

Designing Clothing for Individuals with Locomotor Disabilities

Ranu Burad¹, Dr. Jitendra Sharma², Dr. Rena Mehta³

Research Scholar¹, Professor^{2&3}

Poornima University, Jaipur, India^{1&2}

Indian Institute of Crafts & Design (IICD), Jaipur, India³

Abstract : The world of individuals with special needs is unique, and those with locomotor dysfunction require special care and attention to feel like an integral part of society, enabling them to think and act like others. To enhance their self-confidence, self-esteem, and sense of belonging to the community, clothing can be used as a medium to communicate their equal status in life. When adopting a holistic approach to disability rehabilitation and implementing a socially inclusive model of care, it becomes evident that the clothing-related challenges faced by individuals with disabilities have not been adequately addressed. Consequently, addressing these issues has become a crucial necessity with significant demand from the disabled population in today's society.

This article presents a study on adaptive clothing designed for individuals with disabilities. Specifically, the focus was on trousers tailored for people with physical limitations, particularly those who rely on wheelchairs for daily activities. The study employed a research methodology encompassing anthropometric theory, pattern design, textile materials, and actual surveys to determine the clothing needs of individuals with disabilities. It analyzed and evaluated their mobility requirements and perceptions of clothing.

Keywords: Adaptive clothing, Disabled People, Functional clothing, Quality of life.

1. Introduction

Disability is defined as, —an umbrella term for difficulties encountered due to activity limitations (difficulties in executing activities), impairments (problems in body functions or anomalies in body structure), and participation restrictions (problems with involvement in any area of life) (WHO, 2018). It is neither purely a social nor a biological construct but the result of interactions between personal and environmental factors and health conditions (WHO, 2001). The parameters like the shape and size of the disabled population are increasing over time. Majorly this segment of the population encounters multiple medical, economic, social, and psychological problems. There is an urgent need to focus on such issues. The disabled people have limited movement abilities and they are more susceptible to diseases, syndromes, and illnesses as compared to their generation. An increase in body fat may occur, reduction in bone mass and strength with an increased risk of fracture. This fraction of the population faced a lot of problems while dressing due to their physical in capabilities, by making dressing easier for people with locomotors disability, adaptive clothing can make a major and noticeable difference in their quality of life also it is the only cure used for enhancing or minimizing the deformity of the body. Personalization in the apparel industry entails designing clothing patterns that can accommodate a variety of body shapes and sizes.

Clothing for disabled people should have some essential attributes and functions that ensure physical and psychological stability and comfort. The garment's fabric should be constructed of natural fibers that help to keep body odor at bay. It should also be chosen to meet the needs of the individual, such as sensitive skin, thermal comfort, double layers at pressure points, and ease of care. The adaptive clothing should be simple to put on and take off, with a variety of closures that make their job easier and give them a sense of independence while remaining unobtrusive. A perfect outfit helps a person to express themselves and leads to self-sufficiency. According to research, clothing-related issues can limit independence and social participation (Kabel et.al 2017). In today's market, finding acceptable clothes that require changes to allow social participation and independence is difficult (Change et. al. 2013). Unresolved dressing concerns can exacerbate challenges for the disabled population, as this barrier prevents them from leaving the house for work, resulting in a reduction in social life. Adaptive clothes can improve one's overall quality of life (Azher et al. 2012).

1.1 Needs/requirements of adaptive clothing (Wei–Min Chang (2013):

1. Donning and doffing of garments conveniently and independently.
2. The garment should help the person to hide the deformities but should not make any identity different from others.
3. It should provide psychological and physical stability and comfort.
4. It should be pocket friendly and easy to maintain.

Adaptive clothes can improve one's overall quality of life Adaptive clothing should have the Aesthetics, Comfort, Ability to protect, Ease of movement, Easy Access, Quality, Proper Fit, Wear and Tear property (Azher et al. 2012). It is very essential to improve the quality of life for people with various disabilities or stroke victims. These garments are made to measure or

custom-made to ensure individual physical needs and should be able to allow more freedom and independence when worn. Clothing for disabled people should have some essential attributes and functions that ensure physical and psychological stability and comfort. For disabled persons, it is crucial that their clothing incorporate functional features in addition to being correctly fitting. (S. A. Venkatasubramanian, 2022). So it is important to focus on the basic pattern manipulation to give a perfect fit to body. When creating blocks for clothing to drape over a 3D body to obtain the desired fit with the best possible use of resources, pattern makers use a 2D medium (such as paper or fabric) to work with dimensions of the body or the garment. The purpose for which a garment is meant determines the ideal fit. By creating an appropriate basic block that is created from body dimensions, or by performing some simple manipulations in accordance with body size and shape, the desired fit can be achieved.

1.2 Types of adaptive clothing and special need clothing.

1. For the people who have problems moving their body parts and have to join pain due to paraplegia, leg or hand disease or backbone problem, their garment should be designed with a rear opening and easy to put on and off without much bend in the rotation of joints and muscles.
2. For people with mental disorder garment should be hard to put off during the unusual time
3. For people with oedema their garment should have some unique features that can be easily adjustable as per the requirement.
4. For the people with inconsistent diseases, their garments should have easily removed the feature.

