

**Ergonomic garment design for people with rheumatoid
arthritis**

April 2025

**Ami Tanna
B.Sc.
(Fashion and Apparel Design)**

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A Dissertation Submitted in Partial Fulfillment of the
Requirements for the Degree of Master of Faculty of Family
and Community Sciences

By
Ami Tanna

Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda
Vadodara
April 2025

Jai Shree Krishna 🙏

**This is lovingly dedicated to
my dear brother,
my beloved father, and
my loving mother.**

Your constant support, encouragement, sacrifices, and unconditional love have been the foundation of my journey.

Your blessings and belief in me have given me the strength to move forward and strive for excellence.

With deepest gratitude and love, I dedicate this work to you.

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AMI TANNA

CERTIFICATE

This is to inform you that research work presented in this dissertation entitled “*Ergonomic garment design for people with rheumatoid arthritis*” *in* pursuit of partial fulfilment of the Master’s Degree in Clothing and Textiles is the original bonafide work of the student Ms. Ami Tanna.

Guide

Dr. Reena Bhatia

Assistant Professor

Dr. Reena Bhatia

I/c Head

Department of Clothing and Textiles

Faculty of Family and Community Sciences

The Maharaja Sayajirao University of Baroda

Vadodara

April 2025

ETHICAL CERTIFICATE

PLAGIARISM REPORT

PLAGIARISM REPORT

ABSTRACT

Rheumatoid arthritis (RA) is a chronic autoimmune disorder that affects joint mobility, making daily activities like dressing difficult for patients. Conventional clothing lacks adaptive features, causing discomfort, restricted movement, and increased dependency on caregivers. This study aimed to identify the specific challenges faced by RA patients regarding clothing, design ergonomic garment solutions, and evaluate their usability through wear trials.

The research was conducted across multiple healthcare institutions, including GMERS Medical College & Hospital, Gotri; SSG Hospital, Vadodara; Baroda Arthritis Clinic; Dr. Hemaxi Dave Physiotherapy Centre; Dr. Namisha Patel City Clinic; and Dr. Ripal Shah's One Centre for Rheumatology and Genetics. A three-phase methodology was adopted, comprising Need-Gap Assessment, Prototype Creation, and User Testing. The first phase involved literature review, patient and doctor interviews, and market surveys to identify key challenges such as restricted joint mobility, difficulty in handling small fasteners, discomfort from fabric choices, and limited availability of adaptive clothing in the market.

Based on these insights, 30 design prototypes were conceptualized, integrating ergonomic designs, easy-dressing and undressing openings, and designs requirement of patients as per deformity. From these, 10 designs were shortlisted, and six prototypes were developed for wear trials with RA patients from Dr. Namisha Patel's Clinic and Dr. Ripal Shah's One Centre for Rheumatology and Genetics.

The user trials assessed comfort, mobility, ease of use, and overall satisfaction. Patients reported improved independence in dressing, and enhanced comfort due to soft fabrics. The study highlights the necessity of inclusive and functional clothing for individuals with rheumatoid arthritis conditions. By promoting adaptive garment solutions, this research advocates for the integration of ergonomic clothing to improve comfort, mobility, and overall quality of life for RA patients.

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INTRODUCTION

Chapter I

Introduction

Rheumatoid arthritis (RA) is a chronic autoimmune condition that greatly affects the lives of millions worldwide, causing both physical and emotional challenges. The disease is characterized by prolonged joint inflammation, stiffness, swelling, and pain, which can eventually lead to severe joint deformities. These symptoms significantly impact daily activities, making even simple tasks such as dressing and undressing difficult, frustrating, and exhausting for RA patients. Traditional clothing designs often fail to accommodate their needs, highlighting the necessity for adaptive and ergonomic garment solutions that enhance ease of use, improve mobility and comfort.

Addressing these challenges through thoughtfully designed clothing and requirements of patients can significantly improve the quality of life for individuals with rheumatoid arthritis. As Mahatma Gandhi stated, "The best way to find yourself is to lose yourself in the service of others". This sentiment resonates strongly with the mission of improving the quality of life for individuals with rheumatoid arthritis through ergonomic garment design solutions.

Adapting to RA may mean encountering daily challenges apart from physical, Emotional and psychological burdens, such as frustration, dependency, and low self-esteem, frequently accompany the physical limitations imposed by the disease. Dressing, a fundamental aspect of self-expression and independence, becomes a daunting challenge. Conventional clothing designs fail to accommodate the limited range of motion, joint soreness, and weakness that define rheumatoid arthritis patients, further complicating the challenges for the wearer. These constraints highlight the importance of designing garments as per the requirements with an ergonomic approach that promotes usability, mobility and overall health.

Ergonomic garment design refers to the creation of clothing that aligns with the body's limitations, ensuring functionality, support, and aesthetic appeal. By integrating adaptability into the design process, such garments can transform dressing from a stressful activity into an empowering activity. Soft, stretchable fabrics that reduce friction on sensitive joints, closures like Velcro and magnets that replace traditional buttons and zippers, and loose-fitting silhouettes that facilitate easier movement was among the many potential solutions. Ralph

Waldo Emerson's words, "The first wealth is health" (Emerson, n.d.), highlight the importance of designing garments that contribute not just to physical comfort but also to overall well-being.

For individuals living with RA, clothing represents more than just functionality; it serves as a means of self-expression and independence. A thoughtfully designed garment can regain independence while promoting confidence and social inclusion. Ergonomic clothing, in specific, has been a promising answer, providing creative features that meet the specific needs of RA patients. Yet, even as awareness of ergonomic fashion has grown, the market has not significantly addressed the unique needs of RA patients. Current adaptive designs tend to be unsophisticated, and limited availability discourages widespread use. There is a significant gap in both knowledge and solution.

To bridge this gap, a participatory design approach to actively involve RA patients in the design process can ensure that their preferences, challenges, and lived experiences will help shape the final product. This inclusive methodology will not only lead to more practical and user-friendly garments but also foster a sense of empowerment among participants. It acknowledges that individuals who live with these challenges are best positioned to inform and refine solutions. Additionally, participatory design approach builds trust and collaboration, ensuring that the final garment solutions align with real-world needs.

Moreover, the social dimensions of ergonomic clothing extend far beyond the individual. By allowing those with rheumatoid arthritis to dress themselves, these designs increase independence and help eliminate the stigma often attached to physical limitations. Ergonomic clothing enhances social participation and fosters inclusivity by enabling RA patients to engage more freely with their communities. Coco Chanel's observation that "Fashion is not something that exists in dresses only. Fashion is in the sky, in the street; fashion has to do with ideas, the way we live, what is happening" (Chanel, n.d.) best describes this philosophy. Adaptive fashion reflects this spirit by addressing practical challenges with empathy and innovation, ensuring that fashion is not just about aesthetics but also about functionality and accessibility. A quote reflecting the resilience of those living with RA adds depth to this discussion: "Living with RA doesn't define your limits—it redefines your strength" (Anonymous, n.d.). This

perspective emphasizes the adaptability and determination of individuals navigating life with this condition, highlighting the importance of creating solutions that empower rather than restrict.

In conclusion, ergonomic garment design for individuals with rheumatoid arthritis is not just about creating ergonomic clothing; it is about enhancing quality of life, independence, and restoring dignity. Through user-centric approaches and participatory methodologies, this research aims to address a critical gap in ergonomic garment design. By doing so, it aims to fulfill the requirements of RA patients.

1.1 Statement of problem

The research focuses on developing ergonomic clothing solutions that increase ease of use, improve mobility, and minimize discomfort in order to improve the overall quality of life of individuals with rheumatoid arthritis who face clothing-related challenges, such as difficulty in dressing and undressing, restricted mobility.

1.2 Purpose of the study

The purpose of this study is to develop and evaluate ergonomic clothing designs tailored to the unique needs of individuals with rheumatoid arthritis. By addressing the challenges they faced with conventional clothing, this research created solutions that enhanced comfort, improved mobility, facilitated ease of use, and reduced discomfort. By bridging the gaps in the existing range of adaptive clothing, this study sought to improve the quality of life for individuals with rheumatoid arthritis. Through a systematic approach including needs assessment, prototype development, and user testing this research contributed to the creation of garments that were both functional and user-friendly.

1.3 Objectives of the study

1. To identify the specific needs and challenges faced by people with rheumatoid arthritis (RA) in relation to their clothing.
2. To investigate existing ergonomic garment designs and determine gaps in current solutions.

3. To develop ergonomic garment design solutions that enhance ease of use, comfort, and mobility for individuals with rheumatoid arthritis.
4. To evaluate the ease of use, comfort and mobility of the newly designed garments through user testing and feedback.

1.4 De-Limitations of the study

- The study is limited to the Vadodara city.

**REIVIEW OF
LITERATURE**

Chapter II

REVIEW OF LITERATURE

This literature review provides a strong foundation for the study by shaping its methodology and analysis, ensuring meaningful and relevant findings. Given the focus on ergonomic garment design for people with rheumatoid arthritis, the review explores key theories, existing research, and practical applications related to clothing ergonomics, adaptive apparel, and user-centered accessible design. To ensure a well-rounded perspective, literature was gathered from online databases and research articles, books, journals and Clothing and Textiles department library at The Maharaja Sayajirao University of Baroda. The collected studies were carefully examined. This approach helps in understanding the challenges faced by individuals with rheumatoid arthritis, assessing existing design solutions, and identifying critical gaps that this research aims to address.

2.1. Theoretical review

2.1.1. Arthritis: an overview

2.1.2. Studying joints and determinants of movement

2.1.3. Types of joints movements

2.1.4. Types of Arthritis

2.1.5. Rheumatoid Arthritis

- 2.1.5.a Defining functioning and disability

- 2.1.5.b Deformities in rheumatoid arthritis

2.1.6. Ergonomics- Meaning, definition, principles, aspects, types

2.1.7. Ergonomic design: it's benefits and hazards

2.1.8. User profile, its importance, usage, process

2.1.9. Challenges in dressing for people with disabilities (PWD) and rheumatoid arthritis patients

2.2. Research related review

2.2.1. User-Centered ergonomic garment design in adaptive apparel

2.2.2. Clothing solutions for people with rheumatoid arthritis

2.2.3. Quality of life and daily activities in RA patients

2.1. Theoretical review

2.1.1. Arthritis: an overview

Arthritis (from Greek "arthro-", joint + "-itis", inflammation; plural: arthritides) was a group of conditions involving damage to the joints of the body (Stein & Taylor, 2004). Evidence of it has been traced as far back as 4500 B.C., but it became publicly known in 1715 when William Musgrave published the second edition of his most important medical work, *De Arthritide Symptomata*, which discussed arthritis and its effects.

Arthritis has been the most prevalent chronic condition for middle-aged and older people, based on the National Health Interview Survey (self-reported diagnoses and conditions; Dawson and Adams, 1987; Verbrugge, 1987, 1989, for the U.S.). By gender, arthritis has been the leading condition for women of middle (45-64) and older (65-74, 75+) ages. It stood out prominently for women, with prevalence rates 20-25 percent higher than their second-ranked condition, high blood pressure. For men, arthritis ranked first (ages 65-74) or second (45-64, 75+), and it was less prominent among men's leading conditions (Verbrugge, 1989).

2.1.2 Studying joints and determinants of movement

In most joints, two bones met end-to-end. In the area where they opposed each other, they were covered with a gliding surface called articular cartilage. Cartilage was a slippery, smooth substance that ensured an even, fluid motion of the joint with minimal friction. Each joint was surrounded by a thin capsule lined by a membrane called the synovium, which produced a lubricating fluid known as synovial fluid for each joint.

The stability of each joint was maintained by its ligaments, which were short strips of fibrous tissue that originated and connected to opposite sides of the joint, having differing amounts of tightness depending on the position of the joint at a given time. Joint movement was produced by

the contraction of muscles and the movement of their tendons. The muscles and tendons passed near the joints and inserted into bone beyond the joint. Muscle contraction moved the tendons, which in turn produced bending or straightening of the joints over which the tendons passed.

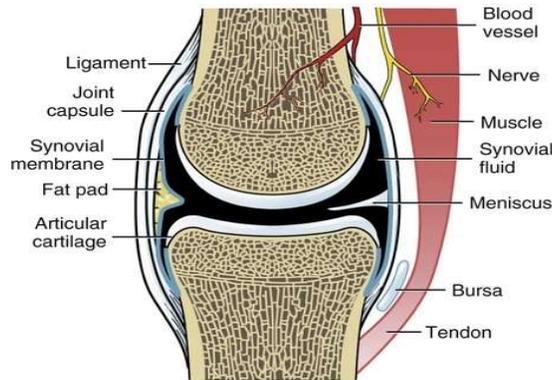


Plate 2.1: Musculoskeletal Key Fastest Musculoskeletal Insight Engine.

Source: Louis, S. (2010). *Musculoskeletal KeyFastest Musculoskeletal Insight Engine*.

Retrieved from <https://musculoskeletalkey.com/structure-and-function-of-joints/>

Joints had different configurations depending on the motion they needed to produce. Some, like the knee, elbow, and finger joints, worked like a hinge, moving up and down. Others, like the hip and shoulder, functioned more like a swivel or ball-and-socket joint, allowing several planes of rotation and sideways movement. Some joints, such as the wrist, were actually comprised of many bones and small joints, which combined to produce very complex, multi-plane motions.

2.1.3. Types of joint movements

Flexion: Bending parts at a joint so that the angle between them decreases and the parts come closer together (bending the lower limb at the knee).

Extension: Straightening parts at a joint so that the angle between them increases and the parts move farther apart (straightening the lower limb at the knee).

Hyperextension: Excess extension of the parts at a joint, beyond the anatomical position (bending the head back beyond the upright position).

Dorsiflexion: Bending the foot at the ankle toward the shin (bending the foot upward).

Plantar flexion: Bending the foot at the ankle toward the sole (bending the foot downward).

Abduction: Moving a part away from the midline (lifting the upper limb horizontally to form a right angle with the side of the body).

Adduction: Moving a part toward the midline (returning the upper limb from the horizontal position to the side of the body).

Rotation: Moving a part around an axis (twisting the head from side to side). Medial rotation involves movement toward the midline, whereas lateral rotation involves movement in the opposite direction.

Circumduction: Moving a part so that its end follows a circular path (moving the finger in a circular motion without moving the hand).

Supination: Turning the hand so the palm is upward or facing anteriorly (in anatomical position).

Pronation: Turning the hand so the palm is downward or facing posteriorly (in anatomical position).

Eversion: Turning the foot so the sole faces laterally.

Inversion: Turning the foot so the sole faces medially.

Protraction: Moving a part forward (thrusting the chin forward).

Retraction: Moving a part backward (pulling the chin backward).

Elevation: Raising a part (shrugging the shoulders).

Depression: Lowering a part (drooping the shoulders).

2.1.4. Types of Arthritis: There are over 120 different forms of arthritis. According to Stein Charles M. et.al. (2004) Primary forms of arthritis are:

Osteoarthritis: It is a kind of a degenerative arthritis or degenerative joint disease. It is a group of mechanical abnormalities involving degradation of joints including articular cartilage and subchondral bone.

Rheumatoid arthritis: It is a chronic, systemic inflammatory disorder that may affect many tissues and organs, but principally attacks synovial joints.

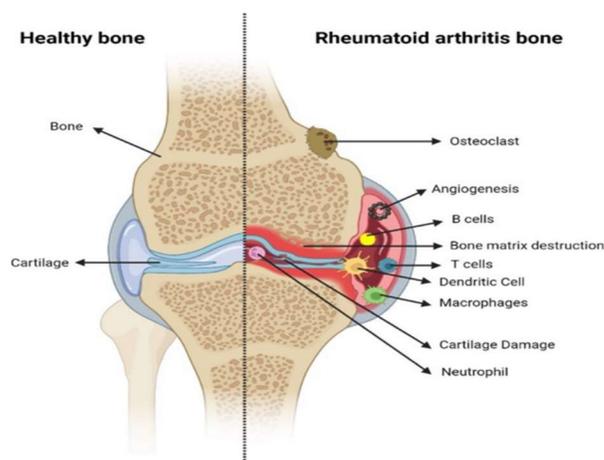


Plate 2.2: A-healthy-synovial-joint and RA joint

Neha Ghosh, S. P. (march 2024). Natural Products and Traditional Herbal Medicines as Managerial Therapies to Combat Rheumatoid Arthritis. *Clinical & Translational Metabolism* 22(1). https://www.researchgate.net/figure/A-visual-representation-illustrating-the-pathophysiology-of-RA-A-healthy-synovial-joint_fig2_378828526

Septic arthritis: It is the purulent invasion of a joint by an infectious agent which produces arthritis.

Gout and pseudo-gout: They are the 2 most common crystal-induced arthropathies. They are debilitating illnesses in which pain and joint inflammation are caused by the formation of crystals within the joint space.

Juvenile idiopathic arthritis: It is a subset of arthritis seen in childhood, which may be transient and self-limited or chronic. It differs significantly from arthritis commonly seen in adults.

Still's disease: The disease typically affects 16–35-year-olds and presents with arthralgia, elevated serum ferritin, a 'salmon-pink' rash, pyrexia and lymphadenopathy.

Ankylosing spondylitis: It mainly affects joints in the spine and the Sacro ilium in the pelvis, and can cause eventual fusion of the spine.

2.2.5 Rheumatoid Arthritis

Among all the forms of arthritis, the Rheumatoid Arthritis is considered to be one of the most destructive one (Meurs Van J.B.J., 2001) Rheumatoid Arthritis (RA) is a type of a poly arthritis which is symmetrical in nature. It is a chronic systemic inflammatory disease that affects about 1 per cent of the population worldwide (E Suresh, 2004) and 0.75 per cent of the adult

population in India (Malaviya A.N., 1993). The disease has a female predominance (female-to-male ratio of 2.5:1), and shows increased incidence with age (Gornisiewicz & Moreland,2001; Goronzy & Weyand, 2001) It may affect many tissues and organs, but principally attacks the joints producing an inflammatory synovitis that often progresses to destruction of the articular cartilage and ankylosis of the joints. The joints most often involved are the wrists, PIP, MCP, elbows, metatarsophalangeal, and temporomandibular joints, although other joints can be involved as well. Rheumatoid arthritis can also produce diffuse inflammation in the lungs, pericardium, pleura, and sclera, and also nodular lesions, most common in subcutaneous tissue under the skin. Although the cause of rheumatoid arthritis is unknown, autoimmunity plays a pivotal role in its chronicity and progression. Recent studies show that between 0.34% to 0.75% of adults in India are affected by RA, which translates to approximately 5 million people. This prevalence is consistent with global estimates but shows regional variations within India. The disease remains more common in women, with the same gender ratio, and its progression often results in joint destruction, loss of mobility, and reduced quality of life.

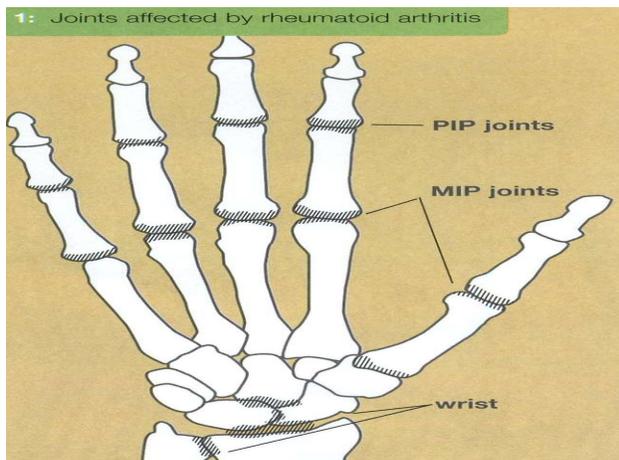


Plate 2.3: Joints affected by RA (Homecare, 2023) AUSTIN HAND, <https://www.austinhandgroup.com/single-post/2016-1-6-rheumatoid-arthritis-of-the-hand>

2.5.1.a Defining Functioning and Disability

‘Functioning’ and/or ‘functional statuses refer to a person's ability to perform the usual activities of everyday life (ADL). It is usually summarizing the concepts of ‘disability’ and ‘social handicap’, as they were defined by the" International Classification of Impairments, Disabilities and Handicaps" (ICIDH) scheme. ‘Disability’ refers to deficiencies or restrictions

of expected activity performance and behavior, i.e. the individual loses its ability to perform a function in a manner considered normal for a human being. Because of the fact that functioning is a multi-dimensional concept, some of the most widely used indices are the 'BADL' and 'IADL' scales. The 'BADL' (Basic Activities of Daily Living) scales assess an individual's ability to perform 'Primary biological activities', i.e. eating or dressing ability, and are more relevant for institutionalized patients and/or elderly individuals with severe disabilities. In addition, in order to assess for example, the ability of an old person with minor health problems to live independently in the community, the 'IADL' indexes (Instrumental Activities of Daily Living) are preferred to the previous ones. These measurement tools include more typical activities of daily living, e.g. gross mobility, home chores, role performance and, this way, cover partially the 'handicap concept'. (Verbrugge, Lepkowski, and Konkol L. 1991; Shanahan, Ahern, Smith, 2010)

2.1.5.b Deformities in Rheumatoid Arthritis

In the rheumatoid joint, there is initial involvement of the synovium with the eventual loss of joint integrity. Tendons, ligaments, cartilage, and the joint capsule are all subject to inflammation and destruction. Hand deformity is a typical feature of RA. Due to disease manifestations in structures of the hand, e.g. tendons, capsules, bone and ligaments, different deformities can occur (Giannestras, 1976). The pathogenesis of hand deformities and the development over time are, however, not fully known. Most prevalent deformities are ulnar deviation of the MCP joints, button hole deformity (BHD) and swan neck deformity (SND). It is not uncommon that the same hand develops different deformities simultaneously (Tubiana R, Toth B, 1984). Deformities together with other deficits such as reduced grip strength and pain can have a major impact on hand function and subsequently the ability to perform activities of daily life (Vliet Vlieland TPM, Van Der Wijk TP, Jolie IMM, Zwinderman AH, Hazes JMW, 1986). It may also lead to distress or depression (Katz PP, Yelin EH, 1995).

2.1.6. Ergonomics- Meaning, definition, principles, aspects, types

Ergonomics, also known as human factors engineering, is the scientific discipline concerned with understanding interactions among humans and other elements of a system. It applies theory, principles, data, and methods to design in order to optimize human well-being and overall system performance (International Ergonomics Association, 2021). Bridger (2017)

defines ergonomics as the study of designing products, processes, and environments to match human capabilities and limitations, thereby enhancing efficiency and reducing discomfort. Dul and Weerdmeester (2008) further elaborate that ergonomics aims to improve safety, comfort, and performance in various settings, including workplaces, healthcare, and daily life.

Principles of Ergonomics

The principles of ergonomics focus on optimizing human interaction with the designed environment to enhance comfort and efficiency. According to Karwowski (2005), some of the key principles include:

1. **Fitting the Task to the Person** – Designing workspaces and tasks to accommodate individual differences, ensuring both comfort and productivity (DAS, 2023).
2. **Reducing Physical Strain** – Minimizing repetitive motions, awkward postures, and prolonged exertion to prevent musculoskeletal disorders (OSHA, 2023).
3. **Enhancing Cognitive Function** – Aligning system designs with human cognitive capabilities to reduce mental workload and improve decision-making (International Ergonomics Association, 2021).

Aspects of Ergonomics

Helander (2006) categorizes ergonomics into three main aspects:

- **Physical Ergonomics** – Focuses on human anatomical characteristics and physiological responses, addressing issues like posture, repetitive movements, and workstation layout (Wikipedia, 2023).
- **Cognitive Ergonomics** – Deals with mental processes such as perception, memory, and reasoning, particularly in human-system interactions (International Ergonomics Association, 2021).
- **Organizational Ergonomics** – Concerned with optimizing socio-technical systems, including organizational structures, communication, and policies to improve overall performance (Dul & Neumann, 2009).

2.1.7. Ergonomic design: it's strength & weakness

Table-2.1: Strength and Weakness of Ergonomic Design

Model Name	Strength	Weakness
<p>The FEA (Function, Environment, and Aesthetics) model developed by Lamb and Kallal in 1992 can be used to analyze wearer responses to specific garment types and general clothing needs.</p>	<p>Detailed in how fashion and design aesthetics may impact disability and specific garments. User-centric model that places human needs first.</p>	<p>Considers the environment in the context of fashion studies and not the overall activity the wearer performs. Excludes the importance of physical safety.</p>
<p>The MOHO (Model of Human Occupation) by Kielhofner and Burke in 1980 is a client centered occupational therapy model examining how routines, roles, habits, and performance capacity (i.e., physical, cognitive, and perceptual abilities) of an individual and the physical or social environment enable occupational participation.</p>	<p>Rather than creating adaptations that might exist within a product, this model champions removing as many inaccessible barriers as possible. Dressing is also included in the model's exploration of an individual's social participation.</p>	<p>Designers may often need advice from occupational therapists and would be exposed to medical terminology. This model doesn't deeply integrate the aesthetics of functional garments as part of the dressing process</p>
<p>The HAAT (Human Activity Assistive Technology) model by Cook and Hussey in 1995 centers on integrating the human, the activity, and the AT</p>	<p>l by Cook and Hussey in 1995 centers on integrating the human, the activity, and the AT. Like the MOHO model, the emphasis on activities allows designers to contextualize an adaptive garment. This model provides a connection between fashion and technology that is inclusive of disability needs</p>	<p>This model is more applicable to occupational therapy. It is strongly focused on assistive technologies, which do not always include or relate to clothing design.</p>
<p>The Social Model of Disability was developed in the 1970s in the United States and further explored by Mike Oliver. The model proposes that disability results from the interaction between a person's characteristics and their unsuitable environment—not their medical condition.</p>	<p>This model provides a powerful perspective when integrating social and political contexts into fashion</p>	<p>The model excludes design principles that are essential in making adaptive fashion.</p>

2.1.8. Consumer/user profile, its importance, usage, process, design affordance

User Persona

User Name _____ Date of Observation _____

Disability _____ Time Experiencing Disability _____
 _____ (number of years)
 Permanent Temporary

How does the user's disability affect body movement and dressing?

 Mobility Assistance
 If yes, what are they?

What type of style does the person describe having?

 Personal Assistance (ex-caretaker)
 If yes, who are they and what are the responsibilities?

What type of style does the observer describe the user having?

Table-2.2: Strength and Weakness

The following is a checklist of dressing observations referenced when working with Dorothy:

Home Activities (that may inform dressing)

- Turning the pages of a book
- Turning a doorknob
- Open and closing doors
- Using a switch (push or plug in)
- Holding a cup
- Using a cell phone

Plate 2.4: User Persona template. Source: Courtesy of Grac

Table 2.3: Strength and Weakness of ergonomic design

Bed-Related Activity	Dressing Activity
• Moving off and on the bed (especially if transferring to a wheelchair)	• Putting on or taking off shirts with buttons
• Sitting upright on the bed	Putting on or taking off pants with zippers
• Rolling right to left/left to right	Removing braces, prosthetics, or other supportive wearable devices attached to the body when tying shoes or putting on pants

Creating a User Journey Map

A user journey map helps contextualize where and when dressing challenges impact a person. Location, situation, and time are useful factors when identifying scenarios in which ergonomic fashion best supports the wearer or user. A template is referenced in Josh pack, and Trans-Skirt. Designers can use these examples to document user activities by identifying the time, occasion, and place. Research suggests that a *user journey map* is a valuable tool for contextualizing dressing challenges and identifying critical moments where adaptive clothing can enhance accessibility (Dorothy owned.). Key factors such as location, situation, and time influence the

effectiveness of adaptive fashion in supporting wearers with mobility limitations (Dorothy owned.). Studies have explored how designers can use mapping techniques to document user activities and determine optimal garment features based on the time, occasion, and place of dressing (Dorothy owned.).

Table 2.4: Pain points of existing jackets, accessibility opportunities

Pain Points of Existing Jackets	Accessibility Opportunities
Elbow area is restricting or confining to arm movement.	Switch fabric to an elastic and soft material that provides increased space for a greater range of motion in arms.
Ribbed cuffs provided stretch but not enough grip when dressing with one dominant arm.	Add loops to the ribbed cuffs to provide extra support for the fingers when putting the jacket on.
Buttons were too small or had magnet fasteners that were too strong to pull apart.	Switch buttons to larger buttons, snaps that look like buttons, magnets, or eliminate the buttons altogether.
Shoulder and underarm areas were restricted in fabrics that provided structural support but had no stretch.	Change fabric to an elastic and soft material that provides increased space for a greater range of motion (Chromat 2021) and reduced shearing.
Back of the jacket was tight-fitted and often uncomfortable for movement.	Install a pleat or Velcro® on the back that exposes additional elastic material to increase arm rotation or movements in the back.
Sleeves in suit jackets were tight-fitted and chic but were too tight to place arms through without experiencing pain or discomfort.	Adding a possible closure at the end of the sleeves, like a zipper or pleat, would help don/ doff sleeves easily.
Pockets were angled in a position that caused keys and other valuable things to fall out easily. Most jacket pockets were on the outside and not large enough for Dorothy’s hands to easily access.	Remove the top flap of the pocket to be an open pocket for use and angle pockets 25 degrees higher from the waistline.
Curved neckline designs of jackets were confining and stiff.	Widen collar based on body measurements to reduce shearing near the neck.
Inside of garments were usually not lined with smooth materials other than leather jackets.	Line inside the jacket with soft or silky material to reduce friction on and sensitivity of skin.

Define the Problem

Using the Design Requirements method, the main pain points from the jacket project fell into the following categories:

Ease of dressing-lack of range of motion, variables that encourage independent dressing, and takes less time to dress. Garment designs that do not impede mobility or movement requirements and should be easy to put on or take off.

Protection-needs materials that provide absorbency when perspiring, breathability qualities, durability, or finishes that help regulate body temperature.

Comfort-challenges in fit, lack of material sensitivity, too much buildup of static electricity, and not inclusive of psychological sense of well-being for wearers.

Appearance-lack of choices in individual style and not related to fashion trends for social occasions and events.

Design Affordances

Design affordances refer to the possibility of an action or function of an object. They help determine the relationship between the person and the object, such as by examining the interaction of a silhouette or functional properties of a fabric. In the case of Dorothy, the following factors help evaluate, test, and measure the design factors that were created in the jackets.

Iterative Prototyping

The iterative process includes a variety of ways to approach design. Each iterative design helps measure the choice of materials, form, and usability, providing ways to better understand how fashion influences aesthetic preferences. In adaptive fashion, the iterative design helps prove a hypothesis. Is this sleeve silhouette providing great movement and comfort for the wearer? Does the fabric feel light when worn?



Plate 2.5: Pattern designs of jackets with wider armholes and pleated back

Source: Illustrated by Grace Jun on the left of the image. The design requirements are reflected in the construction and material of the jackets in the Access & Closure collection. Karen Chan and Jasmine Oh modeling collection, photographed by Alexi Tosti. Courtesy of Grace Jun.



Plate 2.6: A purple top with a discrete zipper that increases the shoulder and neckline opening worn Source: by model Chelsea for June Adaptive. Courtesy of JuneAdaptive.com.

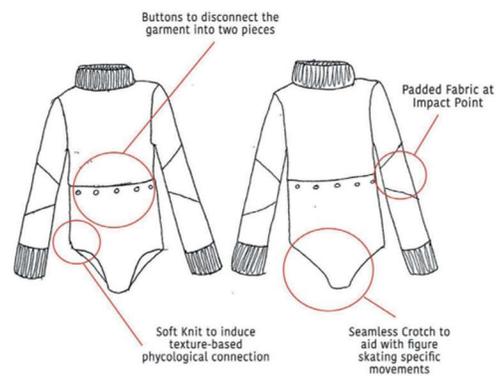


Plate 2.7: An adaptive jumpsuit with detachable features sketched Source: by Abby Gaskin. Courtesy of Abby Gaskin.

