BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg
BG PULSE JOURNAL

DEVELOPMENT OF A METHOD FOR DESIGNING PREVENTIVE AND THERAPEUTIC CLOTHING FOR SCHOOL-AGE CHILDREN TO PROMOTE NORMAL POSTURE

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Doi: https://doi.org/10.5281/zenodo.22342024

Abstract: This article is devoted to researching a method for designing preventive and therapeutic clothing (NQSHBK) intended to prevent spinal disorders and promote correct posture in school-age children. The study analyzes the shortcomings of existing elastic posture correctors, including psychological and hygienic discomfort and the lack of standardized pressure levels, and proposes a method for integrating them into the construction of everyday outerwear.

Through the application of the "elastic band–skin" material package, the optimal parameters of corrective braces (shoulder straps) and structural elements that enhance shape stability were experimentally substantiated. In addition, mathematical relationships for predicting the compressive effect of the garment were established, and experimental models were successfully tested and validated on an industrial scale and in rehabilitation enterprises.

Keywords: normal posture, preventive and therapeutic clothing, NQSHBK, compressive effect, brace, material package, ergonomics, "elastic band–skin" package, shape stability, construction.

Relevance of the research topic. In the current complex economic environment, one of the conditions for the stable and efficient operation of garment manufacturing enterprises is the optimization of their product range, the expansion of markets for their products, and the resolution of issues related to introducing specialized products intended for specific social groups into their assortment [1]. One such social group includes children with postural disorders. The development and production of preventive and therapeutic garments designed to promote normal posture represent a new offering in the market for goods and services.

According to statistical data, approximately 80 percent of the population suffers from spinal disorders, which often lead to disability among patients of the most economically active age groups [2, 3, 4]. A significant increase in spinal disorders is observed among children of primary school age. According to medical practitioners, 70 percent of children enter school with postural disorders, and after one year of schooling, this figure increases to as much as 90 percent [3].

Elastic posture correctors are used for the prevention and treatment of spinal disorders [4]. When the body assumes a position that may lead to postural deformities, corrective elements exert compressive (pressure) effects on specific areas of the human body, encouraging the shoulders to remain in an upright position. However, existing elastic correctors have several disadvantages. They do not provide recommendations regarding the appropriate level of pressure exerted by the corrective elements; they may cause psychological discomfort during wear, particularly among

children and adolescents; they increase the thickness of the clothing material package; and they negatively affect hygienic properties, since they are worn over underwear and subsequently covered by an additional layer of everyday clothing.

Furthermore, the use of such devices is generally recommended after the disorder has already manifested itself, whereas preventing its occurrence is considerably more important.

In this regard, a method is proposed for designing preventive and therapeutic clothing for everyday wear that incorporates elements of posture correctors and contributes to the development of normal posture in children. The task of designing comfortable children's clothing that supports correct posture and prevents spinal disorders is of particular social importance, as the health of the younger generation is closely connected with the health of the nation as a whole.

It is proposed to develop children's clothing designed to promote normal posture by using an "elastic band–skin" material package.

The purpose of this study is to develop a method for designing preventive and therapeutic clothing for children that promotes the formation of normal posture by ensuring a compressive effect that complies with the standards and requirements established for preventive garments.

To achieve this objective, the following tasks were addressed:

- The selection of a method for designing NQSHBK (children's clothing designed to promote normal posture) was substantiated;
- A marketing study was conducted to investigate the demand for NQSHBK;
- Methods and instruments for measuring the compressive effect exerted by clothing on the human body were analyzed;
- The compressive effect of the corrective elements of preventive and therapeutic clothing designed to promote correct posture was investigated;
- Requirements and quality indicators for NQSHBK were developed;
- The product range of NQSHBK was substantiated and developed;
- The relationship between the degree of compression, garment construction parameters, and the properties of the material package was determined;
- The garment construction parameters were experimentally substantiated;
- A low-operation manufacturing technology for producing garments designed to promote normal posture was developed;
- The design and manufacturing technology of NQSHBK were tested and validated on an industrial scale under laboratory and production conditions.

Research methods. A systems approach to solving complex problems was adopted as the theoretical and methodological basis of the research. At different stages of the study, marketing research, systems analysis, and logical analysis methods were employed.