Table1: Characteristics of the Existing Adaptive Clothing

Characteristics of the Existing Adaptive clothing	Mean
Color	4
Construction Quality	4
Fabric Quality	3.71
Comfort	3.42
Usability	3.28
Style	3.13
Body Coverage	3
Protection	2.98
Attractiveness	2.7
Easy to put on & Take off	2.7
Managing fasteners and zippers	2.7
Size	2.7
Fit	2.56
Flexibility and ease in movement	2.41

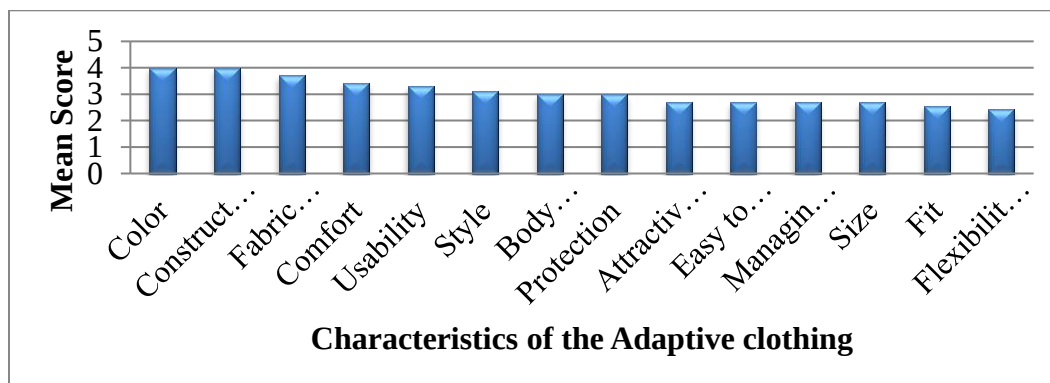


Figure 1: Responses Based on Characteristics of the Existing Adaptive clothing

1.3 Adaptive clothing should have the following features;

1. **Aesthetics:** Clothes play an important role in an individual's life as it reveals the part of the personality, people usually choose clothes according to type of activity (work, party, leisure, etc) and it should help to conceal deformities.
2. **Comfort:** Clothes must be comfortable in terms of movement; also they should have thermal comfort and non-allergic properties.
3. **Protection:** One of the basic uses of clothes is the protection of the human body from various climatic conditions along with personal body protection.
4. **Ease of movement:** It is very essential to maintain ease of movement in every cloth and in the case of adaptive clothing, the wearer's body should feel free while limb movement.
5. **Easy Access:** There should be a front opening that is easily accessible and there should be a larger pull tab or easy fasteners to make disabled people feel independent and a sense of freedom.
6. **Quality:** The quality of adaptive garments should be maintained and special textiles should be used as stress points like knee-elbow etc.
7. **Fit:** The fit of the adaptive garment should be as per the individual's comfort level, too tight or too loose garments will hinder the movement.
8. **Wear and Tear:** Adaptive garments should be strong to avoid daily wear and tear especially subjected to tension.
9. **Price:** The price of the adaptive clothing should be reasonable as most people don't have much income.
10. **Shopping Location:** Adaptive garments should be in all the larger and smaller places which can be easily accessible by physically disabled people and should also be listed on the online platform.

1.4 Locomotors Disability

The Latin words loco and motives, which mean "from a place" and "to move," respectively, are the source of the word locomotors. Therefore, locomotors refers to motion from one location to another. Restricted limb motion is referred to as locomotors disability (i.e. arms and legs). It is seen as a physical impairment involving the joints, bones, and muscles. It makes a person's motions difficult (like walking, picking & holding things etc.) Therefore, a locomotors disabled makes it difficult to travel from one location to another. Mobility impairment is another name for locomotors impairment. In Hindi "Chalnefirnemeinasamarthata," "chalan-sambandhiviklangta," or "asthiviklangta". Numerous medical problems might impair one's capacity to move either temporarily or permanently. Polio is the most well-known illustration which causes people to use wheelchairs and crutches to walk. This is because polio typically weakens limb muscles, preventing the affected person from using their arms and legs without restriction. The measurement of functional impairment is used to estimate locomotors disability. Impairment is defined as any loss or abnormality in a human being's physiological, psychological, or anatomical function or structure. Impairment can result in functional limitations, or the partial or complete inability to perform various tasks required for mental motor or sensory functions, within the range or in the manner that a human being is normally capable.

1.5 Nature and needs of locomotors disable children

1. Because of the impaired strength, endurance speed, and coordination, therapeutic and medical interventions are required.
2. Required attention while coping with the environment including academic task.
3. Due to impaired motion and limb control, the patient required ongoing physical and occupational therapy.
4. Due to impaired mobility, required medical aids such as a walker, crutches, wheelchair, or splints.