2.2. Research related review

2.2.1. Clothing solutions for people with rheumatoid arthritis

2.2.2. User-Centered design in adaptive apparel

2.2.3. Quality of life and daily activities in RA patients

Suresh, E., (2004) conducted a study on the diagnosis of early rheumatoid arthritis (RA), focusing on what non-specialists need to know. Rheumatoid arthritis is a chronic systemic inflammatory disease affecting approximately 1% of the population. It can lead to irreversible joint damage and systemic complications, with age-adjusted mortality rates for those affected exceeding those of the general population. Disease-modifying antirheumatic drugs (DMARDs) are prescribed to slow or arrest disease progression, and early initiation of these treatments is associated with improved functional and radiological outcomes. A guideline from the Scottish Intercollegiate Guidelines Network (SIGN) in 2000 recommended that patients with inflammatory arthritis lasting 4 to 6 weeks should be referred for specialist evaluation. However, recent audits indicate that patients are often referred after 16 weeks from symptom onset. This significant delay in diagnosis is primarily due to late referrals and vague rheumatological diagnoses.

Allison, B., Vlada B., & Megan S., (2011) conducted a study titled "Opening the Book on Design, Disability & Independence," which investigates Anne Kernaleguen's book "Clothing Designs for the Handicapped." The United Nations' Convention on the Rights of Persons with Disabilities recognizes disability as an evolving concept, prompting researchers to rethink its implications. Kernaleguen's book serves as an example of this evolution by presenting new and adapted sewing patterns for creating garments for individuals with various disabilities. The book aims to provide adapted clothing while maintaining attractiveness and fashion, thereby avoiding the labeling of disabled individuals as different. However, Kernaleguen's objectives are sometimes contradicted by the material evidence within the book. The primary goal of adapted clothing is to support independence, defined as an individual's ability to meet their personal needs. This approach is demonstrated through patterns featuring sleeves, wrap-around shapes, and Velcro closures. Additionally, the book includes patterns tailored for wheelchair users, such as skirts with partial backs and trousers with higher waists. Nonetheless, questions

arise regarding the true independence afforded by these garments and the necessity of avoiding labeling disabled individuals as "different."

Deepti, G., (2011) conducted a study on the design and engineering of functional clothing, emphasizing that this process is complex and iterative. It involves assessing user requirements across physiological, biomechanical, ergonomic, and psychological dimensions. The design process includes selecting materials, determining size and fit, pattern making, assembling, and finishing. Technological advancements significantly influence these steps, distinguishing functional clothing design from everyday apparel design. This rapidly developing field represents the future of the textile and apparel industry, particularly in emerging economies like China and India. The study also proposes a roadmap to address challenges faced by this sector.

Azher, N., Saeed, M., et al. (2012) explored adaptive clothing for females with arthritis impairments. Clothing is a fundamental human need, especially for individuals with physical challenges. Adaptive clothing offers a pain-free, time-saving, and accessible way for women with arthritis to dress independently. The researchers conducted a qualitative study involving in-depth interviews and observations of three participants to assess the independence and self-confidence provided by three sets of garments designed specifically for women with rheumatoid arthritis. The findings indicated that the adaptive clothing enhanced the participants' independence and self-confidence while being comfortable and practical. Participants expressed that the garments were attractive, functional, and suitable for casual or outerwear. The study concluded that adaptive clothing effectively met the participants' needs and preferences

Azhar, N., Kalsoom, S., Saeed, M., (2010-2012) conducted a study on the need assessment, design, and effectiveness of adaptive clothing for females with rheumatoid arthritis (RA). The research aimed to explore the physical limitations and clothing challenges faced by women with RA and develop functional clothing tailored to their needs. The qualitative study, carried out in Lahore over two years, utilized in-depth interviews and observations to understand the difficulties experienced during donning and doffing garments. The researchers adopted a co-design approach, collaborating with participants to assess their clothing requirements and create adaptive garments that were tested during a three-week wear trial. The results

demonstrated that adaptive clothing effectively addressed participants' needs and preferences, providing comfort during dressing and enhancing independence. Co-designing the final product proved to be an effective method to ensure the garments met user expectations.

Rosiane, P, A., Laura, B, M., et al. (2014) conducted a study on the ergonomic design of labor garments and the perception of comfort or discomfort among female employees. The research emphasized the significance of ergonomics in promoting worker welfare through clothing that enhances comfort and reduces risks associated with work tasks. The study evaluated the application of project guidelines in designing workwear for female employees in the UFPE-CAA administrative sector, considering the nature of tasks, workers' needs, and preferences. A perception test revealed that physical comfort was more prevalent than discomfort among participants, highlighting the importance of ergonomic considerations in garment design. The study also underscored the role of designers in creating workwear that aligns with workers' needs, thereby contributing to their well-being and social integration.

Soni, S., Archana, S., et al. (2015) conducted a study to address the clothing needs of female patients with lower arm fractures. The researchers developed an interview schedule to assess body needs, challenges, and desired functional features, leading to the creation of five garment designs. These designs, including gowns, kameez (tunics), tops, and trousers, were evaluated by experts, with two selected for their integration of preferred functional features. Key innovations included side-openings, adjustable straps, and magnetic closures to simplify dressing for individuals with limited arm mobility. The study concluded that these garments significantly improved comfort, ease of donning, and self-confidence among participants. The designs prioritized single-handed usability, reducing reliance on caregivers and enhancing practicality for daily wear.

Nupur, A. (2016) focused on developing adaptive clothing for Indian women with rheumatoid arthritis (RA), a condition affecting approximately 0.75 per cent of India's adult population. Recognizing the lack of culturally relevant solutions in existing Western designs, the study aimed to adapt traditional Indian garments such as sarees, salwar-kameez, and blouses. Through surveys of patients and doctors, the research identified critical challenges, including hand deformities, reduced grip strength, and pain during dressing. The resulting designs incorporated features like magnetic closures, elasticized waistbands, roomier silhouettes, and

partial-back garments for wheelchair users. These adaptations balanced functionality with cultural aesthetics, ensuring garments were both easy to don/doff and aligned with regional attire norms. The study highlighted the importance of integrating adaptive solutions into traditional clothing to promote independence and dignity for Indian women with RA.

Goncu-Berk G., & Topcuoglu N., (2017) conducted a study on the design of a healthcare wearable, specifically a smart glove aimed at managing chronic pain for rheumatoid arthritis (RA) patients. Recognizing that chronic diseases like RA require ongoing medication and physical therapy, the researchers focused on developing an e-textile-based smart glove to alleviate pain and limit hand deformities associated with the condition. The design process involved collaboration with medical professionals and patients, utilizing iterative prototyping and testing to refine the glove's functionality. This multidisciplinary approach necessitated a comprehensive framework that encompassed medical and physiological considerations, textile technology, electronics, and manufacturing methods. The implementation phase included comfort characterization tests for textiles, electrical characterization tests for the e-textile structures, and clinical trials to assess the glove's effectiveness in real-world applications.

Mathieu. B., Laurent, J., et al. (2019) performed a systematic review to evaluate the validity and reliability of wearable sensors for estimating joint angles. While traditional motion capture systems are considered the gold standard for joint angle measurement, they are often limited to laboratory settings. This review included forty-two studies assessing commercial and homemade inertial measurement units (IMUs) as potential alternatives. The findings indicated that the validity of IMUs varied based on task complexity and the specific joint being evaluated. Although IMUs showed promise as valid tools for assessing whole-body range of motion, the review highlighted the need for further research on their reliability to draw stronger conclusions about their effectiveness in clinical settings. The authors emphasized that standardizing technical procedures is essential for improving accuracy in data collection using these sensors.

Mustafa A., Muhammad Rashid A., et al. (2021) conducted a study examining the relationship between daily living activities and quality of life in patients with rheumatoid arthritis (RA). The research involved 160 RA patients from the Sulaimani region of Iraq and aimed to identify how various patient characteristics influenced their ability to perform daily

activities and their overall quality of life. The results indicated that both the physical and psychological domains of quality of life were negatively impacted, with physical functions deteriorating as patients aged. Additionally, the study found that quality of life and daily living activities worsened with increasing age, body mass index, disease duration, and the use of walking aids.

Sushila Devi, S., Arya, N., (2022) explored innovative technology for smart functional clothing within the textile industry. Recognizing that this industry is one of the largest globally, employing millions, the researchers noted a shift in focus from traditional end products to advancements in science and technology. Smart functional clothing represents an emerging interdisciplinary area that integrates fashion, textiles, electronics, and healthcare. This research serves as a crucial reference for professionals across these fields, highlighting the importance of developing textiles and clothing products that meet modern needs through technological innovation.

McBee, Black K., (2022) conducted a study titled “Making Life Easier”: A Case Study Exploring the Development of Adaptive Apparel Design Innovations from a User-Centered Approach. The research centers on Mindy Scheier, a former fashion designer and mother of a child with a disability, who developed several adaptive apparel innovations, including magnetic closures, adjustable pant legs, sleeves, and waistbands to facilitate easier donning and doffing. This initiative was part of a groundbreaking collaboration with Tommy Hilfiger in 2016, aimed at creating fashionable clothing that accommodates the needs of individuals with disabilities (PWD). The study utilized a case study methodology to understand Scheier's user-focused design process, revealing that she involved PWD at every stage of development to build trust and ensure that the designs met their needs. Additionally, Scheier navigated the balance between the requirements of PWD users and the apparel industry's standards to integrate adaptive features into mainstream fashion. Her approach demonstrated how adaptive apparel can bridge functionality and inclusivity while remaining commercially viable.

McBee-Black k., Ishtehar, Sharif, S., et al. (2023-2024) conducted a systematic literature review on adaptive apparel for people with disabilities (PWD). This review explored advancements in adaptive design methodologies, user-centered approaches, and inclusive marketing strategies while identifying significant gaps in terms of disability types represented,

research methodologies employed, cultural considerations, and societal barriers faced by PWD. The authors emphasized the urgent need for prioritizing inclusivity and adaptability within the apparel industry to better serve this underrepresented consumer group. The study also highlighted how adaptive apparel remains an emerging field requiring further exploration to address these gaps comprehensively.

Deepti, G., Amrit, D., et al. (2023) conducted a study focused on designing ergonomic garments for elderly Indian women. This research involved 160 elderly women from Delhi and its satellite towns to identify their clothing needs and preferences. The findings revealed that many struggled to find age-appropriate clothing, as most designs were tailored for younger demographics. Over 80 per cent of participants wore traditional Indian sarees but faced challenges regarding the fit and comfort of blouses worn as tops. In response to their feedback, ten blouse designs were developed using various fabrics and style features suitable for different occasions and activities, with three designs discussed in detail. These designs addressed issues such as ease of movement, fabric breathability, and aesthetic appeal while ensuring cultural relevance for elderly users.

METHODOLOGY

Operational Definition

Rheumatoid Arthritis Patients: is an individual who experiences pain and stiffness in specific joints of his/her body which restricts mobility, further impacting his/her daily activities.

Ergonomic Garment Design: is clothing specifically designed for individuals with rheumatoid arthritis, addressing their specific challenges in day-to-day dressing to provide efficiency.

Caregiver: A person who assists rheumatoid arthritis patient who are unable to dress themselves due to severe conditions.

Ease of Use: The ability of a garment to be easily dress and undress by the patient without causing difficulty or needing much effort.

Mobility: The freedom a patient feels to move their body and joints comfortably while wearing the garment without facing restrictions.

Comfort: The physical and sensory ease a patient experiences after wearing a garment, without any irritation, pressure, or pain.

Chapter III

METHODOLOGY

The purpose of this research was to assess the user needs and create ergonomic garments designs specifically suited to the special requirements of people with rheumatoid arthritis (RA). By addressing the difficulties these individuals encountered with traditional apparel, the study aimed to develop garment solutions that, promoted ease of use, enhanced mobility, and reduced discomfort. This research sought to close the gaps in the current situation of RA patients in dressing and undressing, ultimately enhancing the quality of life for such RA patients. Through a methodical procedure involving needs assessment, prototype creation, and user testing, the applied research was intended to be useful for the rheumatoid arthritis patients.

3.1 Collection of Preliminary Information

3.2 Research Design

3.3 Need- Gap assessment

3.3.1 Selection of Sample

3.3.2 Preparation of Tool

3.3.3 Data collection

3.3.4 Analysis of Data

3.3.5 Investigate existing ergonomic garments through market survey

3.4 Design and development of prototypes

3.4.1 Create user profile

3.4.2 Conceptualize ergonomic design

3.4.3 Selection of design

3.4.4 Pattern making

3.4.5 Material sourcing

3.4.6 Development of Specification Sheet

3.4.7 Selection of tailors and artisans

3.4.8 Construction of prototypes

3.4.9 Bill of Materials (BOM)

3.5 User Testing

3.5.1 Selection of participant

3.5.2 Preparation of Evaluation Metrics

3.5.3 Wear trial of prototype garments

3.5.4 Findings of Data

3.5.5 Analysis of Data

3.5.6 Reporting and Recommendation

3.1 Collection of Preliminary Information

Preliminary information was collected from secondary sources and few Privileged observers form a foundation for the study. This involved reviewing on existing literature on ergonomic garment design for individuals with rheumatoid arthritis (RA), examining past research. Understanding the specific clothing needs and limitations of RA was a thought reinforced by initial interactions with individuals who had the privilege to observe the needs of RA patients from close quarters.

3.2 Research Design

The research design included a mixed-methods approach, incorporating both quantitative and qualitative data collection techniques, including surveys, interviews, and observations. Insights were gathered through interviews with rheumatoid arthritis patients and doctors in government hospitals, private hospitals, and physiotherapy center, using snowball sampling. It began with a needs assessment through surveys and interviews to identify common challenges such as restricted mobility, joint pain, and difficulties with self-dressing. The results informed future iterations, aiming to significantly enhance the quality of life for individuals with RA. The investigator utilized resources from the Clothing and Textile Department Library, Faculty of Family and Community Sciences. The Maharaja Sayajirao University of Baroda, Vadodara. This framework enhanced the reliability of insights and ensured the design process aligned with user needs, leading to the development of user-centered ergonomic garment.

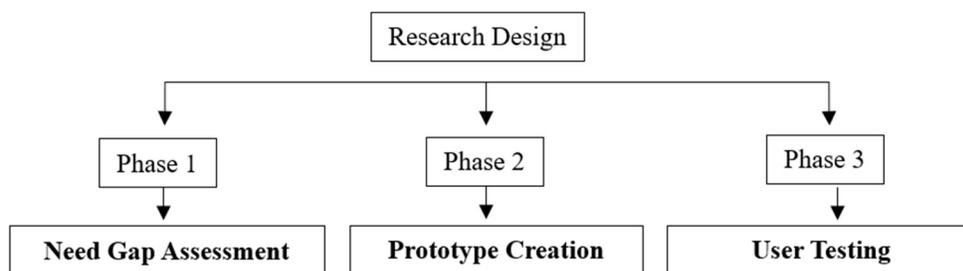


Figure 3.1: Phases in Research Design

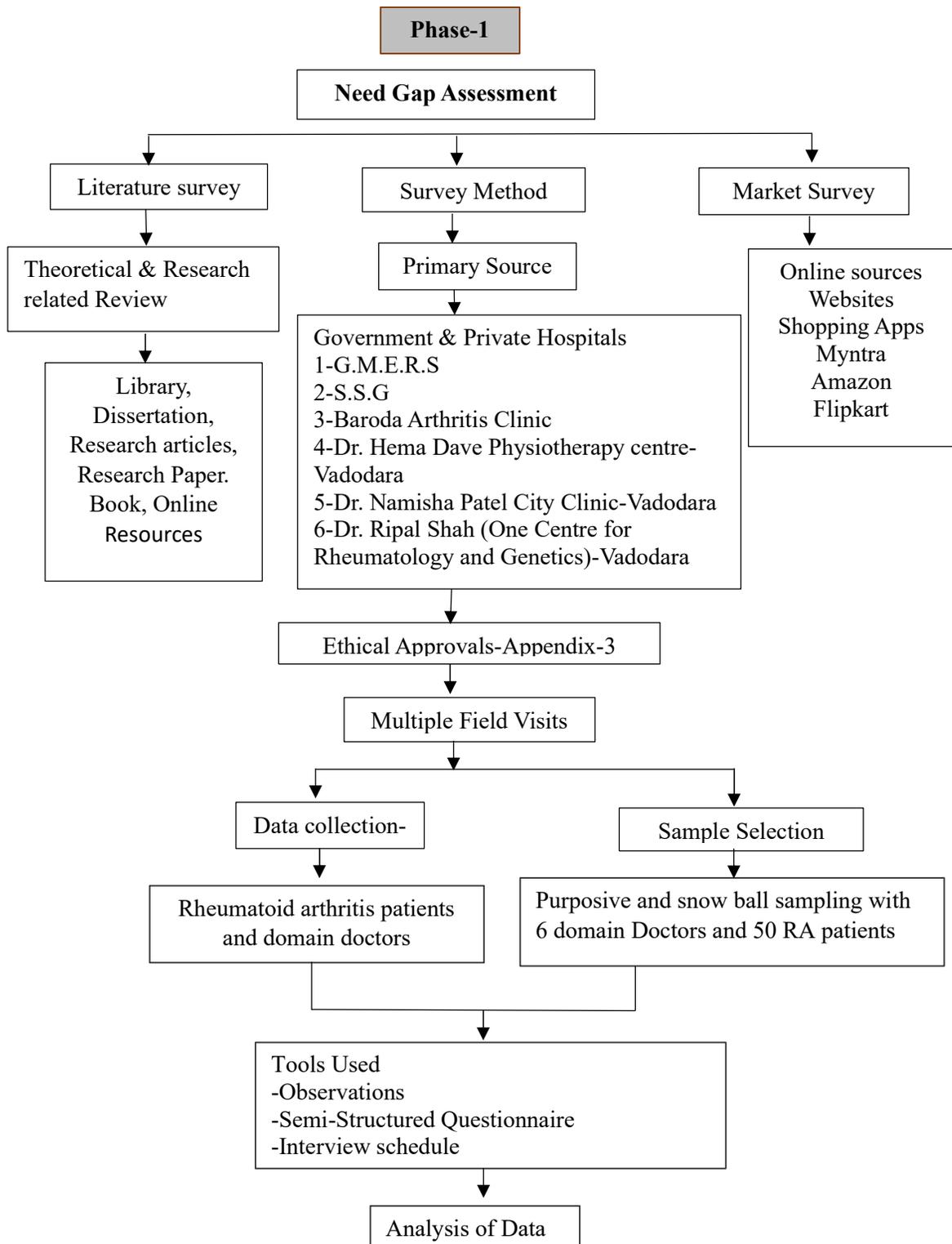


Figure 3.1a: Phase 1 Need Gap Assessment

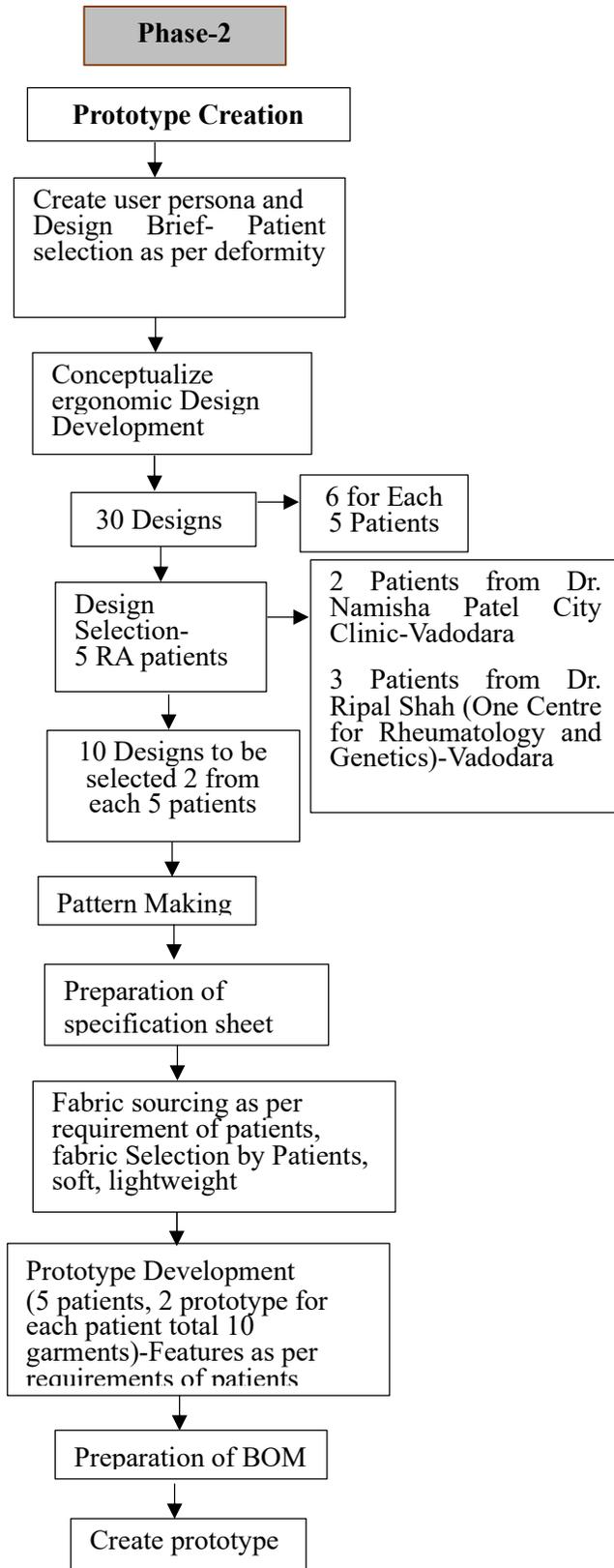


Figure 3.1b: Phase 2 Prototype Creation

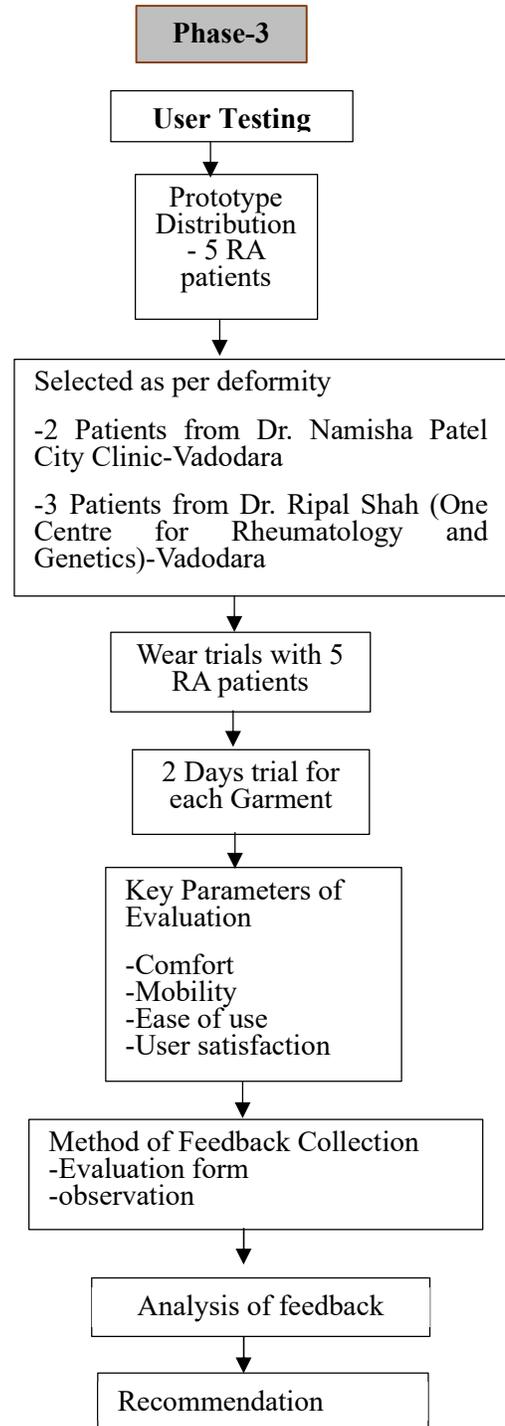


Figure 3.1c: Phase 3 User Testing

3.3 Need-Gap Assessment

The key issue addressed was the challenges RA individuals face in their clothing due to joint pain, and stiffness. The goal was to identify the unmet needs of people with RA in terms of ease of use, mobility, and reduced discomfort caused by their garments.

This phase identified the specific needs and challenges faced by people with rheumatoid arthritis (RA) in relation to their clothing. It involved collecting both primary and secondary data to comprehensively define the problem and explore potential design solutions.

3.3.1 Selection of Sample

The study was conducted across six hospitals in Vadodara, namely SSG Hospital, GMERS Hospital, Baroda Arthritis Clinic, Dr. Hema Dave Physiotherapy Centre (Annexure-4), Dr. Namisha Patel City Clinic (Annexure-2), and Dr. Ripal Shah's One Centre for Rheumatology and Genetics (Annexure-1). Dr. Namisha Patel City Clinic had the highest number of respondents (Twenty-Nine), while Baroda Arthritis Clinic had (Fifteen) (Annexure-3), Dr. Hema Dave Physiotherapy Centre had (3), Dr. Ripal Shah's clinic had 5, and SSG Hospital had 1(Annexure-5), whereas GMERS Hospital had no respondents. In total (Annexure-6), (Fifty-Three) patients and five doctors contributed to the study, with three non-respondents recorded.

Sampling Method: A snowball sampling and purposive sampling method was used to select a representative sample.

Inclusion criteria:

- The patient is limited to individuals diagnosed with rheumatoid arthritis who are residing in Vadodara.
- Patient must have a medical professional's clinical diagnosis of RA verified.
- Patient diagnosed with RA more the 5 years will be selected.
- patient age 25-75 Years will be selected for the study.
- Patient must be able to give informed consent and comprehend the study.

3.3.2 Preparation of Tool

The tool was prepared to gather qualitative as well as quantitative data. Tool in the form of Semi structured questionnaire (Appendix-3), semi-structured interview (Appendix-3) was prepared to gather information on the challenges and preferences related to clothing for bedridden patients. The tool covered areas like:

a) Semi structured questionnaire

- Demographic details,
- Current clothing comfort and requirement,
- Ease of dressing and undressing,
- Fabric preferences,
- Challenges while upper body garments or lower body garments,
- Care needs, enabling the systematic collection of qualitative and quantitative data.

b) Semi-structured interview

Semi-structured interviews were conducted with 6 doctors from each hospital. The interviews focused on basic information about patients and their deformity, what was the challenges faced by rheumatoid arthritis patients and their caregivers, care and needs. overall information collected.

c) Observation:

Observational study was conducted to assess the ease of use, mobility and comfort of existing wearing garment by patient or any adaptive garment purchased by patients.

Tool validation: The questionnaire and interview schedule will undergo content validity to ensure they effectively address the research objectives. The tools will be reviewed by experts in the following field of Fashion and Clothing, Medical and Statistics.

Table 3.1: Expert panel for tool validation

Expert Type	Name & Designation	Institution/Clinic	Role in Research
Designing Expert	Dr. Kruti Dholakia, Associate Professor	NIFT, Gandhinagar	Ensures design-related aspects for RA patients.
Rheumatologist	Dr. Hetal Hindocha Clinic	Rheumatologist Dwarka	Validates the relevance of patient questions.
Statistician	Ms. Shreya Mathur, Temporary Teaching Assistant	Department of Statistics, MSU Baroda, Vadodara	Ensures the questions are structured for reliable data analysis.

-The hospitals selected for the study were:

1. SSG Hospital-Vadodara (Sir Sayajirao General Hospital (Govt.) (Annexure-5)
2. GMERS Hospital - Gujarat Medical Education & Research Society (GMERS) (Govt.) (Annexure-6)
3. Baroda Arthritis Clinic-Vadodara (Annexure-3)
4. Dr. Hema Dave Physiotherapy centre-Vadodara (Annexure-4)
5. Dr. Namisha Patel City Clinic-Vadodara (Annexure-2)
6. Dr. Ripal Shah (One Centre for Rheumatology and Genetics)-Vadodara (Annexure-1)

Total 53-Patients, 5 Doctors selected were 3 non-respondents

Ethical Approvals and Research Permissions:

To ensure compliance with ethical guidelines and institutional regulations, the researcher obtained formal permissions before conducting the study at GMERS Hospital and SSG Hospital.

At GMERS Hospital (Annexure-6), the approval process began with the researcher submitting a formal research request to Dr. Anup Kumar Chandani, the Superintendent. Dr. Chandani then they directed the researcher to Dr. Sandeep Shah, the Head of the Psychiatrist Department and Secretary of the Ethics Committee, for further guidance. Dr. Sandip Shah provided detailed information on the necessary documentation and referred the researcher to Mr. Mayur Bhai, who assisted in understanding the paperwork requirements. After gathering the required documents, the researcher submitted the ethical approval form to Mr. Mayur Bhai and the Ethics Committee. The research proposal was reviewed in an Ethics Committee meeting, and upon approval, the researcher received formal permission to conduct the study. Additionally, Dr. Chirag V. Thakkar, Professor of the Orthopaedics suggested that there were no available patients with rheumatoid arthritis for collecting samples and recommended collect data from a rheumatologist.

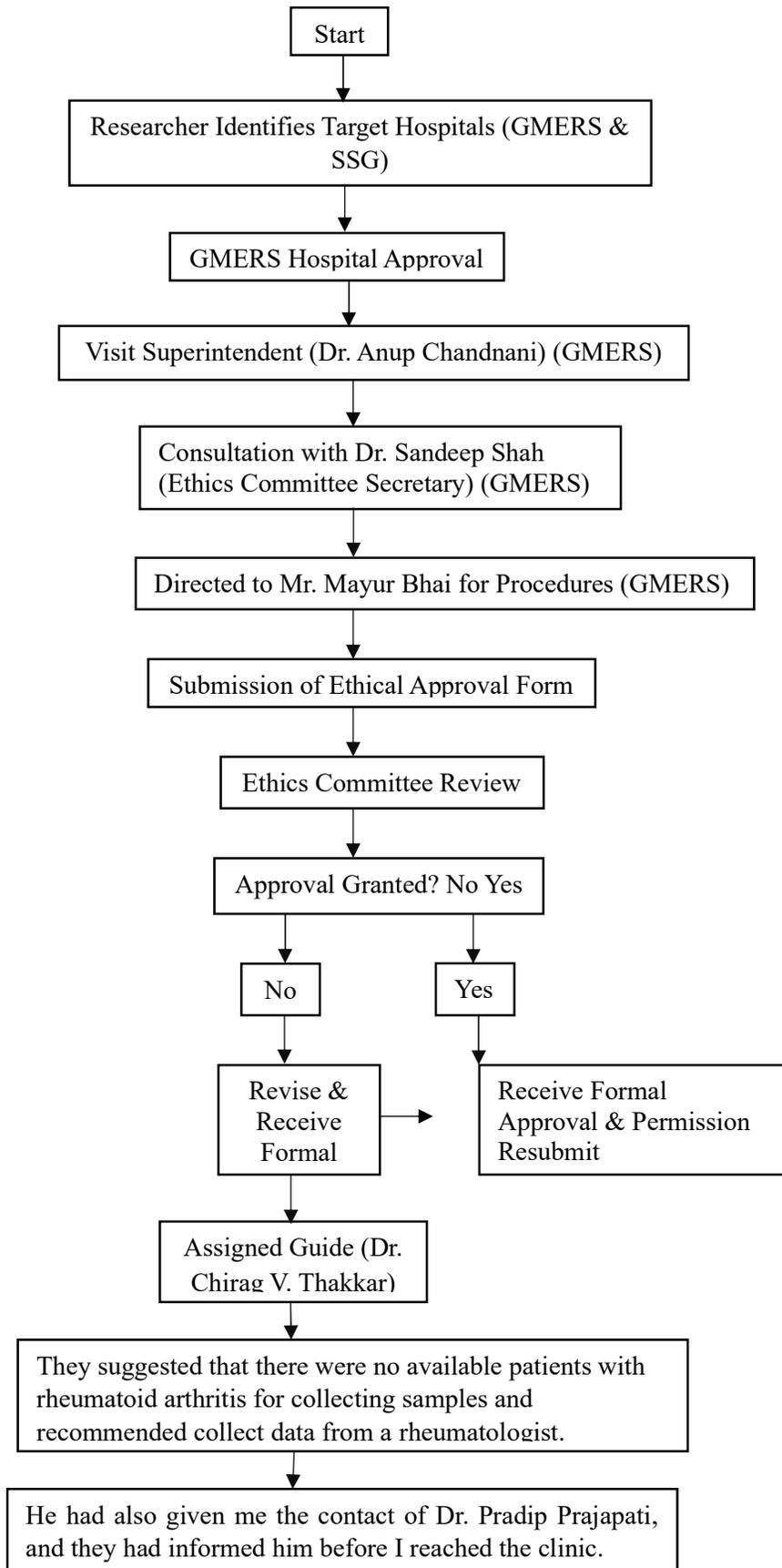


Figure 3.2a: Stepwise Approval Process for Research at GMERS Hospital

At SSG Hospital, the researcher followed a structured institutional protocol to obtain research permission. A formal permission letter was submitted to the Superintendent's office, where Mr. Raju Verma, the Personal Assistant to the Superintendent, provided guidance on the approval process. After reviewing the request, the Superintendent approved and signed the permission letter. The researcher was then assigned to the Physio Department and Ortho Department, where a meeting was held with the Head of Department (Dr. Aruna Talpade-Physio) following discussions regarding the study details, the HOD granted formal permission for data collection in the department.

