

Evaluation and Optimisation of Shirt Structure Design for Female Wheelchair Users [★]

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Abstract

The formal attire of female wheelchair users has received increasing attention in design research, particularly in response to unmet needs in professional settings. However, most existing studies focus on casual or adaptive sportswear, leaving a significant gap in exploring clothing suitable for formal contexts. This study proposes a design method for optimising shirt prototypes for wheelchair users, incorporating two key interventions: structural pattern adjustments and fabric innovation. The method was evaluated through interviews with 51 participants. Conventional shirts often fail to accommodate the seated posture, resulting in poor fit, restricted mobility, and discomfort. To address these issues, structural modifications were introduced to the armholes, sleeve caps, and plackets to enhance forward-reaching mobility and improve dressing convenience. Similarly, fabrics suitable for individuals with limited hand dexterity were selected based on thermal-moisture comfort and usability criteria. Subjective evaluations demonstrated that the synergy between structural refinement and fabric selection significantly improved arm mobility and comfort in a seated position. This study offers practical insights for inclusive formalwear design, presenting a method that balances formal attire for female wheelchair users.

Keywords: Wheelchair Users; Women's Shirts; Structural Optimization; Evaluation

1 Introduction

International academic research predominantly focuses on the functionality and convenience of clothing for wheelchair users, with limited attention to everyday attire. Even within studies on casual clothing, most prioritise sportswear, overlooking formal and social wear. However, as global support for employing persons with disabilities grows, the demand for professional attire tailored to wheelchair users is increasing [1,2].

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Formal attire is clothing for special occasions or professional events rather than casual or domestic settings. Wheelchair users, like others, require garments that are both comfortable and aesthetically pleasing in such scenarios [3]. Bai Weiwen's research [4] on the aesthetic design of daily clothing for people with physical disabilities analyses the limited domestic focus on this area. Similarly, Ma Ning's study [5] on the structural adaptability of clothing for assisted dressing provides insights into the real-life needs of individuals with disabilities through extensive field research. Wu Daiwei's work on the development and evaluation of functional clothing for wheelchair users highlights that the majority of wheelchair users are elderly individuals. The study emphasises the need for designs that enhance the convenience of dressing, structural innovations for bending points, and fabric performance requirements, such as softness, breathability, and warmth [6-7].

Despite these contributions, significant research gaps remain in understanding how different wheelchair types and formal occasion demands influence comfort and fit [38]. This study addresses these gaps by focusing on female wheelchair users as a specific group. It examines the structural patterns of shirts available for wheelchair users, evaluates their fit and fabric requirements against relevant national standards, and optimises these designs. The aim is to redefine women's formal attire by creating shirts that retain aesthetic appeal and comfort while seated, thereby contributing valuable insights to this field [8-10].

1.1 Literature Review

Wheelchair users face significant challenges in finding suitable clothing, primarily due to discrepancies between their body dimensions and standard sizing systems and physical changes caused by prolonged sitting, such as spinal curvature and reduced height [8]. Based on standing posture measurements, traditional garment patterns fail to accommodate seated individuals' needs [9]. Studies reveal that 67% of wheelchair users exhibit a convex back and 64% display abdominal protrusion, both significantly more common than in non-wheelchair users. These characteristics, resulting from prolonged sitting and wheelchair operation, have been categorised into three main body shape classifications: convex back with significant abdominal protrusion, convex back with a flat abdomen, and straight back with moderate abdominal protrusion. Such findings highlight the importance of incorporating seated body shape considerations into adaptive garment design [11].

In addition to these physical characteristics, wheelchair users require clothing that is easy to dress in, accommodates mobility, and resists wear from frequent use. Features such as magnetic closures, adjustable designs, and durable fabrics are highly valued. Clothing must also support flexibility in seated postures, particularly around joints, while maintaining a balance between functionality and aesthetics. Beyond physical needs, clothing is vital in social participation, influencing confidence and enabling roles such as employment and formal engagements. Design elements such as style, colour, and material are thus essential in creating garments that are both practical and socially empowering [5,10].

However, existing designs often fail to address these unique body shapes and functional demands, particularly for formal wear. This gap highlights the need for innovative solutions integrating adaptive functionality with aesthetic appeal, providing wheelchair users with comfortable and elegant options for formal settings.