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User Centred Design Conceptualisation of Upper Body Clothing for Female Hemiplegia Patients

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Clothing is one of the essential human needs and is a subject of universal interest and has a multidimensional approach. Ever increasing dimensions of clothing designing has recently developed its focus on fulfilling special needs of consumers who are physically challenged. The understanding of adaptations required in the upper body clothing designs for the special group of physically disabled female consumers is the focus of this research paper. This qualitative study incorporated user centred designing approach for exploring appropriate solutions. This multistage clothing design campaign propagated as a case study research and involved in depth assessment of specific needs from three selected female study participants suffering from physical challenges due to hemiplegia. Fundamental activities of this user centred clothing design campaign incorporated creation of three adaptive clothing designs for the upper body as line sketches, prototyping and construction of one as dress trial intervention by same study participants to assess effectiveness of the proposed adaptive clothing. Conclusively it was found that a specially designed adaptive clothing solution for the upper body which prioritised user centred needs helped selected physically challenged female consumers to obtain quality of life, maintain dignity, and make the tasks of dressing and undressing easy.

Key words: *user centred design, special needs, adaptive clothing, functional design.*

Introduction

Clothing is one of the essential needs of all people and is a subject of global interest. This subject has a multidimensional approach (Na, 2007; Behrens, 1963). Normal people have very little difficulty in purchasing attractive and fashionable clothing in standard sizes that satisfy their personal and social needs, but the problem of satisfying clothing needs is very difficult or impossible to meet for those who are suffering from some physical challenge (Deepti, 2011; Kidd, 2006). Physical, social, psychological and personal needs are simultaneously fulfilled by clothing (Katherine E. C., 2001). Clothing is an important facet of the human constructed environment surrounding an individual and, therefore, has bearing on quality of life (Boettke & Zook, 1956). Clothing is required for three reasons: protection, comfort, and dignity. Individuals who are affected with a physical challenge are 'differently able' and they need clothing for the same reasons with a certain impact on the comfort which suits their health at that time (Yassi & Hancock, 2005; Reich & Otten, 1991).

Adaptive clothing is a clothing design concept that helps to minimise joint movements performed by the wearer and decreases the amount of manual repositioning of the sufferer by attendants (Yassi & Hancock, 2005). The outcome is reduction in pain and discomfort for both attendant and patient (Garg & Owen, 1992). Clothing problems arising from a medical situation and knowledge of this medical state along with physical limitations and problems faced in daily life by such special need consumers, helps to develop an approach of adaptive design ideas for the garments (Ali, 2004). The concept of physical challenges in special need consumers is very difficult to define or measure specifically due to the diverse nature of its various manifestations in the human body; therefore, conceptual clarity is fundamental to the development of a working theoretical base for clothing research. In general, physical challenges are the various impacts of chronic and acute conditions on the functioning of specific physiologic systems on basic human performance. It affects people's functioning to perform necessary, usual, expected, and personally desired roles in society (Kidd, 2006). The physical challenge begins with an effect at the organ level, then at the body level, expands to affect broad aspects of human performance, and finally, impacts an individual's interaction with society. A physical challenge can manifest itself in many forms at many body levels, and can be very visible or not at all visible to outsiders. Due to the variations of physical challenges that exist among special need consumers, identification of a framework within which unique clothing issues might be clearly defined and organised, is a complex but necessary process (Azhar, Saeed & Kalsoom, 2015). A clothing design conceptualisation for understanding and recognition of the requirements of special need users becomes a prerequisite for appropriate modifications of adaptive clothing designs.

Hemiplegia affects people in different degrees resulting in a restraint in range of motion of one lateral side of body. Such a state of impairment is usually caused due to certain neuro disorders which affect the opposite cerebral hemisphere than the apparent side of weakness. One significant effect of a physical challenge due to hemiplegia is restricted mobility. Mobility is

also a major issue for use of clothing. In this situation especially the act of getting dressed is very painful. (Meinander & Varheenmaa, 2002). If clothing impedes the normal range of body movements, physical and mental fatigue results. Clothing can be made more mobile in relation to an individual's specific needs by varying the construction as well as by using suitable materials to facilitate movement.