2. Literature Review

A garment must have a proper relationship with the body in terms of measures and proportions, or "ease" and "shape," respectively, to achieve a good fit (Alexander, Pisut, & Ivanescu, 2012; (2008) (Petrova and Ashdown). According to Watkins & Dunne (2015), the ease factor, which is the difference between a garment's waist measurement and the body's waist measurement, is important because it allows for comfort while moving the body. The relationship between two metrics (such as the waist-to-hip ratio of a garment and the waist-to-hip ratio of the body) is what determines shape. According to McKinney, Bye, & LaBat (2012), the shape can also be defined as the relationship between a garment's edge shape and the shape of the body. The majority of garment measurements come from patterns. Before being graded into larger and smaller sizes, the pattern for each unique garment type is typically developed using a sample size (Mullet, Moore, & Prevatt Young, 2009). Sample-size patterns for a variety of clothing styles are provided by these modifications to the pattern sloper, which are extremely straightforward and form-fitting garments. According to Gill (2015), Sloper pattern-drafting methods use three-dimensional (3-D) measurements of the body to construct a two-dimensional (2-D) shape. Many of the systems used in sloper drafting patterns are based on two pattern-drafting techniques: Joseph-Armstrong (2010) and Aldrich (2008) (Gill & Chadwick, 2009).

The Sloper design drafting process is simplified by adding additional amounts to the body estimations (Gill, 2011; Rosen, 2004). Patternmaking makes use of some direct additions of ease quantities to body measurements (such as adding 0.5000 to the front hip arc; Gill, 2015). Pattern-drafting methods are difficult to translate into pattern shapes from body shapes. Since body measurements are used in the Sloper drafting process, it is presumed that body shapes and clothing shapes are related in some way. However, these correlations may be altered by the additional simple quantities. There has been little exploration done on body-to-design linkages (straightforwardness and shape) coming from patternmaking procedures. Tuteja et. al [2017] revealed that clothing is a symbol of self-expression and it reflects the individual personality with attributes related to functional and social needs concerning these four garments were designed were constructed keeping in mind the problem with existing clothing. The garments were designed in such a way that they can easily be removed and worn by the respondents and also helped in making them feel self-dependent and confident about themselves as an individual. Tripathi et.al. [2018] in Studied that Disabled people have similar clothing and textile needs that must be satisfied to meet their functional requirements. Some producers or manufacturers specialize in this type of clothing, but they only distribute it via mail order; yet, some disabled persons continue to wear conventional clothing since they believe special clothing will draw attention to their infirmities. There is a need for special clothing because conventional clothing can be altered and the cost can be high because disabled persons do not fit into standard sizes.

3. METHODOLOGY

To manipulate pattern for functional garments for the disabled the study was conducted in two phases

The methodology is based on user centric design under four phases

- a) Problem Identification
- b) Need Assessment
- c) Prototype Development
- d) Evaluation Assessment

Phase 1: Problem Identification consists of interviews, observations, and child experiences. Interviewing guardians or care takers to learn about the child performing the activity and the difficulties they have in relation to clothes.

Phase 2: Need Assessment: During this stage, clothing challenges were discovered through observation and interviews based on the demands that have been analyzed. A garment idea was then be created by translating the needs into a garment specification.

Phase 3: Prototype Development: During this stage, a prototype was created depending on the needs of the particular group. The examined issue was replaced with the determined needs.

Phase 4: Evaluation: The created prototype was rated based on how they perform various aspects of everyday living differently after being tested on children.

3.1 Instrument Development

The clothing preferences and interests of locomotors disabled were assessed using an existing 5- point Likert scale. The questionnaire for the study was developed on the basis of previous studies done on clothing needs assessment (Dickson & Pollack, 2000; Holland, 2007). To identify the clothing needs of locomotors disabled, the questionnaire comprises of seven sections.

3.2 Conceptual Model Framework



Figure 2: FEA model (Lamb & Kallal, 1992)

Table 2: Attributes of Ready-To-Wear Clothing (FEA Model)

Attributes	Mean
Functionality (fit, mobility, comfort, protection, don and doff)	4.6
Expressive (value, status, self-esteem and identity)	4.4
Aesthetics (pleasing, fashionable, design elements)	4.2

