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Study on Men's Garment Draping and Special Body Type Treatment Techniques from an Ergonomics Perspective

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ABSTRACT **Original research paper**

This study systematically explores men's garment draping and the modification of special body types from an ergonomics perspective. The results indicate that methods such as unfolding, folding, dart adjustment, and structural balancing can effectively address structural adaptation issues for body types including prominent chest, hunchback, protruding abdomen, and sloping shoulders. These techniques enhance both comfort and dynamic functionality while maintaining aesthetic appearance and structural stability. The study highlights the close relationship between ergonomics and men's garment draping, providing scientifically grounded and practical solutions for custom tailoring and ready-to-wear production.

Keywords: Ergonomics, Men's garment draping, Special body types, Treatment techniques.

1. Introduction

With the rapid development of the fashion industry, the men's apparel market increasingly demands precise and comfortable tailoring techniques. As consumers place higher expectations on clothing quality and personalization, men's fashion brands must not only follow trends but also prioritize practicality and comfort. Ergonomics, as a discipline studying the relationship between human structure, function, and the usage environment, provides essential theoretical support for garment design and production. By analyzing both static and dynamic characteristics of the human body, it offers a scientific basis for tailoring, ensuring garments fit body contours while accommodating movement needs.

Integrating ergonomic principles into men's garment draping not only improves fit and wearing comfort but also enables personalized customization for special body types, meeting diverse consumer demands. This customized approach takes into account individual body characteristics and wearing habits, providing a more tailored and comfortable experience for the wearer.

2. Research Questions

（1）Why do ergonomic theories have a significant impact on men's garment draping and the treatment of special body types?

（2）How can traditional men's garment draping methods be optimized based on ergonomic principles?

（3）What special treatment techniques should be applied for individuals with distinct body type characteristics?

2. Literature Review

In modern apparel engineering, ergonomics has become an essential theoretical foundation for men's garment draping. Compared with traditional two-dimensional pattern making, draping emphasizes obtaining patterns from three-dimensional space, allowing for a more precise reflection of the body's dynamic curves and structural features, thereby improving the fit between clothing and the body (Li & Zhang, 2020). This is particularly critical in designing clothing for individuals with special body types. For example, features such as overweight, uneven shoulders, or spinal curvature often result in ill-fitting garments, whereas ergonomics-guided draping can achieve more scientific solutions through localized segmentation, paneling, and allowance adjustments (Wang, 2019).

With the rapid development of digital and intelligent technologies, the application of ergonomics in men's garment draping has deepened further. The integration of 3D body measurement and virtual fitting technologies enables researchers to create high-precision human body models and optimize patterns for different body types. Chen and Huang (2021) noted that parameterized draping methods based on 3D scanning can significantly improve pattern fit, especially for body types with notable differences in chest, waist, and hip measurements. Liu (2022) emphasized that virtual simulation technology reduces the need for physical prototypes, optimizes pattern-making processes, and lowers production costs.

Meanwhile, process innovation has emerged as another breakthrough for enhancing comfort and functionality. Zhao and Gao (2020) proposed that combining digital pattern making with flexible paneling techniques not only improves the freedom of movement in the shoulder and back areas but also enhances localized support. In suit production, Sun and Zhou (2021) found that using flexible interlining and three-dimensional paneling can effectively disperse pressure on the shoulders and waist, resulting in a wearing experience that better aligns with ergonomic principles. Further explorations focus on modular and intelligent techniques. Yang (2023) suggested that future men's draping will rely on real-time data feedback to dynamically adjust patterns to meet the needs of diverse body types. Zhou (2021) added that garment process development should consider not only functionality and aesthetics but also sustainability, incorporating eco-friendly materials and circular processes to align with future industry trends.

Overall, the role of ergonomics in men's draping and special body type adaptations has expanded from theoretical guidance to practical application, promoting scientific and personalized development in clothing design. Zheng and Li (2022) highlighted that future research will focus on digital body modeling, intelligent draping processes, virtual simulation optimization, and the integrated use of sustainable materials. These advances not only enhance the functionality and comfort of garments but also expand the diversity and inclusivity of men's fashion, providing more precise solutions for individuals with special body types.

3.2 Men's Draping for Special Body Types

The development of men's garment draping is not solely aimed at standard body types; more importantly, it addresses the discomfort and fit issues associated with diverse special body types. Traditional patterns are typically based on “normal” or “standard” body types, often causing wearers with protruding abdomens, broad shoulders, sunken chests, or spinal curvature to experience pulling, looseness, or localized wrinkling in ready-to-wear garments (Dong & Zhang, 2010). Therefore, specialized techniques for adapting garments to unique body types have become a key focus in recent clothing engineering and draping research.

