for all participants in movement 2, since the sleeve length was already too short for the participants in normal standing position and movement 2 was an elbow movement.

With the jacket of the pattern prepared with the Optikon system, tension occurred around the armhole and armpit since the biceps and sleeve parts were too narrow, as the upper arm muscles bulged although the arm itself was not in motion, and strain was experienced in the sleeve seams in the case of participants for whom the sleeves had to be widened by 20-25mm. Since the sleeve length was too short for the participants in normal standing position and movement 2 was an elbow movement, the sleeve length was also too short for all participants in movement 2.

With the jacket of the pattern prepared by ITKIB, tension was seen to occur around the armhole and armpit, since the arm biceps and sleeve parts were too narrow due to the bulging of the muscles of the upper arm, although the arm itself was not in motion. Like with movement 1, strain in the body parts was experienced by the same participants in this movement as well.

Like with movement 2, in movement 3 wearers of the jacket of the pattern prepared with the Metric pattern system experienced strain in the side seams, around the chest and in the body seams. Tension around the armhole was seen to occur as well as strain on the armpit, since the shoulder and biceps parts were too narrow although the upper arm was not in motion. For participants for whom sleeves were too short only by 10mm or less under normal conditions, the restriction was tolerable in this movement, whereas for the participants for whom the sleeves were too short by more than 20mm under normal conditions, they became too short in movement 3.

With the jacket of the pattern prepared with the Müller pattern system, participants for whom the back and front body parts were too narrow (38.3%) experienced strain in the side seams, tension around the chest and strain in the body seams in movement 3, just as they did in movements 1 and 2. In the case of those for whom the sleeves were too short by more than 20mm under normal conditions, the sleeves became even shorter in movement 3.

With the jacket of the pattern prepared with the Optikon pattern system, tension was seen to occur around the armhole and armpit since the biceps part was too narrow. In the case of participants for whom the sleeves were too short by more than 20mm under normal conditions, the sleeves were shortened even further in movement 3.However, for those for whom sleeves were too short only by 10mm or less under normal conditions, the restriction was tolerable in this movement.

With the jacket of the pattern prepared by ITKIB, no problems occurred when movement 3 was performed.

In movement 4, wearers of the jacket of the pattern prepared with the Metric pattern system experienced strain in the back seams due to the motion of back muscles and bones. Tension occurred around the chest since the front body part was too narrow for 66.8% of the participants. Although the back width fit only 11.9% of the participants, the front body part was wider and compensated for the narrow back part, so that only 66.8% of the participants experienced strain in the side seams and body seams. There was also tension around the armhole and armpit, since the shoulder and biceps parts were too narrow. Since the sleeves were too short in normal standing position, they were also too short for all participants in movement 4.

The jacket of the pattern prepared with the Müller pattern system created the same problems associated with the body seams in movements 1, 2 and 3 in the same participants. Since the sleeves were too short in normal standing position for all participants and the arm was extended from the shoulder by 90° in movement 4, the sleeves were too short for all participants.

With the jacket of the pattern prepared with the Optikon pattern system, tension occurred around the armhole and armpit in movement 4, since the sleeve and biceps parts were too narrow. Participants for whom the sleeves needed to be widened by 20-25mm experienced strain in the sleeve seams in this movement. Since the sleeves were too short in normal standing position for all participants, the sleeves were also too short in movement 4.

With the jacket of the pattern prepared by ITKIB, strain was seen to occur in the back seams due to the motion of the back bones. Since the biceps part was too narrow, tension around the armhole and armpit also occurred in movement 4.