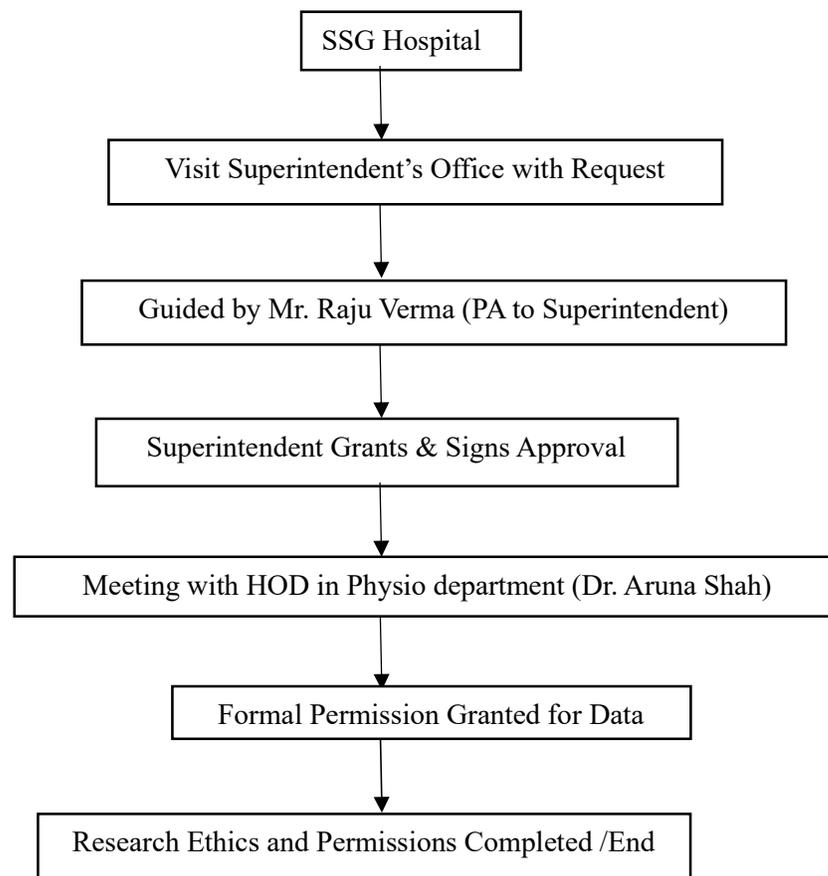


Figure 3.2b: Stepwise Approval Process for Research at SSG Hospital

By adhering to these institutional procedures, the researcher ensured compliance with ethical standards and hospital regulations while maintaining participant confidentiality and informed consent protocols.

The permission process varied across Private hospitals. Baroda Arthritis Clinic and Dr. Hema Dave Physiotherapy Centre required a permission letter and disclosure letter, granting approval within two days, with Baroda Arthritis Clinic permitting data collection for one month. Dr. Ripal Shah's clinic took over a week to grant permission, requiring only a permission letter. Dr. Namisha Patel City Clinic had the longest approval process, taking more than 15 days. Multiple visits were necessary, and the submission of a permission letter, disclosure letter, ethical approval form from the university, and questionnaire was required via email. The clinic permitted data collection for only two days.

3.3.3 Data Collection

Surveys and interviews were conducted in selected hospitals with pre-tested tools. Observational studies were carried out during hospital visits to assess real-time use and challenges of current maternity wear.

3.3.4 Data Analysis

A mixed-method approach was employed, incorporating both qualitative and quantitative data collection. Descriptive statistical analysis was performed using frequency and percentage distributions.

3.3.5 Investigate existing ergonomic garments through market survey

To assess the availability of adaptive clothing for individuals with rheumatoid arthritis a market survey was conducted through both primary and secondary research in Vadodara. The objective was to understand availability, product variety, and distribution channels for ergonomic garments designed for affordability and mobility-challenged individuals. Most stores focused on conventional apparel, with no specialized garments designed for individuals with RA arthritis or mobility issues. Based on the available information, there are no known offline stores in Vadodara, Gujarat, that specialize exclusively in adaptive clothing. Mainstream retailers like Pantaloons have locations in Vadodara, but they do not typically offer adaptive clothing lines. Since offline availability was limited, secondary research was conducted through online platforms such as Amazon, Flipkart, Haxor, JCPenney, Kohl's,

Silverts, to analyze the range and features of adaptive clothing. Findings from this analysis included:

- A variety of adaptive garments were available online, featuring easy-to-use fasteners, stretchable and breathable fabrics, and pain-reducing design elements.
- Product descriptions highlighted features like Velcro closures, magnetic buttons, and soft, non-restrictive seams.
- Customer reviews provided insights into the effectiveness and practicality of the designs, helping to identify preferred features.
- Pricing varied significantly, with some adaptive garments being costly due to their specialized design.

3.4 Design and Development

This phase focused on developing designs for prototype development. Insights from the need-gap identification phase guided the development, ensuring that the garments effectively addressed real-world challenges. designs were conceptualized, emphasizing features like easy-to-handle fasteners, stretchable fabrics, and adaptable closures. The designs aimed to enhance mobility and reduce the pain associated with dressing and undressing, focusing on requirements of the patient's fulfilment. 30 designs were created for 5 patients, 6 for each patient where patients selected 2 designs, all the designs were created as per requirements given by patients all the designs were created in Adobe Photoshop 2023.

3.4.1 Define end user profile.

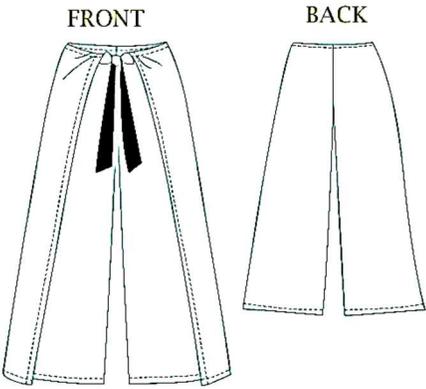
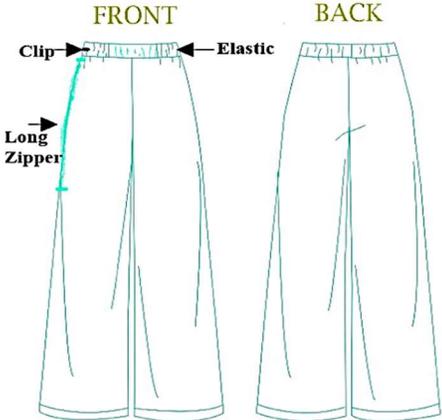
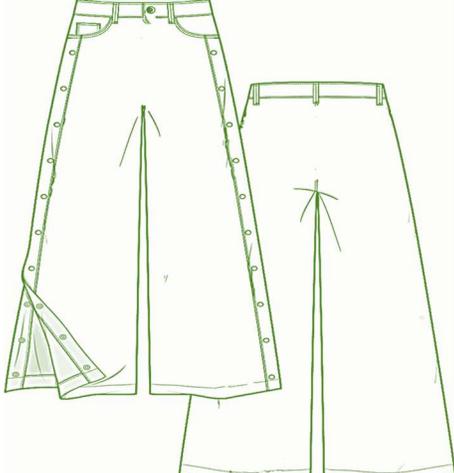
Table 3.2: Create User profile

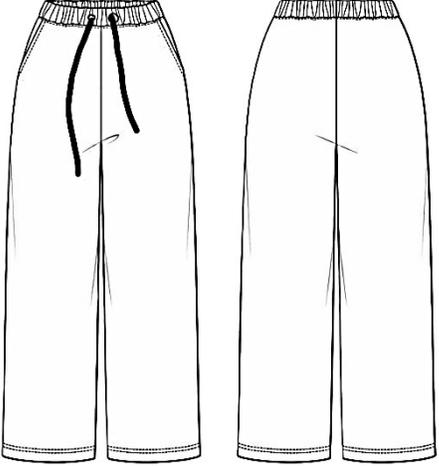
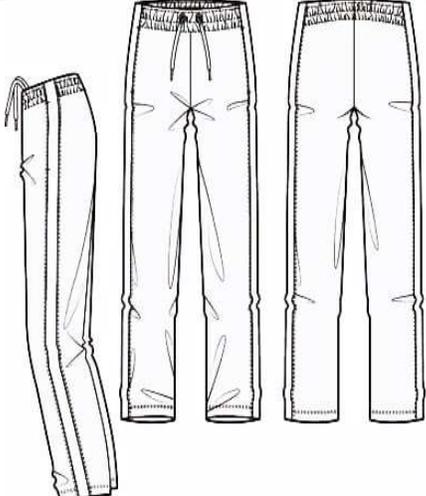
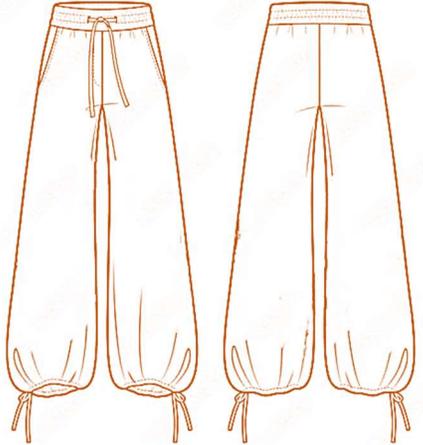
Age	
Gender	
Location	
Education	
Occupation	
Family Structure	
Deformity	
Challenges	
Ease of Use	
Comfort	
Clothing Preferences	
Economic Status	
Affordability	

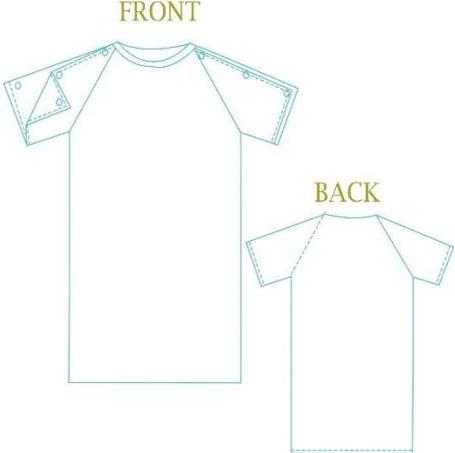
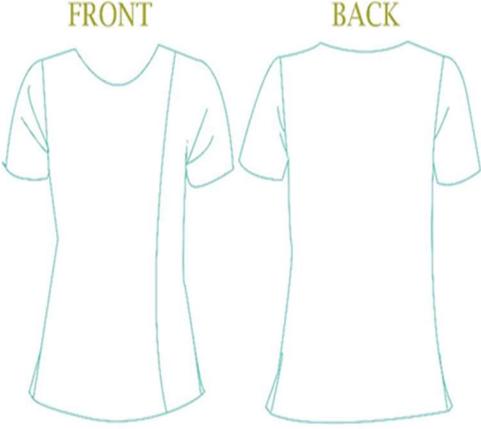
A detailed design brief was developed, outlining the key requirements for adaptive garments based on the identified user needs. This included a user profile of RA patients and their caregivers, detailing their physical conditions, daily activities, and specific dressing challenges encountered which affected in day-to-day life.

3.4.2 Conceptualize ergonomic design

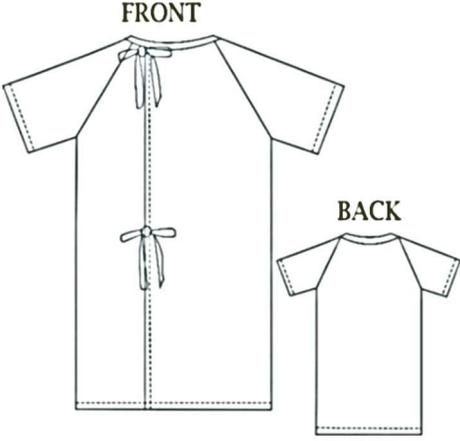
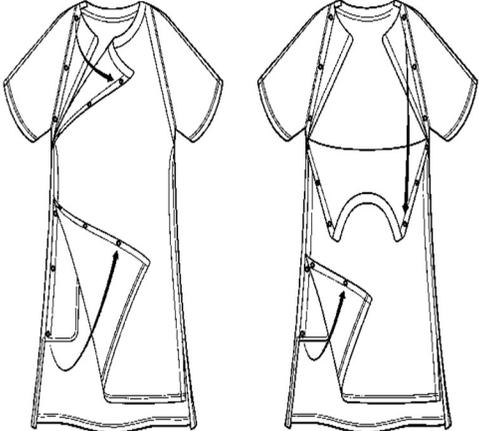
Ergonomic garment designs were conceptualized, emphasizing features like easy-to-handle fasteners, adaptable closures as per requirement of patients. The designs aimed to enhance mobility and reduce the pain associated with dressing and undressing, focusing on require use of buttons, zippers, and other challenging closures.

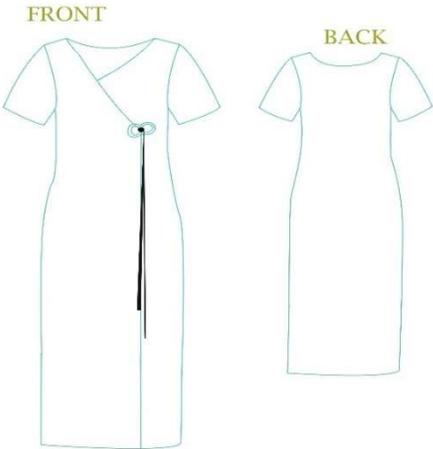
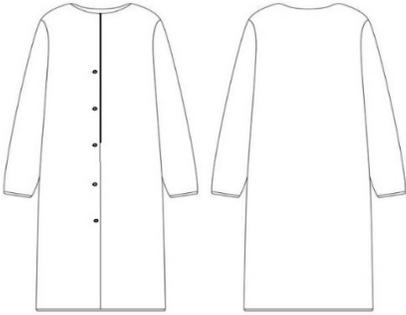
Table 3.3: Conceptual Designs	
Patient A-Knee deformity	
 <p style="text-align: center;">FRONT BACK</p>	<p>Design A1- Wrap around palazzo</p> <p>A loose, adjustable palazzo with a wrap-around design for easy wear.</p>
 <p style="text-align: center;">FRONT BACK</p> <p>Clip Elastic</p> <p>Long Zipper</p>	<p>Design A2- Palazzo with Elastic, long zipper and clip Clouser</p> <p>This design features an elastic waistband for flexibility, a long zipper for easy dressing, and a clip closure for secure fastening.</p>
	<p>Design A3- Palazzo with side snap button, elastic belt</p> <p>Designed for ease, this palazzo features side snap buttons for effortless wear and an elastic belt for a secure yet flexible fit.</p>

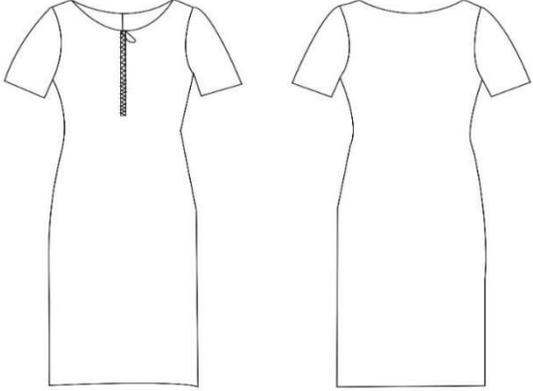
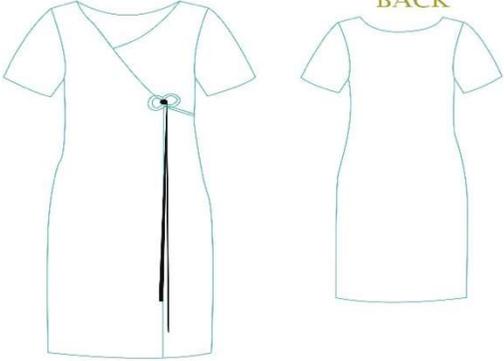
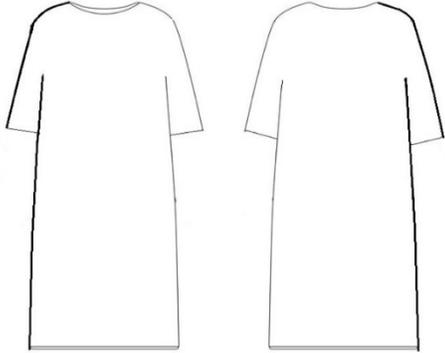
	<p>Design A4- Palazzo with elastic and drawcord</p> <p>This design provides an adjustable fit with an elastic waistband and a drawcord.</p>
	<p>Design A5- straight pant opening with Velcro and elastic.</p> <p>Ensuring a straight-leg design, this pant includes a Velcro opening for easy fastening and an elastic waistband for a comfortable, adjustable fit.</p>
	<p>Design A6- Elastic waist band with a drawcord in waist and bottom hem</p> <p>This pant features an elastic waistband with a drawcord for an adjustable fit and ease of wear. The straight-leg design ensures comfort, while adjustable drawstrings at the hem allow flexibility in movement and styling.</p>

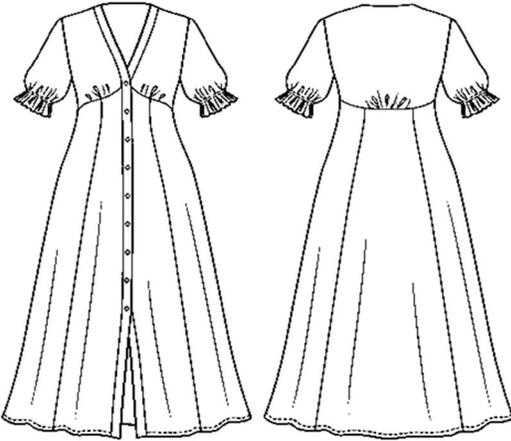
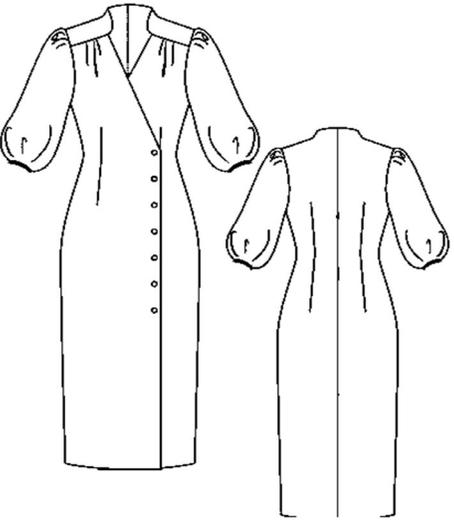
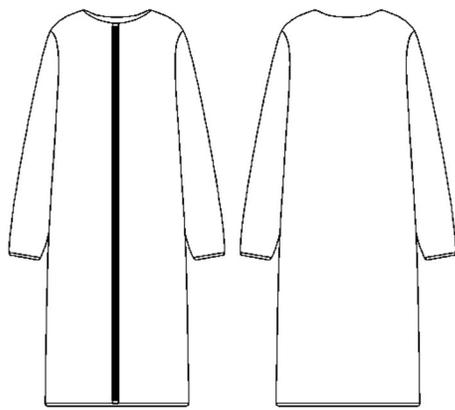
Patient B-Shoulder deformity	
	<p>Design B2- Sholder open and close with tie string- for side opening with invisible zipper</p> <p>This design features a shoulder opening with snap tie string, and side with invisible zipper.</p>
	<p>Design B2- Sholder opening with snap button</p> <p>This design features a shoulder opening with snap buttons, allowing for easy dressing and removal.</p>
	<p>Design B3- Front opening with Velcro, front layered overlap</p> <p>This design features a Velcro front opening for easy wear and removal, with a layered overlap for added coverage, comfort, and a secure fit</p>

	<p>Design B4- Kaftan with tie string</p> <p>A loose-fitting kaftan featuring a tie string for adjustable fit and ease of wear, ensuring comfort and flexibility for the user.</p>
	<p>Design B5- Kaftan with attached belt front Opening</p> <p>This kaftan features a front opening for easy wear and an attached belt for adjustable fit, combining comfort with functional styling.</p>
	<p>Design B6- Top with elastic in shoulder and waist with tie string</p> <p>Top with Elastic at Shoulder and Waist with Tie String: This top feature elastic at the shoulders and waist for a flexible fit, with a tie string for added adjustability.</p>

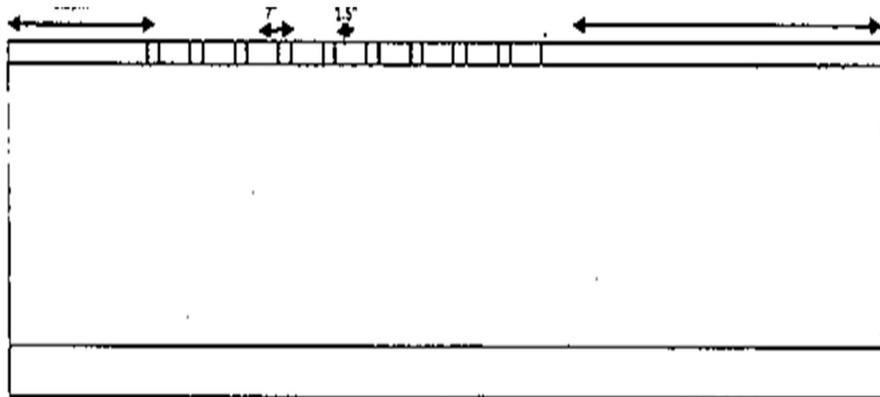
Patient C-RA Bedridden patient	
 <p style="text-align: center;">FRONT</p> <p style="text-align: center;">BACK</p>	<p>Design C1- Front opening top with tie string</p> <p>This design features a front opening secured with tie strings, allowing for easy dressing and removal, ensuring comfort and accessibility for bedridden patients.</p>
	<p>Design C2- Front opening with Velcro</p> <p>This design features a front Velcro closure for quick and effortless dressing, providing ease of use and comfort for bedridden patients and ensuring easy dressing for the caregivers.</p>
	<p>Design C3- Front opening with snap button</p> <p>This design features a front opening with snap buttons for easy fastening, allowing quick dressing and removal while ensuring easy dressing for the caregivers.</p>

 <p>FRONT</p> <p>BACK</p>	<p>Design C4- Front opening with tie string-angarkha type gown</p> <p>This design features a front opening with snap buttons for easy fastening, allowing quick dressing and removal while ensuring easy dressing for the caregivers</p>
 <p>FRONT</p> <p>BACK</p>	<p>Design C5- Front opening with tie string-</p> <p>This design features a front opening with snap buttons for easy fastening, allowing quick dressing and removal while ensuring comfort for caregivers</p>
	<p>Design C6- Front opening with Zipper or snap button</p> <p>This design features a front opening with either a zipper or snap buttons, allowing for quick and effortless dressing while ensuring easy dressing for the caregivers</p>

Patient D-All joints affected with Velcro	
<p style="text-align: center;">FRONT BACK</p> 	<p>Design D1 Front opening with long Zipper and hook</p> <p>This design features a front opening with long invisible zipper and hook. for easy dressing and undressing.</p>
<p style="text-align: center;">FRONT BACK</p> 	<p>Design D2 Front opening with angarkha type knee length kurta with tie string</p> <p>This design features a front opening with tie string. for easy dressing and undressing.</p>
	<p>Design D3 Front open with Velcro simple design</p> <p>This design features a Velcro front opening simple design for easy dressing and undressing.</p>

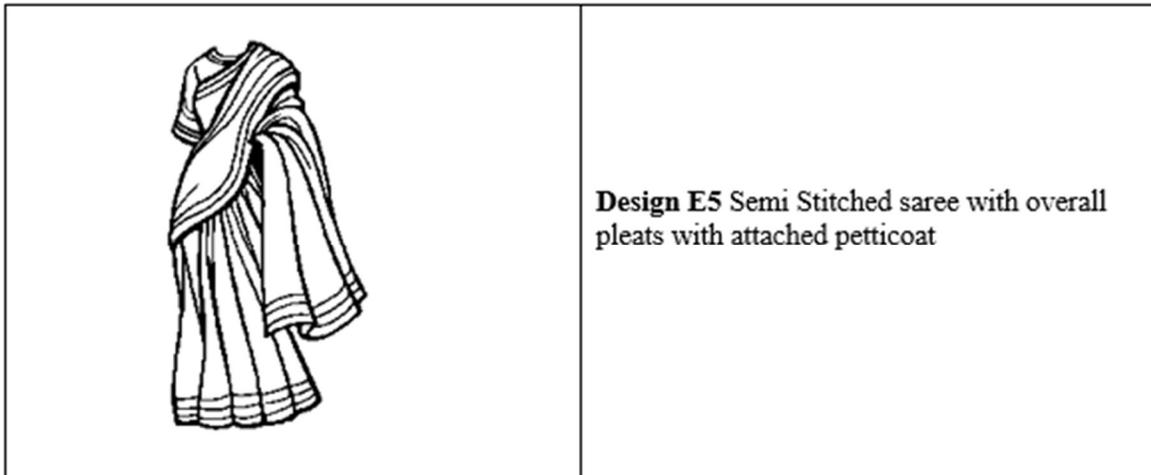
	<p>Design D4 Front open with snap button and elastic in sleeve</p> <p>This design features front open with snap button and elastic for fit adjustability.</p>
	<p>Design D5 Front open with Velcro and show button</p> <p>This design features a Velcro front opening for easy wear, with decorative show buttons for an enhanced appearance while maintaining functionality and comfort.</p>
	<p>Design D6 Front open with Velcro simple design</p> <p>This design features a Velcro front opening simple design for easy dressing and undressing.</p>

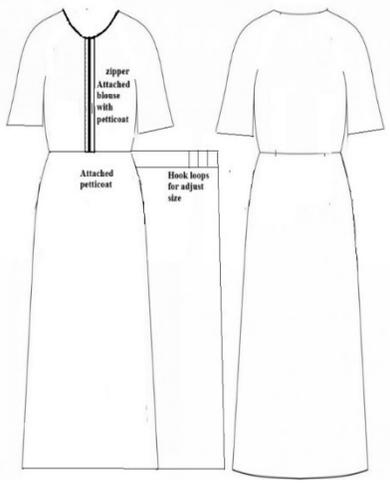
Patient E All joints affected-Design requirement in saree



Design E1 semi stitched saree with adjustable size

This design features a pre-stitched pleated saree with an adjustable waistband (loops and hooks) to fit different sizes. The pallu remains free for customizable draping, ensuring ease of wear while maintaining a traditional saree look.



 <p>zipper Attached blouse with petticoat</p> <p>Attached petticoat</p> <p>Hook loops for adjust size</p>	<p>Design E2 Stitched saree with attached blouse and petticoat</p> <p>This design was created as a fully stitched saree with an attached blouse that had a front zipper opening for easy wear. The petticoat was integrated along with saree included pre-stitched pleats for a drape, while the adjustable waist.</p>
	<p>Design E3 Stitched saree with attached belt and petticoat</p> <p>This design was developed as a pre-stitched saree with an attached petticoat for ease of wear and comfort. A fixed belt was incorporated at the waist to provide a secure fit and stylish look, simplifying the draping process while maintaining the traditional saree appearance..</p>
	<p>Design A3- Palazzo with side snap button, elastic belt</p> <p>Designed for ease, this palazzo features side snap buttons for effortless wear and an elastic belt for a secure yet flexible fit.</p>

3.3.2 Selection of Design

The most feasible and user-friendly design concepts were selected by the researcher and guide. Total of 30 sketches were created, 6 for each deformity (hand deformity, knee deformity, deformity in all joints, bedridden patient). The final 10 designs (2 per each Patient, total 5 patients) were finalized by the RA patients. The chosen designs effectively met user needs, ensuring comfort for patients and ease of use for their caregivers, while also considering aesthetic appeal and cost-effectiveness. These concept sketches were reviewed for practicality.

- i. **Specification sheet development-** The finalized garment designs were documented in a detailed specification sheet outlining critical garment elements. These specifications ensured the garments were tailored for comfort, functionality, and practicality for rheumatoid arthritis patients.

Table 3.4: Specification sheet

Garment Specification sheet			Technical sketch	
Date				
Style				
Hospital				
Description				
			Front	Back
Use				
User				
Environment				
Material & Fabric Selection				
Fabric	Width (in)	Composition	Properties	Colour
Fabric 1			Fabric 1	
Design Features				
Length	Pocket	Fasteners	Waistband	
Garment measurement				
Measurement			Value (in)	
Chest (Bust)				
Waist				
Hip				
Shoulder Width				
Armhole Depth				
Neck Width				
Front Neck Depth				
Back Neck Depth				
Full Length (One-Piece Gown)				
Full Length (Top)				

3.4.4 Material Sourcing

Soft, durable materials were sourced based on their requirement for constructing the ergonomic garments. Special attention was given to selecting fabrics that minimized the risk of skin irritation and pressure sores while providing flexibility for easy dressing and undressing. For this local market including Nava Bazaar, Mangal bazaar and various shops in Fatepura, Baroda prints were visited. Various fabric samples were collected, and the most suitable fabric was selected based on its lightweight, softness, durability, and affordability to meet the requirements of the rheumatoid arthritis patients.

Development of Pattern making in Tukatech software

Table 3.5: Patient A G1 Pieces Description

Code	Description	Material	Quantity	Opposite	Rotation	Piece Image
Cut - 1	Wrap Overlap Palazzo	BASE	1	Up/Down	2-Way	
Cut - 2	Belt	BASE	1	None	1-Way	
Cut - 1	Wrap Overlap Palazzo	BASE	1	Up/Down	2-Way	

The pattern drafting process was carried out using **Tukatech software**, a leading CAD system for precision garment design. This software allowed for accurate measurements, efficient modifications, and seamless grading to achieve the desired fit. A total of 10 ergonomic designs for people with rheumatoid arthritis were created. The digital pattern-making process ensured consistency, reduced fabric wastage, and improved production efficiency. The following section details the step-by-step breakdown of all the 10 designs

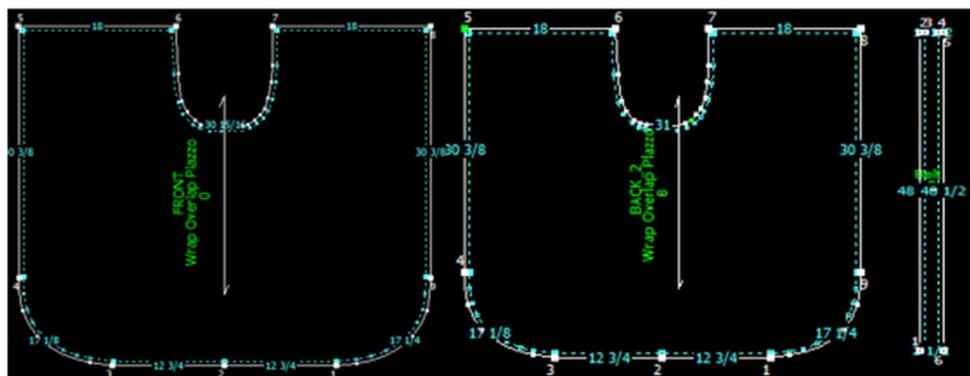


Plate3.1: Patient A G1 Drafting Instructions

Table 3.6: Patient A G1 Drafting Method for Wrap Overlap Palazzo

Step	Drafting Instructions
1. Square Base Lines	Mark Point 0 and square lines from 0-2 and 0-5 on a four-layer fold.
2. Waist Width	1-0 = One-fourth waist + 1.5 cm ease.
3. Full Length	2-0 = 39.5" + 1.5 cm ease.
4. Hip Measurement	8-1 = One-fourth hip + 4 cm ease.
5. Crotch Depth	3-0 = One-twelfth hip + 0.5 cm ease (Front) / 12-0 = 2 cm ease (Back).
6. Crotch Shaping	Curve from 4-3 (Front) and 12-3 (Back).
7. Side Seam	5-0 = One-fourth hip - 1 cm ease, square down to 6.
8. Leg Opening	Bottom width = 17.5", shape curve from 7-9-8.
9. Waistband / Tie	Length = (Waist + Overlap) × 2, Width = 6-8 cm.
10. Seam Allowance	1 cm for seams, 2 cm for the hem.