The mechanical properties of the samples were investigated using standard testing methods. The compressive effect of the garments was examined using the author's original methodology. The processing and analysis of experimental data were carried out using Microsoft Word, Microsoft Excel, AutoCAD, Eleandr. CAD, and other software programs.

Object of the research. The object of the study was the "human–clothing designed to promote normal posture" system.

Scientific novelty of the research. The scientific novelty of the study lies in the development of a new type of preventive and therapeutic clothing designed to promote and support the formation of normal posture in children.

The most significant scientific results obtained in the study:

- The parameters and values of the compressive effect produced by the corrective elements of NQSHBK were established;
- The design of the brace package (shoulder straps) intended for the production of preventive and therapeutic clothing for children designed to promote normal posture was substantiated;
- The relationship between the magnitude of the compressive effect and the construction of NQSHBK, as well as the properties of the material package used for the braces, was determined;
- A method for designing preventive and therapeutic clothing intended to promote the formation of normal posture was developed.

Theoretical significance. The theoretical significance of the study lies in establishing mathematical relationships that make it possible to predict the pressure exerted by NQSHBK elements based on garment construction parameters and the properties of the material package.

Practical significance. The practical significance of the study is reflected in the following results:

- A range of children's clothing designed to promote the formation of normal posture was developed;
- A method for improving the shape stability of children's clothing designed to promote normal posture was developed based on the "elastic band–skin" material package. In addition to fulfilling its primary function, this method makes it possible to address the problem of utilizing waste materials generated by enterprises producing leather goods;
- The construction of children's clothing designed to correct posture was developed. The novelty of this development was confirmed by the Russian Federation Patent for Invention No. 2211651, entitled "Outer Garment for Posture Correction";
- A package of design, engineering, and technological documentation for models of children's clothing designed to promote normal posture was developed for garment manufacturing enterprises in the service sector;
- Children's clothing designed to promote the formation of normal posture was introduced into production.

General conclusions of the study. Based on an analysis of existing scientific research in the field of posture corrector design, as well as the specific approaches to addressing the problem of preventing spinal disorders in children, the перспективность and feasibility of developing a method for designing preventive and therapeutic clothing intended to promote the formation of normal posture were substantiated.

A design framework for NQSHBK was developed within the "human–clothing designed to promote normal posture" system. Insufficiently developed areas of information and data were identified. The demand for NQSHBK was investigated, and its functions and a nomenclature of quality indicators were developed.

The mechanical properties of samples of the "elastic band–skin" material package were investigated. It was established that covering fragments with an elastic base does not reduce their performance properties and contributes to improving the shape stability of the garment components.

Based on the relationship between the pressure exerted by an elastic brace on the upper shoulder area and the stiffness of the brace material, its geometric parameters, and the length of the back-section area, the optimal parameters of the NQSHBK design were experimentally determined. These parameters ensure that the compressive effect meets the standards established for preventive garments under both static and dynamic conditions.

The results of the conducted factorial experiment demonstrated that the area of the brace's discrete shape-stabilizing reinforcement has the greatest influence on the magnitude of compression produced by the NQSHBK elements.

Conclusion. Experimental studies confirmed the possibility of predicting the magnitude of compression based on the design of the brace package.

Based on anthropometric examinations of children, the relationship between the position of the scapular prominence point and the dimensional characteristics of back width and back length to the waistline was established. The optimal parameters for the placement of stiffening ribs within the NQSHBK construction were determined.

The psychological comfort of NQSHBK was evaluated by three groups of experts: garment industry specialists, medical professionals, and consumers. Its high level of psychological comfort was experimentally confirmed.

The developed method for designing NQSHBK makes it possible to expand the range of preventive and therapeutic children's clothing, reduce material consumption, improve hygienic properties, and increase the psychological comfort of posture-correcting garments.

A set of design and technological documentation was developed, and NQSHBK underwent industrial testing under the conditions of the sewing workshops of “Sterlitamak Social Rehabilitation Enterprise of the All-Russian Society of the Blind” LLC and the “Prosthetic and Orthopedic Enterprise” of the Federal State Institution in Ufa. It was established that the results of the dissertation research provide both social and economic benefits. The expected economic benefit from introducing the production of a batch of 100 garments amounts to 7,219.46 Russian rubles.

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