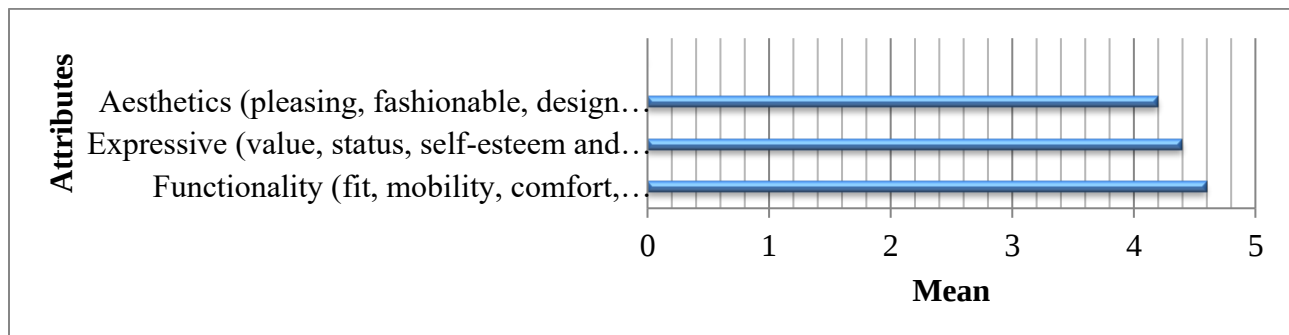
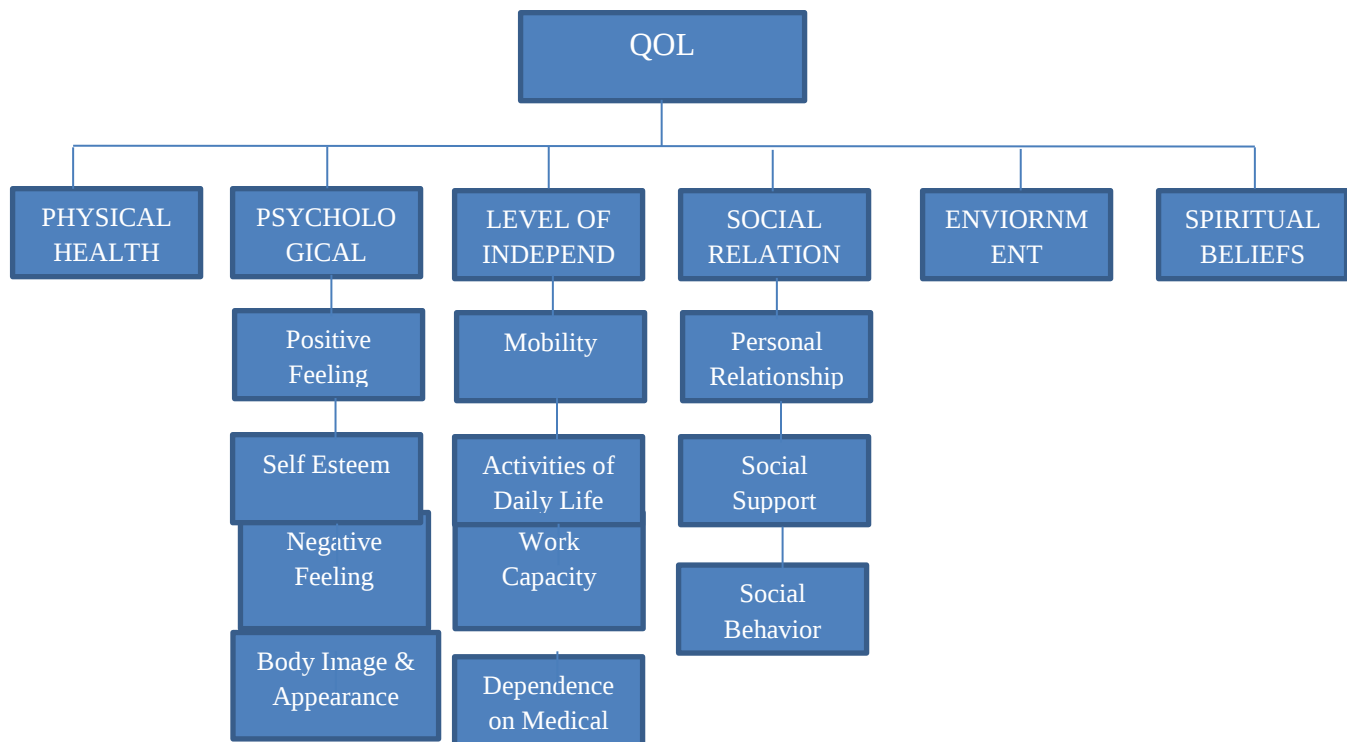
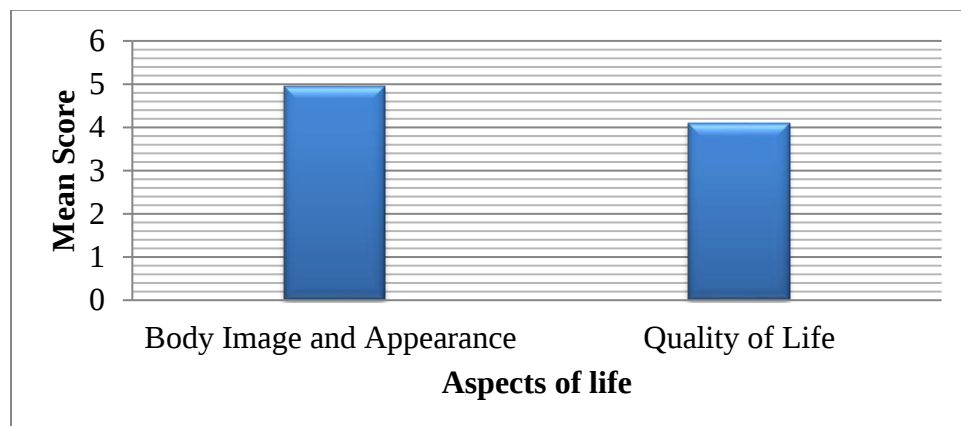
**Figure 3: Responses Based on Attributes of Ready-To-Wear Clothing (FEA Model)****Figure 4: Quality of Life Model (WHOQOL-100)**

