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Creative approach to rhythmic gymnastics costume design

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Abstract. The present study aimed to investigate the evolution of rhythmic gymnastics costume design, in particular their aesthetic, functional and cultural components, with an emphasis on the integration of traditional national elements into the modern context. The study examined the costumes of athletes from such countries as Ukraine, China, the USA, Japan, and Uzbekistan. The materials included visual sources, technological documentation and the requirements of international regulations that define design standards, as well as scientific media publications. The study included an analysis of the historical stages of costume development, cultural symbols and innovative technologies used in their creation. The results of the study showed that the evolution of costume design reflects the complex interaction between cultural identity, technological progress and sports requirements. It was found that modern costumes strike a balance between functionality and artistic expression through the introduction of innovative materials, such as elastic mesh and thermoregulated fabrics, as well as the use of decorative elements such as rhinestones and appliqués. Ukrainian costumes demonstrated uniqueness through the integration of traditional ornaments into modern designs, while Chinese designs were marked by a harmonious colour palette that reflected cultural heritage. American costumes emphasised patriotic motifs through the use of national colours and intricate patterns. The analysis confirmed that international standards are an important factor influencing the creation of costumes, ensuring safety, comfort, and aesthetics. The conclusions of this study highlighted the importance of a harmonious combination of traditions and modern innovations in creating costumes that meet aesthetic and functional requirements. The findings open up new perspectives for research in the field of sportswear design, in particular in the context of the use of environmentally friendly materials and the impact on the psychological state of athletes

Keywords: cultural identity; national symbolism; decorative elements; aesthetics; ornament

INTRODUCTION

Rhythmic gymnastics is one of the most expressive and aesthetic sports that combines physical skill, artistry and technical perfection. Since its inception, this sport has been the subject of scientific research, particularly in the context of its aesthetic, cultural and technological aspects. However, with the constant development of costume design, increasing requirements for functionality and compliance with modern environmental standards, there is a need for a detailed analysis of this topic. The design of rhythmic gymnastics costumes not only serves as a visual addition to the performance, but also acts as a tool to enhance expressiveness, comfort, and compliance with the requirements of modern international standards.

The scientific community has been actively researching various aspects of rhythmic gymnastics, including its aesthetic, historical and cultural dimensions. For example, C. Palmer (2022) drew attention to the symbolic significance of aesthetics in sports disciplines. The author emphasised that costumes, as well as visual elements of the performance in general, perform not only a decorative function but also play a pivotal role in the perception of rhythmic gymnastics as a unique combination of art and sport. This allows us to consider this sport as a form of artistic expression.

At the same time, D. Rayimberdieva *et al.* (2023) drew attention to the engineering and technological aspect of creating rhythmic gymnastics costumes. They

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studied in detail the properties of fabrics, including their elasticity, breathability, and ability to provide comfort during complex elements. The authors highlighted that the right choice of materials not only affects the comfort of the athletes, but also helps to boost their confidence, which is important for a successful performance. The combination of these approaches allows us to unlock both the creative and technological potential of rhythmic gymnastics.

Important observations on the impact of aesthetics on sport are also presented in the work by C. Mazumdar (2020), who analysed the evolution of tracksuits and their role in creating a “hyperfeminine” image in rhythmic gymnastics. The author showed how costume design has become a tool for enhancing expressiveness, but at the same time raised questions of gender stereotypes.

T. Boyle (2022) examined the visual aspects of the representation of the gymnastic body, which allowed for a deeper understanding of how costumes become an integral part of cultural discourse. The author showed that costumes can enhance or transform the image of an athlete, influencing the perception of the audience and judges. This study highlighted how visual elements serve as a tool for expressing artistic identity. Similarly, F.R. Menegaldo *et al.* (2023) focused on the artistic and expressive dimension of gymnastics, emphasising that a harmonious combination of aesthetics and technical excellence is a crucial factor in achieving impressive results. The authors noted that aesthetic elements such as choreography, music, and costume design not only enhance technical skill, but also create an emotional atmosphere that captivates the audience. They found that such performances form a deep emotional connection between athletes and audiences, turning gymnastics into a true art form that both inspires and amazes with the technical capabilities of the human body.

J. Sun & X. Song (2018) addressed the physiological aspect of costumes by investigating the impact of materials and cut on female athletes' blood circulation during performances. In their study, they used modern analysis methods to determine how clothing can enhance or limit physical performance. The results showed that excessive pressure or improper costume design can negatively affect the comfort and health of female athletes, while properly selected fabrics help to optimize physical performance.

C.O. Roberts (2020) focused on the psychological and aesthetic aspects, studying the impact of costumes on the emotional connection between the audience and performers. They pointed out that costumes are a key element in shaping the overall performance experience, helping the audience to better understand the choreography and storylines. Their review also includes an analysis of the different styles and materials that enhance the artistic expression of the performance.

Although previous research has covered many aspects of rhythmic gymnastics costume design, there

are gaps that require further analysis. In particular, insufficient attention has been paid to how modern technology and environmental standards influence the design of rhythmic gymnastics costumes. It is also necessary to explore how traditional cultural elements can be adapted to the modern requirements of international competitions, which opens up opportunities for design innovation.

The aim of this study was to analyse the development of rhythmic gymnastics costume design, taking into account cultural traditions, modern technologies and environmental requirements. To achieve this goal, the following tasks were set: to study the historical development of costume design, from the first samples to modern models, including the influence of cultural and social factors; to analyse technological innovations in the creation of costumes, including the use of innovative materials and technologies; to study the impact of international regulations and standards on modern costume design; to assess the importance of national and cultural motifs in the creation of costumes for international competitions.

