DESIGNING OF HEALTH-SAVING MEN'S GLOVES

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ABSTRACT

Living during a COVID-19 pandemic has negative effects on a person's psychophysiological state such as high-stress levels, leading to poor health, chronic fatigue and insomnia. As a result, the immunity is reduced, which is particularly dangerous today. One way to solve this problem is the use of health-saving clothing, which has additional features that provide the positive effect on the wearer's body. The developed gloves affect the state of the human autonomic nervous system through biological-active locations in the places of the hand and wrist. An anthropometric study of the biological-active locations of the wrist and hand is performed to construct the glove design. An algorithm for constructing a drawing of the design of the designed product based on four measurements is proposed. The effectiveness of the adaptive gloves is confirmed by studying its effect on the psycho-emotional and psychophysiological state of a person without exposure to the product and after its use by software "Intera-Diacor" and "ROFES", and a questionnaire. The evaluation is performed after wearing gloves for 20-40 minutes. It was found that 83.3 % of the wearers of the health-saving gloves showed positive changes in the body's compensatory forces (stress) and the state of internal emotional fatigue. Thus, the use of health-saving gloves has a positive social, therapeutic (health-saving) and economic effect, as the product has several functions It is an accessory fashion, has hand protection, and, has additional features to positively influence the body of the person wearing it. This allows the future to talk about the use of consumer-friendly and effective ways to correct the men's psycho-emotional and psychophysiological states, based on the safer-by-design concept.

KEYWORDS

Health-saving clothing; Health-saving gloves; Energy-information influence; Therapeutic properties clothing; Safer-by-design concept.

INTRODUCTION

Living during a COVID-19 pandemic has negative consequences on a person's psychophysiological condition, such as high-stress levels, malaise, chronic fatigue, and insomnia. As a result, immunity is reduced, which is particularly dangerous today. Therefore, it is necessary to create and develop new alternatives to improve human health and reduce the negative effects of stress.

There are many potential subjects for future research today, including the use of clothing for health savings [1-5]. An important point in improving the life cycle of clothing is providing clothing with predictable and additional functions that positively influence the body of the wearer [3, 4, 6-10]. This feature is interesting and can make clothes more effective.

Analysis of the purpose of modern gloves showed that there are products for not only one purpose. Most gloves are multifunctional. They are an accessory fashion, a means of protecting human hands, and have additional features. The use of gloves with advanced functionality saves money and time for the consumer and improves his quality of life [8-10].

Based on the analysis and systematization of information [2-12], we determined that gloves' most common additional functions are functionally compatible, adaptive, smart functions, and corrective capabilities. The wearable sensing products and sensory feedback devices that record and enhance the sensations of the hand are used in healthcare, prosthetics, robotics, and virtual reality [6, 7, and 9]. The gloves with smart functions permute continuous monitoring and treatment administered throughout an individual's daily life [8, 9]. The gloves with corrective capabilities are aimed at correcting the condition of the person wearing them due to therapeutic or prophylactic properties [3, 10].

The production methods of clothing with predictable and additional functions are the transformation of garments [13, 14]; the use of additional elements (devices, mechanical sensors, overlays, etc.) [4-11];

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the use of new multifunctional textile (nanoparticles, modifier, etc.) [2, 12, 15].

The main characteristic of effective useful clothing is comfort [16]. Comfort is a state of mind influenced by a range of factors: physical, physiological, and psychological.

The predicted health-saving properties of gloves are the improvement of the psychophysiological state of the human body, the reduction of stress, and its negative consequences. To do this, it is proposed to influence the biological-active locations (BALs) of the hands. Such places are a set of acupoints (APs) that have a reflex connection with the internal organs and organ systems, in particular with the organs of the autonomic nervous system. Today, scientists [4, 17-20] have proven the effectiveness of the influence of elements of different origins on APs and BALs of a person. These advances are already used to create functional clothing [4, 20].

The studies [21-23] show necessary anthropometric research of hands to design gloves with additional properties, which can be used for developing health-saving gloves, 3D models of hands, and, also, for designing tools and hand protection.

Establishing textile requirements for garments is an important step in the development of health-saving gloves. Textiles should be indifferent (neutral) and not have an obvious positive or negative energy-information influence on the human body. To select indifferent textiles, it is necessary to determine the level of energy-information influence of textiles on the human body [2, 4, 16, 20].

The health-saving gloves with extended functionality should fit snugly around the palms and fingers and not exert excessive pressure on them. Such textiles must be strong, resistant to mechanical influences, to the action of water, and have high hygroscopicity, air permeability, and softness. A review [24-26] has revealed that the main textile used in the manufacture of such products are a knitted fabric.

Therefore, it is necessary to analyse in more detail the two ways to give the product additional properties - the use of nanomaterials and the use of additional elements.

Nanotechnology is widely used in the industrial and consumer sectors and has the potential to grow further and expand globally. Nanomaterials in clothing can provide him with the following additional properties: antimicrobial activity, conductivity, static electricity or UV protection, fire or water resistance, transfer of medicines, medical and cosmetics, aesthetics and self-cleaning, etc. [4, 15, 27].

The potential of nanotechnology is surely positive. However, there are also negative effects and potential harm of nanotechnology, which can be summarized:

- the possibility of nanotoxicity on human health;
- environmental implications of the nanocomposite's relation with materials and biological systems in the environment;
- dissemination of toxic, persistent nano substances originating environmental harm;
- high energy requirements for synthesizing nanoparticles;
- lower recovery and recycling rates;
- lack of trained engineers and workers [27, 28].

Many textiles with therapeutic or prophylactic properties have antimicrobial silver nanoparticles. However, some nanoparticles are harmful if released into the environment. The environment contains innumerable bacteria and other microbes, and nanoparticles designed for antibacterial activity are evidently going to continue that activity wherever they are. Being ultra-small, nanoparticles are highly mobile, and it is extraordinarily difficult to contain and control; some of them be released when the textiles are laundered [27, 29].

Besides nanoparticles, penetrating into the human body may simply dissolve, and if the dissolution products (e.g., metal ions) are toxic then the nanoparticles must be deemed toxic. If they do not dissolve (e.g., blue asbestos fibres), depending on the surface chemistry they may trigger an inflammatory immune response, which may have secondary adverse effects [28-31].

Based on this a safer-by-design concept has become increasingly important in risk assessment for consumers.