In contemporary complex socio-technical systems of human society, activities of design have a diverse range of applications (Beamish, 1999). User-centred designing is considered as a planned problem-solving activity, involving multi-stage decision making where needs of users dominate the ultimate design. The user centred design approach requires a great deal of involvement from the users during the process of design formulation. Carrying out this approach often includes collecting the end users' opinion right before the start of the design development, as well as during the design process, and in due course designing with them. People suffering from a specific physical challenge, no less than the rest of us, desire good design in the clothes they wear (Meinander & Varheenmaa, 2002). The ethics dictate that the needs of such people should be realised in order to provide opportunities of a better life for them. Better appearance through improvement of clothing will help these people to believe that they have worth in the sight of others and in their own view. Such solutions substantially improve the quality of life of special need users by providing better choices of good looking, purposeful clothing options (Kottke, 1982). Making the most for a consumer's convenience regarding clothing is a step toward self-reliance, and a feeling of acceptance and belongingness. The purpose of this study was to understand and explore deeply the possibilities of making suitable clothing for the upper body of special needs of female users suffering from hemiplegia.

The study specifically aimed to find answers for the following for the selected special needs consumers:

1. What are the physical limitations of the upper body that require clothing adaptations?
2. What are the adaptations required in regular upper body clothing and how to design these?
3. How effective is the suggested adaptive clothing design for the upper body?

Historical Background of Adaptive Clothing Designing

The problem of finding suitable clothing for individuals with physical disabilities has been a topic of concern for clothing, medical, and rehabilitation researchers for over half a century. Beginning in the 1940s, clothing and medical professionals started to examine the relationship between clothing and physical disability. Subsequent research in the latter part of the twentieth century explored the psychological issues of 'functional' clothing, primarily by assessing the importance of clothing as an appearance management tool. Literature suggests that there are several essentials that adaptive clothing designs must have. Schematic representation of the factors affecting adaptive clothing is shown in Fig 1. Successful adaptive designs consolidate all these factors.

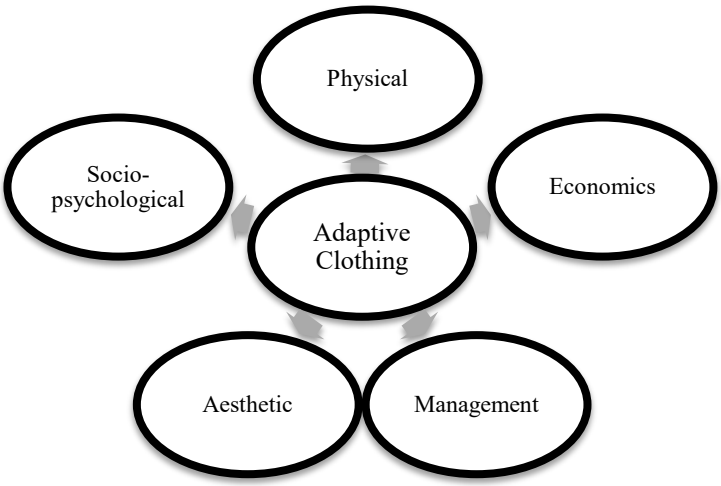


Figure 1 : Factors affecting adaptive clothing (Source: Kidd, 2006).

The physical aspect is associated with comfort with respect to the type of material and manner of construction of the product. Adaptive clothing has to be convenient to put on and take off (Ali, 2004; Beamish, 1999). Clothing must not cause any kind of discomfort while it is being used. In the socio-psychological aspect, looking good, feeling good, and having the right clothes that promote independence in dressing can increase self confidence and self-esteem. Thus, appropriate adaptive clothing can provide an immense socio-psychological boost among the individuals with special needs (Azhar, Saeed & Kalsoom, 2015). In the aesthetic aspect, all clothes need to be attractive and fashionable showing off the wearer's good points and concealing the disablement. For a fashionable look, changes in the adaptive clothing should be invisible when the garment is worn (Lamb, 1993). In the management aspect it is required that garments are made of strong enough material and reinforced construction methods saving the wearer from damage or pressure sores (Kottke, 1982). The economic concern emphasises greater consideration for proposing products at affordable prices as people with special needs have higher living costs (Azhar, Saeed & Kalsoom, 2015).

Need for a concise, distinct classification system to help clothing designers systematically group physical limitations into manageable and mutually exclusive segments has been strongly felt. Such systems have been developed by Yep (1977), Reich and Shannon (1980), and Newton (1984-85) to address the clothing needs of the special need users and to guide research in this area. Reich and Shannon (1980) proposed a simpler system based on empirical data obtained from approximately 300 Arizona residents with various types of physical disability. These researchers developed a grouping of six common physical limitations across disabilities to help address the clothing needs of physically challenged population. These groups are lower leg, lower torso, upper torso, hand, arm, and neck (see figure 2).

