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Research Article

A Practice-Based Study on Clothing for Special Body Types from the Perspective of Visual Culture and Ergonomics

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Abstract
Against the backdrop of growing demands for personalized and inclusive fashion, individuals with special body types have long faced a dual dilemma of poor fit and weakened identity due to the reliance on "standard patterns." This study integrates perspectives from visual culture and ergonomics to construct a three-stage research framework: "Pattern Collection Structural Optimization Cultural Feedback." First, 3D scanning and virtual simulation were used to establish a pattern database for six special body types, including hunchback, chest protrusion, and forward bending. Second, paper patterns were adjusted based on ergonomic parameters, and visual strategies such as vertical lines and soft color blocks were applied to mitigate body shape differences. Finally, focus groups and fitting experiments assessed the acceptability of designs across different cultural contexts. Results indicate that optimized patterns significantly outperform standard prototypes in both comfort and visual proportions, while simultaneously enhancing wearers' self-identity and social evaluation. This research provides a replicate practical path for systematic design of clothing for special body types and expands the theoretical dimensions of inclusive fashion.

Keywords: *Special body types; Ergonomics; Visual culture; Inclusive design.*

1. Introduction
In contemporary society, clothing has long transcended its basic functions of covering and protection, becoming an important medium for conveying cultural meaning and social identity. Visual culture studies emphasize that clothing is an extension of the "visible body," whereby individuals continuously construct and express their self-image through dress, and society classifies bodies into "standard" versus "non-standard" or "beautiful" versus "ugly" categories through visual symbols. Within this context, research on clothing for special body types concerns not only technical fit but also cultural understanding of bodily differences and the reconstruction of identity.

Traditional clothing design predominantly relies on standard body types, often overlooking groups with special body shapes caused by age, occupation, genetics, or environmental factors. Hunchbacks, forward bending, backward leaning, chest protrusion, and protruding abdomens frequently result in poor fit, discomfort, and even awkward appearance, affecting both physical comfort and psychological self-identity. Mainstream aesthetic systems tend to associate non-standard body types with defects, further marginalizing these groups.

Ergonomics provides a scientific approach to address this issue. By measuring body characteristics and analyzing movement patterns, designers can make targeted adjustments during pattern-making. For instance, hunchback bodies benefit from increased back length and curvature to reduce garment lifting, while forward-bending bodies require shortening the front torso and extending the back to balance proportions. Such optimizations improve both comfort and overall silhouette. However, focusing solely on ergonomics does not address the social and cultural significance of clothing.

The perspective of visual culture emphasizes that clothing is not merely functional but also symbolic. Designing for special body types requires using shape, line, color, and ornamentation to confer new aesthetic value to the body—for example, employing vertical lines to elongate the figure or soft colors to reduce local differences—enhancing appearance while supporting positive social perception for wearers.

In recent years, developments in 3D scanning, virtual fitting, and digital pattern-making technologies have facilitated the industrialization of research on special body types. Digital tools enable rapid generation of individualized patterns, shortening production cycles, improving fit, and reducing resource waste, thereby meeting both professionalization and sustainability requirements.

In summary, from the combined perspective of visual culture and ergonomics, research on clothing for special body types represents an interdisciplinary practice bridging science and humanities. It emphasizes the integration of function and aesthetics, enhances wearer comfort and appearance, and promotes social acceptance and identity recognition for diverse body types, offering new possibilities for diversification and aesthetic reconstruction within the fashion industry.

2.Research Questions

1) How can clothing for special body types reflect professionalization and identity construction in the perspective of visual culture?
2) How can principles of ergonomics guide pattern-making optimization for special body types?
3) How can visual aesthetics be integrated with functional requirements to summarize practical design methods?