The exploration of stakeholder perceptions is essential to ensuring that robust risk governance processes are in place for nanotechnology and nano-related products. This study [31] shows to need of improving the multiparametric approaches to the safer-by-design concept of nanoproducts. The main aspect is the definition of the long-term influences of nanoproducts on people's health and the environment.

In addition, the authors [30, 31] recommended that a specific mechanism should be put in place for the safe handling, use, and disposal of nanoproducts, beginning from research and production to consumption and possible recovery or recycling.

Another product with additional properties is smart clothing, created using fusion technology, which combines electronic devices and clothing design. This design process requires a combination of several general different characteristics - electronic efficiency, electrical safety, physical comfort, and clothing aesthetics [32]. Smart clothing design is not considered in this study.

Expansion of apparel functionality, providing it with therapeutic and prophylactic properties, provides the use of medical prophylactic applicators [4, 20, 33].

Analysis of the various metal properties as a means of influence [4, 20, 33-37] shows that the use of silver

allows providing energy-information influence the functional state of the human body, and improving the hygienic properties of the product. Silver has hypoallergenic and antibacterial properties.

However, the design of health-saving gloves should be performed following the general trends of sustainable fashion, so it is advisable to provide for the possibility of disassembly of gloves into components after the end of their service life.

The therapeutic and prophylactic effect of gloves is provided by the use of means of influence - the silver plates containing therapeutic information. Silver plates have a round shapes, diameter – of 5 mm, and thickness – of 0.4 mm. They locate between the lining and the main material of the product. The placement of these plates should correspond to the BALs of the human body, which have a reflex connection with the internal organs and systems of the body. The essence of information waves therapy is that information is subject to influence and control [38]. The biological information of therapeutic and therapeutic content, obtained from drugs, is stored and transmitted through bio molecular structures. At the same time, APs have a higher electrical conductivity than surrounding tissues [39]; therefore, BALs had better-perceived treatment and prevention information. The local influence of means on certain BALs of an organism causes reactions in bodies and systems of bodies, which can restore their normal functioning [4, 20, 21].

Therefore, based on the safer-by-design concept, the main goal of this paper is to develop new gloves with additional properties to reduce the negative effects of stress and improve the positive influence on the body and immunity of the owner.

METHODOLOGY

Conceptual design principles help create predictable products early in the design phase. However, a general methodology for creating health-saving clothing has not yet been proposed.

Several stages of health-saving clothing design have developed, which, in addition to consumers' basic needs, consider additional functions related to health. These stages are the establishment of primary data (predicted properties) required for the clothing production process; the establishment of the textile requirements; the development of primary and model design of clothing; the development of methods of the technological processing; and the evaluation of clothing efficiency.

The predicted health-saving properties of gloves are the improvement of the psychophysiological state of the human body, the reduction of stress, and its negative consequences.

This method is a simple and an effective therapeutic method of stress correction. Therapeutic (health-saving) properties of gloves are provided by the influence of elements of information and wave therapy on BALs of a hand and a wrist. The treatment and prophylactic information on them is written; it provides a corrective effect on an organism of wearers of the gloves.

The health-saving properties of health-saving gloves should be at the maximum contact of silver plates with BALs of the hand and wrist. The locations of such BALs for the design of health-saving gloves are described in Table 1 and [20].

The studies [2, 4, 16, 20, 33] have confirmed the effectiveness of the use of software diagnostic complex (SDC) "Intera-DiaCor" (Register of Medical Technologies of Ukraine from 30.10.2009 № 3277/2004) for textile evaluation of energy-information influence on the functional state of organs and systems of the human body on the cellular level [16]. SDC "Intera-DiaCor" consists of a device for electropuncture diagnostics (DEPD), two electrodes for local electronic diagnosis, and software installed on a personal computer (PC) (Figure 1).

The method used in this study is the following (Figure 1): on the skin areas (1) of the palms, feet, and a face of the person fix the "active" (2) and "passive" (3) electrodes for local electronic diagnosis. Through the electrodes from the device for the DEPD (4), electrical impulses are applied to the skin areas (1), and they also register the frequency-wave characteristics of organs and organ systems. Information from the device for DEPD is transmitted to the PC (5), where the data is processed using the software "Intera-DiaCor", which allows getting a beginning diagnosis of the functional state of the human body. After that, a sample of investigated knitted fabric is introduced into the contour of the "passive" electrode and the frequency-wave characteristics of the organs and systems of the human body are repeatedly recorded with the influence of investigated sample.

Table 1 Topography of the BALs of the hand and wrist of a person

Information wave therapy place – BALs	**Placing of BALs**
BAL-50	On the back of the forearm. The center of the place is 3 cm above the radial-carpal joint, between the radial and ulnar bones. The diameter of the place is equal to the width of the forearm at this level
BAL-51	On the palmar side of the forearm. The center of the place is on the midline, 3 cm above the radial-carpal fold. Width - 1/3 of the diameter of the forearm at this level. Length – 2/3 of the diameter of the forearm
BAL-52	The area includes the thumb and forefinger of the hand, the styloid process of the radial bone, and the radial third of the radial-carpal joint
BAL-53	The area includes the little finger and the lateral half of the ring finger, the styloid process of the ulna, a third of the radial wrist joint
BAL-54	The area includes the distal phalanx of the middle finger on the palmar and dorsal sides

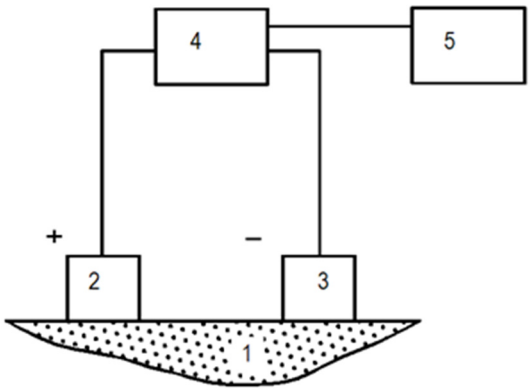

Figure 1. The scheme of SDC "Intera-DiaCor" (Ukraine): 1 – human skin; 2 – "active" electrode for local electronic diagnosis; 3 – "passive" electrode for local electronic diagnosis; 4 – DEPD; 5 – personal computer

After two complete cycles of diagnosis, the results of the evaluation of the functional state of organs and systems of the human body are compared without affecting the textile and it. For that, the histograms that reflect the three basic conditions of the organs and systems of the human body are compared to the PC monitor:

- energy lability (upper histogram columns);
- energy instability (middle histogram columns);
- energy insufficiency (bottom histogram columns).