Body Fit of Jackets in Experiment 1

Table 3. Fit of Jackets on Men's Bodies in Experiment 1

Problems	METRİK		MÜLLER		OPTİKON		ITKIB	
	differencemm.	f(%)	differencemm.	f(%)	differencemm.	f(%)	differencemm.	f(%)
Back width	0	7(11,9)	-10	7(11,9)	0	7(11,9)	0	7(11,9)
	10	30(50)	**0**	**30(50)**	10	30(50)	10	30(50)
	20	10(16,7)	10	10(16,7)	20	10(16,7)	20	10(16,7)
	25	13(22,1)	15	13(22,1)	25	13(22,1)	25	13(22,1)
Front body width	-15	20(33,2)	-10	37(61,4)	-15	37(61,4)	**0**	**37(61,4)**
	5	10(16,6)	10	10(16,6)	5	10(16,6)	20	10(16,6)
	10	13(21,6)	15	13(21,6)	10	13(21,6)	25	13(21,6)
	20	17(28,22)	-	-	-	-	-	-
Shoulder width	20	50(83)	7	50(83)	12	50(83)	15	50(83)
	23	10(16,6)	10	10(16,6)	15	10(16,6)	18	10(16,6)
Waist width	40	30(50)	-50	8(13,3)	-130	8(13,3)	-50	8(13,3)
	50	5(8,3)	-30	3(5)	-110	3(5)	-30	3(5)
	60	14(23,3)	-20	14(23,3)	-100	14(23,3)	-20	14(23,3)
	70	3(5)	-10	5(8,3)	-90	5(8,3)	-10	5(8,3)
	90	8(13,3)	**0**	**30(50)**	-80	30(50)	**0**	**30(50)**
Hip width	-130	60(100)	-60	60(100)	-12	60(100)	**0**	**60(100)**
Sleeve width (from elbow line)	-25	49(81,7)	**0**	**49(81,7)**	10	49(81,7)	**0**	**49(81,7)**
	-35	7(11,7)	10	7(11,7)	20	7(11,7)	10	7(11,7)
	-40	4(6,7)	15	4(6,7)	25	4(6,7)	15	4(6,7)
Biceps width	-15	1(1,7)	-40	1(1,7)	0	1(1,7)	-5	1(1,7)
	5	10(16,7)	-20	10(16,7)	20	10(16,7)	15	10(16,7)
	10	3(5)	-15	3(5)	25	3(5)	20	3(5)
	15	2(3,3)	-10	2(3,3)	30	2(3,3)	25	2(3,3)
	25	41(71,3)	**0**	**41(71,3)**	40	41(71,3)	35	41(71,3)
Sleeve length	10	47(78,3)	15	47(78,3)	10	47(78,3)	**0**	**47(78,3)**
	20	2(3,3)	25	2(3,3)	20	2(3,3)	10	2(3,3)
	25	1(1,7)	30	1(1,7)	25	1(1,7)	15	1(1,7)
	30	10(16,7)	35	10(16,7)	30	10(16,7)	20	10(16,7)
Height	25	52(86,7)	**0**	**52(86,7)**	15	52(86,7)	**0**	**52(86,7)**
	45	7(11,7)	20	7(11,7)	35	7(11,7)	20	7(11,7)
	50	1(1,7)	25	1(1,7)	40	1(1,7)	25	1(1,7)

- Plus (+) signs indicate lengthening/widening,
- Minus (-) signs indicate shortening/narrowing.

Analysis of the data obtained through the first experiment showed that back width and biceps width of the Müller pattern were appropriate, as were the front body, waist width, hip width, sleeve (from elbow line) width, sleeve length, and height measurements of the ITKIB pattern. Since the data indicated that the ITKIB men's jacket pattern fit the participants best, the necessary corrections were made on the ITKIB men's jacket pattern, and the jacket for the second experiment was designed. In the course of designing the pattern for the second experiment, several experimentations were conducted in order to achieve back and shoulder measurements, general body appearance and sleeve positions that fit the body as well as the four movements included in the research. At the stage when the pieces were joined during production, corrections were made through experimentations on men with measurements corresponding to Drop6/Size50, and the pattern for the second experiment was designed by incorporating each of these corrections into the pattern.

Findings of the Second Experiment

Movement 1 was seen to cause tension around the armpit and armhole as well as strain in the side seams since the sleeve was too narrow. Since both the waist and hip were too narrow, this also caused strain in the body seams in movement 1. The sleeves, which were too short for most participants under normal conditions, became even shorter in this movement. Another reason for the excessive shortening of the sleeves was that the armholes were too narrow. The sleeve and body were both seen to become tauter and the sleeve shorter as the sleeve and armhole tightened.