3.Literature Review

3.1 Development of Visual Culture and Aesthetic of Clothing Patterns

Visual culture, as an important theoretical perspective for studying contemporary aesthetics and symbolic systems, emphasizes the interaction among images, the body, and social meanings. In clothing research, visual culture has prompted a renewed understanding of pattern aesthetics, highlighting that clothing is not merely a product of technology and function but also a visual symbol that constructs the body and identity. Jiang, Qu, and Xia (2025) note that in the "post-truth era," visual culture and image-based narratives play prominent roles in emotional influence and information dissemination, while simultaneously reshaping public perception of the body and appearance. This implies that clothing design, especially pattern design, concerns not only fit but also how individuals are "seen" within visual culture.

Traditional clothing structure design has long relied on standard body type prototypes, often neglecting special body types. The introduction of visual culture has made scholars aware that patterns not only reflect technical adjustments but also carry social aesthetic value. Ross (2022), analyzing special upper-body shapes in young women, found that different body characteristics affect not only fit but also the visual presentation of clothing in social interactions. By combining strategies such as visual illusions and color contrast, the interaction between patterns and visual elements can improve the often negatively perceived visual effects of special body types, indicating a shift from purely structural concerns toward deeper integration with visual culture.

The development of visual culture has also driven innovation in fashion design education and experimental methods. Xia, Wang, Ding, and Wu (2024), in their study on virtual simulation experiments for high-end custom suits for special male body types, pointed out that virtual simulation technology not only addresses the long production cycle and high cost of sample garments but also expands students' understanding of pattern aesthetics on the visual level. Through "visual fitting" in virtual environments, designers can directly observe how patterns vary with different body types, making visual effects an important criterion for evaluating patterns and highlighting the profound impact of visual culture on clothing structure education.

In applying visual culture, scholars emphasize the social significance of patterns as "visual symbols." Zhou (2016) argues that for special body types, following standard structural logic not only fails to beautify the body but can exaggerate flaws. Therefore, the aesthetic value of patterns is redefined: they satisfy functional needs while conferring a positive image on special body types. Aesthetic trends among youth further promote the integration of visual culture and pattern design. Yang (2025) found that young people shape unique identities through visual expression, with clothing patterns serving as key visual symbols; Miao (2016) proposed transforming image-based design concepts into pattern correction methods, balancing visual aesthetics with fit requirements.

Overall, the development of visual culture has shifted the aesthetic of clothing patterns from a focus on "fit" to a comprehensive value of "aesthetics–culture–identity." Patterns are no longer merely technical products of cutting and assembling but serve as symbolic language within visual culture, carrying social recognition and aesthetic reconstruction for individuals. Research on special body types provides a more challenging field for applying visual culture, allowing pattern aesthetics to serve not only standardized groups but also, from a cultural perspective, embrace and reshape diverse body types.

3.2 Development of Special Body Types in Clothing Patterns

In traditional clothing design and pattern-making systems, the "standard body type" has long been considered the foundation for pattern construction. This system, based on medium stature and proportional balance, facilitates large-scale industrial production but neglects numerous individuals with special body types. With the rise of visual culture and personalized design concepts, special body types have gradually become a significant topic in clothing research, and their patterns have shifted from peripheral to central, reflecting a design trend from "standardization" to "diversification."

Taking the hunchback body type as an example, Huang and Cheng (2025) note that traditional patterns often cause raised shoulders, shifted garment position, and tight busts when worn by hunchback individuals. These issues affect both comfort and appearance and directly influence wearers' confidence and social interaction. Through structural adjustments and tailored measurements, their study proposed pattern optimization for hunchback bodies, effectively improving fit. This research not only clarifies technical challenges in designing for special body types but also prompts designers to reconsider the limitations of traditional pattern-making logic when addressing bodily differences.

Similarly, Chen (2022), in a study of body characteristics in middle-aged and older women, found that age-related changes in fat distribution and posture habits make standard models inaccurate. Clothing patterns require targeted adjustments in chest-to-waist ratio, shoulder slope, and back curvature to accommodate unique body structures. This indicates that standard body types are not universally applicable, and the physiological traits of special body types directly affect pattern design.