Energy lability is the standard and reflects relatively stable energy processes in organs and systems. Energetic instability shows instability and tension in energetic processes. Energy insufficiency indicates the depression of the energy processes of organs and systems, which leads to the depletion of the functional state of the human body.

These histograms allow us to analyze the state of organs and systems of the human body, which have occurred or not occurred positive or negative changes under the textile influence. The higher the column height, the better the energy and functional state of the organ. The level of negative and positive energy-information influence of textile on the human body, as well as its inertness, is evaluated by the numerical values of the coefficients K_N, K_P, and K_i, respectively:

1) Level of negative energy-information influence of textile on the human body:

$$k_N = K_N / K_D, \quad (1)$$

2) Level of positive energy-information influence of textile on the human body:

$$k_P = K_P / K_D, \quad (2)$$

3) Level of indifferent energy-information influence of textile on the human body:

$$k_I = K_I / K_D, \quad (3)$$

where K_N – the number of organs or systems of the human body, in which functional and energy state there were negative changes, caused by the influence of the textile; K_P – the number of organs or systems of the human body, in which functional and energy state there were positive changes by the influence of the textile; K_I – the number of organs or systems of the human body, in which functional and energy state there not were changed by the influence of the textile; K_D – the number of diagnosed organs of the human body.

The value of each index is less than one, respectively, the sum of all three indexes is equal to one:

$$K_N + K_P + K_I = 1. \quad (4)$$

The next stage is the development of basic and model designs of clothing. Anthropometric research allows determining the size of BALs (Table 1) on the surface of the human body, their length, and their width. These results are required for the construction of parts of the basic glove designs [21].

A model design of gloves is developed by analyzing the range of 200 modern gloves [40-42].

For the manufacture of health-saving gloves, additional operations are performed to connect the plates to the parts of the gloves. Plates in gloves are placed in the cells formed by machine stitches, between the details of the lining and overlays. Accordingly, the technological processing of gloves performs in two stages. The first stage is the sewing of the overlays' details with the lining of the product, the placement of silver plates between them, and the making of the lining of the gloves; the second stage is the making of the main parts and the montage of gloves.

The authors of this article developed a method for evaluating the effectiveness of wearing gloves. According to the method, the assessment of the psychophysiological state of the human body is performed successively in two ways with and without the influence of the product. To do the first way, it is proposed to use the psychological questionnaire of the psycho-emotional state of a person "Well-being - Activity - Mood" ("WAM") [43]. This questionnaire is effectively used to study the psycho-emotional states of athletes and students [44, 45].

"WAM" is a complex of subjective sensations that reflect the degree of physiological and psychological comfort of a person's state, the direction of thoughts, feelings (bad or good well-being, cheerfulness, malaise, a feeling of discomfort in different body parts, etc.) [45].

For self-assessment, an answer sheet is offered with 30 opposite characteristics of well-being, activity or mood, which are characterized by polar assessments with intermediate values on a scale from 1 to 9 for each person. Three "WAM" scales determine the arithmetic average of the respondents' subjective assessment. The obtained points for each of the three states in the range from 4.0 to 9.0 indicate the optimal state of the

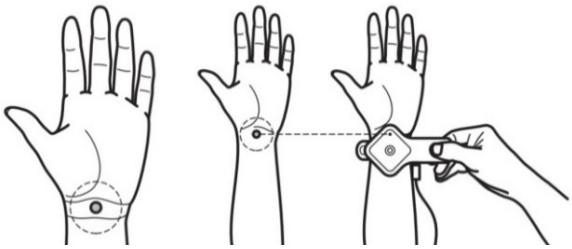

Figure 2. The location of the electrode before the scanning of psychophysiological state of the respondent by the device "ROFES".

respondent. Values below 4.0 points indicate a decrease in well-being, activity and a mood of the respondent [44].

The second way involves assessing the psychophysiological state of man with the device "ROFES" (Certificate of Conformity No. TA 380 14 2243, Tüv Austria CERT GMBH). The device determines psychophysiological indicators: the tension of the body's compensatory forces (the presence of stress), the state of internal psycho-emotional fatigue, the presence of signs of neurosis and irritability [46].

The effectiveness of wearing health-saving gloves is determined by the evaluation in two ways without the influence of the product and with it.

At first, the researchers notify the respondents about the conditions of the experiment to avoid stressing in the face of the unknown.

The first cycle of assessment of the psychophysiological condition of the respondent is carried out without health-saving gloves. For an assessment of the state of well-being, activity, and a respondent's mood the respondent chooses for himself the number that best reflects the relationship between these indicators.

After that, the psychophysiological state of the respondent is assessed without the influence of health-saving gloves by "ROFES". To do this, the "ROFES" electrode is fixed at the level of the APs or BALs on the wrist of the left hand of the person (Figure 2), and the process of scanning the state of the respondent's body begins.

The device is fixed to the left hand so that an active electrode is situated on the APs on the left wrist. After the device has been turned on, it sends a weak electric signal and registers how it is changing. After that, the computer program compares the obtained result with the standard one, which is typical of a healthy person of the same age. The results of the study are displayed on the PC screen in the form of a five-point assessment of the body. In addition to assessing stress, fatigue, and nervous tension, "ROFES" assesses the general state of health and 17 organs and systems [47].

The second cycle of assessment of the psychophysiological state is carried out after the subject has worn gloves minimum of 15 minutes. The respondent takes off the product and the researchers evaluate its state in two ways. However, first, assess the psychophysiological state of the human body using "ROFES", and then conduct a second interview with the questionnaire.

The analysis of the diagnostic results using "ROFES" is carried out by comparing the five-point scales of the psychophysiological state of the examined person before and after the application of the product.

The authors propose to determine a complex indicator of the state of people Kr, which is calculated as the arithmetic mean for three measured values:

for assessing by "WAM"

$$K_{r\,\mathrm{WAM}} = (I_W + I_A + I_M) / 3, \quad (5)$$

for assessing by "ROFES"

$$K_{r\,\mathrm{R}} = (I_s + I_e + I_n) / 3, \quad (6)$$

where I_W – assessment of the psycho-emotional state of person's "Well-being", score; I_A – assessment of the psycho-emotional state of a person "Activity", score; I_N – assessment of the psycho-emotional state of a person "Mood", score; I_s – assessment of compensatory forces (the presence of stress), score; I_e – assessment of the state of internal emotional fatigue, score; I_n – assessment of the presence of signs of neurosis, irritability, score.