Specifically, parameterization and digital approaches offer new pathways for draping special body types. Wu (2022) examined men with protruding abdomens using 3D body scanning to select representative samples, then applied surface flattening and parameterized modeling to develop structural correction models for key areas. The study proposed adjustments such as chest darts and front waist allowances, overcoming the limitations of experience-based modifications and achieving standardized and automated pattern generation. This method not only improves garment fit for protruding-abdomen body types but also demonstrates that draping is increasingly moving toward data-driven, scientific, and systematic approaches.

At the process design level, Tang (2020) proposed, based on business-casual men's wear, that issues of uneven body proportions could be addressed through seam-line design, asymmetrical patterns, and combinations of different sleeve types. Tang emphasized that draping is not only a tool for resolving conflicts between patterns and body types but also a medium for shaping garment style and aesthetic qualities. This illustrates the complementary relationship between special body type treatment and design aesthetics, reflecting the dual value of draping in meeting both functional and visual requirements.

Moreover, regional and ethnic research offers new perspectives for special body type adaptation. Dong and Zhang (2010) used body data of middle-aged men in Tianjin and applied regression analysis to establish prototype patterns, providing a scientific basis for this demographic. In contrast, Wang (2021) approached the topic from an ethnic clothing perspective, integrating Tibetan robe structures with modern men's draping techniques. The voluminous silhouette and "cross-shaped planar structure" of Tibetan robes help modify and conceal proportions for overweight or unusually proportioned individuals, providing a reference for contemporary men's draping. Such studies highlight not only methodological diversity but also the innovative potential of draping in cultural integration and body-type adaptation.

In terms of structural optimization for specific areas, the shoulder is a key region affecting both draping aesthetics and comfort. Liu (2018) emphasized that adjusting the relationship between the shoulder seam and collar is particularly important in modern Chinese men's clothing, improving the wearing experience for individuals with unique shoulder structures. This underscores that local draping adjustments should consider spatial shaping and structural line modification to achieve coordination between localized areas and overall garment design.

In summary, men's draping for special body types is transitioning from experience-based adjustments to data-driven modeling while integrating process innovation and cultural elements. Current research demonstrates that 3D body scanning and parameterized modeling significantly enhance the scientific rigor and efficiency of draping (Wu, 2022), structural design methods balance functionality and aesthetics (Tang, 2020), and ethnic clothing elements expand the cultural dimension of modern draping (Wang, 2021). Future trends will focus on combining digital technology, intelligent draping, and cultural integration to achieve precise adaptation for diverse body types and multifaceted expression (Dong & Zhang, 2010; Liu, 2018).

3.3 Men's Draping and Future Development Trends

With the diversification of the men's apparel market and the growing consumer demand for fit and comfort, draping has gradually replaced traditional flat pattern making as a key trend in men's garment structural design and process improvement. Draping emphasizes a human-centered approach, constructing garment structures intuitively in three-dimensional space to achieve precise adaptation to body curves and dynamic changes. This method not only enhances the garment's aesthetic and comfort but also largely overcomes the limitations of flat pattern making when addressing complex body types (Li & Zhang, 2020).

In terms of process improvement, the introduction of digital and intelligent technologies has significantly advanced draping techniques. The widespread adoption of 3D body measurement enables designers to construct accurate human models via 3D scanning, providing a scientific basis for pattern optimization. Chen and Huang (2021) demonstrated that this data-driven modeling approach significantly improves the fit of men's garments for special body types, particularly in groups with notable differences in chest, waist, and shoulder-back dimensions. Meanwhile, virtual fitting and simulation technologies are rapidly evolving. Liu (2022) noted that virtual prototypes not only reduce repetitive modifications in traditional sample-making but also effectively shorten production cycles and costs, enhancing design efficiency while ensuring proper fit.

In practical process operations, the concepts of flexibility and modularity are widely applied to address special body types. Zhao and Gao (2020) proposed that combining digital pattern making with flexible paneling improves local comfort without compromising overall appearance, allowing greater freedom of movement. Sun and Zhou (2021) found that in suit construction, using flexible interlining and three-dimensional paneling not only disperses pressure on the shoulder and back areas but can also correct uneven posture to some extent, enhancing ergonomic comfort.