Table 3: Important Aspects of life

Aspects of Life	Mean
Body Image and Appearance	4.96
Quality of Life	4.09

**Figure 5: Responses Based on Importance of Aspects of Life**

Section 1	Demographics
Section 2	To Assess Current Satisfaction Level of current ready to wear clothes
Section 3	How Important is FEA of Garment to the Participants
Section 4	Anatomical Discomfort
Section 5	Strength, Limitation and Purchasing Difficulties
Section 6	Adaptive Clothing Brand Awareness
Section 7	Quality of Life

Figure 6: Instrument development

4. RESULTS

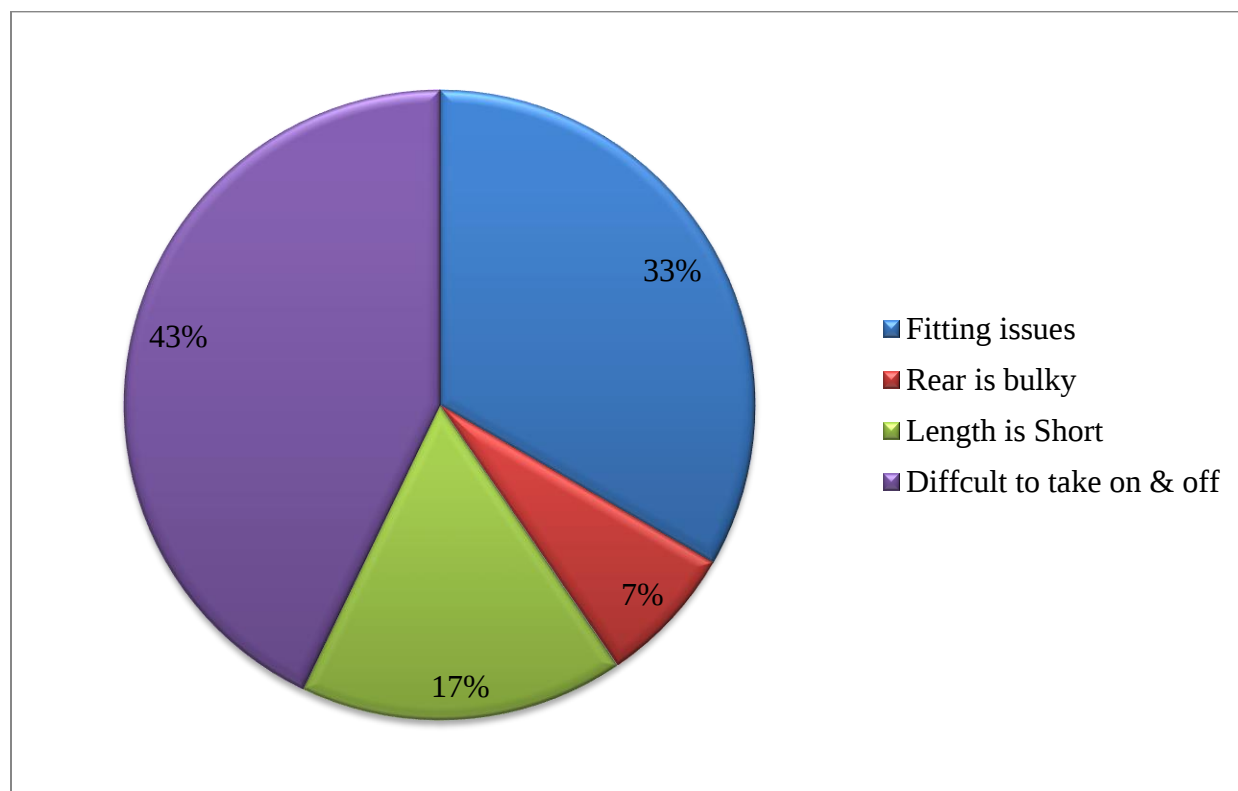
The findings, which were derived from the collected data, measured functioning from various angles, including mobility, functional independence, and participation. Since each of these functional outcomes measures a distinct component of functioning and provides data on functional status, it was hypothesized that they are related to one another.