The value of the complex indicator of a person's psycho-emotional state ("WAM") shows that at 6.5...9.0 points, the respondent's emotional state according to subjective feelings is at a high level. With 4.0...6.49 points, a person has an average level of well-being, activity and mood, which may indicate the development of fatigue processes according to their own feelings. The low levels of values of the complex indicator of a person's psycho-emotional state (at 0...3.99 points) indicate that, according to self-assessment, a person at the time of the survey has difficulty adapting to psycho-emotional loads or stressful situations and needs help.

The scale for assessing the complex indicator of the psychophysiological state of man is given in Table 2.

The proposed method makes it possible to study the psycho-emotional and psychophysiological state of the human body, identify the presence of stress, and assess the effect of the developed products on the psychophysiological state of the human body.

Therefore, the methodology for designing clothing with extended functionality has been developed and described. At the same time, particular attention is paid to the needs of consumers to improve the psychological and physiological state of the owner while wearing clothes, including health-saving gloves.

Table 2. Scale of a complex indicator of a person's psychophysiological state by "ROFES" [46].

The value of the complex indicator ("ROFES")	The level of compensatory forces of the body	Interpretation of state assessment
4.4…5.0	high	The energy organs' resources is high, optimal loading. The risk of disease development is minimal or a compensated process, lack of internal emotional fatigue, no stress, neurosis
3.5…4.3	the medium is close to high	The energy organs' resources is good, insignificant loading. Low risk of disease development or a compensated process, no stress, neurosis, there is slight psycho - emotional fatigue
2.6…3.4	average	The energy organs' resources is decreased, which is a loading consequence. There is a middle risk of disease manifestation, internal emotional fatigue, minor signs of stress, and neurosis
1.7…2.5	the middle is close to the bottom	The loss of energy organs' resources is a heavy loading consequence. The risk of disease development with prolonged exposure to this state is increased, and there are significant psycho-emotional load, signs of stress, and neurosis
1.0…1.6	low	The large loss of energy organs' resources is observed as an excessive load consequence. The risk of disease development with prolonged exposure to this state is high, state of overexertion (stress, neurosis), strong psycho-emotional stress

RESULTS AND DISCUSSION

Materials

The gloves are made from the top material, lining, overlay parts, interfacing, finishing materials, etc. According to [10, 12, 19], the textiles for the men's health-saving gloves were selected as knitted fabrics.

Earlier it was noted that textiles should be neutral to the human body. Since the lining and the overlay details have close contact with the BALs, the energy effect of these materials on the human body is evaluated in the paper. We chose three ready-made samples of knitted fabrics for the lining and the overlay parts of gloves, which we named KF1, KF2, and KF3. Next, we determined the properties of these fabrics (Table 3).

In order to choose thin knitwear for the lining of the gloves, the thickness and weight were investigated. To ensure high hygienic properties, the hygroscopicity and normal moisture of the selected knitted fabrics are determined. For the selection of allowances for the construction of the gloves, breaking load and extensibility were investigated.

Studies have shown that knitted fabrics with such properties (Table 3) can be used for the lining and the overlay parts of gloves. To select indifferent textiles, it is necessary to determine the level of energy-information influence of knitted fabrics on the human body by "Intera-DiaCor" according to the method described above. The results of the study are presented in Table 4.

The analysis showed that the highest level of indifference for the functional state of the human body (0.86…0.97) has a knitted fabric KF1 (Table 4). Such results indicate the absence of excessive positive or negative energy-information influence on the state of organs and systems of the human body caused by knitted fabric. Therefore, we recommended textile KF1 (Table 4) as the lining and the overlay details for the manufacture of health-saving gloves.

As result, the men's health-saving gloves are made of a package of materials: layer 1 (top) - knitted fabric "Double knit interlock" (weight 680 g/m2, 80 % Polyester, 20 % Cotton), layer 2 - overlay parts (Table 3, option KF1), and layer 3 - lining (Table 3, option KF1). Also, the health-saving gloves can have artificial or natural leather overlays. They make it possible to extend the time of wearing gloves.

Development of design of men's health-saving gloves and their technology

To design health-saving gloves, an anthropometric study of the size of the BALs of the men's wrist and hands was conducted.

To find the relationship between the area of the bases, and the necessary measurements for the manufacture of gloves, we chose wrist circumference, hand girth, hand length, hand width, thumb length and little finger length [8-10]. In addition, we proposed to measure thumb circumference, middle finger circumference and forearm width. These measurements are needed to determine the place of BAL-50 and BAL-51. The results of the anthropometric study are presented in Table 5.

We determined the high correlations between wrist circumference and forearm width (0,98), hand length, and thumb circumference (0,71). Therefore, we obtained the values of main and additional measurements that allow you to set the size and place of the required BALs.

Table 3. Some properties of knitted fabrics for the men's health-saving gloves (lining and overlay parts).

Designation, structure of knitted fabrics ISO 8388: 1998 [E/F]	Code of knitted fabrics	Raw material composition, [%]	Thickness [mm] DSTU ISO 5084:2004	Weight [g/m^2] DSTU EN 12127: 2009	Hygro-scopicity [%] DSTU GOST 3816:2009	Normal moisture [%] GOST 8845-87	Breaking load, [N] DSTU EN ISO 13934-1:2018		Extensibility, [%] GOST 8847-85	
							Wales	*Courses*	*Wales*	*Courses*
plaited jersey fabric	KF1	CO 100	0.8	214.6	15.3	0.2	586	368	1.0	11.0
plain jersey fabric	KF2	CO 92 / EL 8	0.8	361.6	6.1	4.5	156	239	7.5	8.2
plain jersey fabric	KF3	CO 93 / EL 7	1.4	365.7	12.2	3.2	274	168	29.5	26.0

Table 4. Levels of energy-information influence of knitted fabrics on the human body.

Levels of energy-information influence of knitted fabrics on the human body	Number of person					
	1	*2*	*3*	*4*	*5*	*6*
KF1						
negative (k_N)	0	0	0.02	0	0.07	0
positive (k_P)	0.07	0.03	0.03	0.05	0.07	0.09
indifferent (k_I)	0.93	0.97	0.95	0.95	0.86	0.91
KF2						
negative (k_N)	0	0.02	0.02	0	0.12	0.02
positive (k_P)	0.12	0.02	0.02	0.23	0.12	0.18
indifferent (k_I)	0.88	0.96	0.96	0.76	0.75	0.8
KF3						
negative (k_N)	0	0	0.03	0	0.21	0.02
positive (k_P)	0.13	0.04	0.02	0.13	0.15	0.20
indifferent (k_I)	0.87	0.96	0.95	0.87	0.64	0.78

Table 5. Statistics of anthropometric study of the men's wrist and hands.

