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User-Centered Design in Adaptive Clothing: Effects of the Design Process on Satisfaction, Functionality, and Comfort among Persons with Mobility Challenges in Nyeri County, Kenya

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Abstract

Globally, approximately 15% of the population live with disabilities, with higher prevalence in Africa due to poverty and limited healthcare access. In Kenya, about 4.6% of the population experiences disability, with mobility impairments most common. Persons with mobility challenges often face difficulties in dressing, reducing independence, comfort, and well-being. Adaptive clothing are garments designed or modified to accommodate physical, functional, and ergonomic needs supporting ease of dressing, comfort, and independence. The study examined how the design process influences usability, functionality, and comfort in adaptive clothing for persons with mobility challenges in Nyeri County, Kenya. Guided by Universal Design Theory (Mace, 1998) and Human-Centered Design (ISO 9241-210, 2010), a convergent parallel mixed-methods design was adopted. A total of 100 participants were selected using purposive and stratified sampling. Data were collected through questionnaires (n = 100), 12 interviews, and 4 focus group discussions. Quantitative data were analysed with descriptive statistics, Pearson correlation, and regression analysis; qualitative data were analysed thematically. Findings indicated, comfort, functionality, ease of dressing, affordability, aesthetics, and compatibility with assistive devices significantly influenced adaptive clothing selection. The design process had strong positive relationships with usability ($r = .79$, $p < .001$), functionality ($r = .74$, $p < .001$), and comfort ($r = .77$, $p < .001$), explaining 67% of the variance ($R^2 = .67$, $F(1, 98) = 169.34$, $p < .001$). Participatory design practices including iterative feedback, prototype testing, and ergonomic adjustments—improved garment performance and satisfaction. The study provides empirical evidence for fashion designers, healthcare providers, and policymakers to develop inclusive, user-centered adaptive clothing that enhances usability, comfort, functionality, and independence.

Key terms: assistive devices, dressing independence, ergonomic modifications, inclusive apparel, physical disabilities.

INTRODUCTION

Clothing is an essential component of daily living that contributes to personal dignity, comfort, and social participation. Beyond its protective function, clothing plays an important role in shaping individuals' identity and self-expression. However, for persons with physical disabilities—particularly those with mobility limitations—conventional clothing can present considerable challenges during dressing and use. Difficulties manipulating buttons, zippers, and other fasteners, limited range of motion, and discomfort when sitting for prolonged periods can make ordinary garments impractical for individuals with mobility impairments. As a result, adaptive clothing has emerged as an important area of innovation within apparel design, focusing on garments specifically modified to enhance usability, comfort, and independence for people with physical disabilities (Poage, 2025).

Globally, disability continues to affect a significant proportion of the population. According to the World Health Organization (2023), more than one billion people live with some form of disability, many of whom experience limitations in mobility that affect their ability to perform routine activities independently. Dressing is one such activity that can become difficult without appropriate clothing design. When garments are not designed with accessibility in mind, individuals with mobility challenges may rely heavily on caregivers for assistance, potentially reducing independence and affecting overall well-being (Poage, 2025). Consequently, adaptive clothing has gained attention among researchers, designers, and healthcare professionals as a means of improving independence and quality of life among persons with disabilities.

In recent years, scholars have increasingly emphasized the importance of inclusive and user-centered approaches in apparel design. User-centered design focuses on understanding the experiences, capabilities, and needs of end users throughout the design process in order to produce products that are both functional and meaningful (Choa et al., 2024; Wu, 2025). Within adaptive clothing design, this approach involves actively engaging individuals with disabilities during different stages of garment development, including needs assessment, prototyping, and evaluation (Poage, 2025). Through such participatory processes, designers are able to gain deeper insight into the functional challenges experienced by users—such as limited dexterity, restricted movement, or difficulties manipulating garment fasteners—and consequently develop clothing solutions that respond to real-life mobility limitations (Choa et al., 2024; Wu, 2025).

