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MODERN SOLUTIONS AND STANDARDS IN THE DESIGN OF UNDERWEAR, TAKING INTO ACCOUNT BIOMECHANICAL AND ORTHOPEDIC ASPECTS

Summary. *The article is devoted to the study of the features of modern solutions and standards in the design of underwear, considering biomechanical and orthopedic aspects. The purpose of this study is to analyze modern developments in the design of underwear, focusing on their biomechanical and orthopedic parameters, as well as assessing their impact on the health and comfort of users. Research objectives: to study the existing standards and requirements for the design of underwear, consider biomechanics and orthopedics, analyze modern materials and technologies used in the production of underwear, and assess the impact of underwear design on the comfort and health of users. The study hypothesizes that modern solutions and standards in the design of underwear, considering biomechanical and orthopedic aspects, significantly improve the comfort and health of consumers compared to traditional models. The author concludes that modern solutions in the design of underwear, based on scientific research in biomechanics and orthopedics demonstrate great potential in improving the quality of life of users. Thus, the introduction of biomechanical and orthopedic aspects in the design of underwear is an urgent task that requires attention from both manufacturers and consumers.*

Key words: *standards, design, underwear, ergonomics, health, comfort, biomechanics, orthopedics.*

Introduction. In recent years, there has been a significant increase in interest in functional underwear that not only satisfies aesthetic requirements but also considers biomechanical and orthopedic aspects. Modern solutions in the field of underwear design strive to provide comfort, support, and health to users, which is becoming especially relevant considering the increased time spent on clothes.

Materials and methods of research. To achieve the stated goal, the following research methods were used: literature analysis (review of scientific publications, articles, and standards related to underwear design, biomechanics, and orthopedics), study of statistical data, comparative analysis (comparison of traditional and modern models of underwear according to several parameters)

Results and discussions. Biomechanics is the study of the mechanical properties of the human body and its interaction with the environment. When developing underwear, designers and engineers consider factors such as anatomy, mobility, as well as the force and distribution of loads on different parts of the body [1].

1. Anatomical shape: Modern underwear models are developed using 3D body scanning, which allows for the creation of perfectly fitting shapes. This not only increases comfort but also reduces the risk of chafing and discomfort.

2. Adaptive Materials: Using 3D textile technology, we can create fabrics that adapt to the body's movements, providing support and freedom of movement. For example, elastic fibers and compression fabrics help improve blood circulation and support muscles.

Some modern lingerie brands are starting to incorporate orthopedic principles into their designs to support health.

1. Supportive constructions: For women, bras with increased support are developed that consider the shape and weight of the breasts, reducing the load on the

back and shoulders. The use of wide straps and special inserts helps distribute the weight more evenly.

2. Shapewear: Modern models of shapewear can not only shape the silhouette but also provide support for the back and abdomen. This is especially important for women after childbirth or those recovering from surgery.

3. Men's Underwear: In recent years, there has been a growing interest in men's underwear that considers anatomical features. Designers are developing models that provide support and comfort in the groin area, reducing the risk of chafing and discomfort.

The use of 3D modeling technologies allows for the creation of products that perfectly follow the contours of the body. This provides comfort and support, especially in sports underwear. Models with adjustable straps and fasteners allow consumers to individually adjust the fitness of underwear, which adds a level of comfort. Special designs and materials can provide the necessary support in critical areas, which is especially important for active women and athletes. The use of compression fabrics helps improve blood circulation and reduce muscle fatigue [2].

The correct fitness of underwear can have a significant impact on your posture. Weapons against bad posture are support structures such as straps, bras, and elastic bands that help distribute the load on the body. Different bra styles, for example, can support the breasts, which in turn helps maintain the correct position of the shoulders and back. In addition, underwear that is too tight can cause discomfort and restrict movement. This can lead to bad posture and chronic back and neck pain. Therefore, it is important to choose styles that provide good support but do not restrict movement.

The choice of underwear materials also plays a key role in human health. Natural fabrics such as cotton have good air permeability and hygroscopicity, which promotes normal blood circulation and reduces the risk of irritation. Synthetic

materials such as polyester or nylon can provoke overheating and increase sweating, which in turn can cause discomfort and even skin diseases. Errors in the choice of sizes and materials can lead to compression of blood vessels and impaired blood circulation. This can cause swelling, varicose veins, and other problems. When discussing the choice of underwear, it is important to pay attention to the elasticity of the fabrics and their ability to return to their original state after stretching. Excessive pressure can have negative effects on blood circulation, so it is worth paying attention to models with regulators and a wide elastic band [3].