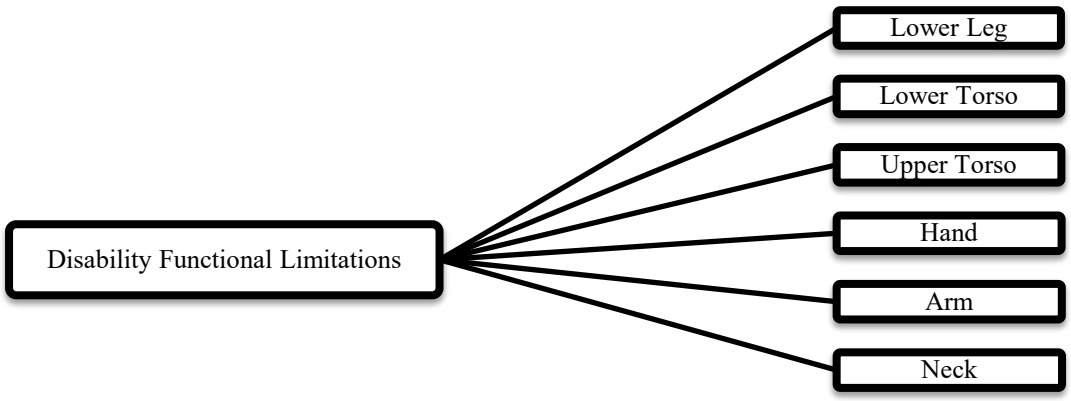


Figure 2 : Grouping Of Physical Limitations For Clothing (Source: Reich & Shannon,1980)

Another possibility of classifying disability for use with clothing research is presented by the Enabler system (see Figure 3); it defines disabilities as combinations of limitations in various parts of the body. This system has been in existence since the 1970s for use in ergonomic design, architectural design, and product design. The Enabler system is an effective way of defining specific limitations in an initial data gathering phase to determine the extent of limitations within the body (Beamish, 1999).