In menswear, Xu (2022) found that Chinese male body characteristics such as shoulder width, waist-hip ratio, and back curvature differ significantly from Western standards. Western-style suits often result in tight waists, misaligned shoulder lines, and improper garment length. Xu proposed constructing localized pattern bases based on the average Chinese male body to provide a standard more suitable for local users, thereby improving fit and satisfaction.

Furthermore, Wang, Sun, and Deng (2023), in research on fitted undergarments for middle-aged and older women, highlighted the balance challenges between comfort and aesthetics for special body types. Through anthropomorphic measurements and 3D fitting analysis, they found traditional undergarments lacked support, adaptability, and proper fit. By adjusting patterns according to body characteristics, garments could structurally accommodate bodily changes while visually optimizing body lines, emphasizing the significance of special body types in pattern design.

With the development of personalized and functional design, research on special body types is no longer an ancillary task of "correcting standard patterns" but has become a core driver of pattern diversification. Through in-depth analysis and structural optimization of different body features, designers enhance fit and comfort while using visual strategies to confer new aesthetic value to the body, transforming special body types from "exceptions" to "norms" in pattern logic and fundamentally elevating their status in clothing pattern design.

3.3 Development of Ergonomics and Its Relationship to Special Body Types

Ergonomics, the study of the relationship among human structure, function, and the environment, has gradually intersected with clothing design since the 20th century, providing scientific support for addressing fit issues. In clothing research, ergonomics focuses not only on dimensional data and postural differences but also on the coordination between garment structure and human dynamics. The development of this discipline provides methodological support for special body type research, allowing pattern adjustments to evolve from empirical exploration to systematic scientific approaches.

Zuo (2022), in a study on ergonomics applications in clothing structure design, emphasized that ergonomics converts different body features into structural parameters through precise measurements and movement analysis. This approach is particularly suitable for special body types, whose posture, proportions, or localized structures often differ significantly, requiring scientific modeling to achieve comfort and functionality. Ergonomics thus serves not merely as a data collection tool but as a bridge connecting the body and clothing.

In women's body research, Wang, Liu, and Li (2023) analyzed differences in bust, waist, and shoulder curves across body types, finding that traditional patterns often overlook these variations, leading to poor fit. Based on ergonomic principles, they proposed a scientific pattern correction method that quantifies body features and directly links design solutions to body characteristics. This approach not only improves comfort for women with special body types but also enhances visual modification of garments.

In menswear, ergonomics similarly plays a critical role. Xu (2022) measured Chinese male body features, finding consistent traits in chest-to-waist ratios, back curvature, and shoulder width. Applying Western standard patterns would cause localized pulling or looseness. Ergonomic analysis led to tailored pattern adjustments for Chinese males, improving dynamic fit and demonstrating that ergonomics addresses both individual differences and group-specific characteristics.

With the advent of digital and intelligent technologies, ergonomics applications have expanded further. Xia, Wang, Ding, and Wu (2024), in virtual simulation experiments, noted that 3D body scanning and virtual fitting technologies rapidly generate accurate data, efficiently supporting pattern adjustments for special body types. Compared with traditional manual measurement, this method visually demonstrates garment-body interaction, predicting fit and comfort at the design stage. This not only increases research efficiency but also advances the practical application of ergonomics in special body type studies.

Overall, the development of ergonomics provides a scientific framework for research on special body types. Through body measurement, structural modeling, and virtual simulation, designers can make precise adjustments according to individual differences, achieving a balance between functionality and aesthetics. Research on clothing for special body types is thus based on scientific data and systematic analysis rather than empirical corrections, enhancing both the academic value of clothing design and the fashion industry's progress toward diversity and inclusive.