Statistics	Wrist circum-ference	Hand length	Hand width	Hand girth	Thumb length	Thumb circumference	Little finger length	Middle finger circumference	Forearm width
Arithmetic mean, cm	18.40	19.70	9.44	21.15	8.37	6.3	6.73	3.72	9.65
Standard deviation, cm	1.33	1.38	0.98	1.45	1.49	0.75	0.93	0.67	1.12
Standard error of the mean	0.24	0.25	0.17	0.26	0.27	0.13	0.17	0.12	0.20
Median, cm	18.00	20.00	9.20	20.85	8.00	6.50	6.70	5.70	10.00
Mode, cm	18.00	20.00	0	20.50	8.00	6.50	7.00	6.00	9.50
Excess coefficient	0.35	0.62	1.29	1.31	-0.11	1.46	-0.14	0.28	-0.60
Asymmetry coefficient	0.63	-0.76	0.27	0.15	0.51	-0.89	0.21	-0.10	-0.56
Sample minimum, cm	16.00	16.00	7.00	17.20	6.00	4.00	5.00	5.00	7.00
Sample maximum, cm	22.00	22.00	12.00	24.20	12.00	7.50	9.00	7.00	11.10

Analysis of the range of 200 modern products of hand wear [8-10, 26, 40-42] demonstrated that the vast majority of them 155 (77.5 %) are gloves. The methods of fixing modern gloves on the wrist are a cuff with a textile fastener (37 %). Other closures include an elastic fastening (22 %), an elastic cuff (19 %), an inelastic cuff (7 %), and 15 % of the gloves do not have a wrist fastening placket.

Analysis of the most popular model designs of gloves shows that the most common model design of gloves is model that has sewn back and palm parts, arrow-strip between them, thumb part with an insert (finger wedge), which is sewn to the palm part of the gloves. Frequency of occurrence this model design is 33.5 %.

Due to that, the most common model design is MC4, we chose it as basic to design men's health-saving gloves. To improve the aesthetics of gloves, it is recommended supplement them with finishing materials and sewing accessories. They can be placed on the palm part or back [8-10, 26, 40-42].

The four main measures of the men's hand and obtained anthropometric correlations were used to construct the design of men's gloves according to the method "M. Müller & Sohn" [48].

Thus, when constructing a drawing of the glove, we took into account the sizes of BAL-50 and BAL-51, which are placed on the back and the palm of the forearm, respectively. We also recommend making gloves with a 7.5 cm wide cuff ready-made. This width of the cuff allows you to completely close these areas and ensure the necessary fit of the influence elements on the body. Places BAL-52 and BAL-53 fully correspond to the measurements used in the construction of gloves. Place BAL-54 is located on the distal phalanx of the middle finger; its length is 5.0 cm. To ensure the effectiveness of the functions of the gloves, their details are constructed taking into account the size of these places.

The sketch of appearance of men's health-saving gloves for correction of a psychophysiological state of an organism is presented in Figure 3.

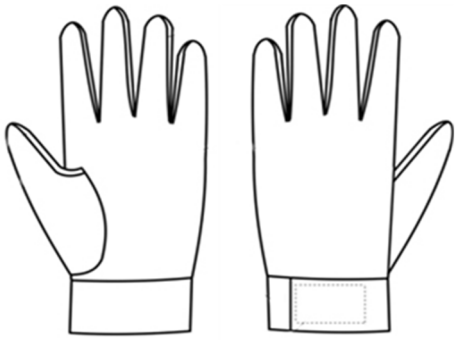

Figure 3. Men's health-saving gloves.

The scheme of construction a drawing of a top, a lining and overlays of gloves (Figure 4) was developed. Areas of gloves with the influence elements are shaded on Figure 4.

Based on the received drawing of men's health-saving gloves, derivative patterns of overlay details are made. The necessary quantity of silver plates and their placement on details are calculated. Silver plates are located between the lining and overlay details of men's health-saving gloves in places that are projections of the corresponding BALs of the human body. We chose the distance between the plates of 30 mm accordingly to [4, 20] (Figure 5).

The appearance of men's health-saving gloves from the inside out showed the places of the BALs after the operations to connect the plates with the part of the gloves (Figure 6).

The plates were placed in the cells formed by machine stitches between the lining and overlay details. The proposed methods of technological processing of men`s health-saving gloves are presented in Figure 7.

In the work [4], the technology of joining materials and influence means of the men's underwear is justified.

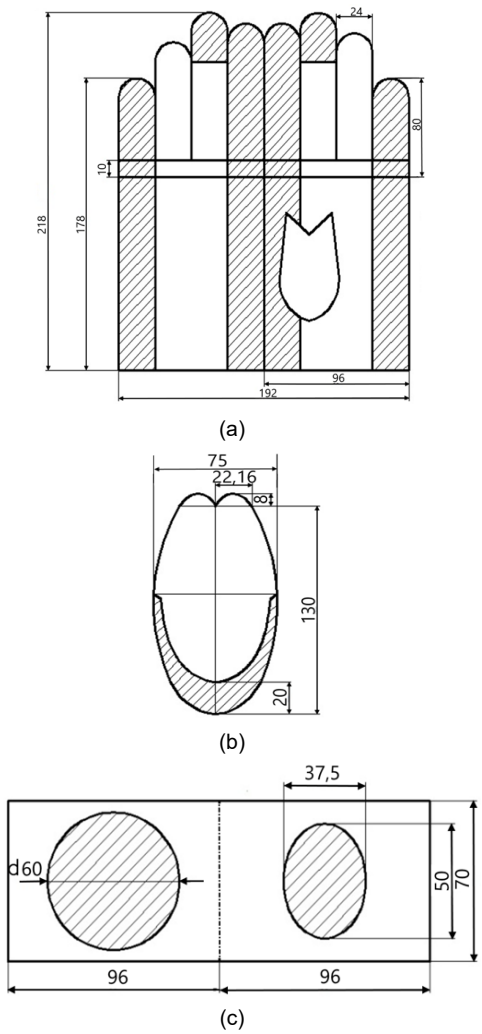

Figure 4. Drawings of a top, a lining and overlay details of men's health-saving gloves: (a) a back part and palm part; (b) thumb insert; (c) cuff.