Moreover, the effectiveness of adaptive clothing largely depends on the design process used in its development. Garments that are developed without adequate consideration of user needs may fail to provide sufficient comfort, accessibility, or practicality. Conversely, design processes that actively incorporate user feedback and ergonomic considerations can lead to garments that significantly improve dressing ease, functionality, and overall satisfaction. Research indicates that when adaptive clothing is designed through participatory and inclusive design methods, users report higher levels of comfort and usability compared to garments developed through traditional design approaches (Wu, 2025). These findings highlight the importance of examining how design processes influence the effectiveness of adaptive clothing.

Despite growing international interest in inclusive fashion and adaptive apparel, research in this field has been largely concentrated in developed countries, with relatively limited empirical evidence addressing adaptive clothing needs in developing contexts (Rana et al., 2024).

In Kenya, persons with mobility challenges often face barriers related to accessibility, availability of assistive technologies, and limited inclusion of context-appropriate products, which can negatively affect their independence and participation in everyday activities. Research on the assistive technology ecosystem in Kenya shows that access to assistive products and related services is constrained by limited supply, coordination challenges among stakeholders, and insufficient integration of innovation training

organizations, suggesting significant gaps in availability and accessibility of assistive tools for persons with disabilities (Smith et al., 2024). Furthermore, there is a lack of empirical research specifically focusing on adaptive clothing design and user experiences within the Kenyan context, meaning that the unique needs of persons with mobility impairments regarding inclusive garment design remain underexplored in scholarly literature.

Understanding how design processes influence adaptive clothing outcomes is therefore particularly important for developing contextually relevant clothing solutions. Examining the relationship between design processes and user outcomes such as satisfaction, functionality, and comfort can provide valuable insights for designers, educators, and policymakers seeking to develop inclusive clothing solutions for persons with mobility challenges.

The objective of the study was therefore to: Examine how the design process affects user satisfaction, functionality and comfort shaping the effectiveness of adaptive clothing design for persons with mobility challenges in Nyeri County, Kenya.

1.2 Statement of the Problem

Although adaptive clothing has the potential to enhance independence, comfort, and dignity for persons with mobility challenges, many available garments do not adequately meet users' functional and experiential needs. Studies have shown that adaptive apparel often lacks appropriate design features that address mobility limitations, resulting in garments that may still be difficult to wear, uncomfortable, or unsatisfactory for users (Choa et al., 2024; Poage, 2025). Moreover, most research on adaptive clothing design has been conducted in developed countries, leaving limited empirical evidence on how design processes influence user satisfaction, functionality, and comfort in developing contexts such as Kenya. In Nyeri County specifically, little is known about how the design process shapes the effectiveness of adaptive clothing for persons with mobility challenges. This knowledge gap highlights the need to examine how the design process affects user satisfaction, functionality, and comfort in adaptive clothing design for persons with mobility challenges in Nyeri County, Kenya.

To achieve this purpose, the following null hypothesis was formulated and tested at .05 confidence level of significance:

H01: There is no significant relationship between usability and comfort in adaptive clothing design among persons with mobility challenges in Nyeri County, Kenya.

LITERATURE REVIEW

2.1.2 Adaptive Clothing and User Needs

Adaptive clothing refers to garments designed with modifications that make them more accessible and usable for persons with physical disabilities, particularly those with mobility impairments. Such modifications may include alternative closures (e.g., magnetic fasteners), adjustable openings, and ergonomic fits that facilitate ease of dressing (Li Zhao & Srinivas, 2023). Standard apparel often overlooks the physical constraints faced by users with limited mobility, resulting in garments that are difficult to don and doff, restrict movement, or cause discomfort during prolonged sitting or ambulation (Wang et al., 2024). Research based on consumer feedback also suggests that adaptive clothing must address not only functional barriers but also users' preferences for style and self-expression, emphasizing that adaptive garments can influence feelings of dignity and personal identity (Futurity, 2023).