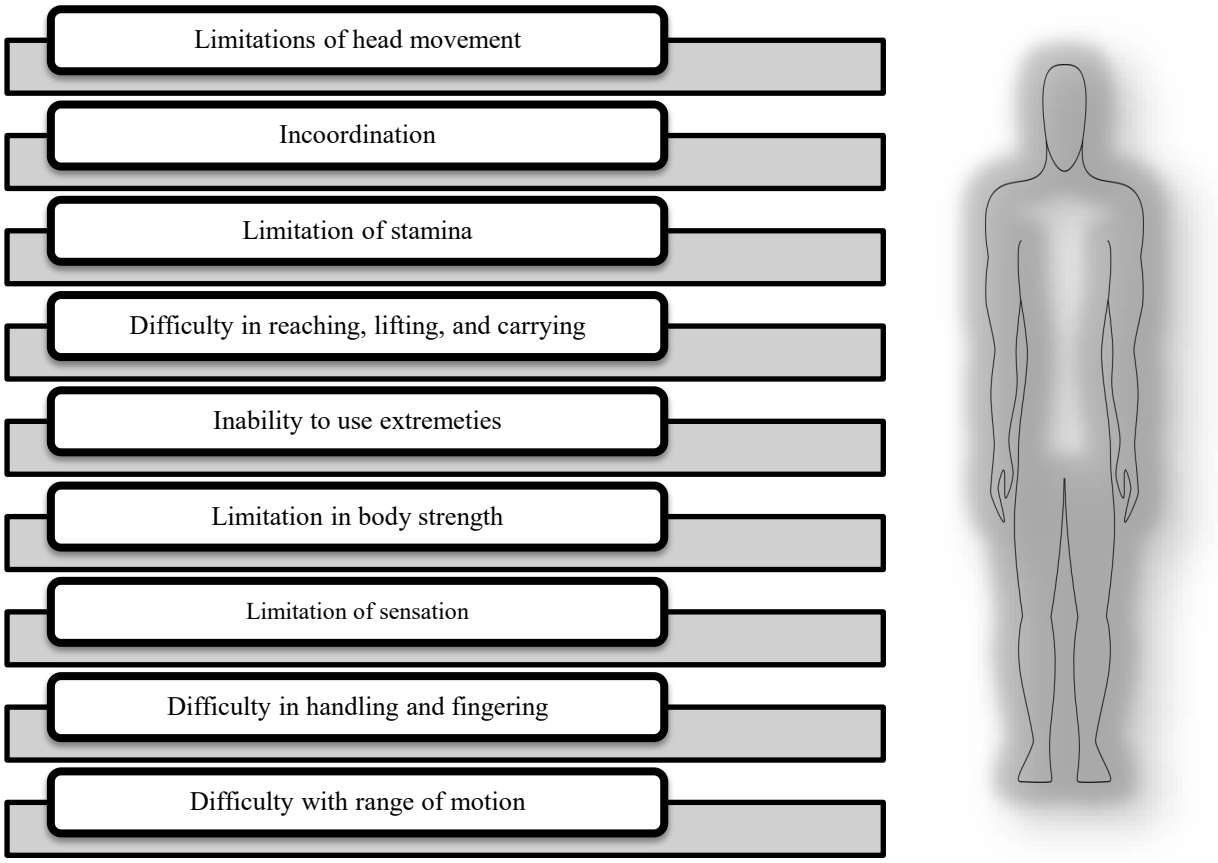


Figure 3 : The Enabler figure (Source:Reich & Otten, 1991)

Absence of adaptive clothing was consistently being felt and some informal activities were seen before Katherine (2001) presented her doctoral research addressing the lack of appropriate products for working women with physical disabilities. The matter of appropriate clothing for disabled people has been rigorously researched in this millennium. Clothing and textile requirements of the elderly and disabled were studied by Meinander and Varheenmaa (2002). They brought in to the lime light the probability of significant improvement in the lives of the disabled and elderly, with an availability of charming dresses with special functional features. Efforts towards inclusion of disabled people within the main stream population were carried out in different regions of the world. A significant work was conducted by the Californian health and Human Services agency (2003) regarding the special type of care needed for children and adults with developmental disabilities. Continuation of similar investigations was found in the study of Kidd (2006) which focused on the development of formal occasion fashionable clothing for special needs of young ladies. Similarly, adaptive clothing issues were explored for Dementia patients by the dementia behaviour management advisory service (2012) as use of clothing becomes a complex phenomenon for such patients. Focused researches in the field of adaptive clothing proved to be more convincing to bring out the best solution according to the nature of each disability. Smith (2013) was inspired by the increasing number of hemodialysis patients in America.

Literature indicated that effective adaptive clothing can provide greatest service to the physically challenged person only if it is specifically improved for specific individual needs of such users. The literature reviewed suggests a gap addressing a dire need for real need realisation of special need clothing users. Thus, it is of much importance to develop a specialised fashion design approach regarding adaptive clothing designing as a user centred design activity in which needs identified by the real end users, prior to the process of design, contribute significantly to adaptive clothing design formulation and construction. Furthermore, the realisation of special needs for adaptive clothing of hemiplegia sufferers is not evident in existing literature.

Theoretical Framework of the Study

User centred design approach or Function-Behaviour-Structure ontology conceptualises design objects in three categories: function (F), behavior (B), and structure (S); they have been utilised in the design practice as a base for exhibiting the procedure of designing as a set of discrete actions. For the current study the model is modified to incorporate major factors of concern for adaptive clothing (see figure 4).