Table 3.7: Patient A G2 Pieces Description

	Piece Name	Code	Description	Material	Quantity	Opposite	Rotation	Piece Image
1	FRONT	Cut - 2	Palazzo with elastic	Base	2	Up/Down	2-Way	
2	BACK	Cut - 2	Palazzo with elastic	Base	2	Up/Down	2-Way	
3	Belt	Cut-1	Palazzo with elastic	Base	1	None	1-Way	

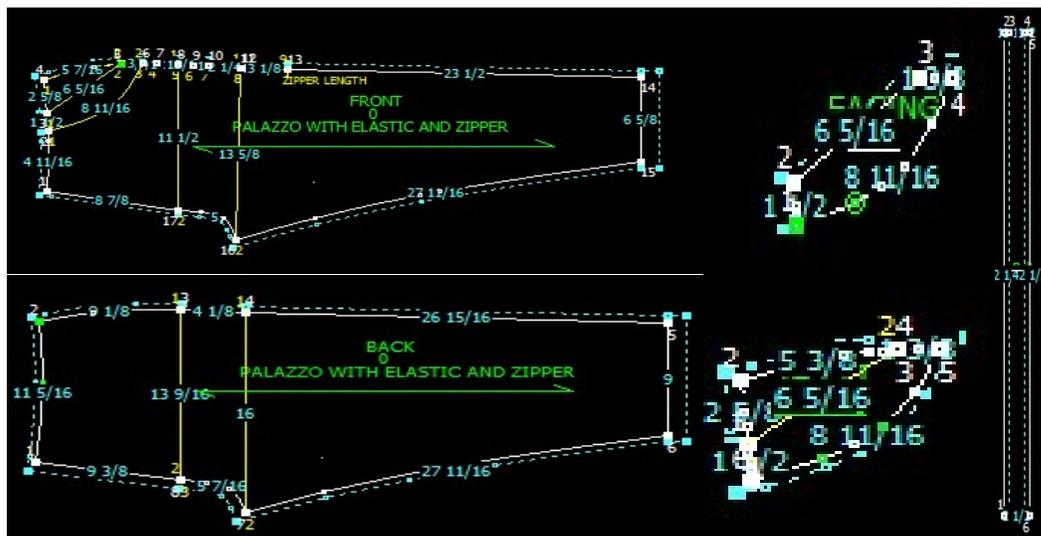


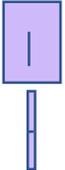
Plate 3.2: Patient A G2 Drafting Instructions

Patient A G2 Drafting Method for elastic with side invisible long zipper close with clip

Table 3.8: Patient A G2 – Drafting instructions

Step	Drafting Instructions
1	Square Base Lines: Mark Point 0 and square down for full length on a four-layer fabric fold.
2	Waist Width: 1-0 = One-fourth waist + 1.5 cm ease for comfort.
3	Full Length: 2-0 = 39.5” + 1.5 cm ease.
4	Hip Measurement: 8-1 = One-fourth hip + 4 cm ease for palazzo fit.
5	Crotch Depth: 3-0 = One-twelfth hip + 0.5 cm ease (Front) / 12-0 = 2 cm ease (Back).
6	Crotch Shaping: Draw a smooth curve from 4-3 (Front) and 12-3 (Back).
7	Side Seam: 5-0 = One-fourth hip - 1 cm ease, then square down to 6 for side seam alignment.
8	Leg Opening: Bottom width = 17.5”, shape curve from 7-9-8.
9	Elastic Waistband: Mark waistband width (6-8 cm) and attach elastic to the back waist for adjustability.
10	Invisible Zipper Placement: Insert a long invisible zipper along the left side seam for a seamless finish.
11	Clip Closure: Add a hook-and-eye or clip at the waistband above the zipper for secure closure.
12	Seam Allowance: Add 1 cm seam allowance for sewing, 2 cm for the hem.

Table 3.9: Patient B G1 Pieces Description

	Piece Name	Code	Description	Material	Quantity	Opposite	Rotation	Piece Image
1	Front and Back	Cut - 1	Kaftan one piece	BASE	1	None	2-Way	
2	BELT	Cut - 1	Kaftan one piece	BASE	1	None	2-Way	

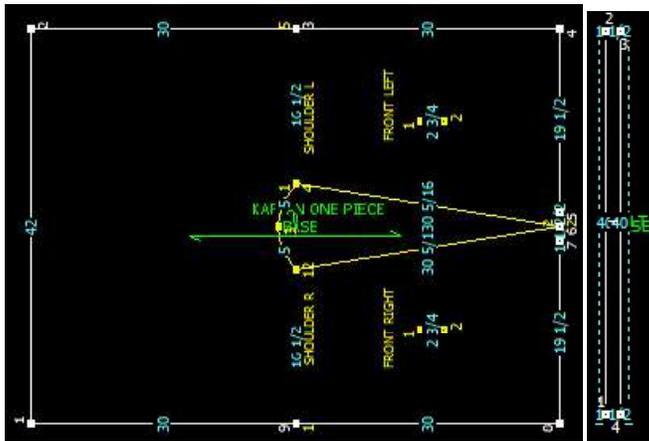


Plate 3.3: B G1 Drafting pattern

Table 3.10: Patient B G2 Drafting Instructions

Step	Drafting Instructions
1	Square Base Lines: Mark Point 0 and draw the kaftan's full length and width on a single-piece fabric.
2	Full Length & Width: Length = 42", Width = 60" (or as per desired fit).
3	Shoulder Marking: Shoulder width = 16.5" (8.25" on each side from center). Square down for the front opening.
4	Front Opening: Mark the center front and cut a vertical slit for the opening.
5	Neckline: Width = 6" (front depth 8-10", back depth 1-2"). Shape as desired.
6	Sleeve Drop: Extend 10-12" from the shoulder point for a draped sleeve effect.
7	Side Seam: From the sleeve drop, mark 10-12" down before tapering into the body width.
8	Attached Belt: Mark belt placement at the waist (length = Waist + Tie allowance, width = 3-4"). Attach at side seams.
9	Hemline Finishing: Add 1" for hem allowance and finish edges neatly.
10	Seam Allowance: 1 cm for seams, 2 cm for hems, and reinforce the front opening with facing or bias tape .

Table 3.11: Patient B G2 Pieces description

	Piece Name	Code	Description	Material	Quantity	Rotation	Piece Image
1	SLEEVE	Cut -2	Front opening with Velcro, front layered overlap	BASE	1	2-Way	
2	BACK	Cut -2	Front opening with Velcro, front layered overlap	BASE	1	2-Way	
3	BACK_1	Cut -1	Front opening with Velcro, front layered overlap	BASE	1	2-Way	
4	FRONT_3	Cut -1	Front opening with Velcro, front layered overlap	BASE	1	2-Way	
5	BACK_4	Cut -1	Front opening with Velcro, front layered overlap	BASE	1	2-Way	
6	PLACKET PATTI	Cut -1	Front opening with Velcro, front layered overlap	BASE	1	2-Way	

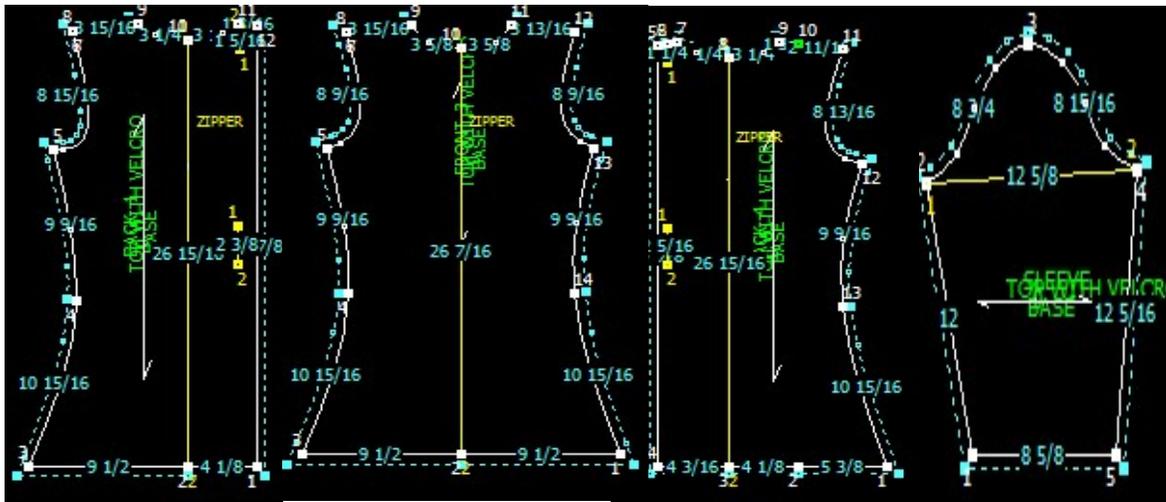


Plate 3.4: B G2 Drafting pattern

Drafting Method for Front Opening Layered Overlap Kurti with Velcro

Table 3.12: Patient C G1 Pieces Description

Square Base Lines – Draw the shoulder, bust, waist, and hip lines on both front and back panels.
Front Panel Drafting –
Draft two front panels (left and right).
Extend one panel (usually the right side) by 1.5”–2” for the overlap allowance.
Back Panel – Draft the back as a single piece or with a center seam, as required.
Neckline – Shape the neckline according to the design (round, V-neck, or mandarin collar).
Shoulder & Armhole – Draft as per body measurements with ease for comfort.
Side Seam & Waist Shaping – Shape the side seams slightly to define the waist while keeping ease for movement.
Front Opening & Overlap –
Extend the front overlap layer slightly and shape it smoothly for a neat layered look.
Ensure the underlap panel aligns correctly.
Velcro Placement –
Mark Velcro positions along the extended front panel and underlap panel for secure closure.
Use small Velcro patches at intervals for easy fastening and removal.
Sleeves – Draft sleeves according to the armhole shape (can be standard, ¾, or full-length).
Seam Allowance – Add 1 cm for sewing and 2-3 cm for hems . For the front opening, leave 2 cm allowance for neat finishing and Velcro attachment.

Table 3.13: Patient C G1 Pieces Description

	Piece Name	Code	Description	Material	Quantity	Rotation	Image
1	SLEEVE	Cut - 2	angarkha type gown	BASE	1	2-Way	
2	FRONT_3	Cut - 1	angarkha type gown	SELF	1	2-Way	
3	BACK	Cut - 1	angarkha type gown	BASE	1	2-Way	
4	FRONT_5	Cut - 1	angarkha type gown	SELF	1	2-Way	
5	FRONT	Cut - 1	angarkha type gown	BASE	1	2-Way	
6	FRONT_1	Cut - 1	angarkha type gown	BASE	1	2-Way	
7	PLACKET PATTI	Cut - 1	angarkha type gown	BASE	1	2-Way	

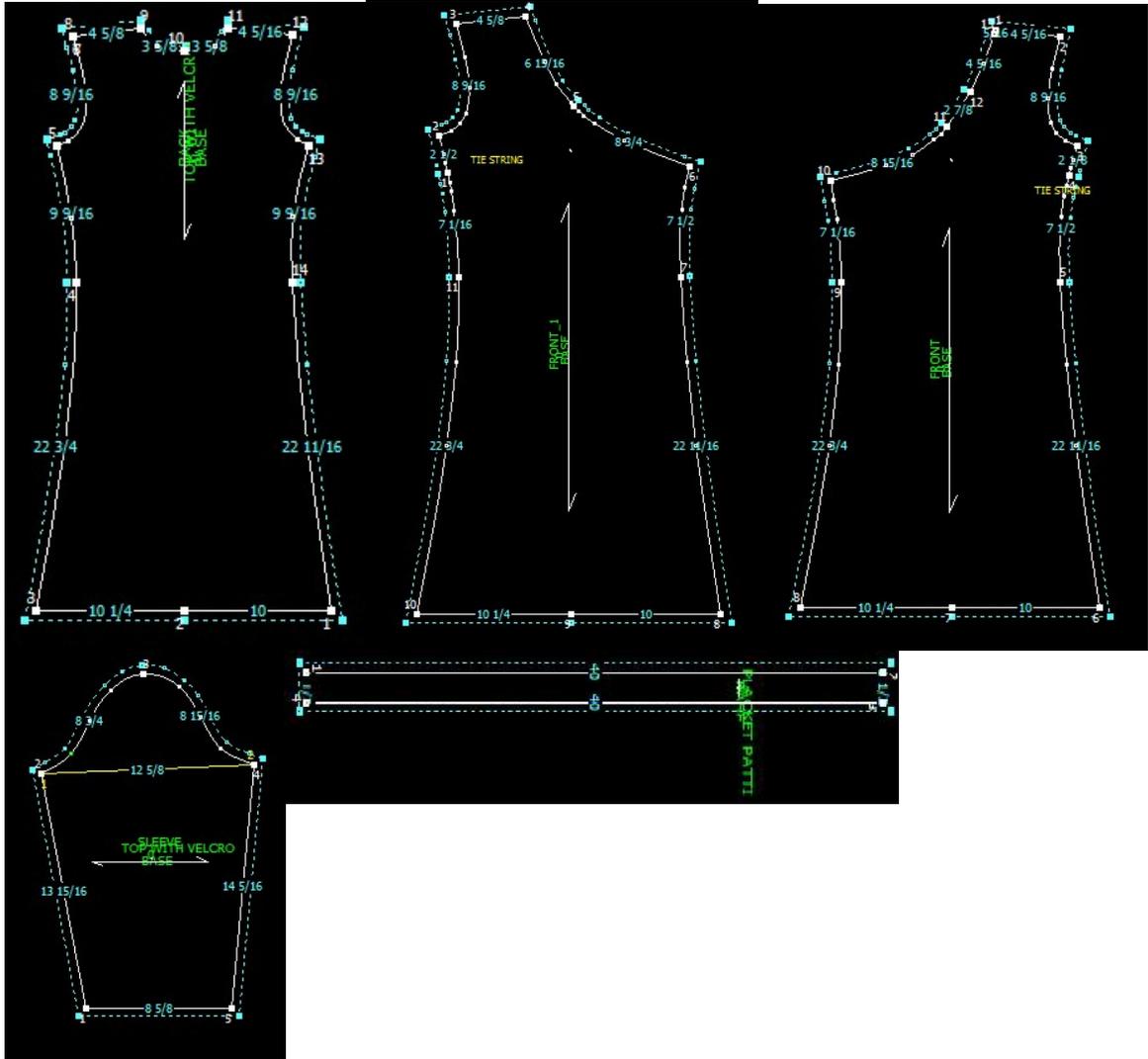


Plate 3.5: C G1 Drafting pattern

Table 3.14: Patient C G1 Drafting Instructions

1. Square Base Lines – Draw shoulder, bust, waist, and full-length lines for front and back panels.
2. Front Panel Drafting –
o Draft two overlapping front panels (left and right) in Angarkha style .
o Extend one panel by 2”–3” for a smooth wrap effect.
3. Back Panel – Draft as a single piece or with a center seam for fitting.
4. Neckline – Shape the neckline according to the design (V-neck or deep curved).
5. Shoulder & Armhole – Draft with ease for comfort.
6. Side Seam & Waist Shaping – Ensure slight curves for waist definition.
7. Front Opening & Overlap –
o Shape the overlapping layer neatly.
o Ensure the underlap panel aligns correctly.
8. Tie String Placement – Attach tie strings at the waist inside and outside for a secure wrap.
9. Sleeves – Draft sleeves as per the armhole (short, ¾, or full-length).
10. Seam Allowance – Add 1 cm for sewing, 2 cm for hems , and extra ease for wrapping.

Table 3.15: Patient C G2 Pieces Description

	Piece Name	Code	Description	Material	Quantity	Rotation	Piece Image
1	SLEEVE	Cut - 2	Front Zipper Kurti	BASE	1	2-Way	
2	FRONT_3	Cut - 1	Front Zipper Kurti	SELF	1	2-Way	
3	BACK	Cut - 1	Front Zipper Kurti	BASE	1	2-Way	
4	FRONT_5	Cut - 1	Front Zipper Kurti	SELF	1	2-Way	
5	LACKET PATT	Cut - 1	Front Zipper Kurti	BASE	1	2-Way	
6	BACK_1	Cut - 1	Front Zipper Kurti	BASE	1	2-Way	

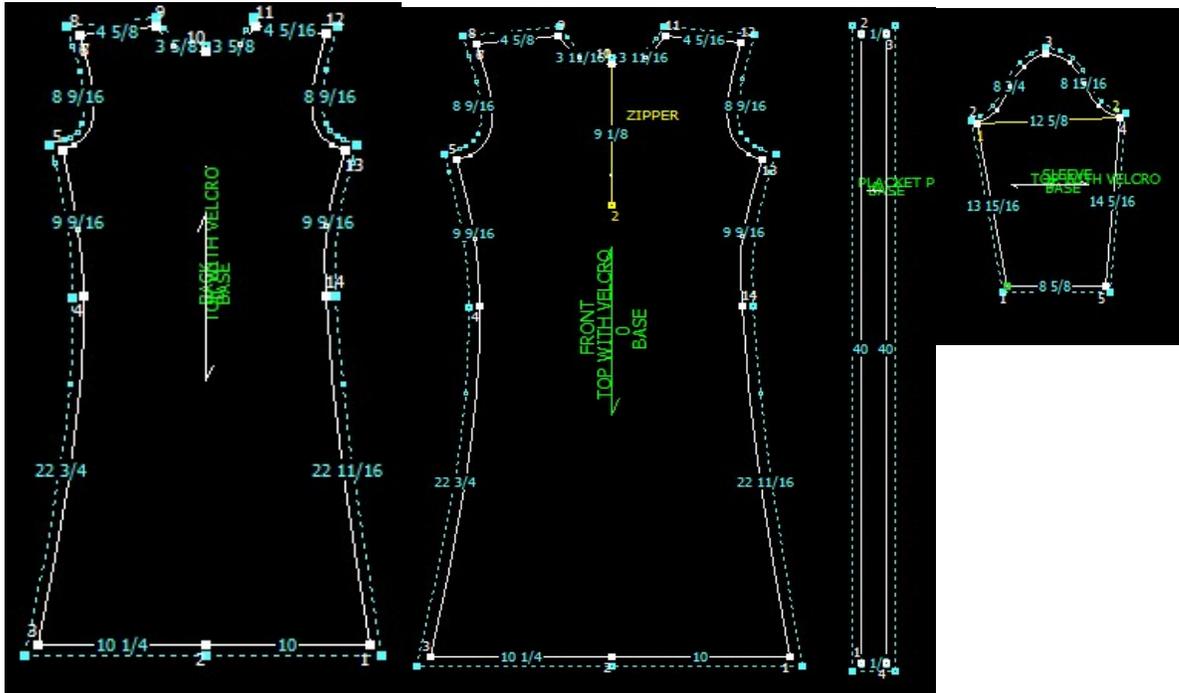


Plate 3.6: C G2 Drafting pattern

Table 3.16: Design C G2 – Drafting Instructions

1. Square Base Lines – Draw full-length garment structure with shoulder, bust, waist, and hip lines.
2. Front Opening – Extend center front to accommodate a full-length or partial zipper .
3. Back Panel – Draft as a single piece or with a center seam.
4. Neckline – Shape according to design (round, V-neck, or high collar).
5. Shoulder & Armhole – Draft as per measurements with ease.
6. Side Seam & Waist Shaping – Light shaping for a defined fit.
7. Zipper Placement –
Mark zipper placement along the front opening.
Attach a hook at the top for extra security.
8. Sleeves – Draft based on armhole measurements (short, $\frac{3}{4}$, or full-length).
9. Seam Allowance – Add 1 cm for seams, 2-3 cm for zipper finishing.

Table 3.17: Patient D G1 Pieces Description

Piece Name	Code	Description	Material	Rotation	Piece Image	
1	SLEEVE	Cut - 2	KURTA WITH BUTTON	BASE	2-Way	
2	FRONT	Cut - 1	KURTA WITH BUTTON	BASE	2-Way	
3	PLACKET PATTI	Cut - 1	KURTA WITH BUTTON	BASE	2-Way	
4	BACK	Cut - 1	KURTA WITH BUTTON	BASE	2-Way	

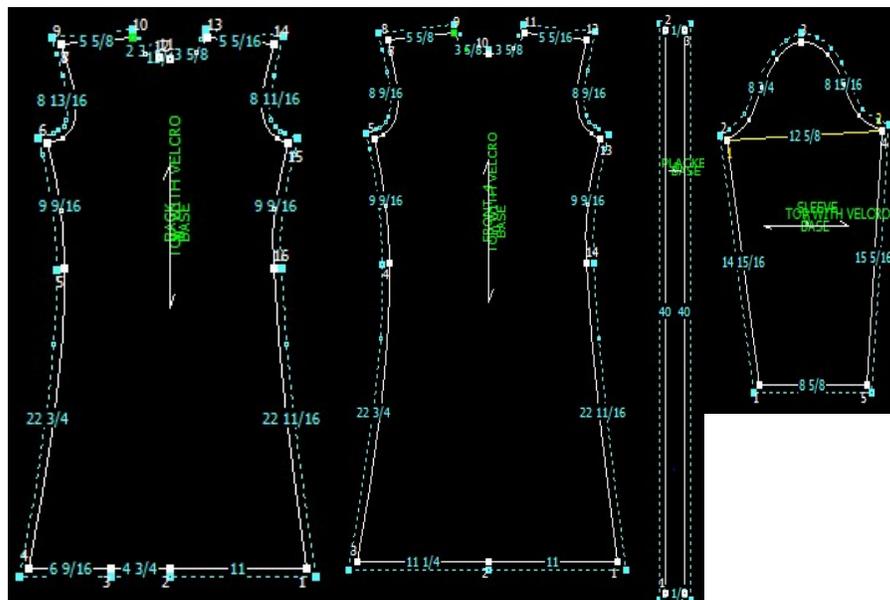


Plate 3.7: D G1 Drafting pattern

Table 3.18: D G1 – Drafting Instructions

Square Base Lines – Draw shoulder, bust, waist, and hip lines for front and back panels.
Front Panel Drafting –
<ul style="list-style-type: none"> • Draft two front panels (left and right). • Extend one panel by 1.5”–2” for Velcro overlap.
Back Panel – Draft as a single piece or with a center seam.
Neckline – Shape the neckline as per design (round, boat, or mandarin collar).
Shoulder & Armhole – Draft for comfortable movement.
Side Seam & Waist Shaping – Slight shaping to enhance fit while keeping ease.
Front Opening & Overlap –
<ul style="list-style-type: none"> • Extend the overlap slightly for a neat finish. • Ensure the underlap panel aligns correctly.
Velcro Placement –
<ul style="list-style-type: none"> • Mark positions for small Velcro patches at intervals. • Secure them for easy fastening and removal.
Sleeves – Draft as per preference (standard, ¾, or full-length).
Seam Allowance – Add 1 cm for sewing, 2-3 cm for hems, and 2 cm for Velcro finishing .

Table 3.19: G2 – Drafting Instructions

	Piece Name	Code	Description	Material	Quantity	Piece Image
1	SLEEVE	Cut - 2	Overlapped Front open tie string kurti	BASE	1	
2	FRONT_3	Cut - 1	Overlapped Front open tie string kurti	Base	1	
3	FRONT_5	Cut - 1	Overlapped Front open tie string kurti	SELF	1	
4	FRONT	Cut - 1	Overlapped Front open tie string kurti	BASE	1	
5	FRONT_1	Cut - 1	Overlapped Front open tie string kurti	BASE	1	
6	PLACKET PATTI	Cut - 1	Overlapped Front open tie string kurti	BASE	1	

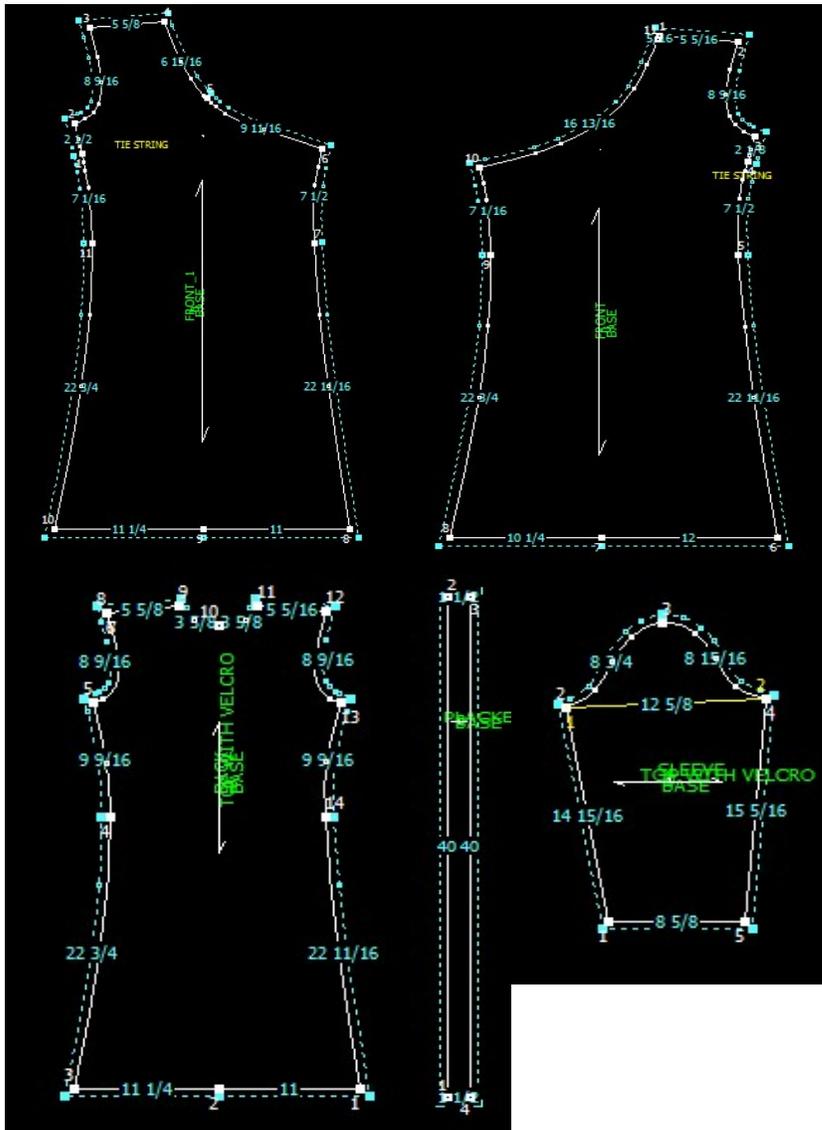


Plate 3.8: D G1 Drafting pattern

Table 3.20: Design D G2 – Drafting Instructions

Square Base Lines – Draw shoulder, bust, waist, and full-length lines for front and back panels.
Front Panel Drafting –
Draft two overlapping front panels (left and right) in Angarkha style .
Extend one panel by 2”–3” for a smooth wrap effect.
Back Panel – Draft as a single piece or with a center seam for fitting.
Neckline – Shape the neckline according to the design (V-neck or deep curved).
Shoulder & Armhole – Draft with ease for comfort.
Side Seam & Waist Shaping – Ensure slight curves for waist definition.
Front Opening & Overlap –
Shape the overlapping layer neatly.
Ensure the underlap panel aligns correctly.
Tie String Placement – Attach tie strings at the waist inside and outside for a secure wrap.
Sleeves – Draft sleeves as per the armhole (short, ¾, or full-length).
Seam Allowance – Add 1 cm for sewing, 2 cm for hems , and extra ease for wrapping.

Table 3.21: E G1 Pieces Description

	Piece Name	Code	Description	Quantity	Rotation	Piece Image
1	SAREE 1	Cut - 1	Semi stitched saree	1	2-Way	

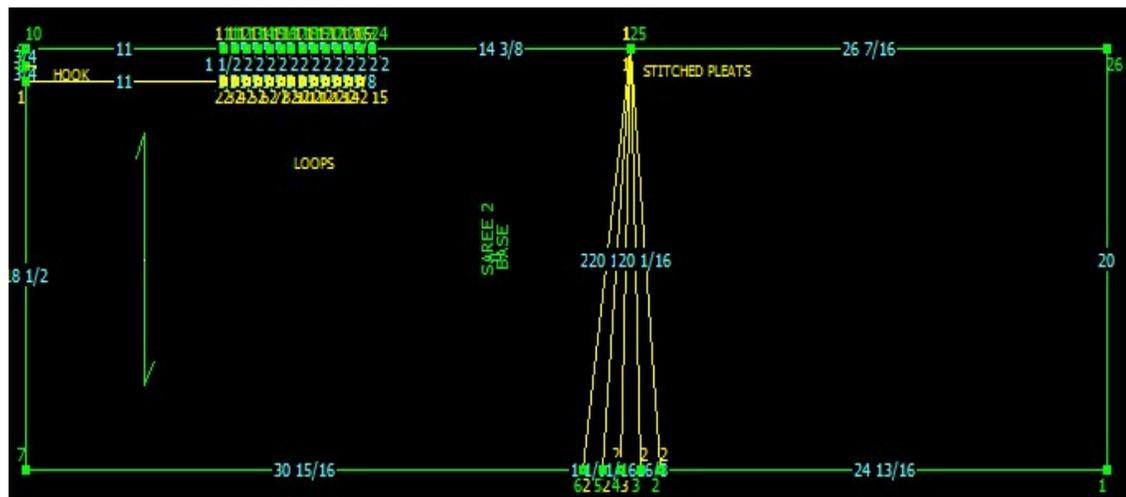


Plate 3.9: E G1 Drafting pattern

Table 3.22: E G1 Drafting Instructions

1. Base Fabric Preparation – Use a 6-yard saree fabric and pre-pleat it at the waist width.
2. Adjustable Waistband – Attach an elastic waistband or drawstring for flexible sizing.
3. Pre-Stitched Pleats – Secure pleats at the center front while keeping some sections open for size adjustments.
4. Pallu Drape – Ensure pallu is free for styling over the shoulder.
5. Seam & Finishing – Add overlock stitching on all edges for durability.