Despite this recognition of user needs, much of the adaptive clothing available in the market continues to prioritize basic functionality over comprehensive usability. Li Zhao and Srinivas (2023) analyzed consumer satisfaction with adaptive apparel and found recurring complaints related to poor fit, lack of garment variety, and limited accessibility of online purchasing platforms. These findings indicate that existing product

offerings do not fully address the spectrum of functional and experiential needs reported by individuals with mobility challenges, highlighting an ongoing disconnect between what users require and what the market currently supplies.

Inclusive Design Frameworks and Participatory Methods

A central theme in recent adaptive apparel research is the importance of user-centered and participatory design approaches. Inclusive design frameworks prioritize the involvement of end users throughout the design process to ensure that the resulting products reflect the lived experiences and needs of the intended population (Choa et al., 2024). User-centered design encourages iterative consultation with users during needs assessment, prototyping, and garment evaluation, which in theory should produce more functional and acceptable adaptive solutions (Poage, 2025). Wu (2025) argues that integrating digital technologies and rapid prototyping into adaptive design practice enhances designers' ability to test and refine products in partnership with users, potentially improving comfort and usability outcomes.

Despite these theoretical advances, evidence remains limited regarding how participatory design processes are implemented in practice and the extent to which they influence key outcomes such as comfort, satisfaction, and overall functionality. Most studies on inclusive design in adaptive clothing have been exploratory or conceptual in nature, focusing on design principles rather than empirical evaluations with end users. This gap suggests a need for research that moves beyond conceptual frameworks to examine actual design processes and their impact on user experiences.

Contextual Influences on Adaptive Clothing Research

Much of the existing literature on adaptive apparel originates from developed country contexts, including North America and Europe, where specialized markets, disability support infrastructures, and research resources are relatively well established. A systematic review by Rana, McBee-Black, and Swazan (2024) confirms that adaptive clothing studies are heavily skewed toward contexts where assistive product research and development are well funded and organizationally supported. This concentration of research raises questions about the applicability of existing findings to settings with different cultural, economic, and infrastructural conditions.

In contrast, adaptive clothing research in developing regions—especially sub-Saharan Africa—remains sparse. Priya (2024) notes that while adaptive apparel research is emerging, there is limited scholarship addressing the intersection of disability, product design, and contextual factors such as climate, cultural norms, and local clothing practices in low- and middle-income countries. These contextual factors may influence both user needs and design priorities, yet they are rarely examined in adaptive clothing literature. The lack of research in African contexts represents a significant gap, as adaptive clothing solutions developed in Western contexts may not translate effectively to settings with different environmental challenges, resource constraints, and daily activity demands.

Barriers to Assistive Technology and Adaptive Solutions in Kenya

Understanding adaptive clothing in the Kenyan context requires situating it within broader discussions of assistive technology access and disability inclusion. Studies examining Kenya's assistive technology ecosystem highlight persistent barriers that persons with disabilities face, including limited supply of assistive products, weak coordination among providers, and gaps in policy implementation (Smith et al., 2024). Such barriers constrain not only access to mobility aids but also related adaptive solutions, potentially including inclusive clothing options. These systemic challenges suggest that persons with mobility impairments in Kenya may encounter additional practical obstacles when seeking garments that accommodate their functional needs, yet empirical research on adaptive clothing within this context is virtually nonexistent.

The dearth of context-specific research on adaptive clothing design in Kenya mirrors broader patterns

observed in assistive technology literature: while global policy discourses emphasize inclusion and accessibility, empirical studies grounded in local experiences remain limited. This gap not only limits scholarly understanding of how adaptive apparel can best serve users in Kenya, but also restricts designers' ability to create culturally and environmentally appropriate solutions.

Design Process and Adaptive Clothing Outcomes

Although the literature acknowledges design process as a critical factor influencing product effectiveness, few studies have empirically examined how different design strategies affect user outcomes such as functionality, comfort, and satisfaction. Theoretical discussions suggest that involving persons with disabilities in iterative design practices can lead to greater usability and better alignment with user preferences (Choa et al., 2024; Wu, 2025), but there is a lack of systematic, user-centered research that evaluates these claims, particularly in non-Western contexts. This gap highlights the need for empirical investigation not only of user needs but of how design processes themselves shape adaptive clothing effectiveness.