4. Research Methods

This study adopts a combined methodology of literature review, case analysis, and practice-based research. First, a systematic review of domestic and international research on visual culture, special body types, and ergonomics was conducted to establish a theoretical framework and clarify the academic status of special body types in clothing pattern design and aesthetic construction. The literature review not only helps researchers grasp the progress and gaps in existing studies but also provides a theoretical basis for subsequent practical work.

Second, in the case analysis phase, typical special body types such as hunchback and forward-bending postures were selected as subjects to compare their body characteristics and garment fit. By recording and analyzing common issues observed during sample fittings, the study revealed structural deficiencies in standard patterns when applied to special body types and explored potential improvement strategies.

Finally, in the practice-based research phase, pattern adjustment strategies were validated. The production of physical prototypes ensured the portability and effectiveness of the proposed adjustments.

5. Research Process

5.1 Collection of Patterns for Special Body Types

Table 1. Overview of Special Body Type Pattern Collection

Collection Stage	Content and Methods	Goals and Description
Body Type Coverage	Hunchback, rounded shoulders, large bust, underweight, overweight, mixed types	Build a diverse pattern database to ensure comprehensive coverage of body types
Data Sources	Existing garment samples, virtual simulation models, actual production samples, anthropomorphic databases	Provide a rich set of samples to ensure data reliability
Recording and Annotation	Garment length, shoulder width, waistline position, sleeve length, collar design, fabric adaptability and elasticity parameters	Provide detailed structural data for subsequent pattern optimization
Key Dimension Standardization	Shoulder width, bust, waist, hip	Ensure comparability and permeability of data across body types
Common Problem Identification	Shoulder wrinkles, uneven waistline, tight back, protruding chest	Provide problem-oriented guidance for pattern optimization
Pattern Classification	Functional optimization, visual correction, structural improvement	Functional optimization: enhance comfort; Visual correction: improve proportions; Structural improvement: technical enhancements

Source: Drawn by the researcher.

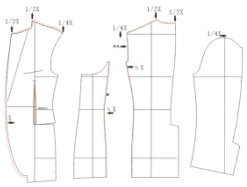
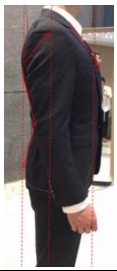
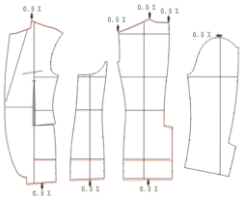
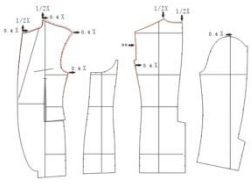
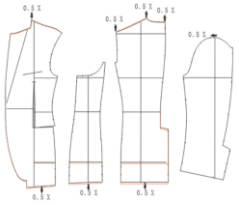
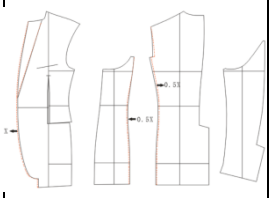
This study systematically collected garment patterns for various special body types, including hunchback, rounded shoulders, large bust, underweight, overweight, and mixed types, establishing a pattern database that covers diverse body characteristics and provides a foundation for optimization. Data sources included existing samples, virtual simulation models, physical prototypes, and anthropomorphic databases (see Table 1).

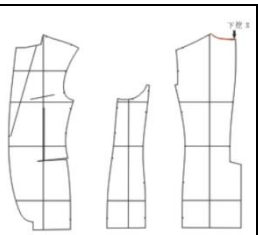
During collection, the research team annotated and standardized key features such as garment length, shoulder width, waistline, sleeve length, collar design, and fabric adaptability. Quantitative data from 3D scanning and body measurements were combined with qualitative analysis from sample fittings to identify common issues such as shoulder wrinkles, uneven waistlines, and tight backs. Patterns were then classified into functional optimization, visual correction,

and structural improvement categories, providing clear directions and methodological bases for subsequent optimization designs tailored to different body types.