Looking ahead, the development of draping techniques is moving toward greater intelligence and sustainability. Yang (2023) suggested that modular and intelligent processes based on real-time data feedback will become the trend, enabling designers to dynamically adjust patterns according to individual body features and achieve highly personalized tailoring. This trend meets differentiated consumer needs and aligns with the apparel industry's direction toward customization and high added value. At the same time, scholars emphasize the necessity of sustainable development. Zhou (2021) noted that men's draping should prioritize fit and comfort while integrating eco-friendly materials and circular processes to satisfy the demands of green apparel production. Zheng and Li (2022) further proposed that future research should integrate digital modeling, virtual simulation, intelligent processes, and sustainable design within the framework of ergonomics, thereby promoting a balance among functionality, comfort, and ecological value in men's fashion.

In summary, the development of men's draping reflects the evolution from traditional techniques to digital modeling, virtual simulation, and finally to intelligent and sustainable design. This progression not only aligns garments more closely with ergonomic principles and accommodates diverse body types but also drives the apparel industry toward scientific, personalized, and sustainable development.

4. Research Methods

This study combines literature review and experimental methods. Relevant domestic and international literature on ergonomics, garment patterning, and special body type adaptations was reviewed to establish a solid theoretical foundation and provide scholarly support for the research. In parallel, various draping methods and treatment techniques were tested and validated through practical experiments. Their effectiveness was observed and comparatively analyzed to identify the most effective processes.

By integrating these methods, the study aims to explore the research questions from both theoretical and practical perspectives, offering valuable guidance for the development of the men's apparel industry.

5. Research Process

5.1 Draping Practice and Process Exploration

Table 1： Draping Process Exploration

Category	Methods and Operations	Objectives and Effects
Standard Body Type Draping	Establish a standard draping workflow; use a standard body type as the reference base and conduct stepwise modification experiments.	Create standardized control samples to serve as a baseline for special body type adjustments.
Overweight Body Type	Increase the number of darts; adjust panel seam lines; add easing at key areas such as the front panel, waist, and abdomen to avoid tightness while maintaining a structured silhouette.	Reduce discomfort caused by fuller body shapes; maintain comfort and freedom of movement.
Slim Body Type	Reduce dart amounts; narrow panel structural lines; adjust shoulder and waist lines to improve fit and avoid looseness, visually enhancing fullness.	Prevent garments from appearing baggy; enhance line definition and overall fit.
Special Posture Body Type	Add allowances at the back panel as needed; adjust shoulder-neck points; ensure the garment moves naturally during dynamic wear.	Accommodate body shapes with posture deviations; enhance natural appearance during movement.
Fabric Experimentation	Test fabric thickness, elasticity, drape, and stretch; repeatedly drape on body models, comparing wrinkle control and dynamic adaptability.	Summarize fabric suitability rules for different body types and garment categories; improve experimental rigor.
Process Feedback and Modification	Conduct fittings and observations to compare visual effects and comfort of different approaches; iterate pattern adjustments based on dynamic fitting results.	Establish a "experiment–feedback–modification" workflow; enhance the scientific and systematic nature of the draping process.

Source: Drawn by the researcher.

Based on the collection and organization of anthropometric data, this study progressed to the practical stage of men's garment draping. Starting with a base pattern for a standard body type, a standardized draping workflow was established, upon which structural adjustments and process explorations for special body types were gradually introduced. Unlike traditional two-dimensional pattern making, draping involves directly manipulating fabric on a body model or mannequin, providing a more intuitive representation of body curves and spatial relationships, and enabling more precise structural adaptation for different body types (see Table 1).

For overweight body types, the draping practice emphasizes "distribution and relief." By increasing the number of darts, adjusting seam lines on the front and back panels, and adding easing at key areas, local tightness caused by fuller body shapes can be effectively mitigated, ensuring comfort and freedom of movement. Simultaneously, attention is given to maintaining balanced contour lines, so that the overall silhouette remains upright and structured while subtly shaping the body.

For slim body types, the strategy focuses on "gathering and refinement." Reducing darts and narrowing panel structural lines enhances the fit of the garment to the body, preventing bagginess and an unshapely appearance. Additionally, careful manipulation of shoulder-line extensions and waist-line adjustments creates a visually fuller and more upright effect, mitigating the thinness associated with slim physiques. Individuals with mild posture deviations, such as a slight hunchback, require additional allowance at the back panel or adjustments to the shoulder-neck points to accommodate posture characteristics, allowing the garment to move naturally during dynamic wear.

Fabric selection and testing are also key components of the process. Different fabrics vary significantly in thickness, elasticity, drape, and stretch, which directly influence the shaping effects of draping and wearing comfort. For instance, structured wool maintains a defined silhouette for suits, whereas lightweight knit fabrics emphasize a softer, closer fit. In experiments, repeated draping on mannequins of various body types allowed comparison of fabric performance in terms of wrinkle control, stretch adaptability, and dynamic extension. From this, fabric suitability rules were summarized for different body types and garment categories.