These factors were determined to be of the utmost significance for the patients based on the analysis:

- Apparel keeps wearers warm, dry, and comfortable in all weather conditions. Flexibility, bulk, weight, and texture are fabric properties that influence physical comfort. Physical comfort is also influenced by garment construction.
- The wearer feels better when they are dressed. It provides insight into the individual. Also, a person's attire influences how others perceive, judge, and respond to them.
- In a social setting, a person may feel either at ease or uneasy when wearing a certain item of clothing or style. When someone wants to "create an impression" through their dress, social comfort may be at play.
- According to the misconception, persons with disabilities don't care about how they look. Yet, studies have found that: Those with disabilities see themselves as others. Their preference for flattering attire is a reflection of their impressionable mindset. Disability-related self-esteem and social acceptance can both be improved by clothing.
- For locomotors disabled in particular, wearing clothing that fits closely to the body is the best option.

Table 4: Challenges while Purchasing Ready to Wear Clothing

Challenges	N	n (%)
Fitting issues	126	43
Rear is bulky	26	7
Length is Short	64	17
Difficult to take on & off	168	50

**Figure 7: Responses Based on Challenges while Purchasing Ready to Wear Clothing**

4.1 Modifying the fundamental design to fit the body

The body measurements of a non-disabled person were used to create the template for the pants using the basic block approach. According to figure 5, the fundamental block for the pattern was modified to fit the disabled people's body types.

4.2 Adjusting basic trousers pattern

To produce a comfortable sitting position for the waist and abdomen, the front bottom trousers' length was decreased, and the front waistline's width was expanded. A 4-cm ply fold was also present at the front knee to avoid stretching of the knee position. To best accommodate the sitting position, the back's height and buttocks' curvature were raised. The front of the pants was 0.5–1 cm shorter than the back (see Figure 5). It was 3–4 cm open at knee height for arranging the pillow pleats. The width of the buttocks was 2–3 cm wider, and the rear of the pants was enlarged by 4–5 cm. Figures 5 and 6 show that the bottom was extended downward by 0.5 to 1 cm as well.

4.3 Modifying pattern design to enable the use of individuals with disabilities

In design 6, the rear of the pants was lifted, enhancing the buttocks' curve, and the ply at the knees was folded to accommodate prolonged sitting. Pleats at the knee (Figures 11 and 14 show knife and inverted box pleats, respectively), four-way stretch fabric (Figures 12 and 13), biased fabric at the knee (Figure 13), and a soft waistband (Figure 7) are some of the features of pants that make using the bathroom more convenient and comfortable while wearing. Additionally, the pants' design makes it simpler to open them, which helps with their personal activities. To make the wearer more comfortable when seated, the writers continued to lengthen the buttocks in these samples (Figures 8, 9 & 10).

4.4 Concept Derived

Decisions for the everyday working Versatility alludes to an individual's capacity to walk, move around and capability consistently. Clothing that gets in the way can hinder mobility, either for the person wearing it or for those who help them. The majority of people prefer clothes that are simple to put on and take off. Assuming an individual requirement helps to strip dressed and, garments that continue and fall off effectively help everybody concerned. It is simpler to put on and take off clothes that fit loosely without being baggy.