The skin is the largest organ of our body, and its health directly depends on what it wears. The fabrics from which underwear is made can affect the condition of the skin. The wrong choice of materials can lead to allergic reactions, rashes, and irritations. Synthetic fibers can retain moisture, which creates an ideal environment for the growth of bacteria and fungi, which can lead to infections [4].

Properly selected underwear can have a significant impact on posture and comfort. Incorrect support or tissue tension can cause tension in the back, which in turn can lead to pain. Orthopedic solutions in underwear are aimed at creating support that helps distribute the load on the spine correctly and reduces the level of discomfort [5].

Features of orthopedic underwear:

1. Lumbar support. Orthopedic underwear often contains structures that support the lumbar region. This can be in the form of special inserts or elastic materials that help keep the back in the correct position and prevent excessive muscle tension.

2. Correct fit. Orthopedic underwear is designed to consider the physiological characteristics of the human body. It fits the figure perfectly, minimizing friction and pressure on sensitive areas, thereby improving blood circulation and providing comfort.

3. Use of innovative materials. Many manufacturers offer underwear made of elastic, breathable, and moisture-absorbing materials. This allows maintaining an optimal level of humidity and temperature, which is especially important for preventing discomfort over a long period of time [6].

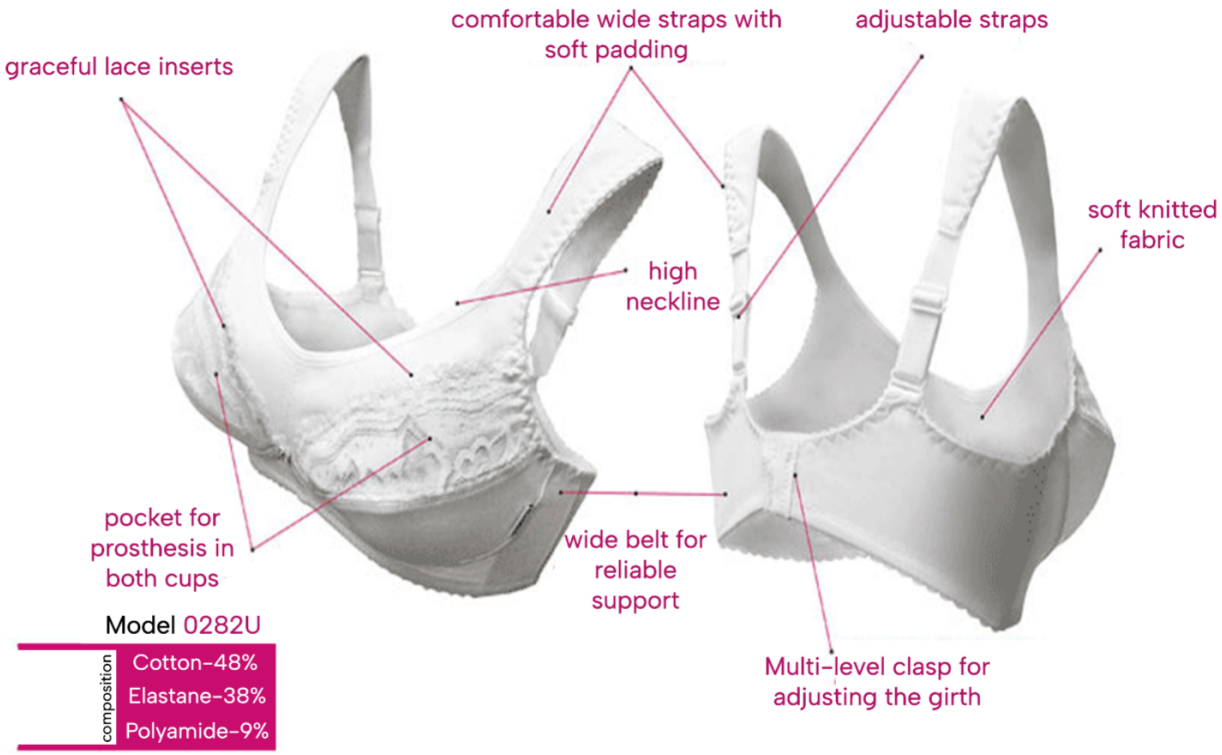

Fig. 1. Orthopedic underwear for women

One of the key factors influencing the design of underwear is comfort. Research shows that the wrong choice of size and materials can cause discomfort, chafing, and even allergic reactions. Therefore, modern manufacturers focus their developments on such physiological parameters as:

- Anthropometric data: Researching human body measurements allows us to create more accurate sizes and shapes of underwear models.

- Materials: Modern technologies allow the use of innovative fabrics with high breathability and moisture-wicking properties. For example, synthetic fibers such as

microfiber or combined natural and synthetic materials help maintain an optimal microclimate and increase comfort [7].