5.2 Classification and Adjustment of Special Patterns

Table 2. Classification and Adjustment of Special Patterns

Body Type	Main Garment Fit Issues	Optimization Strategy	Pattern Illustration	Image Display
Protruding Chest	Front chest gap, lapel not lying flat, front hem lifting, underarm twisting	Lengthen front chest, increase bust dart & front panel width, adjust back sleeve cap ease		
Forward-Bending	Front panel sagging, back panel lifting, back hem gap	Shorten front chest, lengthen back, move sleeve placket forward		
Backward-Leaning	Insufficient front chest width, front hem lifting, back panel sagging with waist wrinkles	Lengthen front chest, shorten back, adjust back sleeve cap ease		
Hunchback	Back collar lifts, center back rises leaving gaps, back sleeve diagonal wrinkles	Increase back length & curvature, enlarge back dart		
Hunchback – Protruding Abdomen	Insufficient front abdominal circumference, front hem flaring, front hem twisting	Increase front abdominal volume & dart, reduce back circumference		

Hunchback – Flat Shoulders / Neck-Back Lean	Back collar pooling, shoulder wrinkling	Lower back collar, reduce back shoulder slope		

Source: Drawn by the researcher.

For clothing design tailored to different body types, this study further summarizes typical body features, common garment fit issues, and corresponding pattern optimization strategies (see Table 2).

Protruding Chest: This body type is characterized by a developed and prominent chest, relatively flat back, and slightly rearward shoulders. Garments often show front chest gaps, lapels not lying flat, front hem lifting, and underarm twisting, particularly in suits and shirts. Pattern adjustments involve lengthening the front chest, increasing bust darts and front panel width, and adjusting back sleeve cap ease to improve chest fit and overall comfort, addressing discomfort and imbalance caused by the prominent chest.

Forward-Bending: This body type leans forward, elongating the back curve. Garments tend to sag in the front panel, lift in the back, and leave noticeable back hem gaps, affecting comfort and appearance. Optimization includes shortening the front chest, lengthening the back, and moving the sleeve placket forward to enhance fit across front, back, and sleeves, improving coordination and overall silhouette flow.

Backward-Leaning: The body leans backward, with a straight back and shortened neck-back curve. Common issues include insufficient front chest width, front hem lifting, back panel sagging, and waist wrinkles. Pattern adjustments involve lengthening the front chest, shortening the back, and modifying the back sleeve cap, balancing front and back proportions, improving fit at the shoulders, chest, and waist, while maintaining comfort and aesthetic appeal.

Hunchback: Characterized by a pronounced upper back, forward-leaning neck, and increased back curve, garments often have lifted back collars, center-back gaps, and diagonal wrinkles on the back sleeve. Optimization focuses on increasing back length and curvature, and enlarging the back dart to achieve a natural back fit, relieving tightness and wrinkles while maintaining ergonomic functionality.

Hunchback – Protruding Abdomen: The abdomen protrudes noticeably, often combined with a backward-leaning or hunchback posture, causing insufficient front abdominal circumference, front hem flaring, and twisting issues. Pattern strategies include increasing front abdominal volume and dart, while moderately reducing back circumference, ensuring enough front abdominal space, alleviating tightness, and improving body proportion for a more harmonious fit.

Hunchback – Flat Shoulders / Neck-Back Lean: Characterized by upright necks and flat shoulders, with excess fabric in the shoulder seam triangle. Garments may show back collar pooling and shoulder wrinkling. Pattern adjustments involve lowering the back collar and reducing back shoulder slope to improve shoulder and collar fit, enhance shoulder smoothness, and achieve a better overall fit and visual appearance.