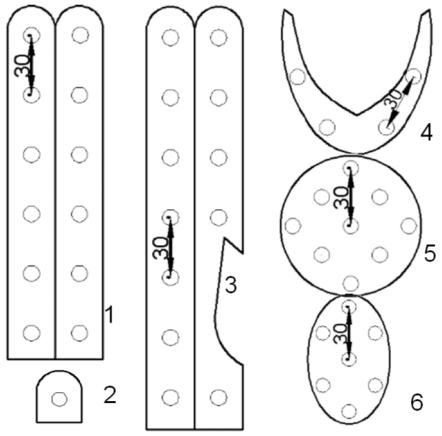

Figure 5. The location of the influence elements on overlay details of men's health-saving gloves: 1 – the little finger overlay (BAL-53); 2 – the middle finger overlay (BAL-54); 3 – the index finger overlay (BAL-52); 4 – the thumb overlay (BAL-52); 5 – the palmar forearm overlay (BAL-51); 6 – the back forearm overlay (BAL-50).

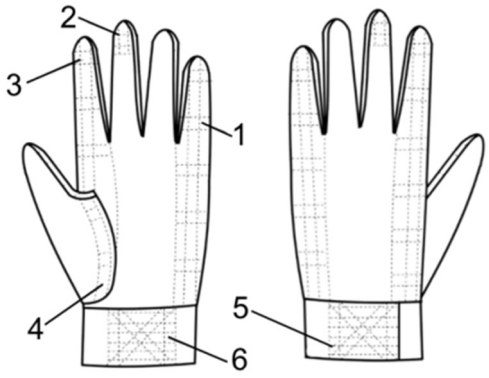

Figure 6. The appearance of men's health-saving gloves from the inside out: 1 – the place of the little finger overlay; 2 – the place of the middle finger overlay; 3 – the place of the index finger overlay; 4 – the place of the thumb overlay; 5 – the place of the palmar forearm overlay; 6 – the place of the back forearm overlay.

The connecting layers of clothing details are fastened with thread stitches. Since the silver plates are inserted between the materials after the stitching, the materials are stretched, and the seam thickness of underwear is increased by 28.2...37.9 % [4]. Besides, it was found that silver plates do not cause discomfort for the consumer and do not deform during the operation of the men's underwear for an hour. Thus, the chosen technology of joining materials and means of influence ensure the clothing's comfort during a use.

Therefore, the method for constructing a drawing of men's health-saving gloves has been improved by using correlations between measurements in the design. This made it possible to develop an ergonomic design of men's gloves with the influence elements in contact with BALs of the human body. The elements create the necessary energy-informational effect and have a therapeutic and corrective effect on the body of the wearers of the gloves.

The gloves were made in two stages. According to the results of the research, the first stage of making gloves was developed. It includes sewing the details of the lining with the product lining, placing silver plates between them and the brand of the lining of the gloves; the second stage – the manufacture of basic parts and installation of gloves (Figure 7).

The evaluation of gloves efficiency

As the design of men's health-saving gloves is a pilot study, a preliminary study was conducted to determine the nature of the energy-information influence of gloves on the consumer's body after their use. For the previous study, 10-th men were selected who used gloves for 15 minutes at rest without emotional communication - walked, sat, and did not watch the news.

The assessment of the energy-information influence of men's health-saving gloves was carried out according to the method described above. The study consumer survey results on the psycho-emotional state are presented in Table 6.

According to the results of the self-assessment of the psycho-emotional state of the respondents after using the men's health-saving gloves at rest for 15 minutes, 80 % of people improved their well-being, 70 % – activity, and 50 % – mood.

Positive changes from the energy-information influence of men's health-saving gloves were found in one of the studied states in 40 % of people, in two states - in 20 %, and a positive effect was found in all three states - in 40 % of consumers.

The results of diagnosing the psychophysiological state of 10 people by "ROFES" without the influence of men's health-saving gloves and after wearing them for 15 minutes are shown in Table 7.

The analysis of the obtained values of the complex indicator state of the people ("WAM") (Table 6) showed that 90 % of the respondents before wearing gloves have a high level of "WAM", and 10 % have an average level. After wearing men's health-saving gloves, the value of this complex indicator increased in 50 % of respondents, 30 % - decreased, in 20 % of respondents - did not change. But each of the interviewees remained in the group with the same level of the complex indicator of the state of people ("WAM").

At the same time, the results of a study by "ROFES" (Table 7) showed that, at first, 60 % of respondents have a state level of "the medium is close to high" (Table 2). After 15 minutes of using health-saving gloves, the group of men with this level already included 90 % of respondents. Before using gloves, 40 % of respondents have average levels. After wearing them, the values of the complex indicator state of the people ("ROFES") increased in most people. Hence, the group of people with an average level decreased and contained only 10 % of respondents.

The results of a previous study in Tables 6 and Table 7 showed that using men's health-saving gloves affects the states. People experienced this effect in improving their mood and well-being as a result of the self-assessment (50 % of respondents). After wearing gloves, the psychophysiological state of 30 % of people (№ 3, № 6, and № 10) improved. Their level grew from the average level, which has the presence of signs of stress (Table 2), to the level of "the medium is close to high". In general, the positive effect of wearing gloves on the psychophysiological state of people by "ROFES" was found in 50 % of respondents.

At the same time, a previous study shows that it is difficult to clearly describe the effectiveness of the gloves on a person's condition after 15 minutes of wearing.