Collectively, the reviewed literature suggests that while adaptive clothing research has expanded in recent years, fundamental gaps remain in understanding the role of the design process in producing garments that meet user needs—especially in developing country contexts. There is a clear need for research that integrates user-centered design evaluation with empirical analysis of user satisfaction, functionality, and comfort within specific cultural and environmental settings.

The study is anchored on the User-Centered Design (UCD) Theory, which provides a conceptual lens for examining how design processes affect the effectiveness of adaptive clothing for persons with mobility challenges. User-Centered Design is a well-established framework in design and human-computer interaction that emphasizes the centrality of the end user in the design process. It asserts that products, systems, or services are more effective, usable, and satisfying when designers actively incorporate users' needs, preferences, and experiences into each stage of development (Norman & Draper, 1986; Choa et al., 2024).

Within UCD, the design process is iterative and involves multiple stages, including needs assessment, prototyping, evaluation, and refinement, all conducted in consultation with users (Poage, 2025). Applying this theory to adaptive clothing design highlights the critical role of user involvement in ensuring garments are functional, comfortable, and satisfactory. For individuals with mobility challenges, UCD principles suggest that designers must consider physical limitations (e.g., restricted range of motion, dexterity issues), personal preferences (e.g., aesthetic style, fabric choice), and contextual factors (e.g., cultural norms, environmental conditions) to optimize the effectiveness of adaptive garments (Wu, 2025).

UCD theory also aligns with participatory design approaches, which emphasize collaboration between users and designers throughout product development. In adaptive clothing, participatory design can help identify practical barriers—such as difficulty with fasteners, garment fit when using assistive devices, or discomfort during prolonged wear—that may not be apparent without direct user engagement (Choa et al., 2024). By integrating UCD principles, the current study conceptualizes the design process as a determinant of user satisfaction, functionality, and comfort, positing that these outcomes are interdependent and collectively shape the overall effectiveness of adaptive clothing.

The framework suggests a causal relationship where the extent and quality of user involvement in the design process influence the functional and comfort outcomes of garments, which in turn affect user satisfaction. Moreover, the theory underscores the importance of iterative feedback cycles, allowing designers to refine garments based on real-time input from users, thereby enhancing usability and acceptance (Norman & Draper, 1986).

METHODOLOGY

Research Design

Bazeley (2018) and Creswell and Plano (2018) discussed the use of concurrent timing in mixed-methods research, where both qualitative and quantitative data were collected simultaneously. The study employed a convergent parallel design, giving equal importance to qualitative and quantitative methods. Each method was analyzed independently, and the two strands were integrated during the interpretation phase to provide a comprehensive understanding of the research findings.

Capturing diverse perspectives, the research highlighted the lived experiences of persons with special needs—specifically those with mobility challenges—in relation to clothing choices and the usability of adaptive designs in Nyeri County, Kenya

Study Area

The study was conducted in Nyeri County, Kenya, an area with functional transportation and communication infrastructure that facilitated participant engagement and data collection. The county's predominantly agricultural economy and a literacy rate of approximately 89% (Kenya National Bureau of Statistics [KNBS], 2019b) provided participants with varying occupational, educational, and socioeconomic backgrounds.

Nyeri County is also home to the Elizabeth Vendramini Naromoru Children's Home, an institution that provides rehabilitation services and assistive devices for children with mobility challenges, highlighting the prevalence and social impact of physical disabilities within the region (Elizabeth Vendramini Naromoru Children's Home, 2023).

Geographically, Nyeri County is bordered by Kirinyaga County to the west, Laikipia County to the north, Meru County to the east, and Murang'a County to the south. The county features diverse landscapes, including the Aberdare Mountain Range in the west and proximity to Mount Kenya in the northeast. Situated approximately 150 kilometers north of Nairobi, the county encompasses both urban and rural settings, providing an appropriate context for assessing adaptive clothing use among persons with mobility challenges across different environmental and socioeconomic conditions.