Throughout the draping practice, the study emphasized not only the operational aspects of pattern and process adjustments but also the importance of an experimental feedback mechanism. By comparing the visual effects and comfort of different draping approaches on mannequins, and integrating observations from dynamic fitting sessions, preliminary solutions were iteratively optimized. This "experiment–feedback–modification" cycle ensured that draping exploration moved beyond experience-based practices toward a scientific and practical workflow, providing a solid foundation for subsequent parameterized modeling and intelligent draping research.

5.2 Analysis of Key Draping Points for Special Body Types

Table 2. Key Draping Points for Different Body Types

Comparison Object	**Characteristics**	**Structural Differences**
Standard Body Type	Proportions of chest, back, shoulders, waist, hips, and limbs are balanced; skeletal and muscular development is even; assumed as the reference standard in garment design	Garment structure designed according to standard proportions; overall structure is stable and balanced
Special Body Type	Influenced by factors such as age, sex, disease, or genetics; local proportions may be imbalanced, non-standard physique	Garment structure must be adjusted to accommodate specific body features
Male Standard	Back panel above chest line is 2.5–2.7 cm longer than front panel	Fixed front-back structural difference within standard range
Female Standard	Back panel above chest line is 0–1.0 cm longer than front panel	Fixed front-back structural difference within standard range
Male/Female Prominent Chest	Chest protrudes significantly; overall posture leans forward	Front-back structural difference reduced, adjusted according to degree of chest prominence

Male/Female Hunchback	Back is noticeably curved; overall posture leans backward	Front-back structural difference increased, adjusted according to degree of spinal curvature

Source: Drawn by the researcher.

In garment structure design, a standard body type is usually taken as the baseline reference. Such body types have balanced proportions across the chest, back, shoulders, waist, hips, and limbs, with normal skeletal and muscular development, allowing garment structures to be designed according to standard proportions, resulting in stable and balanced silhouettes(see Table 2).

In contrast, special body types are influenced by factors such as age, sex, disease, or genetics and exhibit local disproportions or postural deviations. Draping for these body types requires structural adjustments to the garment to better accommodate individual features, ensuring comfort while maintaining aesthetic form.

Regarding gender differences in standard body types, male and female bodies show distinct structural differences above the chest line: the male back panel is approximately 2.5–2.7 cm longer than the front, whereas in females the front-back difference is only 0–1.0 cm. This indicates that the front-back balance point differs inherently between genders and must be considered during pattern making.

Prominent chest and hunchback postures are two typical special body types. For individuals with a prominent chest, the chest protrudes and the body leans forward; thus, the front-back difference should be appropriately reduced, with the degree of adjustment depending on the severity of chest protrusion. Conversely, individuals with a hunchback exhibit a curved back and backward-leaning posture, requiring an increased front-back difference in the garment to compensate for postural imbalance, with adjustment magnitude determined by the severity of the curvature.

In summary, the key points for draping different body types involve not only proportional relationships of the chest, back, and other body areas but also adjustments to the front-back garment structure. Through scientific measurement and differentiated handling, garments can simultaneously satisfy functional comfort requirements and maintain visual harmony and aesthetic appeal.

5.3 Ergonomics-Based Men's Draping and Special Body Type Handling

Table 3. Draping Operations for Typical Special Body Types

Special Body Type	**Key Area**	**Draping Operation**	**Parameter Example**	**Illustration Reference**
Prominent Chest / Pigeon Chest	Front Panel	Cut along chest line and expand upward to add front waist length; for pigeon chest, add darts under the lapel	Expansion 1.0–1.5 cm	
	Back Panel	Fold and lower back neckline; narrow back width	Lower 0.2–0.3 cm	

Hunchback	Back	Cut along back width line; expand center back seam upward to accommodate protrusion	Expansion 1.5 cm (up to 3.0 cm for severe cases)	
	Front Panel	Fold along chest line; lower front neckline to shorten front waist length	/	
	Sleeve	Cut along sleeve girth line; expand outer sleeve seam to move sleeve forward	Forward shift 1.2 cm	
Protruding Abdomen	Abdomen	Add horizontal and vertical length at front stop point; increase "belly dart" to enhance turning effect	Front length +1.5 cm (up to 5.0 cm for severe cases)	
	Overall Balance	Adjust back panel synchronously to prevent lifting	/	
Sloping Shoulder	Shoulder	Cut along shoulder to chest line; fold and lower shoulder endpoint	Increase shoulder slope (1.0)	
Square Shoulder	Shoulder	Adjust front shoulder slope and shorten; flatten and lengthen back shoulder; widen back panel	Back width +0.5 cm (1.0)	

Source: Drawn by the researcher.