MATERIALS AND METHODS

The study examined the costumes of female athletes from different countries, including Ukraine, China, the USA, Japan, and Uzbekistan. The choice of these countries is due to the diversity of cultural traditions, design approaches and the influence of international standards on their evolution. The following materials were used in the study: a list of international standards, including the regulations of the International Federation of Gymnastics (2024), European Gymnastics (2024) and “Rules of sports competitions in rhythmic gymnastics” approved by the Ministry of Youth and Sports of Ukraine (2021), which define the requirements for costumes in rhythmic gymnastics, such as safety, functionality, ethical aspects, as well as compliance of materials and design with modern standards; visual sources, including photographs, competition footage and media publications that reflect the evolution of costume design, as well as a description of design techniques, including the use of decorative elements such as rhinestones, sequins, lace and appliqués.

To achieve the research goal, an interdisciplinary approach was applied, which included several methods. First, the historical and analytical method was used to study the evolution of costumes. The main stages of their development in different countries were analysed – from the first dresses based on ballet patterns to modern functional and aesthetically sophisticated models. The influence of artistic periods, changes in judging criteria, and technological developments were taken into account. Secondly, content analysis was used to evaluate photos, videos of the competition and visual materials. It helped to identify the main trends in the choice of colours, materials and ornaments, as

well as in the use of cultural and decorative elements in costume design. Thirdly, the comparative analysis allowed us to compare the design approaches used in rhythmic gymnastics costumes in different countries. Finally, the review of standards provided an understanding of the requirements for materials, colours, and designs of costumes. Special attention was paid to safety, transparency of materials, lining, and restrictions on decorative elements.

The research process consisted of several stages. At the initial stage, materials were collected from international competitions, including the Olympic Games, World Championships and regional competitions. Authors also studied available publications on the development of costume design. The data collected was systematised into categories such as national characteristics, manufacturing techniques, materials used and compliance with standards. Cultural and decorative elements were separately identified. Cultural and national motifs were analysed through the analysis of colours, ornaments, and other symbolic elements used in the costumes. The materials were evaluated for their compliance with the criteria of flexibility, durability, comfort, and thermoregulation. It was also considered how the costume design affects the performance of complex technical elements. The design solutions of the costumes of female athletes from different countries were analysed using the example of the 2024 Olympic Games in Paris.

RESULTS

Historical development of costume design

Rhythmic gymnastics, as an aesthetic genre, is located on the borderline between art and sports disciplines, which determines unique requirements for costume design. These costumes must combine aesthetic appeal, practicality, and compliance with the anatomical, psychological and kinetic aspects of movement. Costume design also takes into account didactic principles and achievements of sports science. This interdisciplinary approach, which encompasses style, materials, social and cultural aspects, ensures maximum compliance with the needs of female athletes and the requirements of international standards.

The first steps towards modern rhythmic gymnastics were made in the United States in the 1940s. This discipline emerged in the context of dance improvisations that were part of sports courses. At the beginning of its development, the athletes created their own outfits, focusing on the available materials and ideas of classical ballet costumes. Early costumes were mostly basic with a minimum of decorative elements, which limited their variability (Fig. 1). However, over time, costume design evolved to meet the requirements of modern competitions. The key element was the spandex leotard, decorated with crystal stones, sequins, and other decorative elements that provided both functionality and aesthetic appeal (Cleophas & Visser, 2024).



Figure 1. Costumes of the US gymnastics team, 1940s

Source: E. Rayment-Ward (2024)

Among the main factors that influenced the change in costume design are the evolution of musical periods, the development of technology, and changes in judging criteria. In the 1970s and 1980s, when rhythmic gymnastics became part of the Olympic Games, the emphasis on the visual component of performances increased significantly (Fuller, 2021). The costumes began to

emphasise the femininity and grace of the gymnasts, using more elastic materials and new decorative techniques (Fig. 2). The growing popularity of rhythmic gymnastics contributed to the professionalisation of costume design. At this time, new styles emerged that integrated ethnic motifs and modern fashion trends (Meyers, 2016).



Figure 2. Costume of Ukrainian Soviet rhythmic gymnast Irina Deryugina, 1981

Source: N. Puchko (2021)

In the 1990s, costume design reached a high level of individualisation. For example, the starting numbers were moved to the sleeve to ensure the visual purity of the upper part of the suit. At the same time, there was a search for new stylistic solutions that could combine comfort and decorativeness. Modern suits are often named after events or years of their creation, which helps to distinguish them from other models. In the 1990s, the growing interest in rhythmic gymnastics in post-Soviet countries led to the popularisation of monochromatic costumes (Fig. 3), which focused on the athletes' body lines (Kerr *et al.*, 2020). However, the style of costumes varied from country to country. Meanwhile, designers sought to ensure the comfort and practicality of the outfit, which allowed athletes to perform technically difficult elements.



Figure 3. Ukrainian rhythmic gymnast Kateryna Serebryanska's monochrome jumpsuit, 1993

Source: Rhythmic gymnastics leotard history in photos (2013)

Modern rhythmic gymnastics costumes are the result of the integration of advanced technology and the latest design concepts. The use of innovative materials such as stretch mesh, thermoregulated fabrics and environmentally friendly materials has become the standard in the industry (Krafte *et al.*, 2021). In the 2000s, new design solutions emerged, including the use of 3D printing to create complex patterns that make costumes bright and unique (Fig. 4).