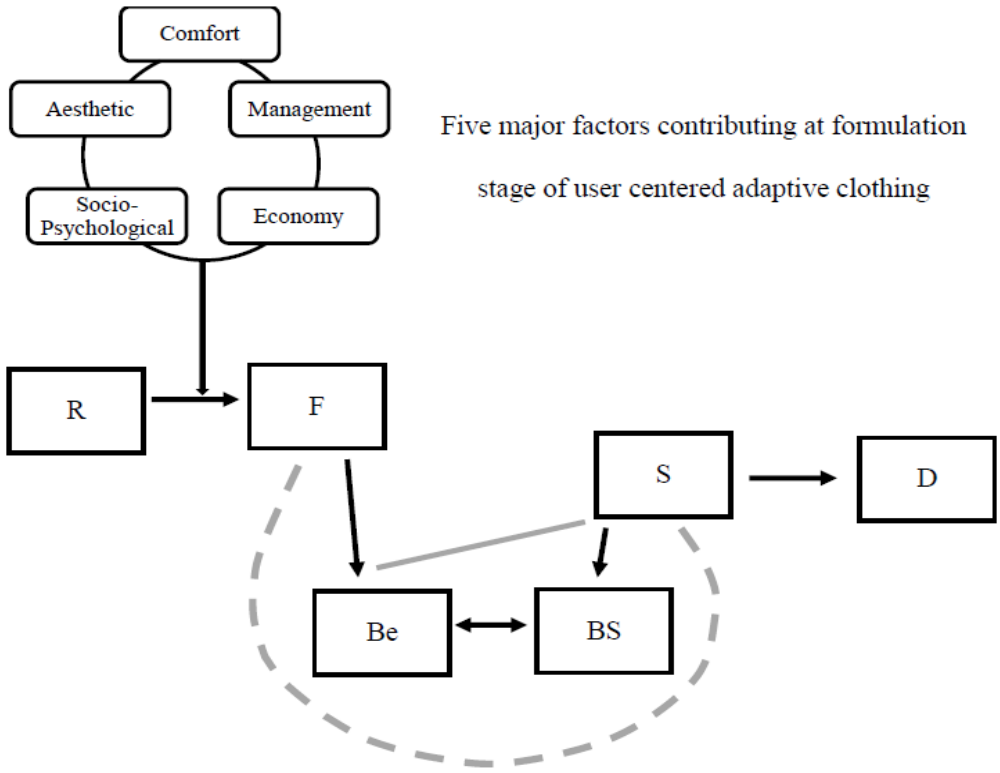


Figure 4: The function behaviour structure framework modification for the current study

According to basic function behaviour structure framework the design activity starts with identification of original requirements, shown as R in figure 4. The phase of need realisation leads to the design formulation stage, shown as F in figure 4, leading to the construction of the

product incorporating realised behaviour in designs, shown as Be in figure 4. Later, the stage of synthesis, shown as S in figure 4, involves trials of constructed design and its analysis which might reiterate the construction, shown as BS in figure 4. If further amendment is not needed, the phase of construction (Be) and design evaluation (S) leads to the last phase of documentation of the complete process of design, shown as D in figure 4. The documentation of the user centred designs must reveal all the necessary details of the process of design and it becomes a base for replication or future reformulation of the design. For this study, the first phase of the framework designated for assessment of requirements from end users is further reinforced by specially focusing five major areas of adaptive clothing design consideration as indicated by the literature.

Materials and Methods

This study aimed to design a suitable adaptive clothing design solution for upper body garment for special needs female users suffering from hemiplegia with following objectives:

1. To find the physical limitations of upper body that demand for clothing adaptations.
2. To find areas of upper body clothing that require adaptations and to design adaptations.
3. To determine effectiveness of suggested upper body adaptive clothing

A qualitative research approach as exploratory case study research methodology was found most appropriate for this user centred clothing design campaign for upper body apparel, accommodating the special needs of female consumers suffering from hemiplegia. For the intricate interpretations of experiences of human participants in complex settings of socio-cultural setups, the qualitative manner of studying a research issue is preferred (Babbie, 1992). Qualifying potential study participants were chosen with the consultation of a specialist doctor. Selected participants were contacted in person; upon their permission, formal consent forms of study were signed. Purposively drawn, a small sample size of study participants helped to yield a larger bulk of true in-depth data. In-depth multiple interviews revealed a correct approach of real end users of this adaptive clothing design campaign. This manner of qualitative interviews had also been found in related literature that helped to collect exhaustive data in various details of clothing issues. This set of participants gave the researcher extended information into the specific nature of each of their problems. Validity and reliability of data collection was carefully sought. The data served as a strong base for combining functional clothing solution with user centred preferences. The study followed a linear progression of data collection and analysis (see figure 5).