5.3 Cultural Feedback and Inclusivity Assessment

Table 3. Cultural Feedback and Inclusivity Assessment Form

Assessment Stage	Methods & Procedures	Audience / Application	Findings & Effects
Assessment Subjects	Groups with diverse gender, age, occupation, and cultural backgrounds	Diverse audience groups	Covers different cultural and body type needs
Assessment Methods	Combination of focus group discussions, questionnaires, practical fittings, and interviews	Participants	Collect comprehensive feedback on comfort, visual body proportion, and cultural identity
Main Findings	Optimized patterns improved visual proportions and wearing comfort, adjusted shoulder-back ratio, waist-abdomen fit, and	Most body type groups	Optimized designs received high recognition in practice, enhancing wearing experience and visual body effect

	overall silhouette coordination		
Cultural Differences	Acceptance of colors, patterns, and detail design varies across cultural groups	Cross-cultural audience	Provides reference for diverse and customized designs, ensuring cultural adaptability
Secondary Optimization	Adjust patterns based on feedback	All optimized patterns	Improves garment inclusivity and cultural adaptability, balancing functionality, aesthetics, and social diversity
Overall Significance	Pattern collection + optimization + cultural feedback forms a complete process	Special body type clothing design applications	Provides practical guidance and theoretical reference for customized and personalized clothing design

Source: Drawn by the researcher.

To ensure that the optimized patterns achieve broad acceptance in real-world wear, the final stage of this study involved cultural feedback and inclusivity assessment. The evaluation subjects included audiences of different genders, ages, occupations, and cultural backgrounds. Methods combined focus group discussions, questionnaires, practical fittings, and interviews to gather participants' feedback on garment comfort, visual body effects, design aesthetics, and cultural identity (see Table 3).

The assessment revealed that the optimized patterns significantly improved visual proportions and wearing comfort for most body types, particularly regarding shoulder-back ratio adjustment, waist-abdomen fit, and overall silhouette coordination. Feedback also indicated that acceptance of colors, patterns, and detailing varies across cultural groups, providing important reference for pattern diversification and customization. Based on this feedback, the research team performed secondary adjustments, further enhancing garment inclusivity and cultural adaptability, ensuring that the designs meet functional requirements while accommodating social and aesthetic diversity.

Through the complete research workflow of pattern collection, optimization, and cultural feedback, this study established a systematic, scientific, and operable methodology for designing garments for special body types. This approach not only provides practical guidance for customized and personalized clothing design but also offers a theoretical reference and applied framework for future research on special body type garments.

6. Discussion

This study proposed a clothing design methodology for special body types through pattern collection, optimization, and cultural feedback assessment. The findings indicate that structural optimization can significantly improve body proportions and wearing aesthetics while maintaining comfort. The optimized patterns showed enhanced fit and dynamic performance across different body type models.

Moreover, cultural feedback revealed that acceptance of colors, patterns, and detailing varies among different groups, suggesting that design solutions must consider social and cultural diversity as well as aesthetic inclusive. In practice, the research team found that visual intervention strategies are particularly effective for key areas such as the shoulders, back, waist, and chest, helping to alleviate prominent body issues and boost wearer confidence.

However, the study has limitations, such as a restricted sample coverage of body types. Future research could expand the sample size and incorporate additional dynamic movement tests to further refine the methodology. Additionally, integrating this design approach with smart textiles and adjustable garment technologies could enable higher levels of professionalization and functionality, offering new directions for the development of clothing for special body types.

7. Conclusion

This study established a clothing design methodology for special body types based on ergonomics and visual culture theory, and validated its feasibility and effectiveness through pattern collection, optimization, and cultural feedback. The results demonstrate that combining structural optimization not only improves body proportions but also enhances comfort and aesthetics, providing practical support for customized and personalized clothing design.

Cultural feedback and inclusive assessment further emphasize that clothing design should accommodate diverse aesthetic preferences and social recognition. The methodological framework developed in this study can serve as a reference for special body type clothing design and offers a theoretical foundation and practical guidance for future exploration of intelligent, digital, and personalized garment design.

Overall, the study enriches the theoretical understanding of special body type clothing design and provides an actionable pathway for promoting more inclusive and human-centered clothing innovation.

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