Figure 4. Rhythmic gymnast costume at the 2000 Olympic Games

Source: Rhythmic gymnastics leotard history in photos (2013)

Cultural and geographical factors play a significant role in the design of costumes. In particular, Ukrainian national motifs, such as embroidery patterns, traditional colours and symbols, have actively influenced the development of rhythmic gymnastics costume design (Fig. 5). In the modern period, these elements are integrated into unique models that combine traditional Ukrainian symbols with innovative design solutions. Such costumes emphasise the harmony between Ukraine's rich cultural heritage and modern style, creating vivid and authentic images for female athletes.

The requirements for gymnasts' costumes set out in the International Federation of Gymnastics Technical Regulations 2024 and European Gymnastics Technical Regulations 2024-2025 aim to ensure a balance between aesthetics, functionality, and safety. They are also reflected in the "Rules of sports competitions in aesthetic group gymnastics" approved by the Ministry of Youth and Sports of Ukraine (2021). The main provisions include the use of materials that are not transparent, with mandatory lining in the torso area. Decorative elements, such as lace, are allowed, provided they do not compromise the integrity of the costume. It is noted that the costumes must be tight-fitting, providing

a clear view of the technical elements of the performance. The costume design excludes the use of additional accessories, such as separate socks or gloves, to avoid the risk of injury. It is important to prohibit asymmetrical colours on both legs, and the use of excessive or dangerous decorations, such as light-emitting diode (LED). The length and colour of the fabric covering the legs must be the same on both sides; the style and decor may vary, but harlequin style is not permitted. Skirts are permitted as long as they do not fall below the pelvic area, but a design resembling a ballet tutu is prohibited. Gymnasts can perform barefoot or in gymnastic shoes. Ethical norms are also taken into account: costumes must meet the standards of aesthetics and ethics, which excludes unacceptable words or symbols. Hair and make-up standards complement the requirements for appearance, ensuring the harmony of the image.



Figure 5. Ukrainian gymnast Hanna Bezsonova's costume design

Source: Ye. Gendina (2024)

In the context of researching innovation in rhythmic gymnastics costume design, these regulations are crucial for designers. On the one hand, they limit creativity within the framework of safety and ethics, while on the other hand, they stimulate the search for innovative materials and solutions, such as stretchy fabrics, safe decorative elements and technological improvements. Taking these requirements into account is essential for creating costumes that meet current trends while maintaining functionality and aesthetics.

Costume is an important factor in shaping the judges' impression of a performance. Compliance with the costume standards allows avoiding penalty points, while its harmony with the music, the style of the exercise and the overall aesthetics can positively influence the judges' subjective perception. For example, well-chosen colours, shape, and decor can enhance the artistic effect of a performance, drawing attention to the gymnast's movements and emphasising the dynamics of her performance. According to the FIG regulations,

violations of the costume or appearance requirements may result in a penalty of 0.3 points. This applies to the use of transparent fabrics without lining, mismatched styles, inappropriate jewellery or hairstyles, as well as violations of the rules regarding make-up or emblems. Even a minor deviation, such as underwear seams visible under a suit, can be grounds for a fine. On the contrary, compliance with all standards and a good presentation can increase the aesthetic component of the score, which can affect the final score in the artistry section.

Creative solutions in the creation of rhythmic gymnastics costumes in the international context, including Ukraine

Staging a rhythmic gymnastics performance is a complex and multifaceted process that combines movements, choreography, music, and costumes. Each element has a key role in creating the overall harmony of the performance. The study of this aspect focuses on the design of costumes, in particular their aesthetic and functional characteristics, which are an important means of expression. The costume in rhythmic gymnastics plays a crucial role, as it not only reflects the theme of the performance, but also emphasises the athlete's movements, harmonising with her form and style. The key elements of costume design are colour, fabric, and shape. Each of these aspects contributes to creating an emotional impact on the viewer and helps shape the overall perception of the performance (Goldschmied *et al.*, 2020).

The choice of colour palette depends on the theme of the performance, the music, and the props used. The principles of colour theory provide numerous resources for creating costumes that can influence both the gymnast and the audience. For example, bright colours such as red or yellow are associated with energy and passion, while darker shades such as black emphasise elegance and strength (Fig. 6). The design also takes into account the cultural meanings of colours, which can vary from region to region. For example, yellow in some cultures symbolises joy and festivity, while in others it can be associated with light and wisdom (Østergaard, 2023). Ornaments and applications add uniqueness to the costume and support the emotional component of the performance.

Suits are made of fabrics with high elasticity, which ensures freedom of movement and comfort. Synthetic materials such as lycra, polyamide, and polyester with the addition of elastomer are popular (Zhu *et al.*, 2023). They are highly durable, resistant to wear and adapt to the shape of the athlete's body. Important characteristics of fabrics are their ability to absorb moisture, breathe and be pleasant to the touch. Elastic fabrics with minimal surface roughness create a second skin effect, which contributes to natural movements and avoids irritation. Fabrics with a glossy or matte finish add aesthetic expressiveness to suits, allowing one to highlight design details.