Table 3.23: E G2 Pieces Description

	Piece Name	Code	Description	Material	Qty	Rotation	Piece Image
1	BACK	Cut - 1	Semi stitched saree	BASE	1	2-Way	
2	FRONT_1	Cut - 1	Semi stitched saree	BASE	1	2-Way	
3	FRONT	Cut-1	Semi stitched saree	BASE	1	2-Way	
4	PETTI COAT	Cut - 2	Semi stitched saree	BASE	1	2-Way	
5	FRONT_2	-	Semi stitched saree	SELF	1	2-Way	
6	SAREE 2	Cut - 1	Semi stitched saree	BASE	1	2-Way	

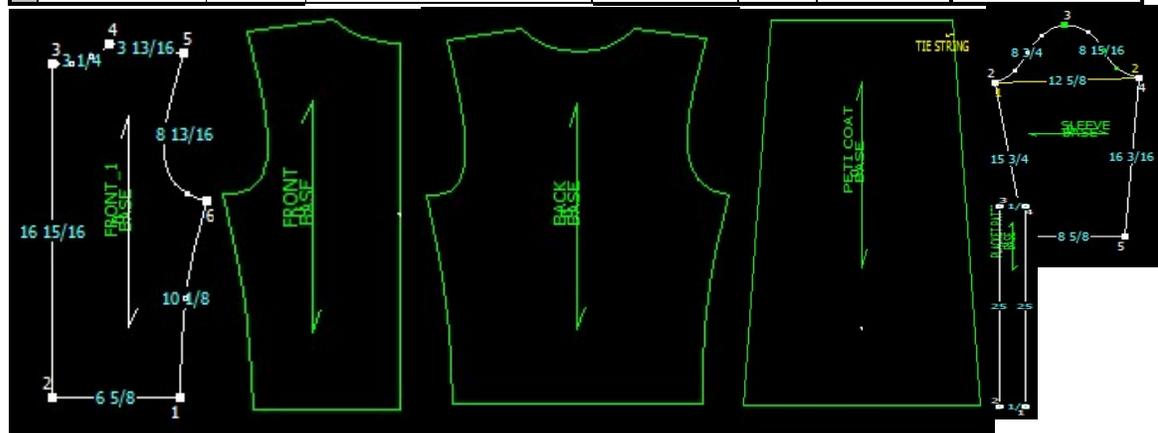


Plate 3.10: E G2 Drafting pattern

Open TUKA cad, create a new pattern, set fabric width (44-46 inches), draw a rectangle (6 yards × fabric width), mark 1-1.5 meters for pleats, add waistband for elastic or hook

attachment, ensure pallu remains free, insert notches for pleats, add seam allowances, and export in DXF format.

Blouse: Create bodice block with front and back panels, mark bust, waist, darts, neckline, and armhole, draft separate sleeve pattern, add seam allowances, finalize, and export as DXF.

Petticoat: Draw a trapezoid shape with waist, hip, flare, and length, divide into 6-8 panels, add a waistband with drawstring or elastic casing, include seam and hemming allowances, finalize, and export in DXF format.

Garment Stitching and Assembly

The garments were stitched by a professional tailor using standard industry techniques to ensure durability and a high-quality finish. Special care was taken with seam finishes, closures, and functional features like best fitting access and adjustable waistbands for better comfort and usability. The tailor was chosen after considering several options based on delivery time and cost.

3.4.6 Construction of Prototype

The construction of ergonomic garments was carried out based on the finalized designs and carefully sourced materials. This phase focused on translating design concepts into functional prototypes, ensuring that the garments met the required standards of comfort, mobility, and ease of use for RA patients and their caregivers. ensuring that each garment incorporated the requirement essential for RA patients.

3.4.7 Selection of Tailors and Artisans

Local tailors with expertise in stitching functional garments and ergonomic clothing were identified through privileged observer information and snowball technique, for the prototype development. Their experience in working with functional clothing was ensured to achieve precision in construction. The tailors were provided with detailed specification sheets, patterns, and sewing guidelines to maintain consistency in design execution and to ensure compliance with the design brief and usability requirements while developing the prototypes.

Table 3.24: Bill of Material

Cost sheet			
Style			
Fabric consumption and cost per garment			
Patient A	Garment 1 - Khadi Cotton (₹90/m)	Garment 2 - Linen Cotton (₹70/m)	Total fabric
Total Cost (₹)			
Fasteners and Trimmings cost			
Item	Quantity	Total Cost (₹)	
Button			
Stitching Cost			
Component	Buttonhole	Stitching labour	Total Cost (₹)
Stitching Cost per Top			
Total Fabric Cost	Fasteners & Trimmings Cost	Stitching Cost	Grand Total (₹)
Grand Total Cost for Top			

3.5 User Testing

The final phase involved testing the prototypes with actual users to ensure they addressed the identified needs of RA patients and caregivers. This phase assessed the comfort, mobility and ease of use of the garments in real world.

3.5.1 Selection of Participant

Five RA patients form different deformities were selected for wear trials. Selection of participants focused on individuals diagnosed with rheumatoid arthritis (RA) of the disease to ensure they meeting inclusion criteria. The Selection of Participant aimed to catered different pain points covered of RA patients. Feedback form individuals experiencing different types of RA conditions.

3.5.2 Preparation of Evaluation Metrics

Comfort in clothing, for RA patients, ease with which individuals with rheumatoid arthritis can easy dressing and undressing and adjust their clothing without physical strain or discomfort. ensuring ease of dressing for RA patients and their caregivers.

Evaluation metrics were created to assess various aspects of the ergonomic garments, including,

Patient comfort (fit, Skin friendliness), ease of dressing (RA patients and their caregivers), mobility and Overall satisfaction & Cost and affordability.

3.5.3 Wear Trial of Prototype Garments

Participants wore the ergonomic garment during their daily routines over a period of 10 to 12 hours, allowing for real-world evaluation of their functionality. The wear trials followed a (Table below) to ensure all garments were tested by RA patients. This structured testing ensured fulfilment wear and evaluate ten garment designs (each patient two garments).

Details about the wear trial of prototypes to patients.

Table 3.25: Wear Trial of Prototypes

Patient: A	
Day 1	Patient 1-Garment 1
Day 2	Patient 1-Garment 2
Patient: B	
Day 1	Patient 1-Garment 1
Day 2	Patient 1-Garment 2

Table 3.26: Wear Trial of Prototypes

Patient: C	
Day 3	Patient 1-Garment 1
Day 4	Patient 1-Garment 2
Patient: D	
Day 3	Patient 1-Garment 1
Day 4	Patient 1-Garment 2

Table 3.27: Wear Trial of Prototypes

Patient: E	
Day 5	Patient 1-Garment 1
Day 6	Patient 1-Garment 2

3.5.4 Findings of Data

Data from the wear trials were analyzed to determine the effectiveness of the prototypes in meeting the needs of rheumatoid arthritis patients. Several methods were employed to gather comprehensive data: Feedback from patients and caregivers was collected through evaluation form, direct observations, and interviews during and after the wear trials. The focus areas for feedback included:

- Comfort and Fit: Did the garment feel comfortable for day to day living?
- Ease of Use: Was dressing and undressing simple for both patients and caregivers?
- Fabric Performance: Did the material fulfil your requirements?
- Functionality: Were the ergonomic features effective in aiding rheumatoid arthritis patient care?

The feedback collection process involved qualitative methods to assess the effectiveness of the ergonomic garments. Qualitative feedback was obtained through interviews with rheumatoid arthritis patients, their caregivers providing insights into their experiences and challenges with the ergonomic garments. Additionally, structured observation checklists were used to document real-time difficulties related to dressing, mobility, and personal caregiver assistance.

3.5.5 Analysis of Data

The collected feedback was systematically analysed to identify strengths and areas for improvement in the garment design. Recurring issues and suggestions were noted, providing valuable insights for refining the final ergonomic garment prototypes. The collected feedback was systematically analysed to evaluate the performance of ergonomic garments in comparison to traditional rheumatoid arthritis patient's daily wear. A comparative analysis was conducted to identify key strengths, such as improved mobility and patient comfort, as well as areas needing refinement. Patterns in qualitative responses were examined to highlight recurring challenges, while statistical data from the Likert scale ratings provided measurable insights into user satisfaction.

3.5.6 Reporting and Recommendation

The study's findings were compiled into a comprehensive research report, serving as a valuable resource for Rheumatoid Arthritis patients, designers, and manufacturers seeking to enhance rheumatoid arthritis patient care through ergonomic garment design for individuals with rheumatoid arthritis (RA). The report detailed the design, evaluation, and effectiveness of ergonomic clothing tailored to the needs of rheumatoid arthritis patients, incorporating insights from both qualitative and quantitative assessments. It emphasized key factors such as comfort, ease of dressing for patients and caregivers. Based on these findings, specific recommendations were provided to optimize garment design for individuals with rheumatoid arthritis.

RESULT AND DISCUSSION

Chapter IV

RESULTS AND DISCUSSION

This study aims to develop an ergonomic garment design for people with rheumatoid arthritis. This ergonomic garment solutions that, promoted ease of use, enhanced mobility, and reduced discomfort. This research sought to close the gaps in the current situation of RA patients in dressing and undressing, ultimately enhancing the quality of life for such RA patients.

The study has been carried out in three phases. Through a methodical procedure the first phase included needs assessment, the second phase included prototype creation, and the third phase included user testing, the applied research was intended to be useful for the rheumatoid arthritis patients. Result has been presented under followings heads:

4.1. Need gap assessment of rheumatoid arthritis patients

- 4.1.1. Demographic details of patients and caregivers.
- 4.1.2. Existing environment and clothing of the patient
- 4.1.3. Key insights from data analysis regarding patient needs
- 4.1.4. Findings of market survey of existing adaptive garment

4.2. Design and development of prototypes

- 4.2.1. Create user profile and design brief
- 4.2.2. Final Design selection
- 4.2.3. Fabric selection
- 4.2.4. Preparation of the specification sheet
- 4.2.5. Prototype construction
- 4.2.6. Bill of Materials

4.3. User Testing

- 4.3.1. Prototype distribution with 5 RA patients as per deformity, shoulder deformity, knee deformity, overall deformity and bedridden patients
- 4.3.2. Wear trial with 5 RA patients-2 days
- 4.3.3. Evaluation parameters- comfort, mobility, ease of use, user satisfaction through evaluation form and observation
- 4.4.4. Analysis of the data.
- 4.4.5 Reporting and recommendation

4.1. Need gap assessment

The key issue addressed was the challenges RA individuals face in their clothing due to joint pain, and stiffness. The goal was to identify the unmet needs of people with RA in terms of ease of use, mobility, and reduced discomfort caused by their garments. This research identified the specific needs and challenges faced by people with rheumatoid arthritis in relation to their clothing. It involved collecting both primary and secondary data to comprehensively define the problem and explore potential design solutions.

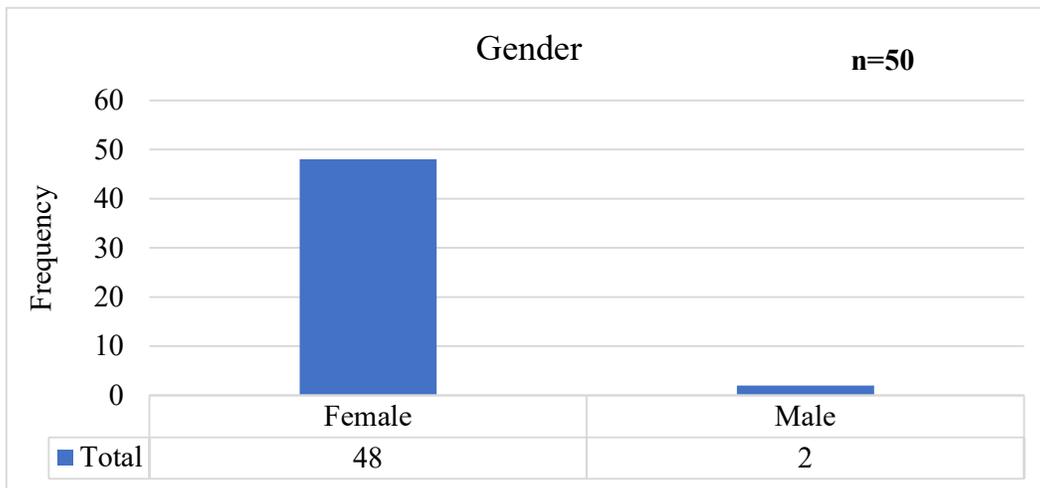
4.1.1. Demographic details of patients and caregivers

Table 4.1: Demographic details of patients and caregivers

Frequency (n=50)	Percentage (%)		
Questions	Response	<i>f</i>	%
Gender	Female	48	96
	Male	2	4
Duration of RA:	10 to 15 Years	34	68
	16 to 23 Years	16	32
Severity of RA	Moderate	6	12
	Severe	44	88
Difficulty in Dressing	Extremely	1	2
	Moderate	16	32
	Severe	17	34
	Slightly difficult	1	2
	Very difficult	15	30
Discomfort Due to Swelling	Extremely	1	2
	Moderate	35	70
	Slightly	1	2
	Very much	13	26
Face challenges with fasteners	Always	1	2
	Never	5	10
	Often	10	20
	sometimes	34	68
Pain While Dressing	Extremely	4	8
	Moderate	2	4
	Slightly	1	2
	very much	43	86

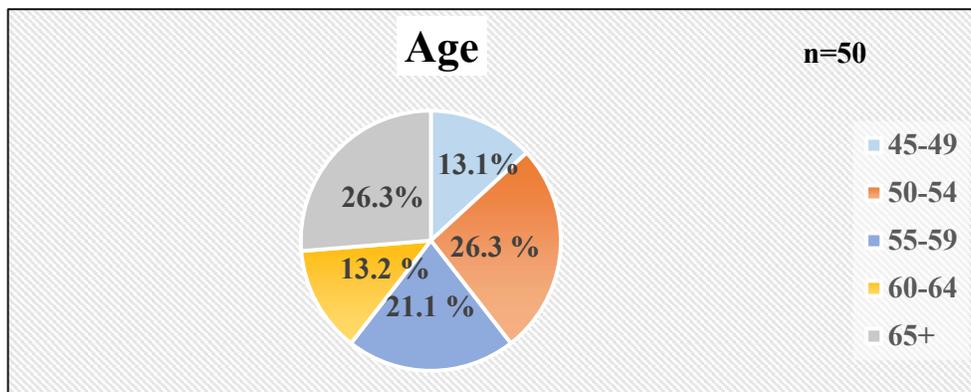
Frequency (n=50)	Percentage (%)		
Questions	Response	<i>f</i>	Questions
Difficult to handle fabric	Always	6	12
	Often	8	16
	Rarely	29	58
	Sometimes	7	14
Pain with Tight/Restrictive Clothing	Extremely	16	32
	Moderate	29	58
	Slightly	1	2
	Very much	4	8
Satisfaction with Current Clothing	Dissatisfied	36	72
	Neutral	9	18
	Very Dissatisfied	5	10
	Neutral	36	72
Existing Clothing Meets Needs	No	47	94
	Partially	2	4
	Yes	1	2
Upper body dressing challenges	Raising Arms above the head	45	90
	Pulling tops over the head	42	84
	Tight Fitting armholes/Sleeves	47	94
	Buttoning shirts	30	60
	Lower Body Dressing Challenges	Fastening pants (zippers/ buttons) Tight Waistbands,	40
Pulling pants/skirts up or down		49	98
Tight Waistbands		45	90

Frequency (n=50)	Percentage (%)		
Questions	Response	<i>F</i>	Questions
Uncomfortable Fabrics/Designs	Stiff fabrics (Denim, thick cotton), Rough textures, Tight fitting designs, Heavy or layered fabrics	44	88
	Stiff fabrics (Denim, thick cotton), Tight fitting designs, Heavy or layered fabrics	1	2
	Stiff fabrics, Tight fitting designs	5	10
Seasonal Clothing Discomfort	Summer, Winter, Monsoon	13	26
	Winter	8	16
	Winter, Monsoon	28	56
	Winter, Summer, Monsoon	1	2
Count of Difficult Traditional Clothing	Salwar kameez, lehenga	5	10
	Sarees	36	72
	Sarees, Kurtas	7	14
	Sarees, Salwar kameez, Kurta	1	2
	Saree	1	2
Need for Custom Garments	No	6	12
	Yes	44	88
Count of Preferred Comfortable Fabrics	Cotton	39	78
	Cotton, Synthetic blends	1	2
	Cotton, knits, Synthetic blends	3	6
	Cotton, Synthetic blends	5	10
	cotton, synthetic blends	2	4
	Cotton	39	78



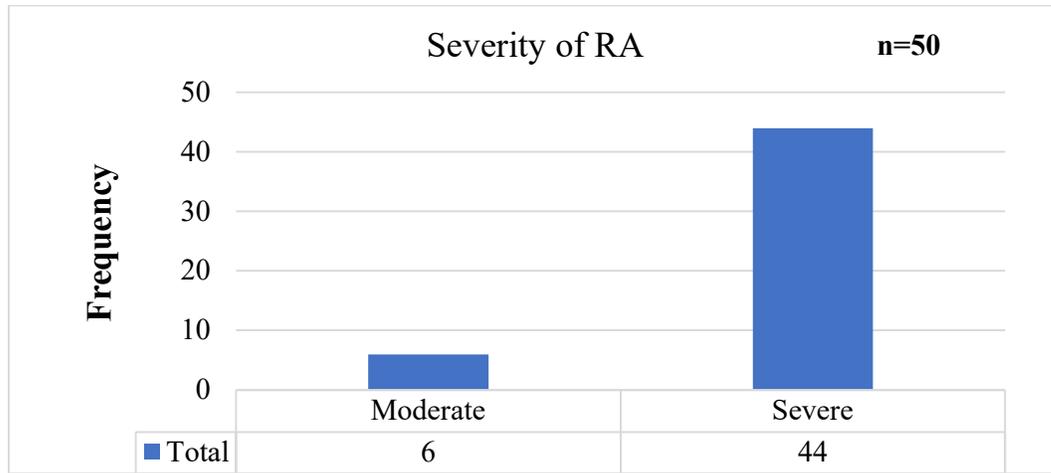
Graph 4.1: Distribution of respondents gender according to diagnose

The study was conducted with a sample size of 50 individuals diagnosed with rheumatoid arthritis. Data were collected through Self-administered Structured Questionnaire, observations, structured interviews with patients and doctors. to understand the specific clothing-related challenges faced by individuals with RA. The findings highlighted key demographic patterns, mobility limitations, and garment-related difficulties, which formed the basis for designing ergonomic clothing solutions. Additionally, expert opinions from doctors provided valuable insights regarding challenges faced by RA in relation to daily activity and clothing adaptations that could enhance comfort, mobility and ease of use for patients. that could enhance comfort and ease of use for patients. The results were presented using charts and tables, followed by a detailed discussion of their implications. The majority of the respondents were female (96 per cent), while only a small proportion (4 per cent) were male. This indicates that rheumatoid arthritis predominantly affected women in the sample group.



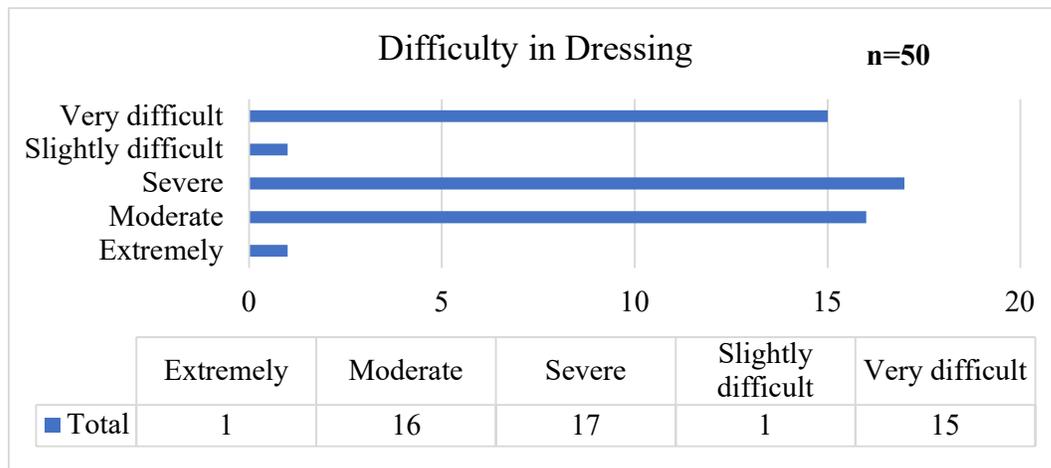
Graph 4.2: Distribution of respondent patients age group

The 50-54 and 65+ age groups were the largest (26.3 per cent), while the 55-59 age group accounted for 21.1 per cent, and the 45-49 and 60-64 age groups had the lowest representation (13.2 per cent).



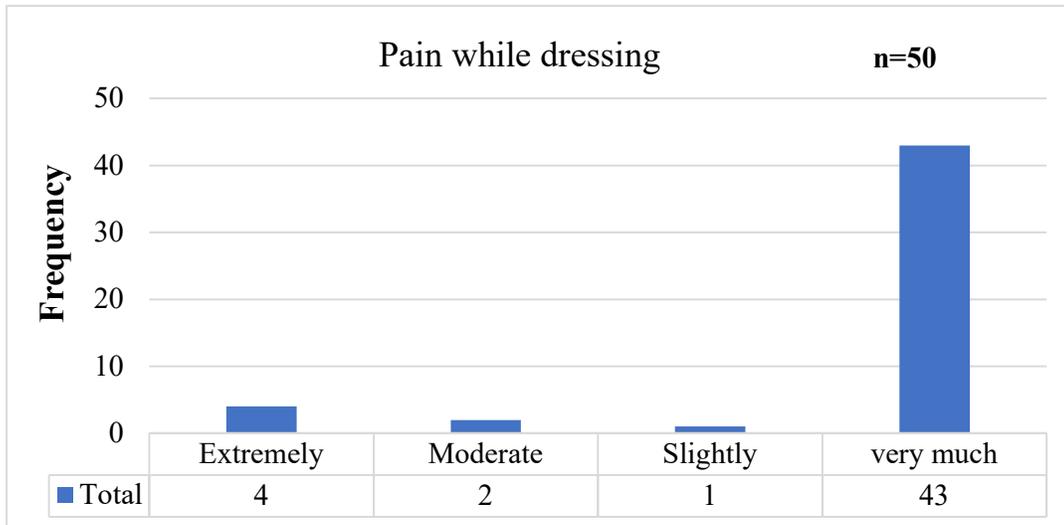
Graph 4.3: Distribution of Severity of RA

The chart illustrated the severity of rheumatoid arthritis (RA) among the surveyed participants. Out of the total respondents, 44 individuals (88 per cent) were categorized as having severe RA, while only 6 individuals (12 per cent) had moderate RA. This significant disparity indicates that a large proportion of the sample experiences severe symptoms, which may have a considerable impact on their daily activities, mobility, and clothing requirements



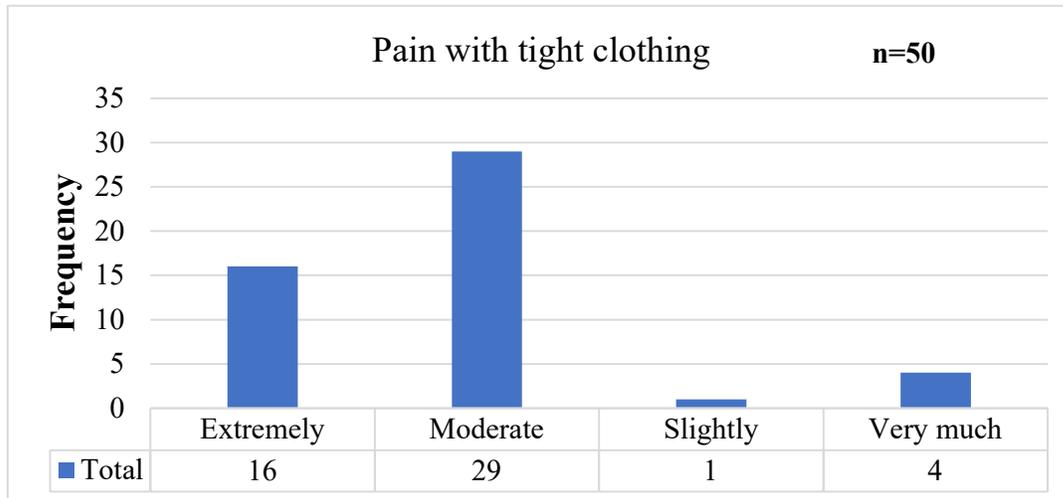
Graph 4.4: Distribution of difficulty in dressing

The chart illustrated the levels of difficulty experienced by individuals with rheumatoid arthritis (RA) while dressing. The highest number of respondents (34 per cent) reported experiencing severe difficulty, followed by 32 per cent individuals who faced moderate difficulty. Additionally, 30 per cent participants found dressing to be very difficult, while only 2 per cent reported slight difficulty and 2 per cent described the challenge as extreme. These findings indicated that the majority of RA patients encounter significant challenges in dressing, with a notable proportion struggling with severe or very difficult experiences.



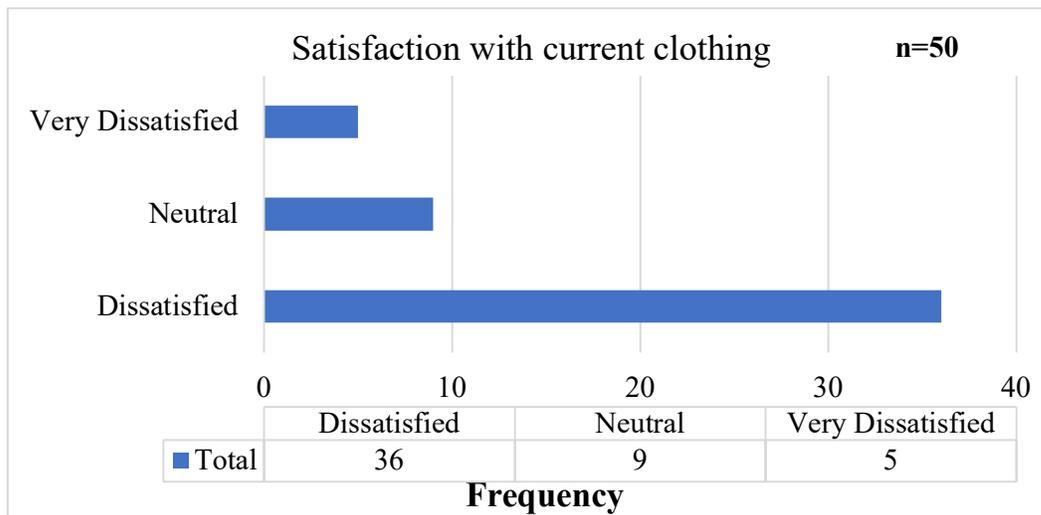
Graph 4.5: Distribution of pain while dressing

The chart indicated the level of pain experienced while dressing among individuals with rheumatoid arthritis (RA). The majority of respondents (86 per cent) reported experiencing "very much" pain, while 8 per cent described their pain as "extreme." Additionally, 4 per cent experienced "moderate" pain, and only 2 per cent reported "slight" pain that highlight the significant pain burden associated with dressing for RA patients.



Graph 4.6: Distribution of pain with tight clothing

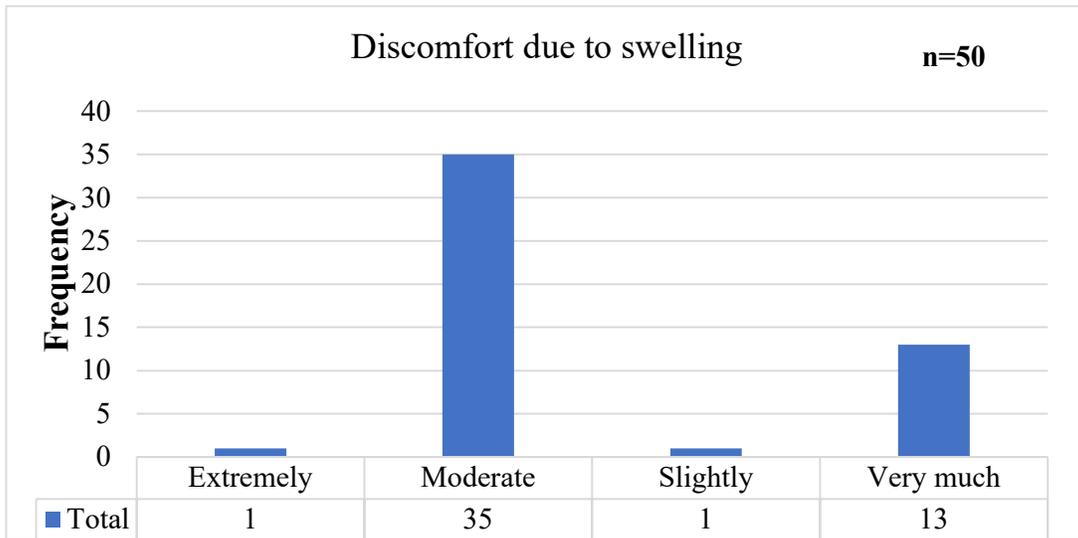
Regarding pain caused by tight or restrictive clothing, 56 per cent participants reported "moderate" pain, while 32 per cent experienced "extreme" pain. Additionally, 8 per cent described their pain as "very much," and only 2 per cent reported "slight" pain. The graph indicated that dressing and wearing tight or restrictive clothing significantly contributed to discomfort among individuals with Rheumatoid Arthritis.



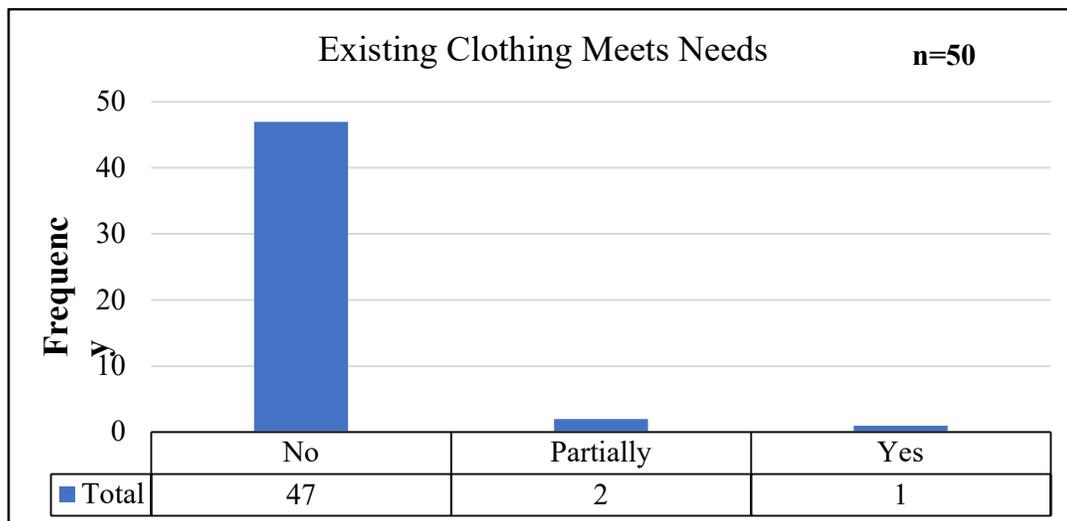
Graph 4.7: Distribution of satisfaction with current clothing

The study evaluated participants' satisfaction with their current clothing. The results showed that 72 per cent of participants felt dissatisfied, while 18 per cent remained neutral, and 10 per cent reported being very dissatisfied with their clothing.

Graph 4.8: Distribution of discomfort due to swelling

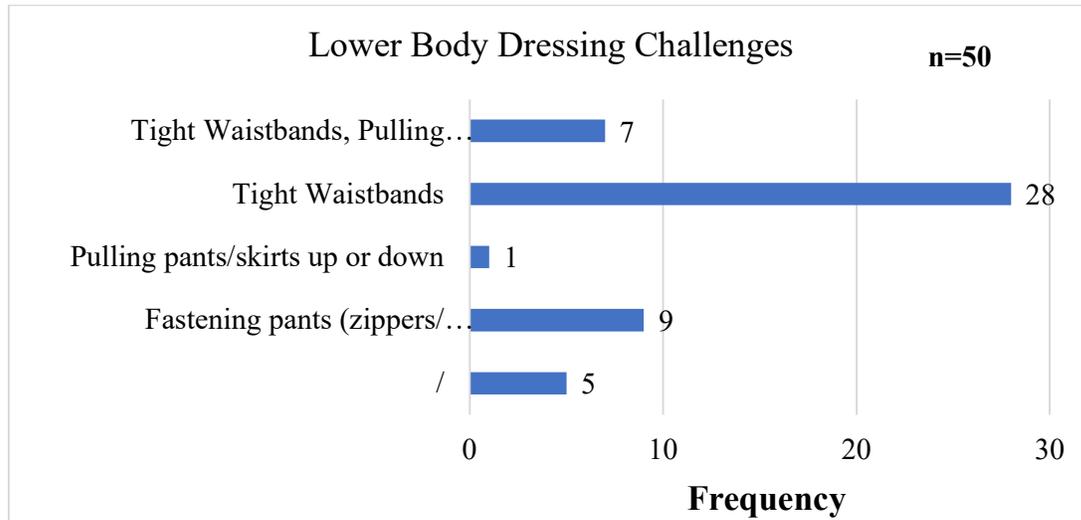


The study assessed the level of discomfort experienced due to swelling. The results revealed that 70 per cent of participants reported moderate discomfort, while 26 per cent experienced it very much. Additionally, 2 per cent each reported feeling discomfort extremely and slightly.