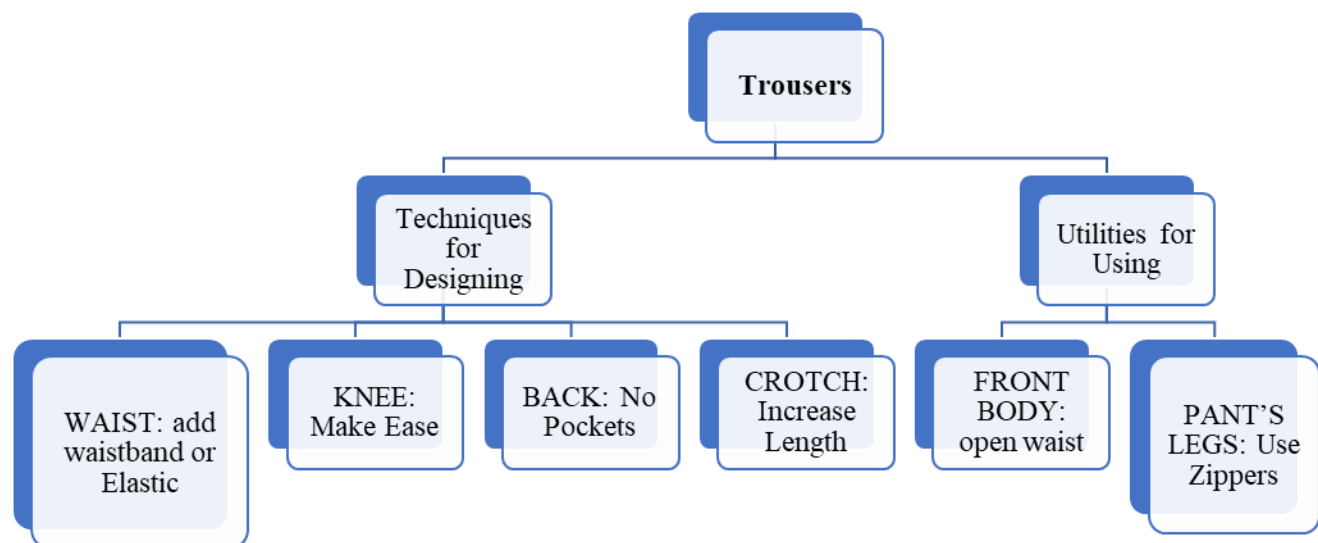


Figure 8: Adaptions in Trousers

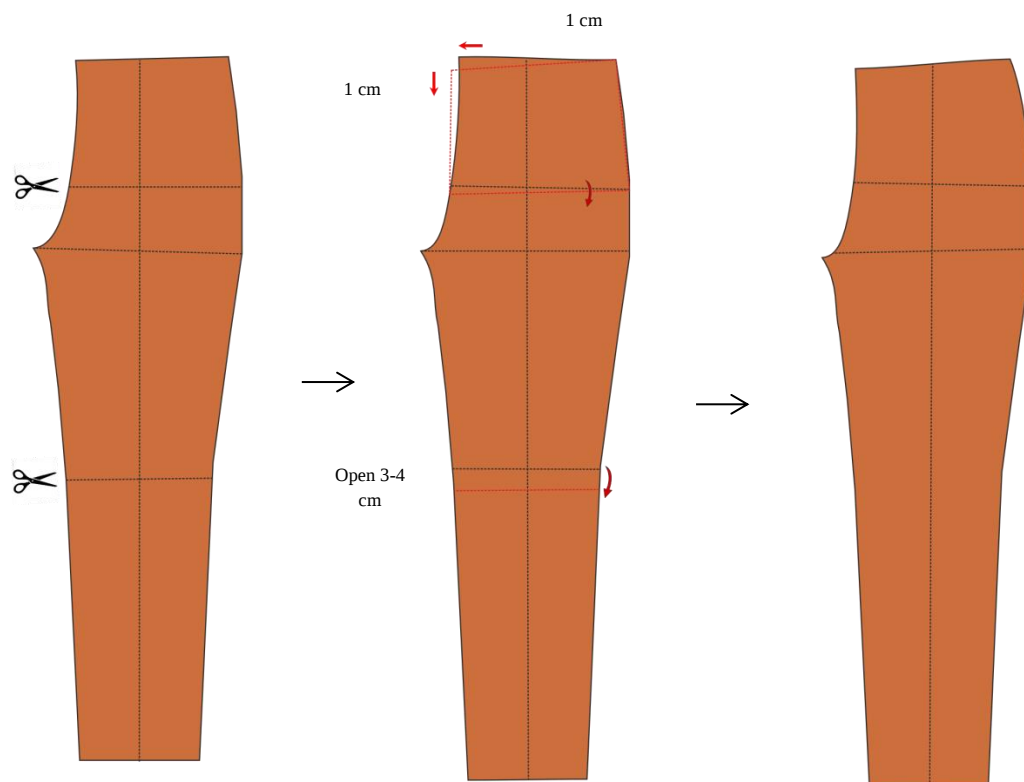


Figure 9: Trousers Front Pattern (left), Adjusted (Middle), Adapted (Right)