Although the upper arm is perpendicular to the ground in movement 2, strain was seen to occur in the joining seam of the side piece and the back piece of the sleeve due to the motion of the muscles. There was also strain in the armhole, resulting from both the bulging of the muscles of the upper arm, although the arm itself was not in motion, and the narrowness of the sleeve. Since movement 2 is directly associated with the elbow, the narrow sleeve led to tension in the elbow line. Since the jacket sleeve is short under normal circumstances, and the fabric has to accommodate to the curvature when the arm is flexed, a little shortening is normal. Tension on the armpit, on the other hand, should not be expected under normal conditions, because the upper arm is perpendicular to the ground. However, the motion of the upper arm muscles is necessary so that the lower arm can move to the front by 145°. While tautness occurred at the point where the back and side parts join with the sleeve, due to the narrowness of the sleeve and the armhole, the front piece was seen to penetrate too deeply into the armhole at its **ae** point part. The strain in the sleeve seams was due to the same reason.

In movement 3, the reason for the tension around the armhole and armpits well as the strain in the sleeve seams was seen to be narrowness of the sleeve, not the movements. Since the movement was not a very sharp elbow movement, the elbow line was seen to be stretched in the participants for whom the sleeves needed to be widened by 15mm and more. Participants for whom the sleeves were seen to shorten in this movement turned out to be the same participants for whom the sleeves also had to be lengthened by 30 mm in normal standing position.

In movement 4, strain was seen to occur in the back seams since the sleeves were too narrow. The narrowness of the sleeve was seen to cause strain around on the armhole, tension on the armpit and strain in the sleeve seams. Since the waist and hip were too tight, strain in the body seams was also seen to occur in movement 4. The sleeves, which were too short for most of the participants under normal conditions, were shortened even further in movement 4. This shortening in the sleeve length in movement 4 was seen to occur due to increasing tautness as the armhole narrowed.

Comparisons of the Men's Jacket Pattern prepared by ITKIB and the Corrected Second Pattern

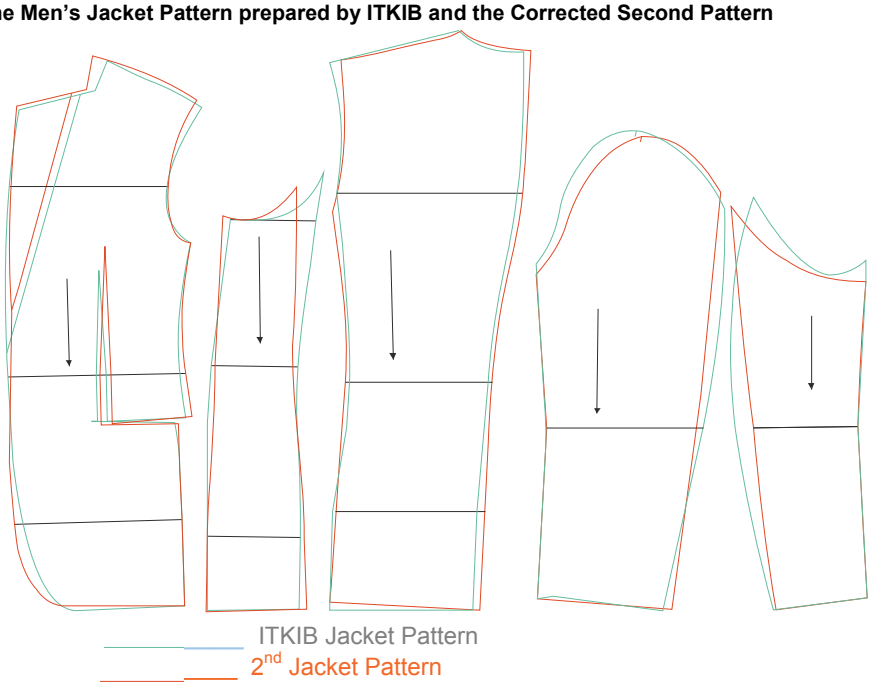


Figure 2. Comparison of the Men's Jacket Pattern prepared by ITKIB and the Second Pattern

Body Fit of Jackets in Experiment 2

With the second jacket pattern, the back width fit 84.8%, of the participants, the front body width fit 92.7%, the sleeve length fit 62.4% and jacket length fit 93.3% of them. The shoulder part was too narrow by 12mm for 79.4% of the participants, while the waist was too narrow by 15mm for 77%, the hip was too narrow by 15 mm for 69.1% of them. Similarly, the sleeves were too narrow by 15mm for 86.7%, and the biceps part too narrow by 15mm for 87.3 of the participants.

Corrections were made on the pattern by taking into account these findings. Several experimentations were conducted on men with measurements corresponding to Drop6/Size50 in order to achieve a pattern that fit the four movements included in the research. The recommended pattern was designed by incorporating each of these corrections into the pattern.