Figure 6. Ukrainian gymnast Hanna Rizatdinova's costume at the 2016 Olympics in Rio de Janeiro

Source: D. Sles (2016)

Innovative textile materials, such as 3D-effect fabrics, allow designers to create unique models that reflect technical excellence and purity of execution. Such fabrics are often tested for elasticity, breathability, and the ability to retain their shape even during intense movements. Modern approaches to suit design include the use of two-piece models that strike a balance between comfort and aesthetics. For example, fabrics with a special mesh are used to create a nude effect, adding sophistication and individuality to suits (Fig. 7). These solutions contribute to a harmonious combination of aesthetics and functionality.



Figure 7. The costumes of the American rhythmic gymnastics team at the Tokyo Olympics, 2021

Source: B. Cassella (2021)

Rhythmic gymnastics costumes are decorated with rhinestones, sequins, lace, and appliqués. Rhinestones are the most popular decorative element due to their sparkle, lightness, and variety of shapes and sizes. They are arranged symmetrically or form complex patterns

that emphasise the theme of the performance. Sequins add dynamism and brightness to costumes during movements, creating a shining effect. Jewellery should be firmly attached to prevent it from falling off during the performance and match the style of the composition (Minaoglou *et al.*, 2024).

The design of the costume should ensure an optimal fit on the body, which contributes to the aesthetic perception of the performance. The silhouette of the costume must point out the lines of the gymnast's body while ensuring freedom of movement. Skirts should not exceed the length of the pelvic floor, and their cut should be such that the legs are visible during movements, which adds lightness and grace to the performance. The main focus is on the design of comfortable and safe leotard that allows performing technically complex elements. The costume should have a perfect fit that provides comfort and eliminates any restrictions (Porterfield & Lamar, 2020).

Nature has always been one of the main sources of inspiration for costume design. Elements of nature, such as textures, shapes, colours and movements, influence the choice of fabrics, embellishments, and construction. For example, some costumes feature motifs of flowers or birds to create the illusion of lightness and flight (Fig. 8). The colours of nature – from the rich green hues of the forest to the bright colours of spring blooms – are often used to enhance the emotional impact of a performance.



Figure 8. Japanese gymnast's costume at the 2021 Rhythmic Gymnastics World Championships

Source: B. Cassella (2021)

Cultural heritage plays an important role in the creation of rhythmic gymnastics costumes, especially when the design reflects national motifs. Traditional patterns, colours, and ornaments are integrated into the costumes to highlight the cultural roots of the gymnast or team. For example, the use of Ukrainian embroidery or ornaments typical of other nations can create an authentic look that reflects historical heritage and identity (Fig. 9). In traditional folklore, costumes often tell stories related to national myths or legends. This approach

allows for the integration of elements that symbolise collective memory and cultural values into costumes.



Figure 9. Design of the costumes of the Ukrainian rhythmic gymnastics team at the 2022 World Championships

Source: Ye. Gendina (2024)

Artistic periods such as Symbolism and Art Nouveau offer designers a wide range of ideas for visual design. Patterns, shapes, and colour combinations from these styles help to create visually intriguing and unusual costumes that harmonise with the choreography of the performance (Weiß *et al.*, 2022). Surrealism, for example, inspires the use of abstract elements that can reflect a unique theme or concept of a number. Such approaches can expand the emotional range of a performance, adding a new dimension to the aesthetic experience.

The creation of rhythmic gymnastics costumes is the result of a synergy between choreographers, costume designers, fashion designers and the gymnasts themselves. Each participant in the process contributes to the balance between aesthetics, functionality, and uniqueness. The success of a performance depends on a properly designed costume that meets the requirements of the sport and emphasises the individuality of the gymnast. The development of technology is combined with innovative approaches to costume design through the collaboration of fashion designers and costume designers. This collaboration combines elements of haute couture and sportswear to push the boundaries of aesthetic possibilities. Designers use the latest technologies, such as 3D printing and laser cutting, to create costumes that combine elegance and practicality (Rayimberdieva *et al.*, 2023). This approach helps to raise the status of rhythmic gymnastics, turning performances into an artistic show that attracts the attention of a wide audience.

Involving gymnasts in the development of costumes is a key aspect of modern design. The athletes provide on the functionality and comfort of the garment, which

allows us to improve its design. This approach ensures that costumes are created that are not only in harmony with the choreography, but also take into account the individual characteristics of athletes. The use of materials that provide comfort and freedom of movement, such as lycra, mesh and innovative synthetic fabrics, allows us to create costumes that meet high standards. The design takes into account the anatomical features of the body, ensuring a perfect fit and preventing discomfort during complex movements. The athletes' involvement in the selection of materials and decorative elements adds emotional value to the costumes, which has a positive impact on their performance.

Collaboration between designers and athletes creates a unique image system that increases the recognition of rhythmic gymnastics. Together with the gymnasts, designers essentially try to create original, unique artworks, and sometimes turn gymnastics into a kind of "fashion show" that can add value to the performance in the eyes of the audience and judges (Mykhailova, 2023). Costumes become part of the brand associated with specific athletes and their performances. They provide not only aesthetic pleasure, but also contribute to the popularisation of sport in the media.