Underwear should not only provide comfort but also support the physiological functions of the human body. Research shows that proper support for breasts and buttocks help prevent several health problems. For example, underwear for women should consider:

- Anatomical features: Bras should provide reliable support for the bust, avoiding excessive pressure on the tissue and promoting proper blood circulation.

- Proper fit: The wrong size can lead to posture problems and even back pain. Support and proper fit are also important for men's underwear to avoid discomfort in the groin area.

One of the key aspects of the influence of physiology on the design of underwear is the correct selection of materials. Materials used to make underwear should be hypoallergenic, breathable, and pleasant to the body. For example, natural fabrics such as cotton, linen, or silk absorb moisture well and provide good air circulation, which prevents irritation and redness of the skin. It is also important to avoid materials containing synthetic fibers, which can cause allergic reactions and provoke the development of various diseases [8].

Finally, it is worth noting the influence of psychology on the design of underwear. Beautiful and comfortable underwear can increase a person's self-esteem, confidence, and comfort, which in turn has a positive effect on their emotional and mental state. Therefore, modern standards and research in the field of physiology consider not only the physical aspects of underwear design but also its impact on a person's psychological well-being [9].

When it comes to hygiene and the design of quality women's underwear, it is important to consider several features and factors that ensure comfort, freshness, and overall well-being:

1. Breathable Fabrics: High-quality women's underwear is usually made from breathable fabrics such as cotton, modal, bamboo, or moisture-wicking blends. These fabrics allow air to circulate, which helps prevent moisture buildup and reduces the risk of bacteria growth and odor.

2. Moisture-wicking properties: Some women's underwear is designed with moisture-wicking properties that draw moisture away from the skin, keeping the intimate area dry and comfortable. This feature is especially useful during exercise or if you live in a hot, humid climate [10].

3. Antimicrobial Treatment: Some women's panties have antimicrobial agents or finishes that help inhibit bacterial growth and reduce odor. These treatments can help keep your panties feeling fresh and hygienic all day long, especially for women with sensitive skin or who are prone to odor.

4. Seamless Construction: Seamless underwear constructions minimize friction, reduce the risk of irritation and chafing. The seamless construction also creates a smooth silhouette under clothing, increasing comfort and hygiene.

Traditionally, underwear was made from cotton, silk, and other natural fabrics. However, modern fabric production technologies allow us to create new, more effective materials. Among them:

1. Microfiber: This material is highly durable, lightweight, and moisture-wicking. It allows the skin to breathe and provides a comfortable feeling throughout the day.

2. Next-generation synthetics: Technologies such as lyocell and modal create soft, lightweight fabrics that wick moisture and provide excellent ventilation.

3. Smart fabrics: Innovative fabrics can have special properties such as thermoregulation, antimicrobial protection, and even anti-cellulite properties. For example, some companies are developing fabrics that respond to changes in body temperature, providing an optimal microclimate.

4. Eco-friendly materials: With the growing environmental awareness of consumers, manufacturers are increasingly looking for ways to use recycled and biodegradable materials. Underwear made from organic cotton or recycled polyester is becoming increasingly popular [11].

Waistbands and trims can vary in width, elasticity, and design. Some may have decorative elements such as lace, ribbons, or embroidery for added aesthetic appeal. A well-designed waistband provides comfort and stability without digging into the skin or causing discomfort. The texture of the fabric used in women's lingerie can range from smooth and silky to textured or ribbed. Different fabric textures provide unique tactile sensations and visual appeal, allowing people to choose based on their preferences for comfort and aesthetics.

New technologies such as smart fabrics, 3D printing, and AI-powered heat mapping are shaping the future of lingerie design. These advances are changing the way people think about the comfort and fitness of clothing. They are also helping to improve sustainability. Artificial intelligence (AI) helps to create lingerie that fits perfectly. AI technology analyzes pressure and movement to create lingerie that supports the body without causing discomfort. This innovation allows designers to create clothing that moves smoothly with the wearer, truly improving fit and comfort [12].

Results and conclusions. Thus, modern standards and research in the field of physiology have a significant impact on the design of underwear, providing not only comfort and convenience but also maintaining human health and well-being. The correct selection of materials, consideration of the physiological characteristics of the body, orthopedic effects, and the psychological aspect of creating underwear - all this allows you to create underwear that is not only beautiful but also useful for a person.

Innovative materials and biomechanics in lingerie design offer a whole world of possibilities for creating products that combine style, comfort, and functionality. Consumers increasingly pay attention not only to appearance but also to quality and convenience, which encourages designers and manufacturers to search for new solutions and technologies. Thus, underwear is becoming not only an element of clothing but also a high-tech product that can improve the quality of life.

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