In movement 1, 0.8% of the participants who experienced strain in the side seams, tension around the chest and strain in the body seams were seen to experience these problems while performing the movement since they were slightly overweight. 0.8% of the participants who experienced shortening of the sleeve and tension around the armhole and armpit experienced these problems since the sleeves were too narrow. For 4.5% of the participants, the sleeve was seen to be too short in movement 1 since it was also too short under normal conditions.

2. Comparisons of the Experiment Jacket Pattern and the Jacket Pattern developed in the Research Process

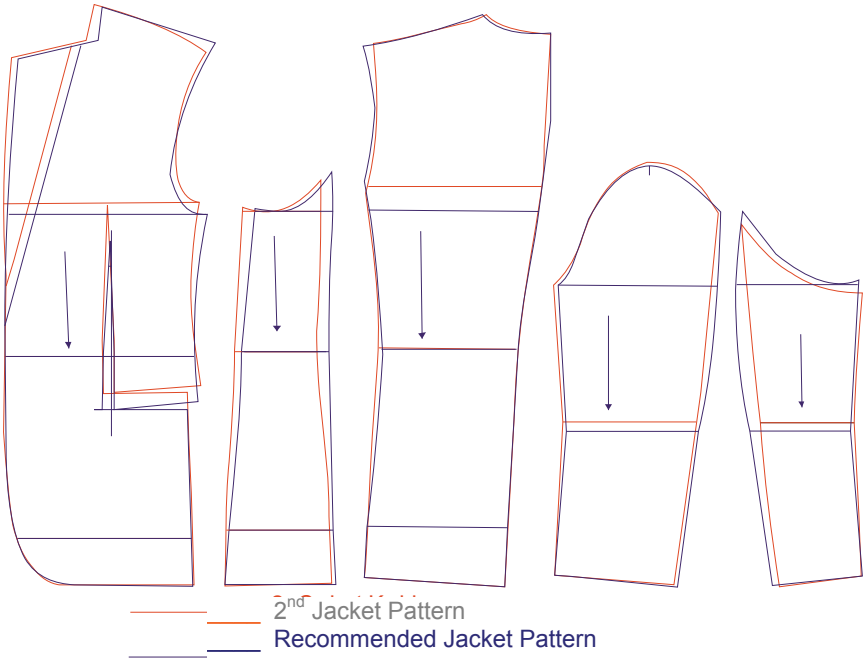


Figure 3. Comparisons of the Jacket Pattern from the Second Experiment and the Jacket Pattern developed in the Research Process

Findings of the Third Experiment

Image 1. Movement 1, 90˚ point

Image 2-3. 2nd Movement 145˚ Point

In movement 2, 0.8% of the participants who experienced strain in the side seams, tension around the chest and strain in the body seams were seen to experience the strain in the body seams since they were slightly overweight, and 1.5% experienced these problems while performing movement 2 since the front body part was too narrow. The tension around the armhole experienced by the participants whose sleeve and biceps parts were too narrow was seen to result from both the bulging of the muscles of the upper arm, although the arm itself was not in motion, and the narrowness of the sleeve. A movement directly associated with the elbow, movement 2 caused normal stretching in 99.2% of the participants which was not seen as a problem. In the participants for whom the sleeves were too short under normal conditions, this shortness was intensified in movement 2. By nature of the movement, some little shortness in 95.5% of the participants is considered normal.

In movement 3, 0.8% of the participants who experienced strain in the side seams, tension around the chest and strain in the body seams were seen to experience these problems since they were slightly overweight, and 1.5% of those experiencing strain in the side seams had these problems since the front body part was too narrow. The tension around the armhole experienced by the participants whose sleeve and biceps parts were too narrow was seen to result from the narrowness of the sleeve. Considering that some extent of shortening is normal since movement 3 is an elbow movement, this amount was disregarded.

During the research, 0.8% of the participants were seen to experience strain in the side seams, tension around the armhole and armpit, and strain in the sleeve seams due to the narrowness of the sleeve. Those participants who experienced strain in the side seams, tension around the chest and strain in the body seams (0.8%) were seen to experience these problems since they were slightly overweight, and those experiencing strain in the body seams (1.5%) had these problems since the front body part was too narrow.