Target Population

The study focused on persons with mobility challenges residing in Nyeri County, Kenya. According to the Nyeri County Office of the National Council for Persons with Disabilities (NCPWD, 2024), approximately 3,000 persons with various disabilities were registered in the county.

Focusing specifically on mobility challenges, Nyeri County had approximately 11,118 persons with mobility-related disabilities (Kenya National Bureau of Statistics [KNBS], 2020). PWMC often encountered difficulties in walking, moving, or dressing independently, underscoring the significance of examining adaptive clothing solutions tailored to meet the needs. The concentration of the population made Nyeri County an appropriate setting for investigating the relationship between usability and adaptive clothing design.

Inclusion Criteria

Primary Population: Persons of all ages with mobility challenges who required or used adaptive clothing.

Secondary Population: Producers of adaptive clothing, including fashion designers, tailors, and garment makers, and care givers who contributed professional insights into adaptive clothing design and functionality.

Exclusion Criteria

Persons without mobility challenges or those with other forms of disabilities that were not the focus of the study.

Sample Size and Sampling Techniques

The study employed purposive sampling to select participants who could provide relevant insights into the

usability and design of adaptive clothing for persons with mobility challenges in Nyeri County, Kenya. Selection criteria included accessibility, willingness to participate, and experience with adaptive clothing. Purposive sampling provided a methodologically rigorous and flexible approach suitable for the mixed-methods design adopted in the study.

Nyeri County recorded approximately 11,118 persons with mobility-related disabilities according to national census data (Kenya National Bureau of Statistics [KNBS], 2019b). Persons with mobility-related disabilities experience difficulties in walking, moving, and dressing independently, highlighting the need for adaptive clothing solutions. Due to the practical challenges in locating all affected individuals, purposive sampling was the most effective strategy to reach participants with diverse and relevant experiences related to adaptive clothing use and design.

As a non-probability sampling technique, the determination of sample size integrated both statistical estimation and practical considerations to ensure sufficient data for analysis:

Data Saturation: In the qualitative component, sampling continued until no new information emerged, ensuring comprehensive coverage of themes.

Expert Judgment: The final sample size was determined based on prior research, expert recommendations, and logistical feasibility, ensuring that the sample adequately represented the study population.

Criteria and Procedure for Selecting the Sample

To ensure a representative sample from the estimated population of 11,118 persons with mobility challenges in Nyeri County, the study applied following specific selection criteria and procedures. The criteria aimed to capture a broad and inclusive range of participants reflecting the diversity within the target population.

Selection Criteria

Type of Disability: Participants were selected to represent various forms of physical mobility-related disabilities, including those affecting movement, walking, or dressing.

Age: The sample included persons from diverse age groups, namely adolescents, young adults, and the elderly, to reflect the influence of age on adaptive clothing needs and preferences.

Gender: Efforts were made to achieve equitable gender representation, targeting approximately 50% males and 50% females to ensure balance in perspectives.

Geographical Location: Respondents were drawn from different areas within Nyeri County, encompassing both urban and rural settings, to capture regional diversity and contextual variations in adaptive clothing use.

Procedure for Selecting Participants:

The selection of participants followed a systematic and purposive process aimed at identifying individuals and stakeholders with relevant experiences and insights.

Identification of Key Informants: The process began by engaging key informants and community leaders with extensive knowledge and experience within the special needs community, particularly those working with persons with mobility challenges. Key informants and community leaders assisted in identifying potential participants who met the inclusion criteria and could provide detailed, relevant, and experience-based data.

Purposive Sampling: A purposive sampling approach was employed to target participants whose roles, experiences, or use of adaptive clothing aligned closely with the research objectives. The method ensured the inclusion of participants capable of offering in-depth and meaningful insights into the usability and design of adaptive clothing.

Stratification: To enhance representativeness, the sample was stratified based on the outlined selection criteria to ensure all relevant subgroups within the population were adequately represented. The stratification facilitated diversity in perspectives and experiences across the study sample.