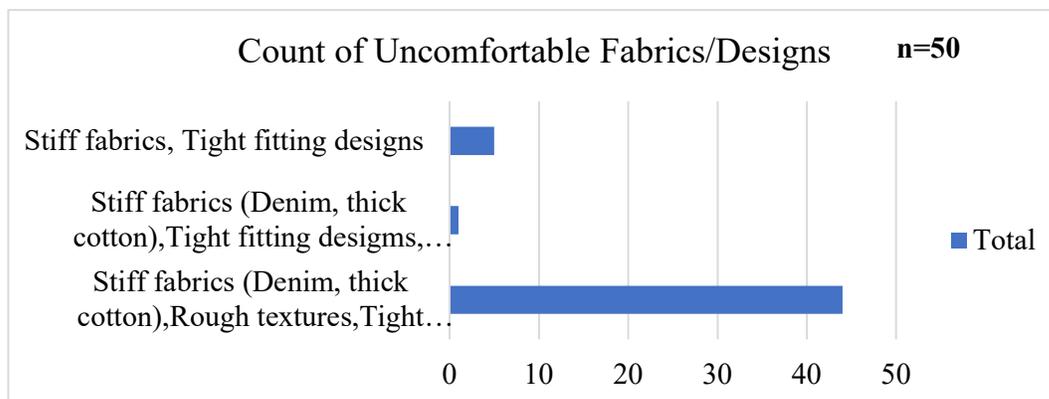
Graph 4.9: Distribution of existing clothing meets needs

The study examined whether existing clothing meets the needs of individuals with rheumatoid arthritis. The results indicated that 94 per cent of participants stated that their clothing does not meet their needs, while 4 per cent reported that it partially meets their needs. Only 2 per cent felt that their clothing completely meets their needs.



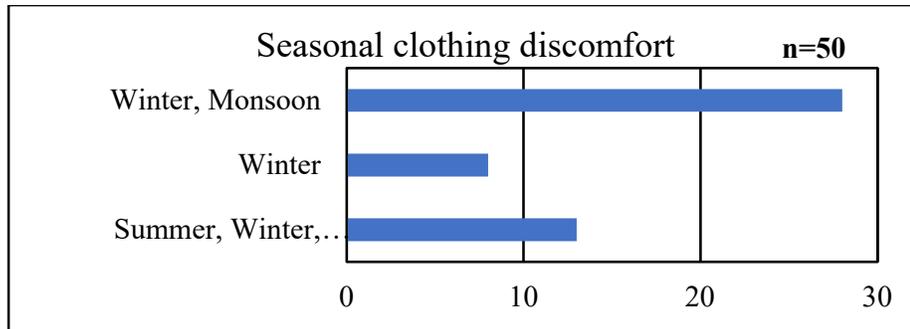
Graph 4.10: Distribution of lower body dressing challenges

The study identified key lower body dressing challenges faced by individuals with rheumatoid arthritis. Tight waistbands were the most significant issue, reported by 28 participants (56 per cent). Fastening pants (zippers/buttons) was a challenge for 9 participants (18 per cent). A combination of tight waistbands and difficulty pulling pants/skirts up or down was reported by 7 participants (14 per cent). Difficulty in pulling pants/skirts up or down alone was mentioned by 1 participant (2 per cent). Other unspecified issues were noted by 5 participants (10 per cent).



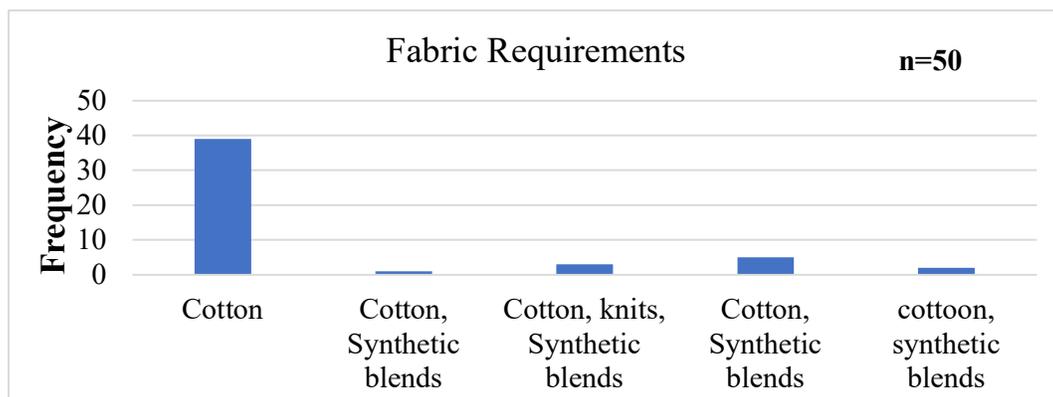
Graph 4.11: Distribution of count of uncomfortable fabrics/designs

The graph shows that stiff fabrics and tight-fitting designs were reported as uncomfortable by 10 per cent of the participants. Additionally, 2 per cent of the participants mentioned that stiff fabrics, including denim and thick cotton, combined with tight-fitting designs and heavy or layered fabrics, caused discomfort. The majority, comprising 88 per cent of the participants, identified stiff fabrics such as denim and thick cotton, along with rough textures, tight-fitting designs, and heavy or layered fabrics, as the most uncomfortable



Graph 4.12: Distribution of problem faced in different seasons

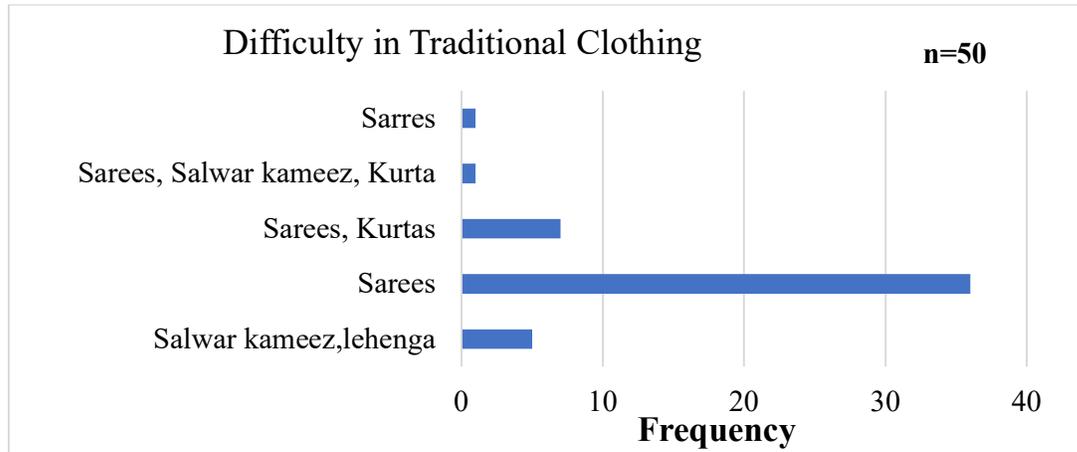
The survey data on problems faced during different seasons revealed varying levels of difficulty among respondents. The highest percentage, around 56 per cent, reported facing problems during Winter and Monsoon, indicating significant seasonal challenges. Approximately 26 per cent of individuals experienced issues across Summer, Winter, and Monsoon, while 18 per cent struggled specifically in Winter alone. marking the least affected category. The data suggests that Winter and Monsoon were the most problematic seasons for the majority.



Graph 4.13: Distribution of Fabric requirements of patients

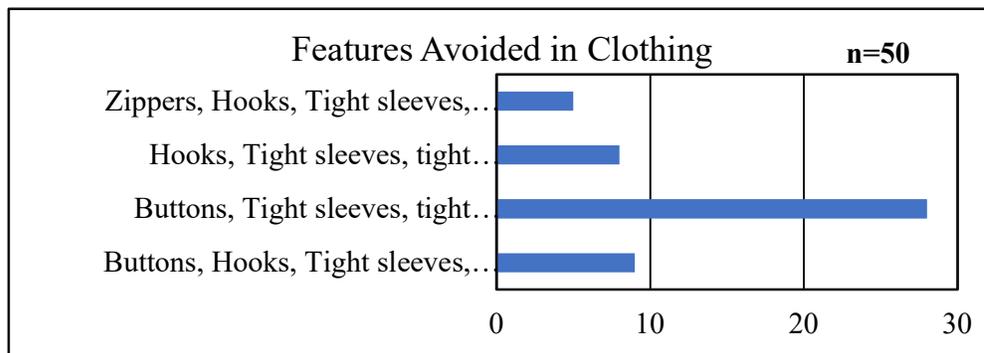
The survey on fabric requirements indicated a strong preference for cotton, with approximately 80 per cent of respondents favoring it over other materials. Cotton and

synthetic blends were selected by about 5 per cent, while cotton, knits, and synthetic blends accounted for around 7 per cent of preferences. Another 6 per cent of respondents opted for cotton and synthetic blends, while a minimal 2 per cent chose cotton, synthetic blends with variations in labeling. The data suggests that cotton remained the most preferred fabric among participants.



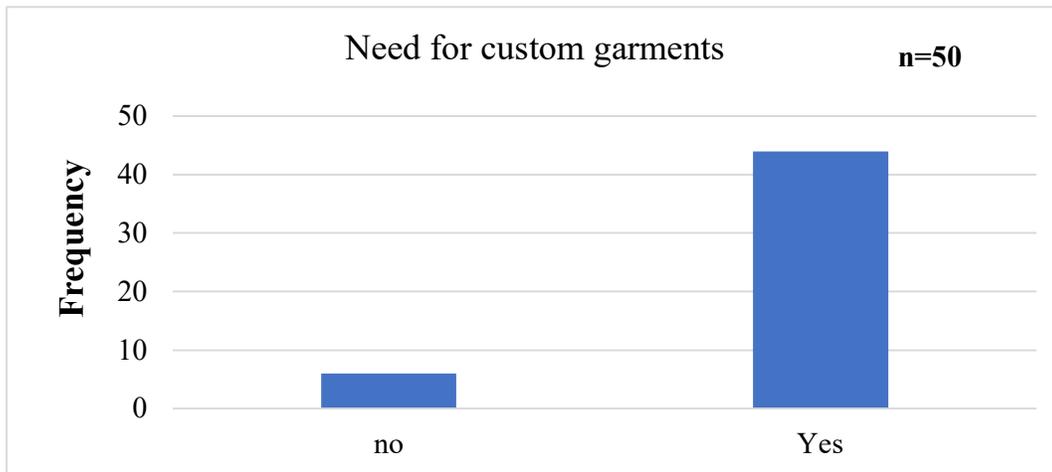
Graph 4.14: Distribution of difficulty in Traditional Clothing

The survey on difficulty in traditional clothing revealed that the majority, approximately 60 per cent, found a particular traditional outfit the most challenging to wear. Another 15 per cent of respondents also struggled with a different type of traditional attire. A smaller 10 per cent reported moderate difficulty with another category, while minimal responses, around 5 per cent each, indicated difficulty with other traditional garments. The data suggests that one specific traditional outfit posed the greatest challenge for most participants.



Graph 4.15: Distribution of features avoided in clothing

The survey on features avoided in clothing revealed that buttons, tight sleeves, tight waistbands, and heavy fabrics were the most disliked, with approximately 50 per cent of respondents avoiding them. Around 20 per cent of participants avoided hooks, tight sleeves, tight waistbands, and heavy fabrics, while 15 per cent found zippers, hooks, tight sleeves, tight waistbands, and heavy fabrics uncomfortable. Additionally, 15 per cent of respondents avoided buttons, hooks, tight sleeves, tight waistbands, and heavy fabrics. The data suggests that restrictive and heavy clothing features were widely disliked.



Graph 4.16: Distribution of Need for Custom Garments

The survey on preference for adaptive clothing indicated that a significant 85 per cent of respondents favored adaptive clothing, highlighting a strong demand for accessible and comfortable apparel. In contrast, only 15 per cent of participants showed a preference for non-adaptive clothing.

OBSERVATION POINTS



Plate 4.1: Toe Deformity



Plate 4.2: Toe Deformity

The researcher found that some patients had toe deformities, which affected their daily activities like dressing, handling fabrics, and overall routine. It was also observed that toe deformities impacted their entire day-to-day life. Additionally, some respondents had foot and knee deformities, which caused difficulties in movement and affected their whole body. -The researcher observed that respondents faced challenges while sitting, standing up, and walking.

One important thing noted was that when the researcher visited respondents' houses to collect data, it was observed that they woke up around 5 AM. However, they needed at least an hour before they could start moving or responding properly.

-Another observation was that all rheumatoid arthritis patients preferred wearing cotton, loose-fitted kurtas with loose fit pants or palazzo.

-Older respondents preferred wearing sarees in any condition, even if they faced difficulties in draping and managing them.

They insisted on wearing sarees because they had worn them throughout their lives, and their cultural background also influenced their clothing choices.

-It was also observed that some respondents had very limited mobility and could not do daily activities on their own. Still, wearing a saree remained compulsory for them.

-Lastly, it was found that patients had no other clothing options, and despite their struggles, they chose to suffer silently without expressing their difficulties.



Plate 4.3: Knee Deformity



Plate 4.4: Foot Deformity

-Respondents with knee deformities faced difficulty in standing up from a seated position and required support while walking.

-Some patients struggled with bending their knees, making it hard for them to wear lower garments like pants, leggings, or salwar's.

-Knee pain and stiffness limited their ability, which affected their dressing habits and daily routine.

- Due to knee deformities, some respondents avoided wearing fitted clothing and preferred loose garments for ease of movement.
- Long-standing or continuous walking increased discomfort, making simple tasks like dressing or wearing footwear challenging.
- Some respondents completely avoided wearing footwear due to pain, swelling, or discomfort caused by foot deformities.
- A few patients found it difficult to put on or remove footwear, especially those with stiff or swollen toes.
- Some respondents preferred walking barefoot at home as wearing any type of footwear caused irritation or pain.
- Due to misaligned or deformed toes, certain patients struggled with balance, making footwear unnecessary or uncomfortable for them.
- Those who did not wear footwear often mentioned that even soft slippers caused discomfort due to pressure on their joints.
- Bedridden respondents faced severe mobility restrictions, making dressing and undressing a major challenge.
- Many required complete assistances from caregivers for each activity, including changing clothes.
- Most bedridden patients preferred loose-fitting clothing such as cotton nightgowns or sarees draped in a simplified manner for ease of wear.
- Some bedridden patients avoided changing clothes frequently due to pain and discomfort.

4.1.2. Existing environment and clothing of the patient

The patients currently wear different types of garments with the help of their caregivers. One patient wears a saree daily due to cultural and ritual significance, assisted by her husband. Another patient wears only Kurtis, with support from her daughter. The third patient, who has leg-related issues, wears only palazzos and is helped by her husband or daughter. The fourth patient wears all types of garments, including sleeveless tops, with assistance from her sister. The fifth patient, who is bedridden and has no mobility, wears a full-length gown, dressed daily by her husband.

4.1.3. Key insights from data analysis regarding patient needs

The data analysis revealed several key insights into the clothing-related challenges and daily struggles faced by patients with rheumatoid arthritis. Many patients suffer from toe, foot, and knee deformities that significantly affect their mobility and independence, especially during dressing and other routine activities. The researcher observed that even simple tasks like sitting, standing, walking, or wearing garments became difficult for many respondents, particularly those with severe joint stiffness and pain. Most patients preferred loose-fitted, cotton garments such as kurtas and palazzos for comfort and ease of movement, while older patients insisted on wearing sarees due to lifelong habits and cultural attachment, even if it caused them discomfort.

Some respondents found it difficult to wear lower garments like Palazzo due to knee pain and limited bending ability. A few patients completely avoided footwear as toe and foot deformities caused irritation, pain, or swelling, and even soft slippers were uncomfortable. Many preferred walking barefoot indoors to avoid pressure on their joints. Patients with misaligned toes also experienced poor balance, which further discouraged the use of footwear.

In rheumatoid arthritis bedridden cases, respondents had almost no mobility and were entirely dependent on caregivers for dressing and undressing. These patients wore full-length gowns or simplified sarees for convenience and comfort. Due to pain, many avoided changing clothes frequently.

Overall, the data analysis found that patients required adaptive ergonomic garments that accommodated their specific physical deformities while also respecting their cultural significance and personal clothing preferences. The findings highlighted the urgent need for thoughtfully designed clothing solutions that not only offered ease of use, comfort and mobility but also aligned with the cultural identity and routine practices of individuals living with rheumatoid arthritis.

4.1.4. Findings of market survey of existing adaptive garment



Plate 4.5: Ergonomic clothing brand reference

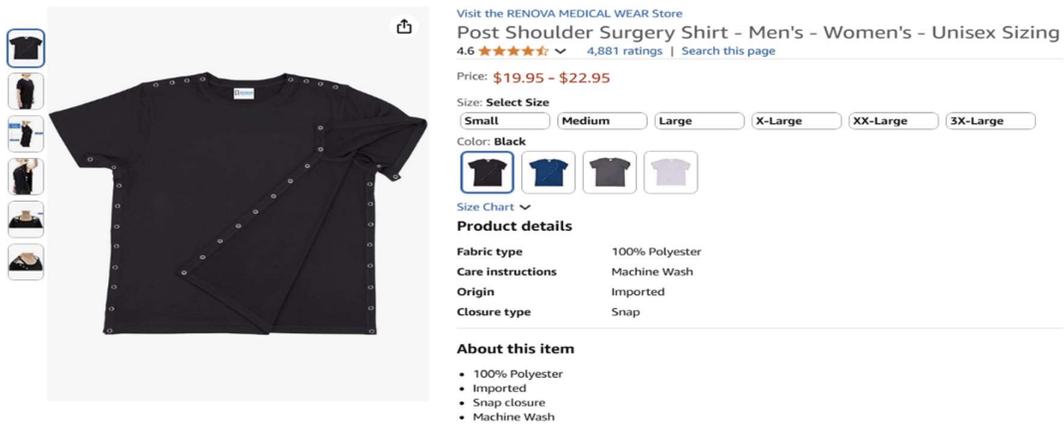


Plate 4.6: Ergonomic clothing brand reference

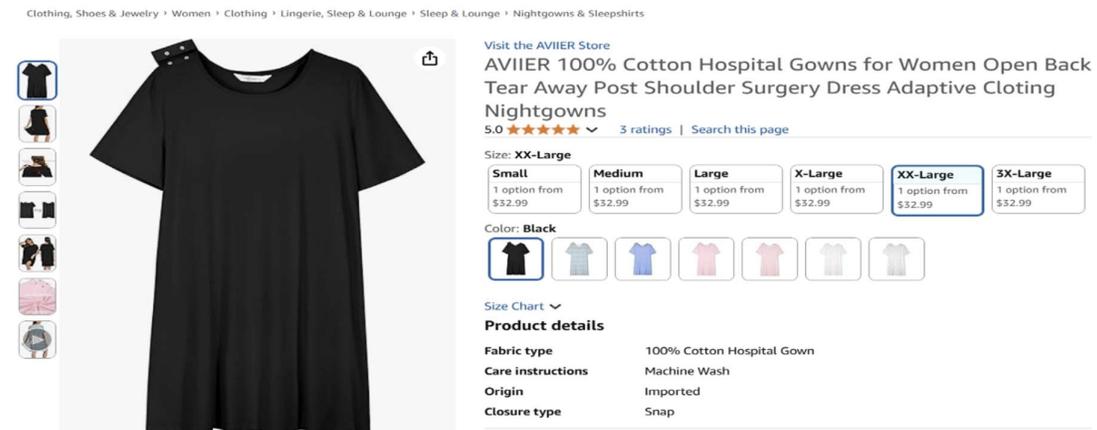


Plate 4.7: Ergonomic clothing brand reference

- The study found that adaptive garments for individuals with rheumatoid arthritis (RA) were available online but were highly expensive.
- Due to high costs, these garments remained inaccessible to many RA patients, especially in India.
- Local brands offered limited ergonomic wear, and the few available options were also priced significantly higher than regular clothing.
- Affordability was a major concern, as most RA patients preferred loose-fitted and clothing like kurtas, leggings, or sarees.
- Many respondents were unaware of adaptive clothing or found it difficult to access due to price constraints and limited availability.
- The findings highlighted the need for affordable, ergonomic garments to improve the daily comfort and mobility of RA patients.

4.2. Design and development of prototypes

This result focused on developing clothing prototypes that met the identified ergonomic needs of RA patients. Insights from the need-gap identification that required the development, ensuring that the garments effectively addressed real-world challenges and fulfil the patient's requirement.

4.2.1. Create user persona and design brief

Patient A:

Table 4.2: User persona

Category	Details
Age	38 years
Gender	Female
Location	Vadodara
Education	Higher secondary
Occupation	Small scale business worker
Family Structure	Lives with spouse and daughter
Deformity	Knee deformity
Challenges	Difficulty in wearing tight-fitted bottoms
Ease of Use	While dressing and undressing
Comfort	Soft materials, not to tight or restrictive, allowing freedom of movement
Mobility	Move freely without restriction
Clothing Preferences	lower garments (loose pants (Cotton, Rayon), palazzo)
Need	Elastic waistband, wrap-around palazzo, or pants with side openings
Economic Status	Medium
Affordability	500-1000 INR

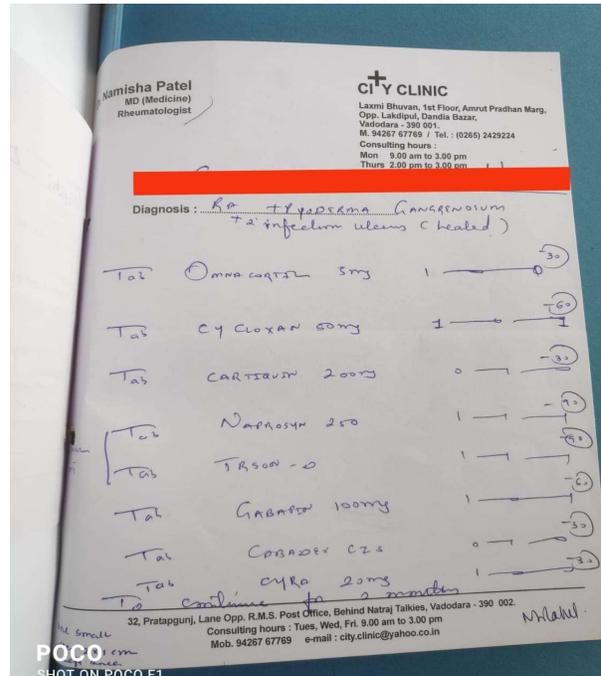


Plate 4.8: Patient original RA report



Plate 4.9: Patient currently wearing

Patient B:

Table 4.3 User persona

Category	Details
Age	25 years
Gender	Female
Location	Vadodara
Education	Graduate
Occupation	Preparing for study for abroad
Family Structure	Mother and father
Deformity	Shoulder deformity
Challenges	Difficulty in lifting arms and managing overhead clothing, difficulty in wearing armhole tight-fitted garments
Ease of Use	While dressing and undressing
Comfort	Soft materials, not to tight or restrictive, allowing freedom of movement
Mobility	Move freely without restriction
Clothing Preferences	Prefers garments with adjustable closures and wide armholes for easy dressing, respondent most preference in short kurta with jeans and one piece. they don't have deformity in knee so their requirement is for only upper garment. Tops with front openings, Back opening (Velcro, magnets, or zippers) in soft fabric.
Need	Upper garments with front opening or back opening with Velcro, cotton rayon fabrics
Economic Status	Medium
Affordability	500-100 INR

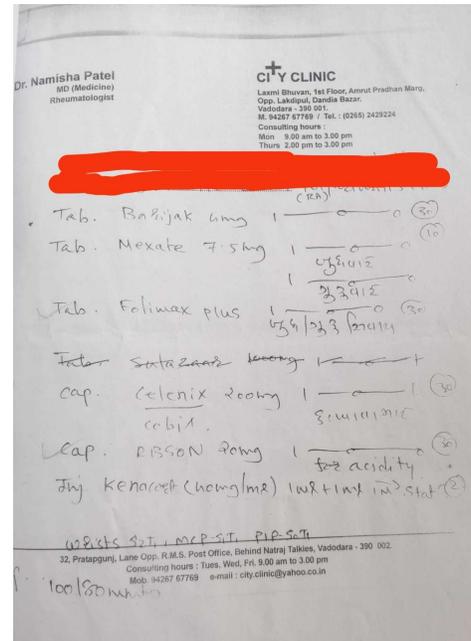


Plate 4.10: Patients original report



Plate 4.11: Patient currently wearing

Patient C:

Table 4.4: User persona

Category	Details
Age	58 years
Gender	Female
Location	Vadodara
Education	Higher secondary
Occupation	Homemaker
Family Structure	Lives with spouse (husband assists in dressing)
Deformity	All joints affected; wears saree due to regional customs
Challenges	Needs help for pleating and tucking; difficulty in pallu management
Ease of Use	While dressing and undressing
Comfort	Easy to manage
Mobility	Move freely without restriction
Challenges	Difficulty in wearing saree
Clothing Preferences	Traditional saree but struggles with draping
Need	Semi-stitched saree with hooks/clip. The respondent said yes but is there any possibilities to do with saree
Economic Status	Medium
Affordability	500-100 INR

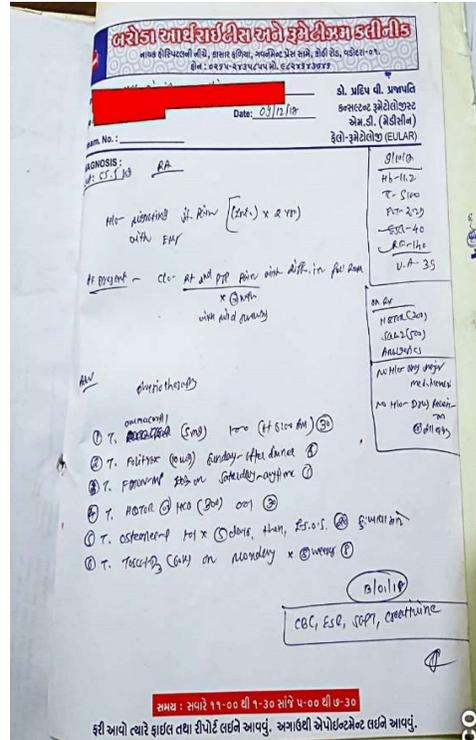


Plate 4.12: Patients original report

Patient D:

Table 4.5: User persona

Category	Details
Age	61 years
Gender	Female
Location	Vadodara
Education	Primary level
Occupation	Home maker
Family Structure	Lives with spouse son and daughter in law these are their caregivers
Deformity	All the joints are affected, Bedridden
Challenges	Difficulty in wearing tight-fitted bottoms
Ease of Use	While dressing and undressing
Comfort	Soft materials, not to tight or restrictive, allowing freedom of movement
Mobility	Move freely without restriction
Challenges	Difficulty in wearing tight-fitted bottoms
Clothing Preferences	lower garments (loose pants (Cotton, Rayon), palazzo)
Need	Elastic waistband, wrap-around palazzo, or pants with side openings
Economic Status	Medium
Affordability	500-100 INR

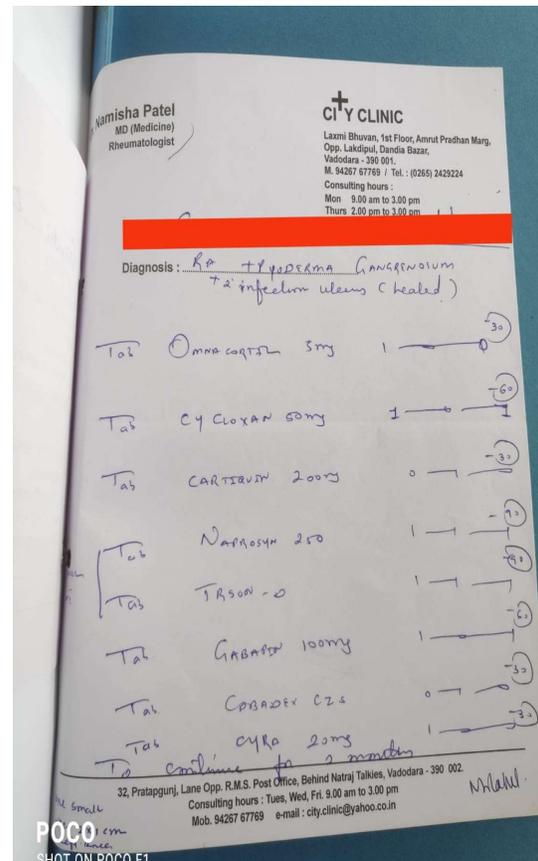


Plate 4.13: Patients original report



Plate 4.14: Patients original report

Patient E:

Table 4.6: User persona

Category	Details
Age	61 years
Gender	Female
Location	Vadodara
Education	Primary Education
Occupation	Home maker
Family Structure	Lives with spouse, son and daughter in law
Deformity	all joints are affected
Challenges	Arm and knee mobility limitations
Ease of Use	While dressing and undressing
Comfort	Soft cotton materials, not to tight or restrictive
Mobility	Move freely without restriction
Challenges	Difficulty in wearing tight-fitted upper garments
Clothing Preferences	Prefers upper garments that are easy with minimal effort
Need	Specific requirement front-opening with zippers and tie string
Economic Status	Medium
Affordability	500-100 INR

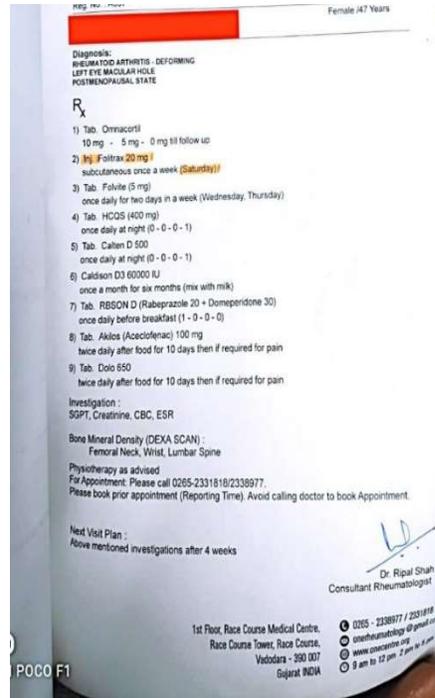


Plate 4.15: Patient original report



Plate 4.16: Patients currently wearing

4.2.2.2. 10 Designs to be selected 2 from each 5 patients

The finalized ergonomic garment designs were selected by the patients themselves, based on their individual needs, physical limitations, and dressing convenience. Patient A, who has a knee deformity, chose Design A1, a wrap-around palazzo, and Design A2, a palazzo with an elastic waist, long zipper, and clip closure, for their ease of wear and movement. Patient B, with a shoulder deformity, selected Design B3, a front-opening garment with Velcro and front-layered overlap, and Design B5, a kaftan-style outfit with an attached belt and front opening, as these minimized arm strain. Patient C, who is bedridden, opted for Design C4, an angarkha-type gown with a tie-string front opening, and Design C1, a front-opening top with tie strings, both offering comfort and easy caregiver assistance. Patient D, affected in all joints, preferred Design D1, a front-opening style with a long zipper and hook, and Design D2, a knee-length angarkha-style kurta with tie strings, for their minimal hand strain and ease in dressing. Patient E, requiring modified saree options due to full joint involvement, selected Design E1, a semi-stitched saree with adjustable sizing, and Design E2, a stitched saree with an attached blouse and petticoat, offering traditional aesthetics with simplified dressing.