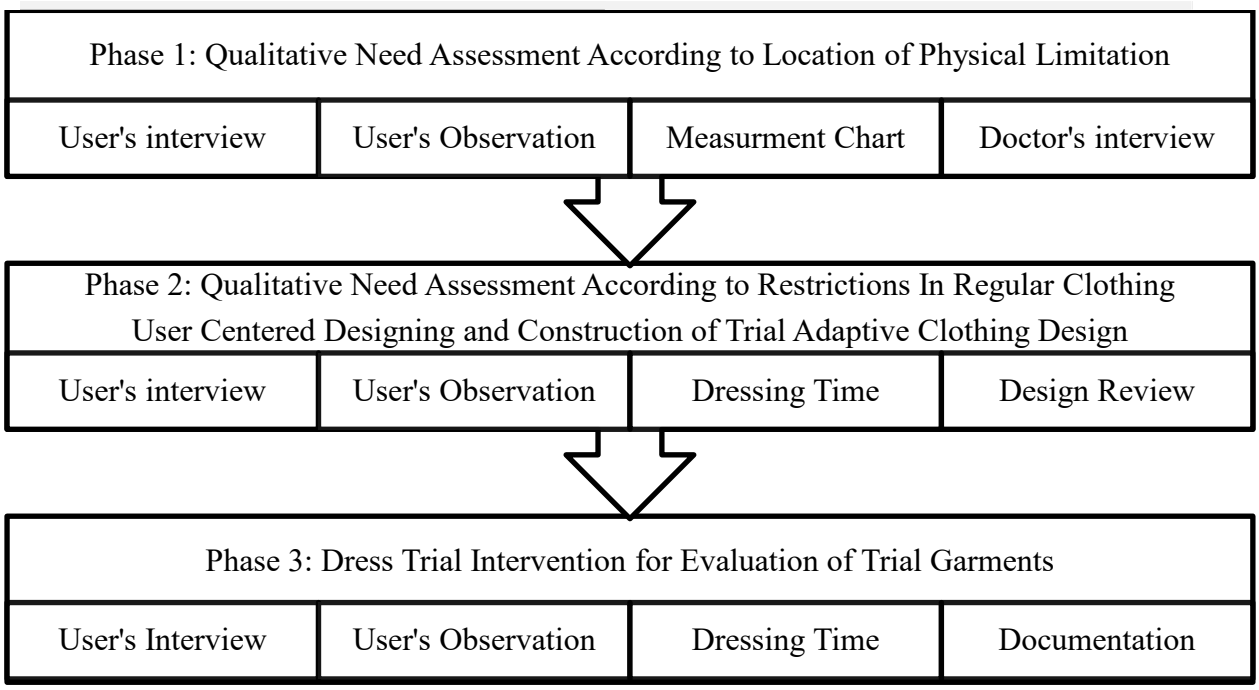


Figure 5: Flow chart of research activities for current study

Table 1 shows list of instruments which were used to gather data from study participants.

Table 1: List of Instruments Used in Each Stage of Study

	Study Phase	Instrument	Description
1	One	Instrument IA	Partial Enabler figure for physical limitations.
		Instrument IB	Body Measurement chart
2	Two	Instrument IIA	List of potential clothing problems.
		Instrument IIB	Line drawing from basic bodice block
		Instrument IIC	Specification Sheet for construction.
3	Three	Instrument III	Wear test about clothing relief.

The study was divided into three phases: Phase one focused on gathering data from participants to provide necessary information for need assessment according to the location of the physical limitation of this specific group of female users of adaptive clothing. Instrument one, section A was used to gather information regarding their physical limitations and its B section was used to record their body measurements. The measurements recorded were bust, waist, hips, arm length, across back and centre back. Observations of participants for the limitations of

movements were recorded and a medical specialist was consulted to enhance the understanding of physical limitations.

Phase two of the study focused on areas of concern in regular clothing and creation of design according to the expressed requirements. Instrument two, section A was to identify the nature of clothing problems for each participant. Time taken to dress by regular clothing was recorded. The latter part of this phase was focused on user centred designing of adaptive clothing. Instrument two section B comprised of basic bodice blocks that were used as standard while sketching the adaptive clothing design. The information obtained from the study participants provided needed guidelines. The designing phase was interactive and participants were asked to make their opinion while the sketches were in initial stages. The completion of detailing of the sketches was the outcome of co-designing efforts of the researcher and study participants. The instrument two section C consisted of a specification sheet. This specification sheet served to combine the selected design and body measurement sets gathered in Instrument one, so that the trial adaptive garment could be constructed for every participant. All construction details were written carefully in the specification sheet of every part to ensure conformance to recommendations. This step also ensured replicability of the current study. The phase two ended with the construction of the three sets of the same trial adaptive garment in the required size of each participant.