Body Fit of the Pattern developed in the Research Process to Men's Bodies

Back, shoulder, sleeve and biceps parts needed to be widened by 15 mm in 0.8% of the participants, while the front body width fit 97.7% of the participants, and the shoulder width fit 98.6% of the participants. The waist and front body parts were too narrow for 0.8% of the participants due to slight pot bellies, whereas the hip width fit 100% of the participants. The sleeve and biceps widths fit 99.2%, the sleeve length fit 95.5%, and the jacket length fit 76.7% of the participants.

Image 4-5. 3rd Movement

Image 6. 4rd Movement

Image 7. Front View

Image 8. Back View

Image 9. Side View

CONCLUSIONS

In this research, an ergonomic classic jacket pattern was designed that allowed comfort while performing the 4 upper body movements included in the research.

The classic jacket pattern created in this research is recommended to the ready-made clothing sector, to educators, and students.

In the education system, apparel design instruction should ensure that students learn to carry out the designs with due consideration for garment fit and freedom of movement.

The recommended jacket pattern fits the measurements corresponding to Drop6/Size50. Companies and researchers may continue the production of this jacket pattern in accordance with other measurements and analyze its fit and comfort for men with different measurements.

Similar studies may also be conducted for different products by the companies in the sector and researchers.

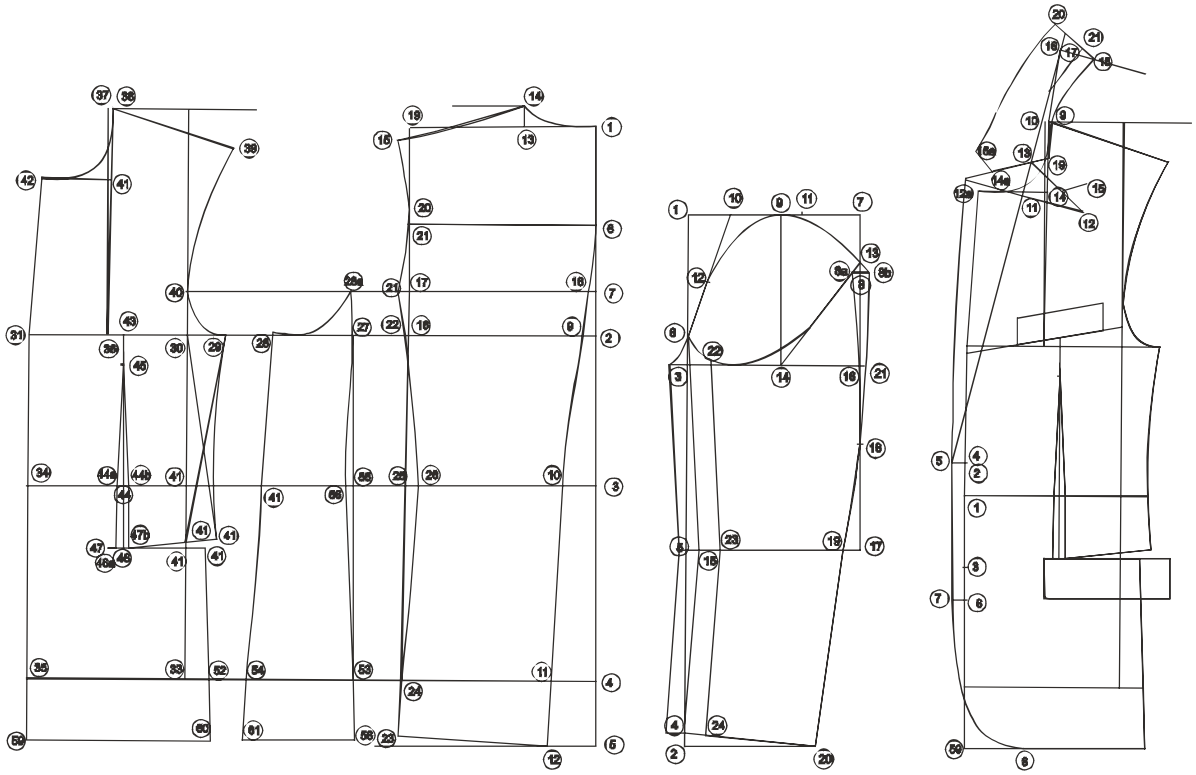


Figure 4. Body Drawing of the Recommended Jacket Pattern

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