Table 4.7: Finalized design by patients

Patient A-Knee deformity	Design A1- Wrap around palazzo
	Design A2- Palazzo with Elastic, long zipper and clip Clouser
Patient B-Shoulder deformity	Design B3- Front opening with Velcro, front layered overlap
	Design B5- Kaftan with attached belt front Opening
Patient C Bedridden patient	Design C4- Front opening with tie string- angarkha type gown
	Design C1- Front opening top with tie string
Patient D All joints affected	Design D1- Front opening with long Zipper and hook
	Design D2- Front opening with angarkha type knee length kurta with tie string
Patient E All joints affected-Design requirement in saree	Design E1- semi stitched saree with adjustable size
	Design E2- Stitched saree with attached blouse and petticoat

4.2.4. Finalized design and development of specification sheet and bill of materials

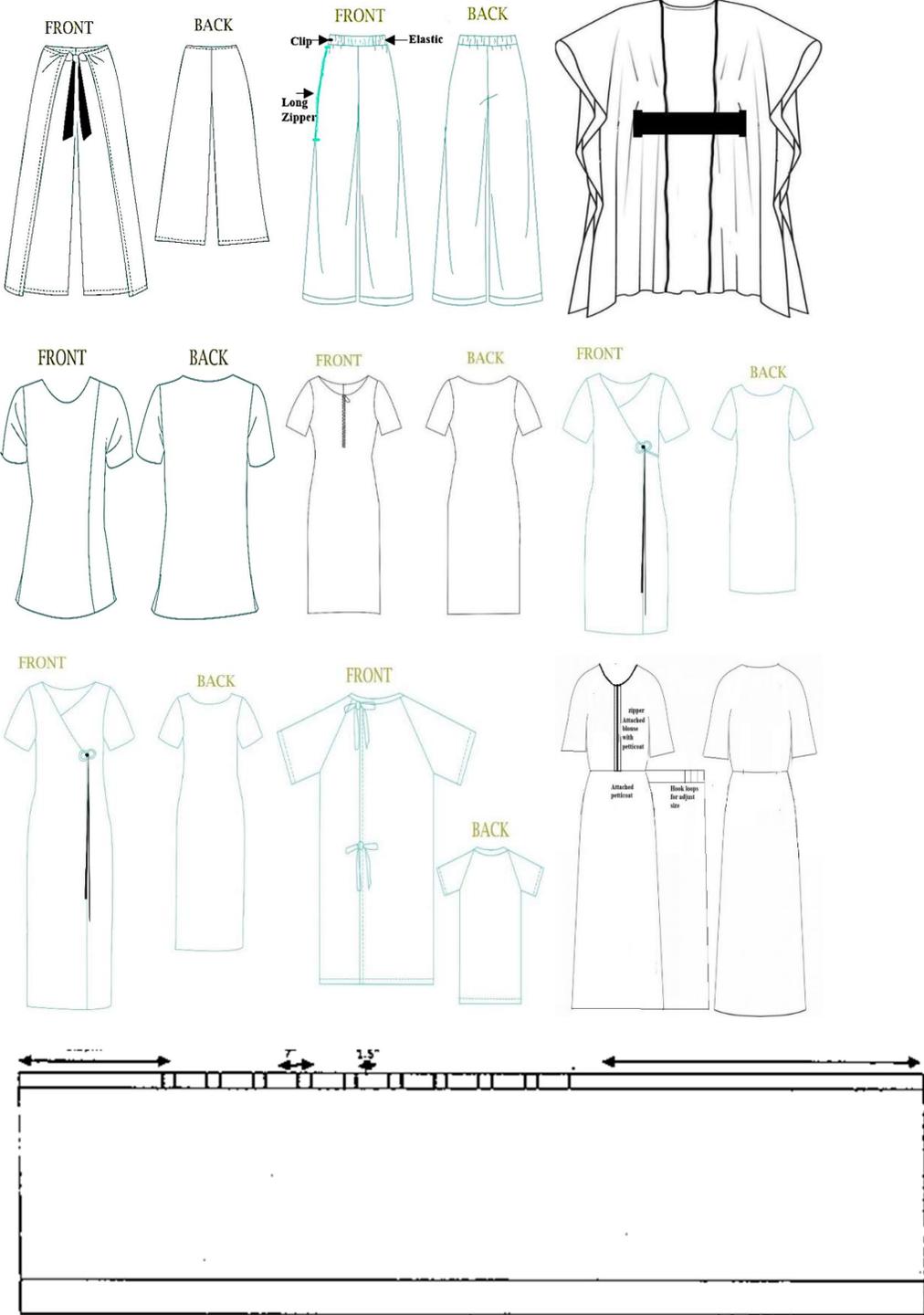


Plate 4.17: Final design

4.2.3. Fabric sourcing and selection as per requirement of patients

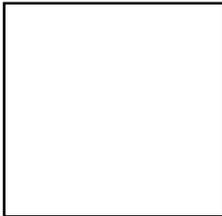
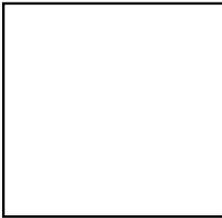
Materials were sourced based on their requirement for constructing the ergonomic garments. Special attention was given to selecting fabrics that minimized the risk of skin irritation and pressure sores while providing flexibility for easy dressing and undressing. For this local market including Nava Bazaar, Mangal bazaar, various shops in Fatepura, and Baroda prints were visited. Various fabric samples were collected, and the most suitable fabric was selected based on lightweight, softness, and affordability to meet the requirements of the RA patients. All the fabric selected by patients, fabric collected from the Baroda prints and Nava Bazaar.

Fabric samples reference for selection final prototype



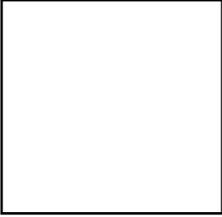
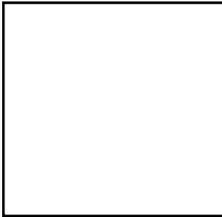
Plate 4.18: Fabric samples

Final selected samples by rheumatoid arthritis patients



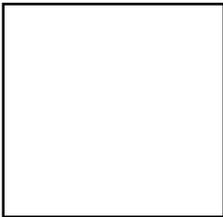
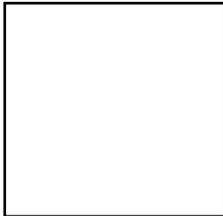
Patient- A Rayon Fabric

Patient- A Rayon Fabric



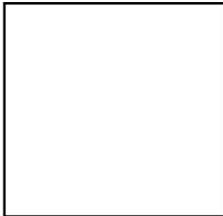
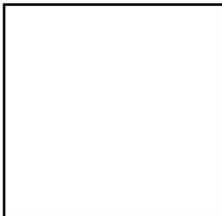
Patient- B Rayon Fabric

Patient- B Cotton Fabric



Patient- C Cotton Fabric

Patient- C Cotton Fabric



Patient- D Cotton Fabric

Patient- D Cotton Fabric

Table 4.8a: Specification Sheet of Patient A G1- Wrap around palazzo

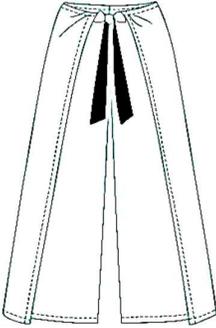
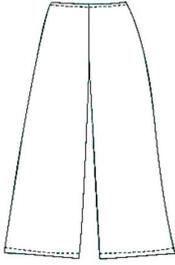
Garment Specification Sheet		Technical Sketch	
Date	04-03-2025	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>FRONT</p>  </div> <div style="text-align: center;"> <p>BACK</p>  </div> </div>	
Style	Design G1- Wrap around palazzo		
Hospital	City clinic		
Description	A loose, adjustable palazzo with a wrap-around design for easy wear with belt.		
		Front	Back
Use	Ease of use, comfort and improve mobility for people with RA		
User	Individual diagnose with RA		
Environment	Day to day living		
Material & Fabric Selection			
Fabric	Width (in)	Properties	Colour
Fabric-1 Rayon	42 (in)	Soft, breathable, and comfortable	Pink
Fabric Swatch			
Design Features			
Length	Pocket	Fasteners	Waistband
Waist to ankle	No	No	Attach with belt
Garment measurement			
Measurement	Value (in)		
Waist	36		
Hip	40		
Thigh	28		
Bottom	17.5		
Full Length	39.5		

Table 4.8b: Specification sheet of patient A G2-Palazzo with invisible zipper, elastic and clip

Garment Specification Sheet		Technical Sketch	
Date	04-03 -2025		
Style	Design G2- Palazzo with invisible zipper, elastic and clip Clouser		
Hospital	City clinic		
Description			
This design features an elastic waistband for flexibility, a long zipper for easy dressing, and a clip closure for secure fastening.		Front	Back
Use	Ease of use, comfort and improve mobility for people with RA		
User	Individual diagnose with RA		
Environment	Day to day living		
Material & Fabric Selection			
Fabric	Width (in)	Properties	Colour
Fabric 1 Rayon fabric	45 (in)	Soft, breathable, and comfortable	(beige-white)
Fabric Swatch			
Design Features			
Length	Pocket	Fasteners	Waistband
Waist to ankle	No	Zippe, clip, elastic	Attach with belt
Garment measurement			
Measurement		Value (in)	
Waist		36	
Hip		40	
Thigh		28	
Bottom		17.5	
Full Length		39.5	

clip

Table 4.8c: Specification Sheet of patient B G1- Front opening with Velcro

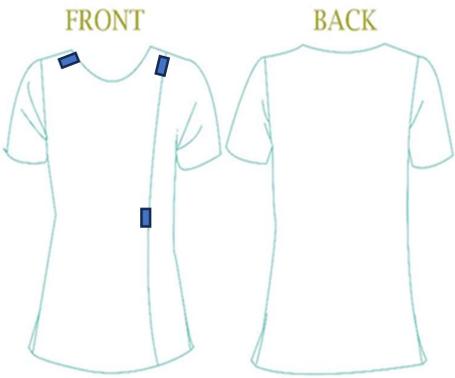
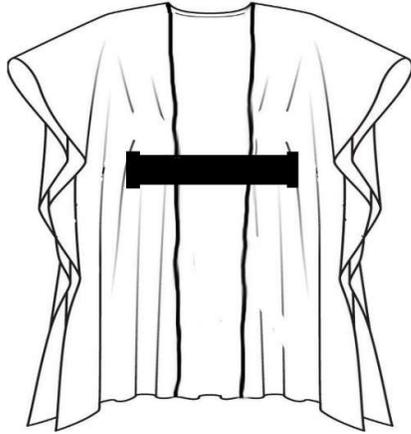
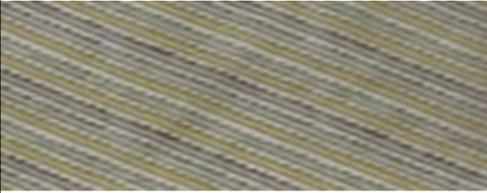
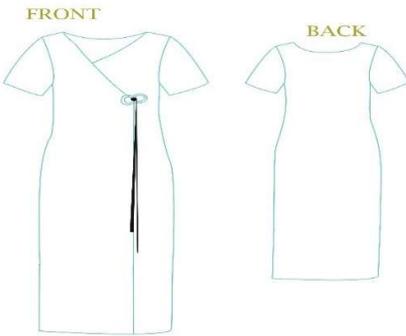
Garment Specification Sheet		Technical Sketch	
Date	04-03-2025		
Style	Patient B G1- Front opening with Velcro, front layered overlap		
Hospital	City clinic		
Description			
This design features a Velcro front opening for easy wear and removal, with a layered overlap for added coverage, comfort, and a secure fit.		Front	Back
Use	Ease of use, comfort and improve mobility for people with RA		
User	Individual diagnose with RA		
Environment	Day to day living		
Material & Fabric Selection			
Fabric	Width (in)	Properties	Colour
Fabric 1 Cotton	45 (in)	Soft, and comfortable	Multi colour
Fabric Swatch			
Design Features			
Length	Pocket	Fasteners	Waistband
Hip length	No	Velcro	No
Garment measurement			
Measurement		Value (in)	
Length		27	
Waist		37	
Bust		40	
Hip		42	
Sleeve l.		13	
Sleeve R		10	

Table 4.8d: Specification Sheet of Patient B G2 - Kaftan with attached belt and front

Garment Specification Sheet		Technical Sketch	
Date	04-03-2025		
Style	Patient B G2-Kaftan with attached belt and front opening		
Hospital	City clinic		
Description	<p>This kaftan features a front opening for easy wear and an attached belt for adjustable fit, combining comfort with functional styling.</p>		
		Front	Back
Use	Ease of use, comfort and improve mobility for people with RA		
User	Individual diagnose with RA		
Environment	Day to day living		
Material & Fabric Selection			
Fabric	Width (in)	Properties	Colour
Fabric Rayon	1 42 (in)	Soft, and comfortable	Green
Fabric Swatch			
Design Features			
Length	Pocket	Fasteners	Waistband
Knee	No	No	Belt
Garment measurement			
Measurement		Value (in)	
Length		27	
Waist		37	
Bust		40	
Hip		42	
Sleeve l.		13	
Sleeve R		10	

opening

Table 4.8e: Specification sheet of patient C1-front opening with tie string- angarkha type

Garment Specification Sheet		Technical Sketch	
Date	04-03-2025		
Style	Patient C1- Kaftan with attached belt and front opening		
Hospital	City clinic		
Description			
<p>This design features a front opening with tie string for easy fastening, allowing quick dressing and removal while ensuring easy dressing for the caregivers</p>		Front	Back
Use	Ease of use, comfort and improve mobility for people with RA		
User	Individual diagnose with RA		
Environment	day to day living		
Material & Fabric Selection			
Fabric	Width (in)	Properties	Colour
Fabric 1 cotton	42 (in)	Soft, and comfortable	Light blue
Fabric Swatch			
Design Features			
Length	Pocket	Fasteners	Waistband
Full	No	Elastic	Partially elasticated waistband
Garment measurement			
Measurement		Value (in)	
Length		55	
Waist		37	
Bust		40	
Hip		42	
Sleeve l.		13	
Sleeve R		10	

gown

Table 4.8f: Specification Sheet of patient- C2 Front opening top with button and tie string

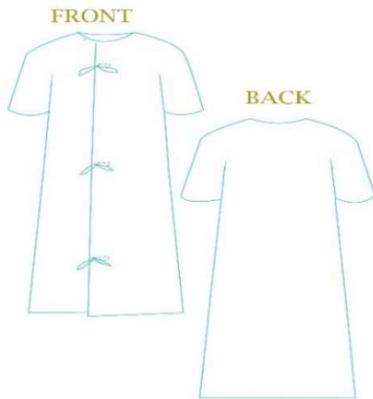
Garment Specification Sheet		Technical Sketch	
Date	04-03-2025		
Style	Design 1- C2 Front opening top with button and tie string		
Hospital	City clinic		
Description			
<p>This design features a front opening with buttons for easy fastening, allowing quick dressing and removal while ensuring comfort for caregivers.</p>		Front	Back
Use	Ease of use, comfort and improve mobility for people with RA		
User	Individual diagnose with RA		
Environment	day to day living		
Material & Fabric Selection			
Fabric	Width (in)	Properties	Colour
Fabric 1 Cotton	42 (in)	Soft and comfortable	(beige-white)
Fabric Swatch			
Design Features			
Length	Pocket	Fasteners	Waistband
Full	No	Buttons	Partially elasticated waistband
Garment measurement			
Measurement		Value (in)	
Measurement		Value (Inches)	
Length		55	
Waist		37	
Bust		40	
Hip		42	
Sleeve l		13	
Sleeve R		10	

Table 4.8g: Specification sheet of patient D G1-front opening with long zipper & hook

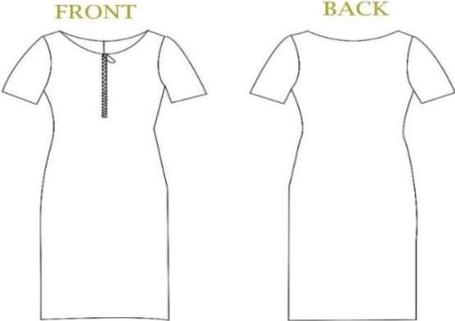
Garment Specification Sheet		Technical Sketch	
Date	04-03-2025		
Style	Design D1- Front opening with long Zipper and hook		
Hospital	One Centre for Rheumatology and Genetics		
Description		<p>This design features a front opening with long invisible zipper and hook. for easy dressing and undressing.</p>	
		Front	Back
Use	Ease of use, comfort and improve mobility for people with RA		
User	Individual diagnose with RA		
Environment	day to day living		
Material & Fabric Selection			
Fabric	Width (in)	Properties	Colour
Fabric- cotton	45 (in)	Soft, breathable, and comfortable	Indigo
Fabric Swatch			
Design Features			
Length	Pocket	Fasteners	Waistband
Full	No	Elastic	Partially elasticated waistband
Garment measurement			
Measurement		Value (in)	
Length		25	
Waist		32	
Bust		32	
Hip		36	
Sleeve l.		14	
Sleeve R		8.5	

Table 4.8h: Specification Sheet of patient D G2- Front opening with angarkha type knee length

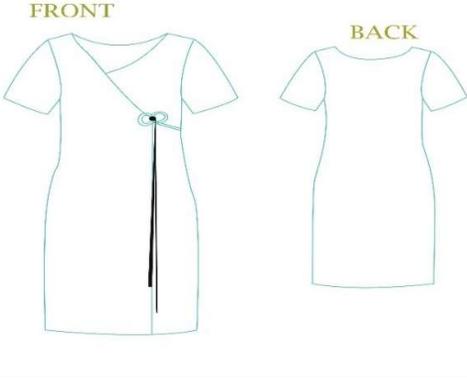
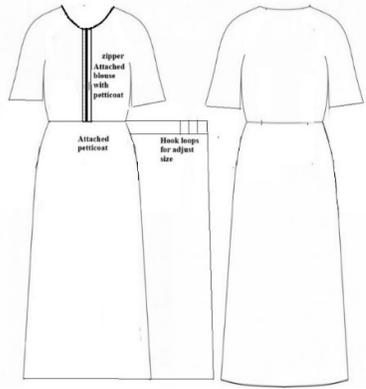
Garment Specification Sheet		Technical Sketch	
Date	04-03-2025		
Style	Design D2-Front opening with angarkha type knee length kurta with tie string		
Hospital	One Centre		
Description			
Front opening with angarkha type knee length kurta with tie string This design features a front opening with tie string. for easy dressing and undressing.		Front	Back
Use	Ease of use, comfort and improve mobility for people with RA		
User	Individual diagnose with RA		
Environment	day to day living		
Material & Fabric Selection			
Fabric	Width (in)	Properties	Colour
Fabric 1	45 (in)	Soft, and comfortable	Yellow
Fabric Swatch			
Design Features			
Length	Pocket	Fasteners	Waistband
Full	No	Elastic	Partially elasticated waistband
Garment measurement			
Measurement			Value (in)
Length			25
Waist			32
Bust			32
Hip			36
Sleeve l.			14
Sleeve R			8.5

Table 4.8i: Specification Sheet of Design E1- Saree

Garment Specification Sheet		Technical Sketch	
Date	04-03-2025		
Style	Design A1- Wrap around palazzo		
Hospital	City clinic		
Description			
This design features a pre-stitched pleated saree with an adjustable waistband (loops and hooks) to fit different sizes. The pallu remains free for customizable draping, ensuring ease of wear while maintaining a traditional saree look.		Front	Back
Use	Ease of use, comfort and improve mobility for people with RA		
User	Individual diagnose with RA		
Environment	day to day living		
Material & Fabric Selection			
Fabric	Width (in)	Properties	Colour
Fabric 1 Georgette Printed	45 (in)	Soft, and comfortable	Light blue
Fabric swatch			
Design Features			
Length	Pocket	Fasteners	Waistband
Full	No	Clip	Waistband with canvas
Garment measurement			
Measurement		Value (in)	
Length		35	
Waist		40	
Bust		38	
Hip		42	
Sleeve l.		14	
Sleeve R		10.5	

Table 4.8j: Spec sheet of patient E E2-Semi stitched saree with blouse and petticoat

Garment Specification Sheet		Technical Sketch	
Date	04-03-2025		
Style	Design G2- Semi stitched saree with blouse and petticoat		
Hospital	City clinic		
Description	This design was created as a fully stitched saree with an attached blouse that had a front zipper opening for easy wear. The petticoat was integrated along with saree included pre-stitched pleats for a drape, while the adjustable waist.		
		Front	Back
Use	Ease of use, comfort and improve mobility for people with RA		
User	Individual diagnose with RA		
Environment	day to day living		
Material & Fabric Selection			
Fabric	Width (in)	Properties	Colour
Fabric 1 Chinon Zari Patta	45 (in)	Soft and comfortable	(Black and golden)
Fabric Swatch			
Design Features			
Length	Pocket	Fasteners	Waistband
Full	No	Zipper	
Garment measurement			
Measurement		Value (in)	
Length		35	
Waist		40	
Bust		38	
Hip		42	
Sleeve l.		14	
Sleeve R		10.5	

4.2.5 Prototype construction

Patient A-Knee deformity

G1- Wrap around palazzo & G2- Palazzo with Elastic, long zipper and clip Clouser



Plate 4.19: Patient A-Knee deformity

Patient B-Shoulder deformity

G1- Front opening with Velcro, front layered overlap & G2- Kaftan with attached belt front Opening



Plate 4.20: Patient B- Shoulder deformity

Patient C All the joints affected

G1-Front opening with tie string- angarkha type top & G2- Front opening top with zipper



Plate 4.21: Patient C All the joints affected

Patient D Bedridden patient



G1- Front opening with tie string- angarkha type gown & G2- Front opening top with tie string

Plate 4.22: Patient D Bedridden patient

Patient E All joints affected-Design requirement in saree

E1- semi stitched saree with adjustable size & E2-Stitched saree with attached blouse and petticoat



Plate 4.23: Patient E All joints affected



Plate 4.24: Patient E All joints affected

4.2.6 Bill of Materials

Table 4.9: BOM patient A:

Bill of Materials			
Style	G1 Wrap around palazzo, G2 Palazzo with long zipper, elastic and clip		
Fabric consumption and cost per garment			
Patient A	Garment 1 – Rayon (₹70/m)	Garment 2 - Rayon (₹70/m)	Total fabric
Total meters	3 meters	2.5 meters	5.5
Total Cost (₹)	210	175	385
Fasteners and Trimmings cost			
Item	Quantity	Total Cost (₹)	
Zipper, Elastic, Clip	1	20	
Stitching Cost			
Component	Elastic, clip	Stitching Labour	Total Cost (₹)
	50	750	800
Stitching cost for patient A garments			
Total Fabric Cost	Fasteners & Trimmings Cost	Stitching Cost	Grand Total (₹)
385	50	750	1185
Grand Total cost for patient A garments			1185

Table 4.10: BOM patient B:

Bill of Materials			
Style	G1- Front opening with Velcro, front layered overlap & G2- Kaftan with attached belt front Opening		
Fabric consumption and cost per garment			
Patient B	Garment 1 - Cotton (₹70/m)	Garment 2 – Rayon (₹70/m)	Total fabric
Total meters	1.5 meters	3 meters	4.5
Total Cost (₹)	105	210	315
Fasteners and Trimmings cost			
Item	Quantity	Total Cost (₹)	
Velcro, buttonhole	0.5 meters, 2 hole	20	
Stitching Cost			
Component	Buttonhole, Velcro	Stitching Labour	Total Cost (₹)
	20	730	750
Stitching cost for patient A garments			
Total Fabric Cost	Fasteners & Trimmings Cost	Stitching Cost	Grand Total (₹)
315	20	730	1065
Grand Total cost for patient A garments			1065

Table 4.11: BOM patient C:

Bill of Materials			
Style	G1-Front opening with tie string- angarkha type top & G2- Front opening top with zipper		
Fabric consumption and cost per garment			
Patient C	Garment 1 – cotton (₹130/m)	Garment 2 - Linen Cotton (₹166/m)	Total fabric
	1.80	2.60	4.40
Total Cost (₹)	235	450	685
Fasteners and Trimmings cost			
Item	Quantity	Total Cost (₹)	
Zipper, hook	1	20	
Stitching Cost			
Component	Elastic, clip	Stitching Labour	Total Cost (₹)
	50	750	800
Stitching cost for patient A garments			
Total Fabric Cost	Fasteners & Trimmings Cost	Stitching Cost	Grand Total (₹)
685	50	700	1435
Grand Total Cost for patient C garments			1435

Table 4.12: BOM patient D

Bill of Materials			
Style	G1- Front opening with tie string- angarkha type gown & G2- Front opening top with tie string		
Fabric consumption and cost per garment			
Patient D	Garment 1 - Cotton (₹70/m)	Garment 2 - Cotton (₹70/m)	Total fabric
	3	3	
Total Cost (₹)	210	210	420
Fasteners and Trimmings cost			
Item	Quantity	Total Cost (₹)	
Button	20	20	
Stitching Cost			
Component	Buttonhole	Stitching Labour	Total Cost (₹)
	40	700	740
Stitching cost for patient A garments			
Total Fabric Cost	Fasteners & Trimmings Cost	Stitching Cost	Grand Total (₹)
420	40	700	1160
Grand Total Cost for patient D garments			1160

Table 4.13: BOM patient E

Bill of Materials			
Style	E1- semi stitched saree with adjustable size & E2-Stitched saree with attached blouse and petticoat		
Fabric consumption and cost per garment			
Patient E	Garment 1 -georgette printed (₹70/m)	Garment 2 – Chinon Zari Patta (₹70/m)	Total fabric
	4	4.5	
Total Cost (₹)	280	315	595
Fasteners and Trimmings cost			
Item	Quantity	Total Cost (₹)	
Clip, Zipper	3	50	
Stitching Cost			
Component	Buttonhole	Stitching Labour	Total Cost (₹)
	-	1500	1300
Stitching cost for patient A garments			
Total Fabric Cost	Fasteners & Trimmings Cost	Stitching Cost	Grand Total (₹)
595	50	1300	1945
Grand Total Cost for patient E garments			1945

4.3. User Testing

4.3.1. Prototype distribution with 5 RA patients as per deformity, shoulder deformity, knee deformity, overall deformity and rheumatoid arthritis bedridden patients

The final prototypes were distributed to five rheumatoid arthritis patients in their home. The patients were selected based on the severity of their deformity and their willingness to participate. 5 patients selected based on different deformity- knee deformity, shoulder deformity, all the joints affected and RA bedridden patient. The final prototypes were developed according to each patient specific requirements. 10 prototypes developed. 2 prototypes distributed to each patient. The designs were not highly innovative due to their necessity for daily wear and cultural significance but the small modifications in the prototypes improved their day-to-day living experience.

4.3.2. Wear trial with 5 RA patients-2 days

Participants wore the ergonomic garment during their daily routines over a period of 10 to 12 hours, allowing it possible to test how well they worked in everyday life. The wear trials followed a (Table below) to garments wore by RA patients. This structured testing ensured fulfilment wear and evaluate 10 garment designs.

Table:4.12 Wear Trial of Prototypes

Patient: A	Knee deformity
Day 1	Patient 1-Garment 1
Day 2	Patient 1-Garment 2
Patient: B	Shoulder deformity
Day 1	Patient 1-Garment 1
Day 2	Patient 1-Garment 2

Table:4.13 Wear Trial of Prototypes

Patient: C	All joints affected
Day 3	Patient 1-Garment 1
Day 4	Patient 1-Garment 2
Patient: D	Bedridden patient
Day 3	Patient 1-Garment 1
Day 4	Patient 1-Garment 2

Table:4.14 Wear Trial of Prototypes

Patient: E	All joints affected
Day 5	Patient 1-Garment 1
Day 6	Patient 1-Garment 2

4.3.3. Evaluation parameters- comfort, mobility, ease of use, user satisfaction through evaluation form

The wear trials were conducted for two days with each RA patient. each patient tested a two garment- one garment for one day ensuring a evaluation of comfort, ease of use, mobility,

softness of fabric and overall satisfaction in day to day living. The trial duration was 10-12 hours per day (10 AM-10 PM). As per convenience of the patient. feedback was gathered through evaluation form and observation focusing on ease of use, overall comfort, mobility and overall satisfaction for daily routine. This procedure ensured comprehensive feedback on each garment’s performance from different deformities in patients and under various conditions, aiding in the reporting and refinement of the final designs. evaluate each based on the given criteria and rate them on a scale of 1 to 5 (1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent). Additional comments were encouraged for detailed feedback.