The latest techniques and features of modern design when creating costumes for rhythmic gymnastics

The early 2000s were marked by significant changes in the design of rhythmic gymnastics costumes, which resulted from the influence of modern trends and technologies. New forms of costumes appeared, such as jumpsuits, models with long pants, and styles using fabrics that match the colour of the skin. These innovations allow us to emphasise the dynamics of female athletes' movements while ensuring comfort and functionality. Advances in textile technology have led to the creation of materials with improved characteristics such as elasticity, moisture wicking and optimal microclimate. This provides gymnasts with comfort during complex exercises and reduces the risk of injury. The use of stretch fabrics with four-way elasticity – that is, fabrics that can stretch both horizontally and vertically – allows us to create costumes that perfectly adapt to the body's movements, providing freedom and naturalness of performance. These fabrics are different from "bilateral elasticity", where the material can only stretch in one direction (usually in width) (Rayimberdieva *et al.*, 2024).

The high level of technical characteristics and consideration of the gymnasts' movements are focused primarily on possible movements and tumbling. Therefore, the flared skirts (if any) are made of dense mesh or stretchy material, usually complemented by flounces. The top is also made of a dense and elastic material that is properly stitched to allow athletes to stretch, jump, and not restrict their body movements. The use of P-shaped

cuts and special seams guarantees stability and support when performing complex elements. Particular attention is paid to the selection of fabrics with high elasticity, the ability to wick away moisture and maintain an optimal microclimate. The production process involves the use of automated systems to create precise patterns and unique decorative solutions, such as airbrushed patterns or metal inserts. High-tech fabrics, including those with a glazing effect, meet modern standards and enhance the artistic impression. Durability is achieved through in-depth study of all technological operations. The costume must retain its attractive for a long time, as gymnastics involves active use and frequent washing.

The growing interest in sustainability is changing the way we approach costume design. Attention is being paid to methods that reduce the environmental impact, such as zero waste and seamless designs. Zero-Waste Fashion is a fashion design concept that aims to minimise or eliminate waste of textile materials during production (Rissanen & McQuillan, 2023). The main principles of this model include: efficient use of fabrics (patterns are designed to use all the material without leftovers); recycling of leftovers (any fabric scraps are used to create other garments or accessories); minimisation of overproduction. The Folded Garment Construction model is an approach to garment design where the key element is the folding or folding of fabric to create structured shapes without significant material loss (Kim, 2020). Characteristic features of this approach include: closed construction (patterns are designed so that the fabric folds into complete shapes without trimming); reduced seam count (this reduces the complexity of production and the use of resources such as thread and additional trim fabrics); stylish functionality (the garment remains modern and attractive while maintaining a minimal ecological footprint). In the context of rhythmic gymnastics leotards, this means creating models with precise calculations to reduce fabric residues and use them for decorative elements. These approaches aim to minimise waste and optimise the use of materials. Innovative eco-friendly solutions, such as the use of recycled fabrics or biomaterials, contribute to the implementation of sustainable design principles, which is an important step towards preserving the environment and supporting the biosphere (ISPO Munich 2024..., 2024).

Innovations in design include geometric and asymmetrical shapes that give the costumes a modern look and highlight the individuality of the athletes. Airbrushed and metallic colours are used for decoration, complemented by lace, rhinestones, sequins, and appliqués (Fig. 10). These elements contribute to the creation of sophisticated and vivid images that match the theme of the performances. Social media also plays an important role in spreading ideas and trends, creating a demand for unique and eye-catching (Bento-Soares & Schiavon, 2020).



Figure 10. Combination of different decorative elements in a rhythmic gymnastics costume

Source: Rythmic gymnastic leotard history in photos (2013)

The costume designs also take into account the cultural and geographical features of the host cities or countries, which adds a local flavour to rhythmic gymnastics performances. Unique costume solutions that reflect national traditions or artistic motifs allow us to integrate historical and cultural aspects into modern sportswear. The innovative approach to costume design focuses on a harmonious combination of functionality, aesthetics and artistic expression that meets the high demands of modern sport.

The theme of the costume for a rhythmic gymnastics' performance is usually chosen by the athlete together with the coaching staff. The choice of theme can be arbitrary or pre-determined, but the basis for creating the costume and performing the exercises is the musical accompaniment, which sets the rhythm, creates emotional tension and immerses the gymnast in the artistic atmosphere of the performance. The costume should be in harmony with the rhythm and style of the composition, while effectively reflecting its interpretation. The colour, shape, and model of the costume must correspond to the character of the performer and the chosen theme. The colour scheme should be consistent with the emotional tone of the composition, avoiding excessive contrast or the use of overly bright colours (Goldschmied *et al.*, 2020). The costume should be of a balanced cut, with a well-thought-out structure of decorative and artistic elements. The shape of the costume, especially when choosing a model with a skirt or a basic line, should not interfere with the performance of the programme elements. In particular, the skirt should not cover the upper body during the exercises and prevent the implementation of rotational elements in the second phase of rotation. This allows maintaining the

aesthetic appeal of the costume and provides the full freedom of movement necessary to perform technically complex elements.

The costume makes up a significant part of the performance and broadly reflects the internal content of the programme. The leotard should be of high quality and comfortable, as it is worn on the naked body and should not cause discomfort to the gymnast. Leotard is a necessary and mandatory attribute for any rhythmic gymnastics programme. One of the main tasks of leotard companies is to develop exclusive and innovative designs that are not just leotards for rhythmic gymnastics programmes, but also a constantly relevant fashion item. When creating a collection, manufacturers consider the age category of gymnasts, distinguishing junior models from adult leotards to come up with offers that will suit both categories. The collection can include both monochromatic models and swimsuits with an expressive contrasting combination. Sequins and crystals can also be used for decoration, emphasising the bright details of the swimsuit design. However, when choosing

and creating a design for the programme, it is extremely important to take into account the athlete's personality and the programme music, the colours of which often become the basis for sketches and allow the use of various materials and ornaments.