In draping practice for typical special body types, key areas require differentiated operations while maintaining overall balance. The primary challenge for prominent chest and pigeon chest types lies in the forward projection of the chest, causing insufficient front waist length and pulling in the front panel. For these body types, the front panel is typically cut along the chest line and expanded upward to supplement front waist length. For pigeon chest, additional darts are placed under the lapel to absorb excess volume and ensure a natural front chest curve. Expansion is generally controlled between 1.0 and 1.5 cm (see Figures 2 and 4). The back panel is adjusted by folding the neckline downward 0.2–0.3 cm and narrowing back width, balancing the front-back difference(see Table 3).

Hunchback types are characterized by a pronounced back curve and a backward-leaning posture. Adjustments include cutting along the back width line and expanding the center back seam upward to accommodate the protrusion, typically 1.5 cm, and up to 3.0 cm for severe cases (see Figure 5). The front panel is folded along the chest line and the neckline lowered to shorten front waist length, preventing imbalance caused by an overly long front panel. Sleeve adjustments involve cutting along the sleeve girth line and expanding the outer seam to move the sleeve forward, usually by 1.2 cm, to match the backward posture.

For protruding abdomen types, the main difficulty is the forward abdomen. The front stop point is widened and lengthened, and a “belly dart” is added to strengthen the turning effect. Common adjustments increase the front panel by 1.5 cm, and in severe cases up to 5.0 cm. To maintain overall balance, the back panel is simultaneously corrected to prevent lifting caused by front lengthening.

Sloping shoulder types exhibit overly downward shoulder lines. Adjustments include cutting along the shoulder to chest line and folding the shoulder endpoint downward, increasing the shoulder slope (denoted as “Sloping Shoulder 1.0,” see Figure 7). In contrast, square shoulders appear too flat; adjustments include modifying the front shoulder slope and shortening, flattening and lengthening the back shoulder, and slightly widening the back panel (typically +0.5 cm, denoted as “Square Shoulder 1.0,” see Figure 8) to maintain shoulder-back structural balance.

In summary, prominent chest, hunchback, protruding abdomen, sloping shoulder, and square shoulder types all require targeted structural adjustments in draping. By applying expansion, folding, dart modification, and added allowances, structural imbalances can be effectively corrected, improving both aesthetic appearance and wearing comfort, as well as dynamic adaptability.

6. Discussion

Through the in-depth exploration of this study, several key findings emerged. First, the application of ergonomic principles in men’s draping is critically important, as it enables designers to more accurately understand human morphology and movement patterns, thereby achieving an optimal fit between garments and the body. For example, fully considering proportional relationships, muscle distribution, and movement trajectories during the draping process allows garment lines to flow more naturally, enhancing both wearing comfort and aesthetic appeal.

Second, handling special body types requires highly individualized techniques, with adjustment strategies tailored to the specific characteristics of each body type. The process interventions proposed in this study demonstrated effective results in practice, significantly improving garment fit and meeting the dressing needs of individuals with atypical physiques. This has practical implications for expanding the men’s fashion market and enhancing the competitiveness of men’s wear brands.

Third, the draping and special body type handling system established in this study integrates the scientific rigor of ergonomics with the creativity of fashion design. It provides designers with greater inspiration and conceptual approaches during the design process, promoting breakthroughs in combining science and art within the men’s fashion industry.

7. Conclusion

This study, grounded in ergonomic theory, systematically investigated men’s draping and process interventions for special body types. Through literature review, anthropometric measurements, and practical experimentation, the research confirmed that ergonomic principles not only provide a scientific foundation for men’s garment construction but also effectively guide structural adjustments for typical body types such as prominent chest, hunchback, protruding abdomen, and sloping shoulders.

Results indicate that under ergonomic guidance, draping techniques—such as expansion, folding, dart modification, and overall structural balancing—can achieve individualized adaptation, enhancing both comfort and dynamic functionality while maintaining aesthetic form and structural stability. Moreover, the process system proposed in this study offers a more practical and systematic technical pathway for men’s garment design and customization, improving the wearing experience across diverse body types.

Looking forward, with the continuous advancement of 3D body scanning, virtual fitting, and intelligent modeling technologies, ergonomics-based men’s draping is expected to progress further toward digitalization and intelligent solutions. This development will provide robust support for accommodating diverse body types and promoting personalized, sustainable growth within the men’s fashion industry.

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