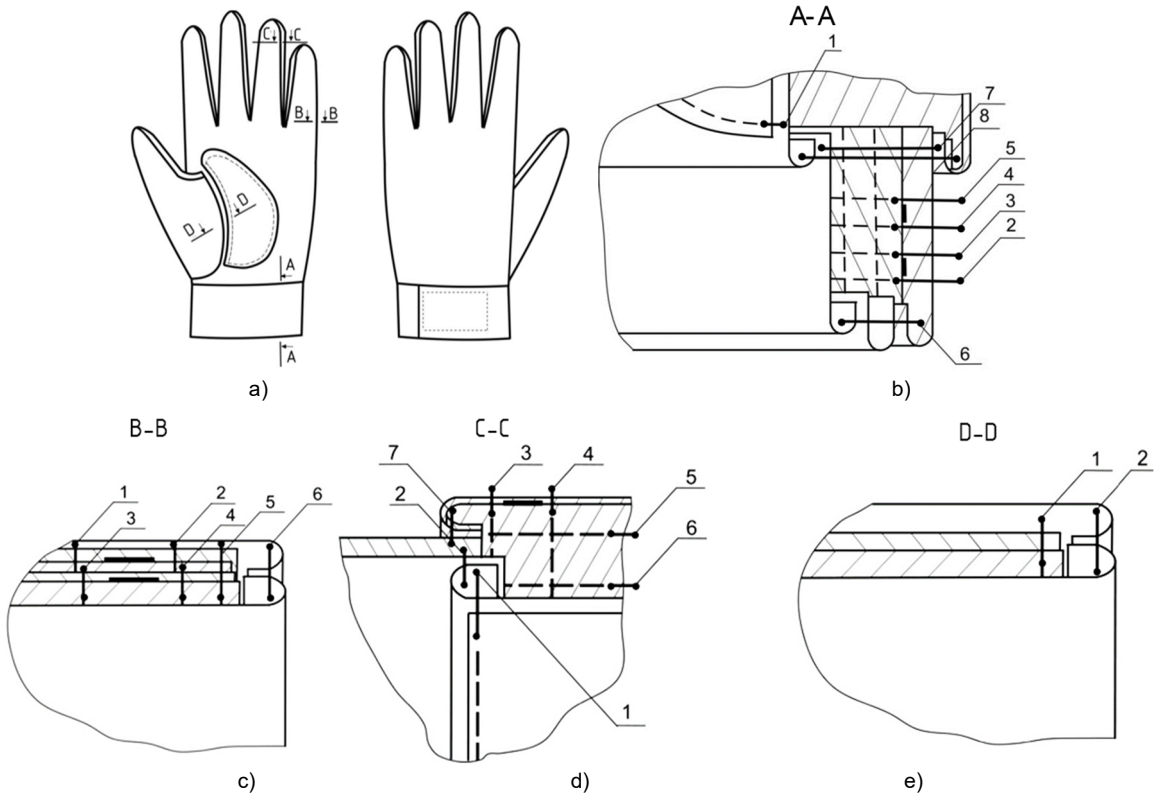

Figure 7. The illustrations of methods of technological processing of men's health-saving gloves: (a) location of the cross-sections on the gloves; (b) to cross-section A-A; (c) to cross-section B-B; (d) to cross-section C-C; (e) to cross-section D-D.

Table 6. The results of the self-assessment of the respondent's psycho-emotional state

Number of person	The self- assessment of the researched person						Complex indicator state of the people ("WAM") (formula 5)	
	Well-being		*Activity*		*Mood*			
	Without gloves	*With gloves*	*Without gloves*	*With gloves*	*Without gloves*	*With gloves*	*Without gloves*	*With gloves*
1	8.4	8.0	6.6	6.8	8.7	8.5	7.90	7.77
2	5.5	5.8	5.1	3.9	6.4	6.2	5.67	5.30
3	6.6	6.9	6.3	6.4	7.5	7.2	6.80	6.83
4	6.8	7.5	6.8	7.6	7.3	7.8	6.97	7.63
5	8.0	8.2	7.9	8.2	8.6	9.0	8.17	8.47
6	7.7	6.9	6.3	6.4	6.0	7.5	6.67	6.93
7	6.3	6.6	7.8	7.3	7.4	7.1	7.17	7.00
8	7.1	7.3	6.7	6.7	7.2	7.1	7.00	7.03
9	6.8	6.9	7.5	7.7	7.4	7.5	7.23	7.37
10	7.1	7.4	6.9	7.3	7.2	7.4	7.07	7.37

Table 7. The results of the previous study on the state of the people by "ROFES"

Number of person	Evaluation						Complex indicator state of the people ("ROFES") (formula 6)	
	The state of compensatory forces (stress)		*The state of internal emotional fatigue*		*The state with signs of neurosis*			
	Without gloves	*With gloves*	*Without gloves*	*With gloves*	*Without gloves*	*With gloves*	*Without gloves*	*With gloves*
1	3	4	5	5	4	4	4.0	4.3
2	3	4	5	5	4	4	4.0	4.3
3	3	3	3	5	4	4	3.3	4.0
4	3	3	3	3	4	4	3.3	3.3
5	3	3	5	5	4	4	4.0	4.0
6	3	4	3	5	4	4	3.3	4.3
7	3	3	5	5	4	4	4.0	4.0
8	3	3	5	5	4	4	4.0	4.0
9	3	3	5	5	4	4	4.0	4.0
10	3	3	4	4	3	4	3.3	3.7

For that reason, the authors decided to study the effectiveness of wearing gloves for a longer time. The intervals for determining the nature of the effect of the men's health-saving gloves were 20, 40, and 60 minutes.

The continuation of the experiment revealed difficulties in the application of the "WAM" questionnaire, since the questions were repeated every 20 minutes, and the respondent's self-assessment lost its adequacy due to the increase in the subjectivity of the survey.

Therefore, only a hardware device "ROFES" was used for further research, which, unlike a subjective assessment, allows quantifying the effect on the three states of the body during selected time intervals.

To minimize the influence of variables and increase the reliability of the results of evaluating the impact of gloves, the authors decided to exclude such a factor as previous use of the product. Because of that, for further research, the respondents were 12 men who never used health-saving gloves before.

The results of diagnosing the psychophysiological state of 12 people by "ROFES" without the influence of men's health-saving gloves and after wearing them for selected time intervals are shown in Figure 8.

Evaluation of the energy-informational impact of men's health-saving gloves (ROFES) (Fig. 8) showed that after 20 minutes of using the gloves, improvement occurred in 50 % of respondents. When the time of using gloves is increased to 40 minutes, a positive effect is observed in 71 % of people.

Initially, 50 % of the respondents have a state level of "medium close to high", and 50 % of the respondents have average levels. After 20 and 40 minutes of using health-saving gloves, the group of men with an average level was only 16.67 % of the respondents. At the same time, 83.33 % of respondents had a level of "the medium is close to high". After wearing it for 60 minutes, a positive effect was found in 50 % of people (Fig. 8).

The analysis of the study showed that the psychophysiological state of the respondents improved in at least one of the three states in 50 % of men (Fig. 9).

In general, a positive impact of the men's health-saving gloves on the psychophysiological state of 10 out of 12 studied people was noted. It has been established that positive changes in the psychophysiological state of most respondents occur after 40 minutes of using health-saving gloves.