At the 2024 Olympic Games in Paris, rhythmic gymnasts demonstrated not only their athletic skills, but also unique design solutions that became an important part of their performances. This paper examines vivid examples of design solutions that combine functionality, artistic expression and cultural symbols. The analysis of the participants' costumes on the example of the Olympic Games in Paris allows us to explore current trends in sportswear design and their impact on the perception of rhythmic gymnastics.

The costumes of the national team of Ukraine are a vivid example of a successful interpretation of national motifs in modern sports design (Fig. 11). They are not only functional, but also emotionally charged, which makes them an important component of the team's visual identity in the international arena.

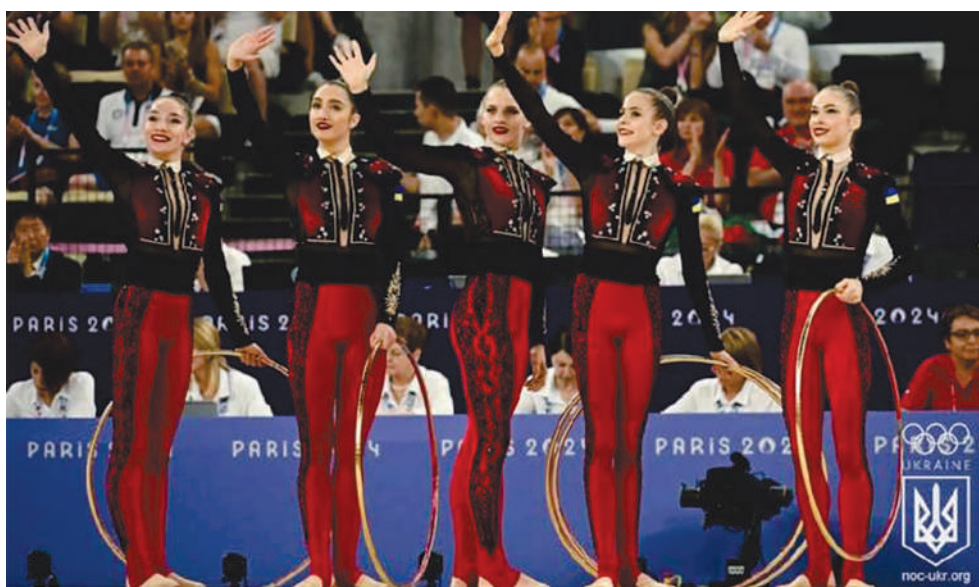


Figure 11. Costumes of the Ukrainian rhythmic gymnastics team at the 2024 Olympic Games in Paris
Source: O. Vasylyshyn (2024)

The costume is based on red and black colours, which symbolise Ukrainian tradition, in particular embroidery, where red and black are a classic combination. These colours not only emphasise national identity but also add drama and emotion to the performance. The costume has a tight fit that provides maximum freedom of movement and points out the athletes' physical shape. Transparent inserts on the upper part of the costume add lightness and sophistication to the look, while maintaining a balance between functionality and aesthetics. The combination of rich colours and patterns creates a dynamic visual effect while moving. Uzbek gymnast Takhmina Ikromova's costume for the ribbon

performance at the 2024 Paris Olympics is a successful example of a combination of art and sport (Fig. 12). Its design is inspired by Cubism, in particular the work of Pablo Picasso, which is expressed through asymmetrical graphic lines and abstract geometric motifs. The restrained colour scheme with an emphasis on black and white emphasises the conceptual nature of the image. The image of the Eiffel Tower on the back, which refers to French culture, and the ribbon in the colours of the French flag add another layer of symbolism. The costume harmoniously complements the composition, reflecting the synergy between music, movement and visual aesthetics.



Figure 12. Uzbek gymnast Takhmina Ikromova's costume at the 2024 Olympics in Paris

Source: Ya. Kachkovska (2024)

The costumes of Chinese gymnasts are distinguished by their multi-layered and complex composition, which combines traditional oriental motifs with modern design solutions (Fig. 13). The central accent is the ornamentation inspired by the luxurious patterns of imperial clothing of the dynasties, which symbolises strength, harmony and cultural heritage. Rich red and gold colours are associated with good luck and prosperity in Chinese culture, while green accents add contrast and dynamism. Rhinestone and fringe decorations create a movement effect that harmoniously complements

gymnastic exercises. Symmetry in the placement of the ornaments emphasises the aesthetics of unity and synchronisation of the team, making the performance visually coherent and expressive.



Figure 13. Costumes of the Chinese rhythmic gymnastics team at the 2024 Olympic Games in Paris
Source: China becomes first non-European country to claim Olympic gold in rhythmic gymnastics (2024)

The US gymnasts' leotards for the 2024 Olympic Games in Paris combine aesthetic sophistication with high functionality (Fig. 14). Each leotard is embellished with more than 10,000 Swarovski crystals, creating a sparkling effect under the stage lighting, emphasising the athletes' movements.



Figure 14. Costumes worn by American gymnasts at the 2024 Olympic Games

Source: J. Sullivan (2024)

The design, developed by GK Elite, reflects patriotic motifs through the use of red, white, and blue colours to symbolise national pride. The use of four-way stretch fabrics provides the comfort and freedom of movement needed to perform complex elements. The process of creating the swimsuits took four years and involved a team of 50 people, which demonstrates the careful approach to every detail.