RESULTS AND DISCUSSION

This section presents the analysis of how the design process influences the usability, functionality, and comfort of adaptive clothing for persons with mobility challenges in Nyeri County, Kenya. The corresponding null hypothesis tested was:

H0: The design process does not significantly affect the usability, functionality, and comfort of adaptive clothing for persons with mobility challenges in Nyeri County, Kenya.

The analysis evaluated how elements of the design process—including pattern adaptation, fabric selection, fastener design, testing and fitting sessions, and incorporation of user feedback—influence the perceived usability, functionality, and comfort of adaptive clothing. Both quantitative and qualitative findings were integrated to provide a comprehensive understanding of how design practices influence clothing performance and user experience.

Descriptive Statistics

Descriptive statistics were computed to assess respondents' perceptions of the design process and the outcome variables: usability, functionality, and comfort. The results are summarized in Table 1.

Table 1

Respondents by Design Process, Usability, Functionality, and Comfort of Adaptive Clothing (N = 100)

Variable	M	SD
Design Process	3.42	0.50
Usability	3.32	0.47
Functionality	3.40	0.49
Comfort	3.35	0.48

Source: Research Data (2025)

The results in Table 1 indicate that respondents rated the design process moderately high (M = 3.42, SD = 0.50), suggesting a generally positive perception of adaptive clothing design practices. Similarly, usability (M = 3.32, SD = 0.47), functionality (M = 3.40, SD = 0.49), and comfort (M = 3.35, SD = 0.48) were rated relatively high. These findings suggest that when adaptive clothing is developed through a structured and inclusive design process, it tends to produce favorable outcomes in terms of usability, functionality, and wearer comfort.

Correlation Analysis Between Design Process and Adaptive Clothing Outcomes

Pearson product–moment correlation analysis was conducted to examine the association between the design process and each of the three outcome variables: usability, functionality, and comfort. The results are presented in Table 2.

Table 2

Pearson Correlation Analysis Between Design Process and Adaptive Clothing Outcomes (N = 100)

Variables	R	p
Design Process × Usability	0.79	< .001
Design Process × Functionality	0.74	< .001
Design Process × Comfort	0.77	< .001

Source: Research Data (2025)

The findings in Table 2 indicate that the design process has a strong and statistically significant positive correlation with usability ($r = .79$, $p < .001$), functionality ($r = .74$, $p < .001$), and comfort ($r = .77$, $p < .001$). These results suggest that when the design process is more inclusive, iterative, and user-centered, the resulting adaptive clothing tends to be more usable, functional, and comfortable.

Regression Analysis on the Predictive Power of the Design Process

A regression analysis was conducted to determine the extent to which the design process predicts the combined outcomes of usability, functionality, and comfort. The results of the regression model are summarized in Table 3.

Table 3

Regression Analysis Summary for Design Process Predicting Usability, Functionality, and Comfort of Adaptive Clothing (N = 100)

Predictor	B	SE B	t	p
Constant	0.33	0.10	3.30	.001
Design Process	0.86	0.07	12.29	< .001

Model Summary: $R^2 = .67$, $F(1, 98) = 169.34$, $p < .001$

Source: Research Data (2025)

The regression results indicate that the model was statistically significant, $F(1, 98) = 169.34$, $p < .001$, explaining 67% of the variance ($R^2 = .67$) in the combined outcomes of usability, functionality, and comfort. The regression coefficient for the design process was positive and statistically significant ($B = 0.86$, $SE = 0.07$, $t = 12.29$, $p < .001$), indicating that improvements in the design process—such as greater user involvement, prototype testing, and ergonomic design considerations—substantially enhance usability, functionality, and comfort in adaptive clothing.

Based on these results, the null hypothesis was rejected, confirming that the design process significantly affects the usability, functionality, and comfort of adaptive clothing among persons with mobility challenges in Nyeri County, Kenya.

Qualitative Findings

Qualitative evidence from interviews and open-ended responses reinforced the statistical findings. Respondents emphasized the importance of being involved in the design stages, particularly during testing and fitting sessions, noting that participation improved both comfort and ease of use. One participant explained that trying the clothes during fitting allowed them to inform the designer where the garment pulled or felt tight, resulting in a final garment that was easier to wear.