Phase three aimed at wear testing of the constructed trial adaptive garment for the upper body with the same group of participants. Information was collected about their experience after three weeks of use. Instrument three consisted of an evaluation questionnaire. Participants were asked to rate features of the trial adaptive garment using a three-point Likert-type scale anchored at one (worse than I envisioned) to three (better than I envisioned), and centred at two (just as I envisioned). This phase concluded with interview questions relating to the overall relief felt by the participants and record of time taken for dressing.

Researcher documented responses to all interview questions in different phases of the study; these interviews were also audio-taped to help in later detailed writing of notes. Each case was individually analysed first to exclusively know each participant's real needs then their cross case examination further elaborated similarities and differences expressed by the participants. Cross case consolidation revealed desired performance requirements of comfort, management, economy, socio-psychological and aesthetics with regard to the nature of the material and the manner of structural design of adaptive clothing for the upper body for female hemiplegia patients.

Results Discussion and Conclusion

Nine areas of potential limitations were recognised by the participants which were also identified from the literature. These areas were (a) in-coordination, (b) limitations in body strength, (c) limitations of head movement, (d) limitations of stamina, (e) limitations of

sensation, (f) difficulty in lifting, reaching or carrying, (g) difficulty in handling and fingering, (h) inability to use extremities, and (i) difficulty with range of motion of the body. The data gave the researcher expanded information into the particular nature of each participant's problem.

Information produced from each participant's clothing issues was analysed and it identified nine potential clothing problems listed as: (a) difficulty putting on and taking off (donning and doffing) clothing, (b) difficulty managing fastenings (e.g., hooks and eyes, zippers, buttons) due to restricted use of hands and lack of mobility, (c) lack of freedom of movement for a variety of activities (e.g., crutch walking, sitting in a wheelchair), (d) inappropriate and uncomfortable style, (e) inadequate coverage of the body, (f) some features are irritating and get in the way, (g) styles of clothing can be constricting and uncomfortable especially during temporary changes in size (periods of weight gain and loss), (h) construction quality inadequate for stress exerted by user, and (i) not all clothing solutions are aesthetically pleasing. Afterwards, the ideas given by all participants were consolidated into three complete sketches of adaptive clothing designs for upper body female garment (see figure 6). A standard bodice block of a female fitted long shirt was manipulated by the researcher to achieve the adapted styles.

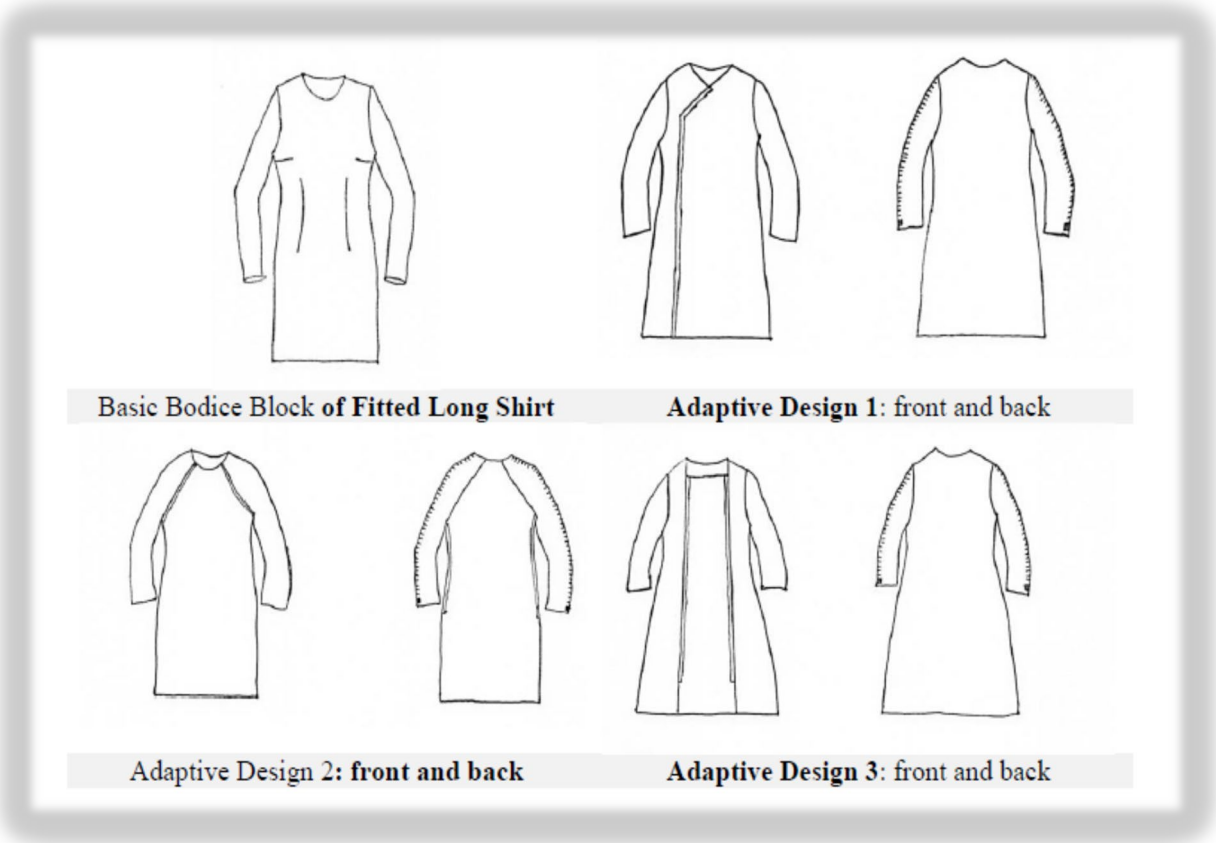
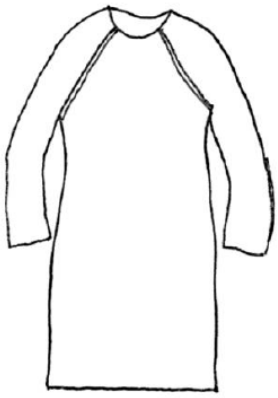