According to the results of the study, reliable positive changes in indicators of compensatory forces of the body (stress) and the state of internal emotional fatigue were found in 83.3 % of people who wore men's health-saving gloves for 20 and 40 minutes. It was established that is after putting on gloves, the state with signs of neurosis remains unchanged at the level of "medium close to high". Therefore, this state was not taken into account in the furthest analysis of studies.

Research results confirm the effectiveness of using the men's health-saving gloves.

The appearance of the men's health-saving gloves is shown in Figure 10.

The health-saving gloves are made of black knitted fabric. The top layer of the gloves is made of black double knit interlock, and the lining is made of grey plain jersey fabric.

The gloves are recommended to wear in the cold season. To improve the aesthetics and strength of the product, a leather insert is proposed on the palm of the gloves (Figure 10, b).

To the aesthetic appearance of the men's health-saving gloves can use other products for dressmaking such as webbing, tapes, zippers, snap buttons, etc.

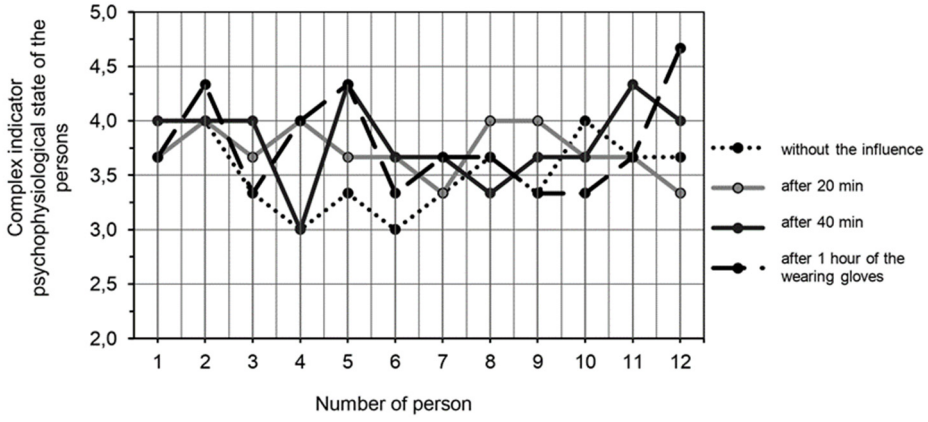

Figure 8. The results of research on the psychophysiological state of the people by "ROFES".

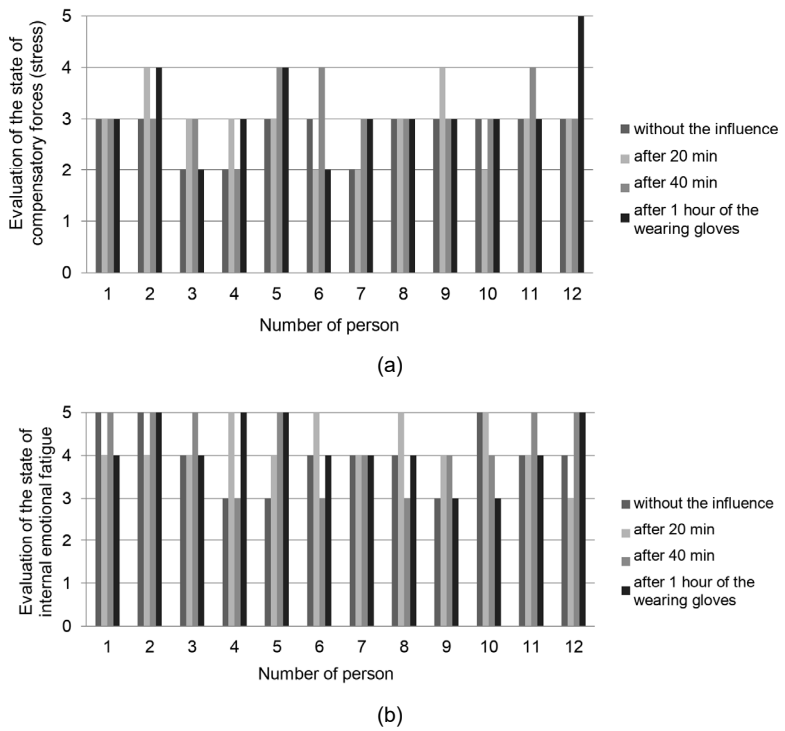

Figure 9. The results of the diagnosis of the psychophysiological state of people after wearing health-saving gloves over time: a – the state of the compensatory forces; b – the state of internal emotional fatigue.

a) b) c)

Figure 10. Appearance of the men's health-saving gloves: a - the back side, b - the palm side, c - the inside of the cuff of the glove with a clasp.

The color does not affect the functional properties of the product. The color of the men's health-saving gloves can change depending on the fashion and personal preferences of the consumer. Color can also have a positive effect on the psycho-emotional state of a person. We didn't investigate the effect of color on the functional properties of the product. But this is a promising direction for further research.

The study confirmed that silver plates are elements of positive energy-information impact on BALs. They are located between the substrate layers and fixed by parallel stitches (Figure 10, c). The results of the respondents' survey showed that the presence of plates in the men's health-saving gloves does not reduce hand motility, and they are not felt in the product on touch.

The results of evaluation are to be used as a data set to fill the database with knowledge of the previously developed expert system to support clothing design process [49]. In addition, the system can be used for the designing and for the selection of ready-made garments that meets predefined customer's impressions (e.g., in the shops, including online stores) and to select a prototype to develop new model of clothing that meets the wishes of the consumer.

As part of this study, we obtained results reflecting the psycho-emotional and psychophysiological characteristics of the consumers, as well as their dynamics in conditions of use. Since it was a pilot study, the sample size was not huge. These results are difficult to generalize to a broad sample. However, they are a start for further research on the states of more people after the use of gloves for a longer period.

CONCLUSION

The study's results of the state of tension of the compensatory forces of the organism by "ROFES" indicate the presence of an average stress level for 86 % and a significant level of stress for 14 % of the people. Such results show the need to wear products to reduce the negative effects of stress. The effectiveness of the proposed health-saving gloves was confirmed experimentally. We noted a decrease in the level of stress after their use for 83.3 % of the people.

Thus, the use of men's health-saving gloves has a positive social, therapeutic (health-saving), and economic effect, as the product has several functions It is an accessory fashion, has hand protection, and has an additional positive influence on the body of the person wearing it.

This allows the future to talk about the use of consumer-friendly and effective ways to correct the men's states, based on the safer-by-design concept.

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