DISCUSSION

The study examined the evolution of rhythmic gymnastics costume design, including the integration of traditional cultural motifs with modern technological innovations and environmental approaches. The results obtained show that designers successfully combine elements of cultural heritage with modern trends, which contributes to the aesthetic appeal and functionality of

costumes at the international level. The study results showed that the use of national motifs in the design of costumes enhances the identity of female athletes, makes their performances unique and creates an emotional connection with the audience. Such costumes become not only aesthetically pleasing but also culturally significant, promoting national art and traditions through sport. This is consistent with the findings of M.C. Nemeth *et al.* (2020), who investigated the relationship between body image and dressing behaviour among female team athletes. The authors found that national motifs in costumes also serve as a means of self-identification for female athletes, allowing them to feel proud of their cultural heritage. Such elements create a special visual accent that distinguishes performances at international competitions. This is in line with research findings that highlighted that costumes with aesthetically pleasing cultural details can increase support among both judges and audiences. The harmonious blend of traditional and contemporary elements in the design enhances the image of female athletes and helps them express their individuality through the art of gymnastics.

In addition, the results of the study showed that modern technologies such as laser cutting and 3D printing are actively used to create innovative costumes in rhythmic gymnastics. These technologies allow achieving high precision patterns, complex decorative elements and ensure the uniqueness of each costume. The use of such approaches significantly increases the aesthetic appeal and functionality of the costumes, making them perfectly adapted to the requirements of athletes. These observations are consistent with the study by A. Harlin *et al.* (2020), who emphasised the importance of using high-tech textile materials in sports. The authors found that materials with high elasticity, breathability, and wear resistance are critical to athletes' comfort and performance in competition. The integration of the latest technologies in the production of suits allows us to take into account the individual needs of athletes, ensuring not only comfort but also their confidence during performances. This demonstrates the synergy between innovation and practicality in sports fashion.

The issue of aesthetics and its impact on the perception of performances was one of the key aspects of the study, as costume design plays an important role in shaping the overall image of an athlete. L. Bosc (2023) investigated the relationship between positive body image and sports performance in rhythmic gymnasts. The author noted that costumes that highlight individuality and aesthetic expressiveness have a positive effect on the emotional state of athletes, increasing their confidence and, as a result, their performance in competitions. These conclusions are in line with the results obtained, which confirmed that stylish and comfortable costumes can create additional emotional support for female athletes, contributing to their psychological

preparation. A harmonious combination of aesthetics, functionality, and compliance with design standards not only provides visual appeal, but also helps gymnasts feel comfortable and confident, which is important for achieving high results.

The results of this study on the introduction of innovative materials and technologies in the creation of rhythmic gymnastics costumes were consistent with the findings of J. Wang (2022), who analysed marketing strategies on the example of Chinese rhythmic gymnastics in the context of the active development of social media. The author emphasised that the use of high-tech costumes with modern design solutions not only increases functionality and comfort, but also attracts the attention of the audience, creating a unique image of athletes. This approach helps to promote sports and build a strong national brand. Similar trends can be seen in this study, which notes that the integration of the latest technologies, such as 3D printing and laser cutting, significantly increases the aesthetic appeal of costumes, making them recognisable on the international stage. Such innovations not only improve the public's perception of sports, but also help female athletes stand out from the competition, contributing to their success on a global scale.

Some differences were identified when comparing the results of this study with the findings of L.J. Hackett & J. Coghlan (2023), who focused on the analysis of the transformation and control of female athletes' bodies through the prism of swimwear as a uniform. In their work, the authors raised the question of how sportswear standards affect the perception of female athletes' bodies, emphasising that uniforms can both help to highlight their skills and trigger discussions of gender stereotypes. In this study, while the issues of standards and regulation of costume design are relevant, the focus was on cultural and technological aspects. Particular emphasis is placed on how the use of national motifs and modern technologies contributes to the creation of unique costumes that harmoniously combine aesthetics with functionality. This approach avoids controversial discussions about the physicality of female athletes by focusing on their individuality and professionalism, which are enhanced by innovative design solutions.

In this study, the historical development of costume design was considered in the context of changes in materials, styles and decorative elements that meet the requirements of modern sport, as well as the influence of international standards on their formation. Particular attention was paid to the International Federation of Gymnastics regulations (2024) and their role in ensuring harmony between aesthetic and functional solutions that meet modern sports requirements. In the study by K. Krafte *et al.* (2023), the authors emphasised the importance of adapting visual communications to the specifics of young female athletes, which shapes their artistic style and meets their age characteristics

and noted that the standards strike a balance between safety and artistic expression. The comparison shows that both studies focused on the interaction between aesthetics and functionality, but this study paid more attention to the historical perspective and design solutions that cover all levels of rhythmic gymnastics. In contrast, K. Krafte *et al.* focused mainly on youth categories and their specific approaches to interpreting standards.

Innovations in costume design have become an important stage of development, including the use of the latest materials, such as elastic mesh and thermoregulated fabrics. T. Mykhailova (2022) studied the influence of artistic and technological solutions on the formation of images for Olympic ceremonial costumes. Her work discussed the importance of combining innovative materials with cultural symbols, which coincides with the approach of this paper to the integration of innovation into design. The difference lies in the focus: this study analysed in detail the practical aspects of using materials to improve the comfort of female athletes, while T. Mykhailova focused on symbolism.