Figure 6: Sketches of Proposed Adaptive Clothing Designs for This Study

Details for construction of a trial adaptive garment were shown in a specification sheet (see figure 7). From this specification sheet three sets of trial adaptive garment were made for each participant.

Description of trial adaptive design	A loosely fitted long shirt with round neckline having full opening at both sides with velcro strips attached to both sides of back of shirt and corressponding soft part of velcro on both sides at front, as clouser in stead of side seams. Long, loosely fitted raglan sleeves with velcro as fastener at front diagonal raglan line providing an openings in front. Sleeves with double sided zipper, stiched with one flap facing back ward through out the length of sleeve across top with two sliders moving in opposite direction		
Measurments of dress in inches	1	2	3
Bust	23	25	26
Waist	21	23	24
Hip	25	27	28
Full Length	39	36	40
Sleeve Length	21	20	21
Sleeve Opening	6.5	6.5	7
Across Back	14.5	15	16
Side Slit	19	17	20



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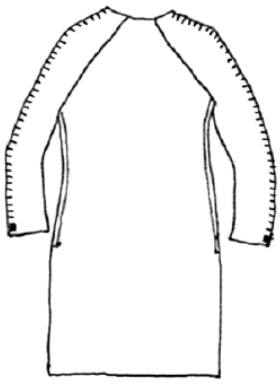

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Figure 7: The Specification Sheet for the Trial Adaptive Garment for This Study

Specific physical limitations that were common to this group (*n*=3) of special needs female users suffering from hemiplegia were grouped into the following categories, (a) range of motion, (b) motor planning, (c) strength, (d), sensory, (e) stamina, and (f) other. All categories impacted both the wearing of clothing and styling of clothing. The clinical definition of a disease appeared to be consistent to the identification of physical limitation categories. This finding supported previous clothing research by Yep (Yep, 1977), Reich and Shannon (Reich & Shannon1980), and Newton (Newton, 1984) who arrived at similar conclusions with different categories of physical limitations. Physical limitations impacted the ability of such women to find suitable clothing in a number of ways. The problems with constricting styles were solved with designing garments that had plenty of room built into them for ease of movement. Using a user centred technique, the researcher established common clothing features preferred among study participants, which were put into a trial adaptive clothing solution. These included a loose, unfitted shape; no defined waistline area; a front or side opening; a simple basic neckline with no collar; raglan, deep set in, and sleeve with gusset. All participants wanted to find clothing that was easy to move in, easy to dress or undress and fasten, and which maintained a suitable appearance. As one participant stated, “women with physical disabilities want clothing that does not set them apart from other women.” With the accepted linkage between disability and limitations, these features are also applicable for upper body adaptive clothing for female populations with a range of similar physical disabilities.

The Authors declare that there is no conflict of interests.

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