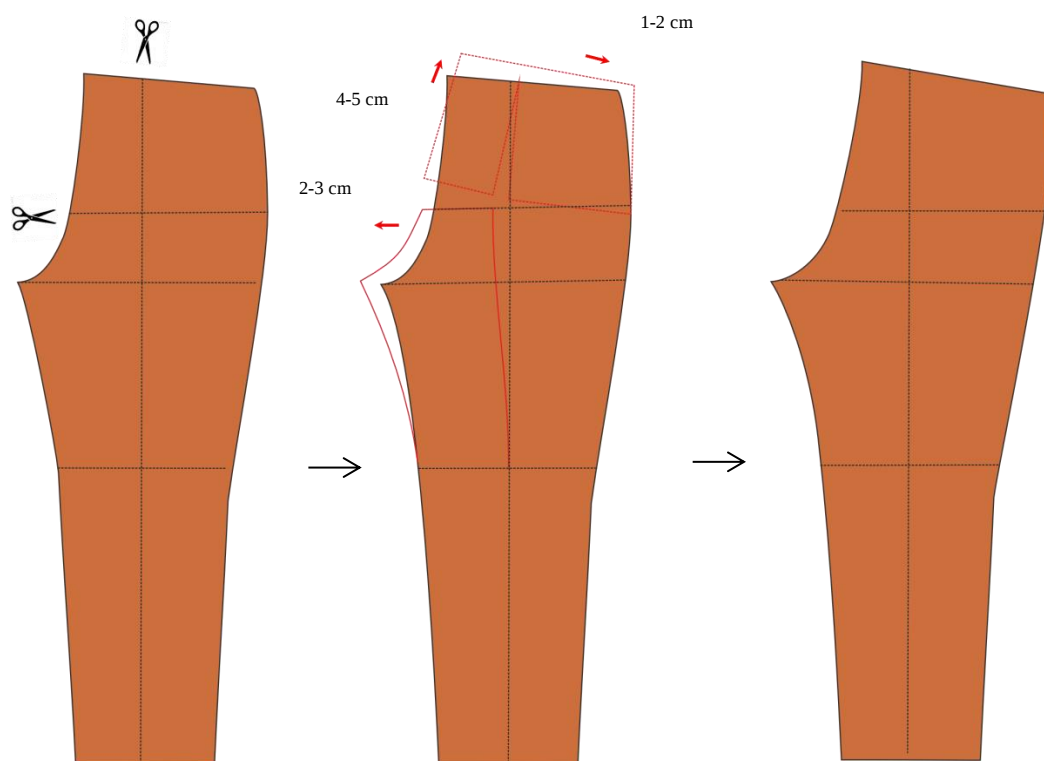


Figure 10: Trousers Back Pattern (left), Adjusted (Middle), Adapted (Right)



Figure 11: Soft Belt



Figure 12: Mid-Thigh Pocket

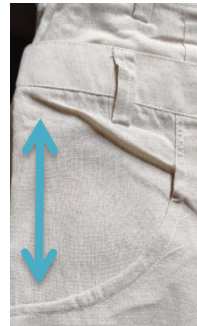


Figure 13: Increase space in between belt to pocket- 1



Figure 14: Increase space in between belt to pocket- 2



Figure 15: Knife pleats at Knee



Figure 16: Four way stretchable fabric at knee

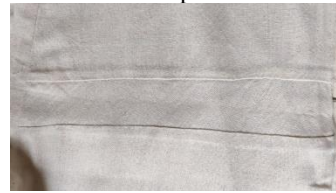


Figure 17: Bias fabric at knee



Figure 18: Inverted Box Pleat at knee

Conclusion

In this paper, data was gathered through in-depth interviews and observations using a qualitative method. The researcher identified the gaps in the participants' daily attire and collaborated with them to determine their preferences for the adapted clothing that promotes their independence and self-assurance. Those who were physically disabled were able to live regular lives without having to worry about daily wardrobe or exercise because to this study. People with locomotor disabilities can dress themselves freely, in comfort, and yet feel good about themselves because to adaptive clothing, which boosts self-confidence. This design idea is exceptional in the context of contemporary civilization and has the potential to assist many more people in the future who have limitations that are somewhat comparable.

References

1. Alexander, Marina, Gina R. Pisut, and Andrada Ivanescu. "Investigating women's plus-size body measurements and hip shape variation based on SizeUSA data." *International Journal of Fashion Design, Technology and Education* 5, no. 1 (2012): 3-12. <https://www.tandfonline.com/doi/abs/10.1080/17543266.2011.589083>
2. Armstrong, Helen Joseph. *Patternmaking for Fashion Design*. Pearson, 2014. <https://thuvienso.hoasen.edu.vn/handle/123456789/11086>
3. Azher, Naheed, and Muhammad Saeed. "Adaptive clothing for females with arthritis impairment." *Journal of University Medical & Dental College* 3, no. 2 (2012): 52-59. <https://jumdc.com/index.php/jumdc/article/view/360>
4. Chang, Wei-Min, Yu-Xiao Zhao, Rui-Ping Guo, Qi Wang, and Xiao-Dan Gu. "Design and study of clothing structure for people with limb disabilities." *Journal of Fiber Bioengineering and Informatics* 2, no. 1 (2009): 62-67. <http://www.global-sci.org/v1/jfbi/issue/v2n1>
5. Gill, Simeon, and Nicola Chadwick. "Determination of ease allowances included in pattern construction methods." *International Journal of Fashion Design, Technology and Education* 2, no. 1 (2009): 23-31. <https://doi.org/10.1080/17543260903018990>
6. Howe, Imogen. "Fashioning identity: Inclusive clothing design and spinal cord injury." (2010). <https://d1wqtxts1xzle7.cloudfront.net/62162881>
7. McKinney, Ellen Carol, Elizabeth Bye, and Karen LaBat. "Building patternmaking theory: A case study of published patternmaking practices for pants." *International Journal of Fashion Design, Technology and Education* 5, no. 3 (2012): 153-167. <https://www.tandfonline.com/doi/abs/10.1080/17543266.2012.666269>
8. Newell, Alan F., and Peter Gregor. "User sensitive inclusive design"—In search of a new paradigm." In

- Proceedings on the 2000 Conference on Universal Usability*, pp. 39-44. 2000.
<https://doi.org/10.1145/355460.355470>
9. Petrova, Adriana, and Susan P. Ashdown. "Three-dimensional body scan data analysis: Body size and shape dependence of ease values for pants' fit." *Clothing and Textiles Research Journal* 26, no. 3 (2008): 227-252.
<http://www.hec.afrl.af.mil/HECP/Card4.shtml>
 10. Watkins, Susan, and Lucy Dunne. *Functional Clothing Design: From Sportswear to Spacesuits*. Bloomsbury Publishing, 2015.