Caregivers similarly highlighted how their involvement in fitting sessions improved usability for the individuals under their care. They reported that participating in testing enabled them to suggest adjustments that made dressing quicker and less stressful.

Fashion designers also emphasized the value of user feedback during prototype development. They observed that user testing enabled practical adjustments to seam placement and garment openings, thereby reducing dressing time and improving overall functionality.

Material and fastener choices were also highlighted by both users and caregivers as critical factors affecting comfort and usability. Participants noted that magnetic closures, elastic waistbands, and stretch fabrics made garments easier to handle and more comfortable to wear, while heavy fabrics and complex fasteners often reduced comfort and usability.

Overall, the qualitative accounts illustrate that an iterative design process grounded in user testing, appropriate material selection, and functional fasteners is a key determinant of successful adaptive clothing design. These findings demonstrate that the design process is a critical determinant of adaptive clothing performance. A participatory design approach that integrates user feedback, prototype testing, and ergonomic considerations significantly enhances usability, functionality, and comfort. These findings are consistent with previous studies emphasizing inclusive and iterative design methods in adaptive fashion development (Yang et al., 2022; Kay et al., 2020; Kim et al., 2025; Rana et al., 2024; Sadretdinova et al. 2022). Kenyan research similarly highlights the importance of breathable fabrics, easy-to-operate fasteners, and user involvement in design decision-making as critical

factors influencing comfort, confidence, and garment satisfaction (Marinda, 2001).

The relatively high R^2 value (0.67) further underscores the substantial predictive influence of design methodology on user experience. Involving end-users throughout the design cycle ensures that clothing solutions align with mobility needs, physical limitations, and comfort preferences, ultimately resulting in garments that promote independence, dignity, and satisfaction. These findings highlight the importance of continuous improvement and co-creation in adaptive clothing design.

The findings demonstrate that the design process plays a significant role in shaping the usability, functionality, and comfort of adaptive clothing for persons with mobility challenges. Both the quantitative and qualitative results indicate that adaptive clothing developed through a participatory, user-centered, and iterative design process is more likely to meet the practical and comfort needs of its users. The statistical evidence revealed strong positive correlations between the design process and usability ($r = .79$), functionality ($r = .74$), and comfort ($r = .77$), while the regression model explained a substantial proportion of variance in these outcomes ($R^2 = .67$). These results suggest that improvements in the design process can significantly enhance the effectiveness and user satisfaction associated with adaptive clothing.

The descriptive findings indicated that respondents generally perceived the adaptive clothing design process positively, as reflected in the relatively high mean scores for the design process ($M = 3.42$), usability ($M = 3.32$), functionality ($M = 3.40$), and comfort ($M = 3.35$). These results suggest that when designers incorporate structured processes—such as pattern adaptation, ergonomic considerations, and testing sessions—adaptive clothing tends to achieve higher performance in meeting the needs of persons with mobility challenges. This supports the argument that the design phase is a critical determinant of the practical success of adaptive garments.

The strong correlations observed between the design process and the three outcome variables indicate that improvements in design practices are closely associated with improved clothing performance. These findings align with previous studies emphasizing the importance of inclusive and participatory design approaches in adaptive fashion. For example, studies have shown that involving users in design decisions improves garment fit, usability, and overall satisfaction because designers gain direct insight into the functional needs and physical limitations of the intended users (Yang et al., 2022; Kay et al., 2020). Similarly, Kim et al. (2025) found that iterative design processes that include prototype testing and user feedback significantly enhance clothing functionality and ease of dressing for individuals with physical disabilities.

The regression analysis further reinforces the importance of the design process by demonstrating that it is a strong predictor of usability, functionality, and comfort. The high R^2 value (0.67) indicates that the design process accounts for a large proportion of the variation in adaptive clothing outcomes. This suggests that design-related factors—such as user participation, ergonomic considerations, and material selection—are central to the development of successful adaptive garments. These findings are consistent with the work of Rana et al. (2024) and Sadretdinova et al. (2022), who emphasize that adaptive fashion requires continuous refinement through collaborative design methods involving both designers and end users.