Cultural and national motifs in the design of rhythmic gymnastics costumes are an important aspect that emphasises the individuality of athletes. J. Wang & D. Yao (2024) investigated the use of the colour palette of the Chinese national team's costumes as a semi-conscious construct reflecting the country's cultural heritage. This study also focused on the integration of Ukrainian traditional motifs into modern design. The similarity lies in the use of cultural symbols to reinforce the identity of athletes, but your study extends this aspect by analysing national symbols in a global context, while J. Wang & D. Yao limited themselves to the specific case of the Chinese team. The significance of colour and decoration in costume design is highlighted in this study through an emphasis on visual dynamics and highlighting the movements of the athletes. J. Wang & D. Yao considered colours as a tool for conveying cultural values and aesthetic characteristics.

In general, the results of this study are consistent with the trends identified by other researchers, confirming the importance of an integrated approach to rhythmic gymnastics costume design. The combination of aesthetics, functionality, technological innovation and cultural identity contributes not only to the improvement of sports performance, but also to the promotion of the sport at the international level.

CONCLUSIONS

The study found that the design of rhythmic gymnastics costumes is a multifaceted process that integrates aesthetic, functional, technological and cultural aspects. The analysis has shown that the combination of traditional motifs with modern technologies allows for the creation of unique costumes that enhance the expressiveness of athletes' performances and their confidence in competitions. This underscores the importance of

preserving cultural identity in the context of the globalisation of sport.

The results of the study confirmed that the use of modern technologies, such as laser cutting and 3D printing, helps to improve the quality of suits. These technologies ensure precision in the manufacture of parts, comfort and functionality, which is critical for high-level athletes. The integration of these approaches allows designers not only to create aesthetically pleasing costumes, but also to ensure that they meet the specific technical requirements necessary for the comfortable performance of complex gymnastic elements. At the same time, the use of innovative materials, such as breathable and hypoallergenic fabrics, has a positive impact on the physical condition and performance of female athletes during performances, reducing the risk of discomfort and injury.

The analysis also showed that costumes with elements of national symbols help to strengthen the self-identity of female athletes, which confirms the importance of cultural aspects in design. The use of national motifs, such as ornaments, traditional colours or symbolic elements, allows female athletes to emphasise their cultural uniqueness. Such costumes form an emotional connection with the audience and judges, adding to the uniqueness and international recognition of performances. Furthermore, the results of the study stated that the harmonious combination of aesthetics and functionality in the costumes helps to increase the psychological confidence of female athletes, which, in turn, has a positive impact on their sporting achievements.

An important aspect of the research was the study of ecological approaches to the creation of costumes. The use of environmentally friendly materials that meet modern standards reduces the negative impact on the environment and at the same time opens up new opportunities for innovation in sportswear design. The usage of such materials contributes not only to environmental responsibility, but also to improving the characteristics of the suits, such as their lightness, elasticity, and resistance to wear.

Prospects for further research could include a deeper study of the impact of eco-friendly materials on the performance of female athletes, exploring ways to integrate eco-friendly technologies into mass production, and analysing the psychological aspects of the perception of costumes by both gymnasts and audiences. It is also worth investigating the interaction between designers, athletes, and coaches in the process of creating costumes to ensure that they meet the needs of all parties. Thus, this study points out the importance of a multifaceted approach to rhythmic gymnastics costume design that takes into account cultural, technological and psychological aspects.

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Креативний підхід до дизайну костюмів для художньої гімнастики

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Анотація. Дане дослідження мало на меті вивчення еволюції дизайну костюмів для художньої гімнастики, зокрема їхньої естетичної, функціональної та культурної складових, з акцентом на інтеграцію традиційних національних елементів у сучасний контекст. У процесі дослідження було розглянуто костюми спортсменок із таких країн, як Україна, Китай, США, Японія та Узбекистан. Матеріали включали візуальні джерела, технологічну документацію та вимоги міжнародних регламентів, які визначають стандарти дизайну, наукові масмедіа-публікації. Вивчення охоплювало аналіз історичних етапів розвитку костюмів, культурних символів та інноваційних технологій, що використовуються у їх створенні. Результати дослідження показали, що еволюція дизайну костюмів відображає складну взаємодію між культурною ідентичністю, технологічним прогресом та спортивними вимогами. Виявлено, що сучасні костюми забезпечують баланс між функціональністю і художньою виразністю завдяки впровадженню інноваційних матеріалів, таких як еластична сітка і тканини з терморегуляцією, а також використанню декоративних елементів, як-от стрази та аплікації. Українські костюми демонстрували унікальність завдяки інтеграції традиційних орнаментів у сучасний дизайн, тоді як китайські зразки відзначалися гармонією кольорової палітри, що відображало культурну спадщину. Американські костюми акцентували увагу на патріотичних мотивах через використання національних кольорів і складних візерунків. Аналіз підтвердив, що міжнародні стандарти є важливим фактором, який впливає на створення костюмів, забезпечуючи безпеку, комфорт і естетику. Висновки даного дослідження підкреслили важливість гармонійного поєднання традицій і сучасних інновацій у створенні костюмів, що відповідають естетичним і функціональним вимогам. Отримані результати відкривають нові перспективи для досліджень у сфері дизайну спортивного одягу, зокрема в контексті використання екологічних матеріалів та впливу на психологічний стан спортсменів

Ключові слова: культурна ідентичність; національна символіка; декоративні елементи; естетика; орнамент