Qualitative findings from participants further illustrate how the design process influences clothing performance. Respondents highlighted the importance of participation during testing and fitting sessions, noting that such involvement enables designers to identify issues related to garment fit, pressure points, and movement restrictions. This feedback allows designers to make adjustments that enhance comfort and ease of dressing. Similar observations have been reported in adaptive clothing research, where user involvement during the prototype stage has been shown to improve garment functionality and reduce dressing time (Kay et al., 2020).

The role of caregivers in the design and testing process also emerged as an important factor. Caregivers often assist persons with mobility challenges during dressing, and their input can provide practical insights into how clothing features affect dressing efficiency and comfort. Their suggestions regarding seam placement, garment openings, and closure systems help designers develop clothing that is easier to put on and remove, particularly for individuals with limited mobility. This reinforces the argument that adaptive clothing design should consider the experiences of both users and caregivers in order to achieve optimal outcomes.

Material selection and fastening systems were also identified as key elements of the design process that affect clothing usability and comfort. Participants emphasized the benefits of stretch fabrics, elastic waistbands, and magnetic closures, which simplify dressing and enhance comfort. Conversely, heavy fabrics and complex fastening systems were associated with reduced comfort and usability. These observations align with previous research indicating that fabric flexibility, breathability, and ease of manipulation are essential design considerations for adaptive clothing (Yang et al., 2022; Rana et al., 2024). Within the Kenyan context, earlier research has similarly highlighted the importance of breathable fabrics and simple fastening systems in promoting comfort and confidence among persons with disabilities (Marinda, 2001).

Overall, the findings underscore the importance of a participatory and user-centered design approach in adaptive clothing development. By actively involving persons with mobility challenges and their caregivers throughout the design cycle—from concept development to prototype testing—designers are better able to create garments that address real-life functional needs. Such collaborative approaches not only improve usability, functionality, and comfort but also contribute to greater independence, dignity, and quality of life for individuals with mobility challenges. Consequently, the results highlight the need for designers, manufacturers, and researchers to prioritize inclusive and iterative design practices in the development of adaptive clothing solutions.

Discussion should be focused, blending literature review, theory and results.

CONCLUSION AND RECOMMENDATIONS

The findings of the study demonstrate that the design process is a critical factor influencing the usability, functionality, and comfort of adaptive clothing for persons with mobility challenges. The statistical results showed strong positive relationships between the design process and the three outcome variables, while regression analysis indicated that the design process accounts for a substantial proportion of the variation in usability, functionality, and comfort. These findings confirm that adaptive clothing developed through well-structured and user-centered design practices is more likely to meet the practical and comfort needs of persons with mobility challenges.

The study highlights the importance of adopting a participatory and iterative design approach in adaptive clothing development. Involving persons with mobility challenges and their caregivers throughout the design stages—particularly during prototype testing and fitting sessions—enables designers to identify functional challenges and refine garment features accordingly. Such collaboration ensures that design decisions regarding pattern adaptation, seam placement, garment openings, and closure systems are informed by the lived experiences and practical needs of users.

Material selection and fastener design also emerged as important considerations in enhancing garment usability and comfort. The use of stretch fabrics, breathable materials, elastic waistbands, and easy-to-operate fasteners such as magnetic closures was identified as particularly beneficial in improving dressing efficiency and comfort. These design elements reduce physical strain during dressing and contribute to greater ease of use, especially for individuals with limited mobility.

Overall, the findings underscore the importance of integrating inclusive design principles in the development of adaptive clothing. A design process that prioritizes user participation, ergonomic considerations, and iterative refinement can lead to garments that not only address functional mobility needs but also promote independence, dignity, and improved quality of life for persons with mobility challenges. The study therefore emphasizes the need for designers, manufacturers, and researchers to prioritize collaborative and user-centered design approaches in the development of adaptive clothing solutions.

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