Knee Deformity- (patient from Namisha shah city clinic)

Table:4.15: Details of Patient A-Knee deformity

Details	Patient A	Garment details
Name	Gaytri Doshi	Design G1- Wrap around palazzo
Age	38 years	
Deformity	Knee deformity	Design G2- Palazzo with Elastic, long zipper and clip Clouser



Plate 4:25: Patient A G1 Wrap around palazzo



Plate 4:26: Patient A G2 Palazzo with elastic, long zipper and clip closure

Table:4.16: Details of Patient B-Shoulder deformity

Details	Patient B	Garment details
Name	Kinnari Parmar	Design G1- Front opening with Velcro, front layered overlap
Age	25 years	
Deformity	Shoulder deformity	Design G2- Kaftan with attached belt front Opening
Duration of RA	22 Years	



Plate 4.27: Patient B G1 Front opening with Velcro, front layered overlap



Plate 4.28: Kaftan with attached belt front Opening

Table 4.17: Details of Patient C-Bedridden patient

Details	Patient C	Garment details
Name	Manjula ben	Design G1- Front opening with tie string- angarkha type gown
Age	61 years	
Deformity	Bedridden patient	Design G2- Front opening Gown
Duration of RA	21 Years	



Plate 4.29: Patient C G1 - Front opening Gown



Plate 4.30: Patient C G2 - Front opening with tie string- angarkha type gown tie string- angarkha type gown

Table 4.18: Details of Patient D-All joints affected

Details	Patient C	Garment details
Name	Vibha Parikh	Design G1- Front opening with long Zipper and hook
Age	58 years	
Deformity	All joints affected	Design G2- Front opening with tie string- angarkha type gown
Duration of RA	22 Years	



Plate 4.31: Patient C G1 - Front opening Gown



Plate 4.32: Patient C G2 angarkha top

Table 4.19: Details of Patient E-All joints affected

Details	Patient E	Garment details
Name	Meera Khandelwal	Design G1- Semi stitched saree with adjustable size
Age	55 years	
Deformity	All joints affected	Design G2- Stitched saree with attached blouse and petticoat



Plate 4.33: Patient E G1 - Semi stitched saree with adjustable size



Plate 4.34: Patient E G2 Stitched saree with attached blouse and petticoat

Table 4.20: Feedback form patient A

Participant name	Gayatri Jignesh Kumar Doshi	
Date of evaluation	26-03-2025	
Type of garment	Wrap around palazzo	Palazzo with elastic and long zipper
Type of deformity	Knee Deformity	
Questions	Patient A: G1	Patient A: G2
How comfortable do you feel while wearing the garment	Very Comfortable	Comfortable
Does garment cause any pressure points or discomfort during wear	No	No
would you rate the overall comfort (while dressing) of this garment?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
would you rate the overall comfort (while undressing) of this garment?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Does the garment contribute to overall ease and relaxation?	Yes	Yes
Fit and Adjustability	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Does the garment allow you to move freely without restrictions?	Yes	Yes
How soft does the fabric feel?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Have you experienced any irritation or discomfort from the fabric?	No	No
Are the closures (e.g., Velcro, Zippers, tie string) easy to manage?	Yes	Yes
How would you rate your overall preference for this garment?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Would you recommend this garment to other caregivers or patients?	Yes	Yes
Overall satisfaction: comfort, ease of use, mobility, fabric softness, overall satisfaction	★ ★ ★ ★ ★	★ ★ ★ ★ ★
What improvements would you suggest for this garment?	No	No
Additional Comment	Both garments are comfortable and easy to handle	
Which garment do you prefer most?	G1	

Table 4.20: Feedback form patient A

Table 4.21: Feedback form patient B

Participant name	Kinnari Parmar	
Date of evaluation	15-03-2025	
Type of garment	Cotton Top with Velcro	Kaftan with attached belt front Opening
Type of deformity	Shoulder deformity	
Questions	Patient B: G1	Patient B: G2
How comfortable do you feel while wearing the garment	Comfortable	Very Comfortable
Does garment cause any pressure points or discomfort during wear	No	No
would you rate the overall comfort (while dressing) of this garment?	★ ★ ★ ★	★ ★ ★ ★ ★
would you rate the overall comfort (while undressing) of this garment?	★ ★ ★ ★	★ ★ ★ ★ ★
Does the garment contribute to overall ease and relaxation?	Yes	Yes
Fit and Adjustability	★ ★ ★ ★	★ ★ ★ ★ ★
Does the garment allow you to move freely without restrictions?	Yes	Yes
How soft does the fabric feel?	★ ★ ★ ★ ★	
Have you experienced any irritation or discomfort from the fabric?	No	No
Are the closures (e.g., Velcro, Zippers, tie string) easy to manage?	Yes	Yes
How would you rate your overall preference for this garment?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Would you recommend this garment to other caregivers or patients?	Yes	Yes
Overall satisfaction: comfort, ease of use, mobility, fabric softness, overall satisfaction	★ ★ ★ ★	★ ★ ★ ★ ★
What improvements would you suggest for this garment?	No	No
Additional Comment	Overall comfortable both the garment	
Which garment do you prefer most?	-	G2

Table 4.22: Feedback form patient C

Participant name	Manjula ben	
Date of evaluation	28 03 2025	
Type of garment	Full length gown with front opening with tie string	Full length gown with Front open
Type of deformity	RA Bedridden patient	
Questions	Patient C: G1	Patient C: G2
How comfortable do you feel while wearing the garment	Very Comfortable	Comfortable
Does garment cause any pressure points or discomfort during wear	No	No
would you rate the overall comfort (while dressing) of this garment?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
would you rate the overall comfort (while undressing) of this garment?	★ ★ ★ ★ ★	★ ★ ★ ★
Does the garment contribute to overall ease and relaxation?	Yes	Yes
Fit and Adjustability	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Does the garment allow you to move freely without restrictions?	Yes	Yes
How soft does the fabric feel?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Have you experienced any irritation or discomfort from the fabric?	No	No
Are the closures (e.g., Velcro, Zippers, tie string) easy to manage?	Yes	Yes
How would you rate your overall preference for this garment?	★ ★ ★ ★ ★	★ ★ ★ ★
Would you recommend this garment to other caregivers or patients?	Yes	Yes
Overall satisfaction: comfort, ease of use, mobility, fabric softness, overall satisfaction	★ ★ ★ ★ ★	★ ★ ★ ★
What improvements would you suggest for this garment?	No	Additional features
Additional Comment	No	N0
Which garment do you prefer most?	G1	

Table 4.23: Feedback form patient D

Participant name	Vibha Parikh	
Date of evaluation	29-03-2025	
Type of garment	Front opening Kurti with zipper and hook	Front opening overlapped angarkha type kurti with tie string
Type of deformity	All joints affected	
Questions	Patient D: G1	Patient D: G2
How comfortable do you feel while wearing the garment	Comfortable	Very Comfortable
Does garment cause any pressure points or discomfort during wear	No	No
would you rate the overall comfort (while dressing) of this garment?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
would you rate the overall comfort (while undressing) of this garment?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Does the garment contribute to overall ease and relaxation?	Yes	Yes
Fit and Adjustability	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Does the garment allow you to move freely without restrictions?	Yes	Yes
How soft does the fabric feel?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Have you experienced any irritation or discomfort from the fabric?	No	No
Are the closures (e.g., Velcro, Zippers, tie string) easy to manage?	Yes	Yes
How would you rate your overall preference for this garment?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Would you recommend this garment to other caregivers or patients?	Yes	Yes
Overall satisfaction: comfort, ease of use, mobility, fabric softness, overall satisfaction	★ ★ ★ ★	★ ★ ★ ★ ★
What improvements would you suggest for this garment?	No	No
Additional Comment	Satisfied with garments	
Which garment do you prefer most?	G1	G2

Table 4.24: Feedback form patient E**4.4.4 Analysis of the data**

Participant name	Meera Khandelwal	
Date of evaluation	27-03-2025	
Type of garment	Semi stitched saree	Saree with attached blouse and petticoat
Type of deformity	All joints affected	
Questions	Patient E: G1	Patient E: G2
How comfortable do you feel while wearing the garment	Comfortable	Very Comfortable
Does garment cause any pressure points or discomfort during wear	No	No
would you rate the overall comfort (while dressing) of this garment?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
would you rate the overall comfort (while undressing) of this garment?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Does the garment contribute to overall ease and relaxation?	Yes	Yes
Fit and Adjustability	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Does the garment allow you to move freely without restrictions?	Yes	Yes
How soft does the fabric feel?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Have you experienced any irritation or discomfort from the fabric?	No	No
Are the closures (e.g., Velcro, Zippers, tie string) easy to manage?	Yes	Yes
How would you rate your overall preference for this garment?	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Would you recommend this garment to other caregivers or patients?	Yes	Yes
Overall satisfaction: comfort, ease of use, mobility, fabric softness, overall satisfaction	★ ★ ★ ★ ★	★ ★ ★ ★ ★
What improvements would you suggest for this garment?	No	No
Additional Comment	No	No
Which garment do you prefer most?	G1	G2

The evaluation compared two garment designs, G1 (Wrap-around palazzo) and G2 (Palazzo with elastic and long zipper). G1 was rated as very comfortable, whereas G2 was considered

comfortable. Both garments performed well in comfort, fit, and mobility, yet G1 received higher ratings for ease of wear and adjustability. Fabric softness was similar for both, with no reported irritation. However, both garments were easy to handle, closures were easier to manage. The patient preferred G1. Patient recommended both the garments for others patient. Overall, G1 was the preferred choice due to its better comfort, ease of.

Patient B, who has a shoulder deformity, evaluated two garment designs: G1 (Cotton Top with Velcro) and G2 (Kaftan with an attached belt front opening). G1 was rated as comfortable, whereas G2 was considered very comfortable. Both garments did not cause any pressure points or discomfort and contributed to overall ease and relaxation. However, G2 received slightly higher ratings for dressing and undressing comfort. Both garments allowed free movement without restrictions, and neither caused irritation. Fabric softness was rated similarly for both, and their closures were easy to manage. The patient rated G2 higher in overall preference and recommended it over G1. Both garments were considered comfortable, but G2 was preferred due to its greater ease of wear and overall satisfaction

Patient C, who had RA and was bedridden, evaluated two garment designs: G1 (Full-length gown with a front opening and tie string) and G2 (Full-length gown with a front open). G1 was rated as very comfortable, whereas G2 was considered comfortable. Both garments did not cause any pressure points or discomfort and contributed to overall ease and relaxation. G1 received slightly higher ratings for dressing and undressing comfort. Both garments allowed easy undressing, and neither caused irritation. Fabric softness was rated equally for both garments. The closures of both garments were manageable. The patient caregiver ultimately preferred G1 due to its easy undressing.

Patient D, who has all joints affected, evaluated two garment designs: G1 (Front opening Kurti with a zipper and hook) and G2 (Front opening overlapped Angarkha-style top with a tie string). G1 was rated as comfortable, whereas G2 was considered very comfortable. Both garments did not cause any pressure points or discomfort and contributed to overall ease and relaxation. However, G2 received higher ratings for dressing and undressing comfort. Both garments allowed free movement without restrictions, and neither caused irritation. Fabric softness was rated equally for both garments. While the closures of both garments were manageable, both the was preferred overall. The patient was satisfied with both garments.

Patient E, who has all joints affected, evaluated two garment designs: G1 (Semi-stitched saree) and G2 (Saree with an attached blouse and petticoat). G1 was rated as comfortable, whereas G2 was considered very comfortable. Both garments did not cause any pressure points or discomfort and contributed to overall ease and relaxation. However, G2 received slightly higher ratings for dressing and undressing comfort. Both garments allowed free movement without restrictions, and neither caused irritation. Fabric softness was rated equally for both garments, and the closures were easy to manage. The patient preferred G1

and G2 both the garments overall and recommended it to other patients. No improvements were suggested, and both garments were found to be satisfactory

Patient preferred garment type, comfort rating ,ease of wear.

Table 4.25 Feedback summary

Patient	Preferred Garment	Comfort Rating	Ease of Wear	Notes
A	G1 (Wrap-around Palazzo)	Very Comfortable	Higher than G2	G1 rated better in comfort, adjustability, and ease
B	G2 (Kaftan with Belt)	Very Comfortable	Higher than G1	G2 rated higher for dressing/undressing ease
C	G1 (Front opening, tie string gown)	Very Comfortable	Higher than G2	G1 preferred by caregiver for ease of undressing
D	Both (Zipper Kurti & Angarkha)	Very Comfortable (G2)	G2 higher than G1	G2 rated higher in ease but both acceptable
E	Both (Semi-stitched & fully stitched sarees)	Very Comfortable (G2)	G2 slightly higher	Both garments recommended, no discomfort

The evaluation of adaptive garment designs across five patients with varying mobility challenges highlighted the importance of comfort, ease of wear, and mobility. Designs with features such as wrap-around styles, front openings, adjustable belts, and easy closures like Velcro and zippers were highly appreciated. Most garments allowed unrestricted movement, had soft, irritation-free fabrics, and were simple to manage during dressing and undressing. Patients and caregivers consistently favored garments that prioritized functionality without compromising comfort. Overall, the findings suggest that well-designed adaptive clothing can significantly improve the daily dressing experience for individuals with rheumatoid arthritis and similar conditions, offering both physical relief and sensory comfort.

4.4.5 Reporting and Recommendation

The study evaluated different ergonomic garment designs for rheumatoid arthritis (RA) patients, focusing on comfort, ease of dressing, mobility, fabric softness and overall comfort. Ten patients (A–E) participated, each comparing two garment types based on their specific requirement, challenges and deformities.

Patient A (RA with knee deformity) compared G1 (Wrap around Palazzo) and G2 (Palazzo with invisible long zipper and clip). The patient preferred G1, as the wrap around palazzo provided better mobility and was easier to secure.

Patient B (RA causing shoulder deformities) evaluated G1 (Kurti with Velcro) and G2 (Kaftan with an attached belt front opening). The patient found G2 more preferred due to its greater ease of wear and overall satisfaction.

Patient C (Bedridden RA patient) compared G1 (Full-length gown with tie string) and G2 (Full-length gown with front opening). While both garments were comfortable, G1 was preferred by caregiver for its ease of dressing and undressing.

Patient D (All joints affected by RA) assessed G1 (Kurti with zipper and hook) and G2 (angarkha-style kurta with tie string). Both the garments were preferred, as it provided better dressing comfort.

Patient E (All joints affected by RA) evaluated G1 (Semi-stitched saree) and G2 (Saree with an attached blouse and petticoat). Both the saree was preferred due to its convenience and ease of dressing, eliminating the need for draping.

These findings confirm that the prototypes successfully addressed patient comfort and fulfil requirements of RA patients.

Recommendation:

1. Comparative Analysis with Other Chronic Conditions – Future studies could examine similar adaptive clothing solutions for patients with other musculoskeletal disorders, such as osteoarthritis, cerebral palsy, or post-stroke conditions.
2. Conduct larger-scale testing with diverse patient groups and RA patient caregivers to refine the designs based on deformity and increase functionality.
3. Cost-Effective Production & Market Feasibility – Further research is needed to explore scalable production methods, ensuring that ergonomic clothing remains affordable and widely accessible for both hospital and home use.
4. Caregiver Feedback & Usability Studies – Conducting studies that incorporate caregiver perspectives would provide valuable insights into garment ease of assistance, dressing efficiency, and overall usability in caregiving settings.

CONCLUSION AND SUMMARY

Chapter V

CONCLUSION AND SUMMARY

5.1 Introduction

A chronic condition that affects millions of people globally, rheumatoid arthritis (RA) severely affects in daily activities like dressing. Ergonomic and adaptable clothing solutions are necessary since traditional clothing often fails short in addressing the problems caused by discomfort in the joints, stiffness, and restricted mobility. This study investigated how ergonomic garments might improve RA patients' comfort, independence, and simplicity of usage. The studies user-centered and adaptive design methodology has determined the key components needed for adaptable clothing, such as ease of use, comfort and mobility. ergonomic designs, accessible fasteners including Velcro and magnets, and soft, elastic materials. These designs promote social inclusion and self-confidence, which enhances emotional well-being in addition to physical comfort. The results emphasize how important it is to work along with RA patients to make sure clothing suits their individual requirements and tastes.

5.2 Purpose of the study

The purpose of this study is to develop and evaluate ergonomic clothing designs tailored to the unique needs of individuals with rheumatoid arthritis. By addressing the challenges they faced with conventional clothing, this research created solutions that enhanced comfort, improved mobility, facilitated ease of use, and reduced discomfort. By bridging the gaps in the existing range of adaptive clothing, this study sought to improve the quality of life for individuals with rheumatoid arthritis. Through a systematic approach including needs assessment, prototype development, and user testing this research contributed to the creation of garments that were both functional and user-friendly.

5.3 Objectives of the study

1. To identify the specific needs and challenges faced by people with rheumatoid arthritis (RA) in relation to their clothing.

2. To investigate existing ergonomic garment designs and determine gaps in current solutions.
3. To develop ergonomic garment design solutions that enhance ease of use, comfort, and mobility for individuals with rheumatoid arthritis.
4. To evaluate the ease of use, comfort and mobility of the newly designed garments through user testing and feedback.

De-Limitations of the study

- The study is limited to the Vadodara city.

5.4 Methodology

This study followed an applied research approach to address the clothing-related difficulties faced by individuals with moderate to severe rheumatoid arthritis (RA). The methodology was divided into three systematic phases: need-gap assessment, development of ergonomic prototypes, and user testing to ensure the designs were functional, comfortable, and user-friendly.

In the first phase, a detailed need-gap assessment was conducted to identify the specific issues faced by RA patients during dressing and undressing. Data collection tools included structured questionnaires, interviews, and observations. Thirty participants were selected using stratified purposive sampling, and the study focused on patients from various medical institutions in Vadodara—namely SSG Hospital, GMERS Hospital, Baroda Arthritis Clinic, One Centre for Rheumatology and Genetics, Dr. Hema Dave Physiotherapy Centre, and City Clinic. The results indicated challenges such as joint pain while handling regular garments, discomfort from tight-fitting clothes, and difficulties with buttons and hooks.

Based on the insights gathered, the second phase focused on developing ergonomic garment prototypes. A total of 30 design sketches were created, from which three designs were shortlisted for prototype construction. The designs emphasized soft, breathable fabrics, user-friendly fasteners like Velcro and magnetic closures, and adaptive features that support ease of movement and reduce dressing-related pain.

The final phase involved wear trials and user testing with five selected RA patients. The purpose was to evaluate the garments' performance in terms of comfort, accessibility, mobility, and overall satisfaction. Structured evaluation sheets and participant feedback helped measure the effectiveness of the designs. The results validated that the ergonomic garments significantly improved the wearability experience, offering both physical relief and psychological ease during daily wear.

5.5 Result and Discussion

This study aimed to design and develop ergonomic clothing for individuals with rheumatoid arthritis (RA) to enhance comfort, mobility, and ease of use. The garments were specifically designed to address challenges related to joint stiffness, limited hand dexterity, and restricted mobility faced by RA patients, particularly those undergoing treatment in hospitals and clinics. The focus was on creating functional and adaptive clothing solutions that reduce physical strain, improve accessibility, and provide a dignified and practical alternative to conventional garments. Additionally, sustainable materials and innovative fasteners were integrated to ensure ease of use while maintaining affordability and durability.

5.5.1 Need Gap Assessment

To identify the specific challenges faced by RA patients, a detailed need-gap assessment was conducted across six hospitals and clinics in Vadodara: SSG Hospital, GMERS Hospital, Baroda Arthritis Clinic, Dr. Hema Dave Physiotherapy Centre, Dr. Namisha Patel City Clinic, and Dr. Ripal Shah's Rheumatology and Genetics Centre. Surveys and interviews were conducted with five selected RA patients and healthcare professionals to gain insights into their clothing difficulties.

The findings revealed that conventional clothing posed significant challenges for RA patients due to complex fasteners, restrictive fabric choices, and discomfort during movement. Many patients reported difficulty in fastening buttons, pulling up zippers, and wearing garments with tight sleeves due to limited hand dexterity. The study also highlighted the need for garments that accommodate fluctuating joint swelling and provide easy access for medical procedures. Additionally, healthcare professionals emphasized the importance of breathable, stretchable fabrics and minimal-seam construction to prevent skin irritation. These insights formed the foundation for developing ergonomic clothing solutions tailored to the needs of RA patients.

- Alternative fasteners: Magnetic closures, Velcro straps, and elasticized openings to reduce the need for fine motor skills.
- Adjustable fittings: Drawstring waistbands and expandable panels to accommodate fluctuating joint swelling.
- Breathable, soft fabrics: Stretchable and lightweight materials to enhance comfort and mobility.
- Wider neck and sleeve openings: To facilitate ease of dressing without straining the joints.

5.5.2 Development of Prototypes

Based on the identified need gaps, the second phase of the study focused on designing and developing ergonomic clothing prototypes to improve ease of dressing and overall comfort. The design process incorporated user-friendly features such as: A total of ten ergonomic clothing prototypes were developed, including adaptive tops, bottoms, and full-body garments as per requirement of patients. The designs aimed to reduce dressing effort, provide comfort, and ensure functional ease, making them suitable for both home use and hospital stays. Cost estimation and feasibility analysis were also conducted to ensure affordability for patients.

5.5.3 User Testing

The final phase of the study involved wear trials with five selected RA patients across the participating hospitals and clinics. Each patient tested two ergonomic garment prototypes over two garment wear sessions to evaluate their functionality and comfort. The key evaluation criteria included ease of dressing, fabric comfort, fastener accessibility, mobility support, and overall user satisfaction.

The results demonstrated a significant improvement in dressing ease and mobility. Patients particularly appreciated front open designs and Velcro fasteners, as they minimized the need for precise hand movements. The fabric choices were well-received, with participants reporting reduced discomfort and better adaptability.

Conclusion

The study successfully demonstrated that ergonomic clothing can significantly enhance the dressing experience and mobility of RA patients by incorporating adaptive design elements. The integration of user-friendly fasteners, soft fabrics, and adjustable fittings addressed key challenges faced by RA patients. The findings emphasize the need for adaptive clothing solutions in day to day living, ensuring that RA patients have access to clothing that supports their functional needs while maintaining their dignity and independence.

Recommendation:

1. Comparative Analysis with Other Chronic Conditions – Future studies could examine similar adaptive clothing solutions for patients with other musculoskeletal disorders, such as osteoarthritis, cerebral palsy, or post-stroke conditions.
2. Conduct larger-scale testing with diverse patient groups and RA patient caregivers to refine the designs based on deformity and increase functionality.
3. Cost-Effective Production & Market Feasibility – Further research is needed to explore scalable production methods, ensuring that ergonomic clothing remains affordable and widely accessible for both hospital and home use.
4. Caregiver Feedback & Usability Studies – Conducting studies that incorporate caregiver perspectives would provide valuable insights into garment ease of assistance, dressing efficiency, and overall usability in caregiving settings.

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APPENDICES



Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda
Fatehgunj Road, Vadodra-390002
Ph: (+91-0265)2795522

Appendix-1

Date:

Permission Letter

To,

Subject: Request for Permission to conduct Research interviews with Rheumatoid Arthritis patients, Doctors, health providers and management team for research on "Ergonomic Garment Design for People with Arthritis"

Dear Sir/Madam

I am writing to request your kind permission to facilitate a research study being conducted by one of master's student Ms. Ami Tanna at our department under my supervision. The research is titled "*Ergonomic Garment Design for People with Rheumatoid Arthritis*" and aims to develop adaptive clothing that enhances comfort, mobility, and ease of use for individuals affected by rheumatoid arthritis.

In order to carry out this study, it is essential to gather insights from healthcare professionals and patients. We respectfully seek your approval to allow my student to conduct interviews and collect data from doctors, management and patients at your esteemed hospital. These interactions will provide critical data to ensure that the garment designs are practical and beneficial to those experiencing mobility challenges due to rheumatoid arthritis.

The research will be conducted with strict adherence to ethical guidelines, and informed consent will be obtained from all participants. I assure you that the confidentiality and privacy of all individuals involved will be rigorously protected, and the data collected will be used solely for academic purposes.

We would be grateful for your collaboration in this academic endeavour, which aims to contribute significantly to the well-being of people living with rheumatoid arthritis. If you have any specific guidelines or conditions for permitting such research at your hospital, we would be more than willing to comply.

Thank you for your consideration of this request. Please feel free to contact me if you need any further details or clarification.

Sincerely and Best Regards,

Dr. Reena Bhatia
I/C Head and Guide
Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda



**Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda
Fatehgunj Road, Vadodra-390002
Ph: (+91-0265)2795522**

Appendix-2

Date:

To,

Subject: Disclosure Letter for Research Participation

Dear Sir/Ma'am

I am writing to request your kind permission to facilitate a research study being conducted by one of master's student Ms. Ami Tanna at our department under my supervision. The research is titled "*Ergonomic Garment Design for People with Rheumatoid Arthritis*" and aims to develop adaptive clothing that enhances comfort, mobility, and ease of use for individuals affected by rheumatoid arthritis.

In order to carry out this study, it is essential to gather insights from healthcare professionals and patients. We respectfully seek your approval to allow my student to conduct interviews and collect data from doctors, management and patients at your esteemed clinic. These interactions will provide critical data to ensure that the garment designs are practical and beneficial to those experiencing mobility challenges due to rheumatoid arthritis.

The research will be conducted with strict adherence to ethical guidelines, and informed consent will be obtained from all participants. I assure you that the confidentiality and privacy of all individuals involved will be rigorously protected, and the data collected will be used solely for academic purposes.

The research will be conducted with strict adherence to ethical guidelines, and informed consent will be obtained from all participants. I assure you that the confidentiality and privacy of all individuals involved will be rigorously protected, and the data collected will be used solely for academic purposes.

We would be grateful for your collaboration and No personal or identifying details of the patients involved will be recorded, shared, or disclosed. All data collected will remain confidential and anonymized. Selected participants will be asked about clothing challenges and may try garment prototypes. Participation is voluntary, and they can withdraw anytime without explanation. The study adheres to strict ethical guidelines, ensuring privacy, comfort, and informed consent from all participants.

in this academic endeavour, which aims to contribute significantly to the well-being of people living with rheumatoid arthritis. If you have any specific guidelines or conditions for permitting such research at your clinic, we would be more than willing to comply.

Thank you for your consideration of this request. Please feel free to contact me if you need any further details or clarification.

Sincerely and Best Regards

Dr. Reena Bhatia

I/C Head and Guide

Department of Clothing and Textiles

Faculty of Family and Community Sciences

The Maharaja Sayajirao University of Baro

Appendix-3

Institutional Human Ethics Committee

CDSO Registration No. #ECR/4 : 1Inst/GJ/42351RR-24 Approved upto 37 / April / 4229

NECRBHR Registration No. ECINEWIINST/2021GJ/0016 Approved upto 15 / November / 2026

GMERS Medical College & Hospital, Gotri, Vadodara – 390021, Gujarat, India

Phone: (0265) 2398008, Fax: # (0265) 2398009, #Email: ihecmcgv@gmail.com

Annexure I (A) - IHEC Application form for Academic Project of faculty/PG/UG students.

For Office Use
Received Date:
IHEC No:
Returned after IHEC evaluation:
Received after revision:
IHEC Approval Date:

Photograph of PI

Proposal Title:

Investigators details:

	Name, Qualifications & Designation	Address, Mobile & Email ID	Signature
Faculty/Student			
Co-I/Guide			

Minimal Risk

Yes / No

Checklist for attached documents:

1. IHEC Application form Yes
2. Curriculum Vitae Principal Investigator Yes
3. GCP Certificate Yes / No
/ NA
4. Approval of departmental scientific committee/Institutional scientific board Yes
5. Proposal (Introduction, Review & Justification, Objectives, Methodology, Outcome measures, Plan for data analysis) Yes
6. Case Record Form and / or questionnaires Yes
7. Patient information sheet (Dardi Mahiti Patrak) in English Yes / No
/ NA
8. Patient information sheet (Dardi Mahiti Patrak) in vernacular language Yes / No
/ NA

9. Informed Consent form (Dardi Sahmati Pratrak) in English Yes / No
/ NA
10. Informed Consent form (Dardi Sahmati Pratrak) in vernacular languages Yes / No
/ NA

Date:

Name & Signature of Faculty/Student
I/Guide

Name & Signature of Co-

Institutional Human Ethics Committee

CDSCO Registration No. #ECR/4 : 1Inst/GJ/42351RR-24 Approved upto 37 / April / 4229

NECRBHR Registration No. ECINEWIINST/2021GJ/0016 Approved upto 15 / November / 2026

GMERS Medical College & Hospital, Gotri, Vadodara – 390021, Gujarat, India

Phone: (0265) 2398008, Fax: # (0265) 2398009, #Email: ihecmcgv@gmail.com

Annexure – 3

Investigator's Undertaking

Study Title:

1. We certify that, we have determined that the proposal herein is not unnecessarily duplicative of previously reported research.
2. We certify that, we are qualified by education, training and have enough experience to do such a study.
3. For procedures listed under proposal, we certify that we have reviewed the pertinent scientific literature and have found no valid alternative to any procedure described herein which may cause less pain or distress to the patient.
4. We certified that, study will be initiated only upon review and approval of scientific intent by IHEC GMERS Medical College and Hospital Gotri, Vadodara and getting a certificate from IHEC.
5. We will do necessary changes in our study protocol as per the suggestions given by respected IHEC members during meeting before getting approval letter and bound to submit the changes to IHEC. We will obtain approval from the IHEC GMERS Medical College and Hospital Gotri, Vadodara, before making any significant changes in this study. Institutional Biosafety Committee's (IBC) certification of review and concurrence will be taken (Required for studies utilizing DNA agents of human pathogens).
6. We will do our study according to ICH-GCP guidelines and maintain all the study related records. Whenever asked, we are bound to produce to IHEC GMERS Medical College and Hospital Gotri, Vadodara.
7. We will report adverse drug reaction to Pharmacovigilance Cell & IHEC whenever, we come across the adverse drug reaction while doing research work. (If Applicable)
8. We certify that, we will follow the recommendations of IHEC and Govt. of Gujarat rules and regulation issued from time to time.
9. We certify that, record of all premature termination of a study with a summary of the reasons/final report after completion of the study including microfilms, CDs and Video recordings; will submit to the IHEC GMERS Medical College and Hospital Gotri, Vadodara.

Name, Signature & Date of All Investigators

Appendix-4

Questionnaire for Research Study: "Ergonomic garment design for people with rheumatoid arthritis"

Researcher: Ami Tanna

Department: Clothing and Textiles, Faculty of Family and Community Sciences

University: The Maharaja Sayajirao University of Baroda, Vadodara

Guide: Dr. Reena Bhatia

The questionnaire is prepared by Ami Tanna Sr. M. Sc student of Department of Clothing and Textiles, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda, Vadodara. The following questionnaire schedule will be used as a tool for collecting data. The below mentioned survey will be undertaken as a part of her research entitled **Ergonomic garment design for people with rheumatoid arthritis** guided by **Dr. Reena Bhatia**.

Thank you for participating in this research study. Your input will help improve ergonomic garment for people with RA.

➡ Objective 1 and Objective 2

1. To identify the specific needs and challenges faced by people with rheumatoid arthritis (RA) in relation to their clothing.
2. To investigate existing ergonomic garment designs and determine gaps in current solutions.

Patient Initials

1. Age:
 - 30-40 years
 - 41-50 years
 - 51-60 years
 - Above 60 years
2. Gender:
 - Male
 - Female
 - Other
3. Duration of RA:
 - 10-15 years
 - 16-20 years
 - More than 20 years
4. Severity of RA:
 - Mild
 - Moderate
 - Severe
5. How difficult is it for you to dress independently?
 - Not at all difficult
 - Slightly difficult
 - Moderately difficult

- Very difficult
 - Extremely difficult
6. Do your clothes cause discomfort due to joint swelling?
- Not at all
 - Slightly
 - Moderately
 - Very much
 - Extremely
7. Do you face challenges with fasteners like zippers or buttons?
- Never
 - Rarely
 - Sometimes
 - Often
 - Always
8. Does putting on or removing clothes cause you pain?
- Not at all
 - Slightly
 - Moderately
 - Very much
 - Extremely
9. Do you find it difficult to handle fabric due to stiffness in your fingers or joints?
- Never
 - Rarely
 - Sometimes
 - Often
 - Always
10. Do you have challenges with clothing being too tight or restrictive for your swollen joints?
- Not at all
 - Slightly
 - Moderately
 - Very much
 - Extremely
11. Does your clothing accommodate the movement and comfort needs of your joints?
- Not at all
 - Slightly
 - Moderately
 - Very much
 - Completely
12. How satisfied are you with the current clothing you wear in terms of comfort and ease of use?
- Very satisfied
 - Satisfied
 - Neutral
 - Dissatisfied
 - Very dissatisfied

13. Do you believe existing clothing meets your physical needs caused by RA?

- Yes
- No
- Partially

14. In your opinion, what are the top three limitations of your current clothing?

_____ (open-ended)

15. Have you made any personal adjustments to your clothing to make it more comfortable for your condition?

- Yes
- No
- If yes, please describe: _____

16. What challenges do you face when dressing **upper body garments**?

- Raising arms above the head
- Pulling tops over the head
- Tight-fitting armholes/sleeves
- Buttoning shirts
- Other: _____

17. What challenges do you face when wearing **lower body garments**?

- Fastening pants (zippers/buttons)
- Tight waistbands
- Pulling pants/skirts up or down
- Difficulty with footwear/with current footwear
- Other: _____

18. Do you use customized Footwear?

- Yes
- No
- Reason for customized footwear _____

19. Which types of fabrics/designs cause discomfort?

- Stiff fabrics (e.g., denim, thick cotton)
- Rough textures
- Tight-fitting designs
- Heavy or layered fabrics
- Other: _____

20. How do **seasonal changes** impact your comfort with clothing?

- Summer: _____
- Winter: _____
- Monsoon: _____

21. Do you prefer **loose-fitting or adjustable** clothing?

- Loose-fitting

- Adjustable with drawstrings or elastic
- Both

22. What **features** do you avoid in clothing due to difficulty?

- Buttons
- Zippers
- Hooks
- Tight sleeves
- Tight waistbands
- Heavy fabrics

23. Are there any **cultural or traditional garments** you find difficult to wear?

- Sarees
- Salwar-kameez
- Kurtas
- Lehenga
- Other (please specify): _____

24. Do you require **custom-made garments** to suit your needs?

- Yes
- No

25. How do you manage your discomfort with clothing during **travel or events/Functions**?

- Wear lightweight clothing
- Use adaptive or modified clothing

Other (please specify): _____

Current Garment Preferences

26. Which **fabrics** do you find most comfortable?

- Cotton
- Linen
- Knits/Stretch fabrics
- Wool (for winter)
- Synthetic blends
- Other: _____

27. Which **fasteners** do you prefer in your clothing?

- Velcro
- Magnetic closures
- Elastic bands
- Zippers with pull tabs
- Buttons (large-sized)

28. Do you use any **accessories or aids** while dressing?

- Dressing sticks

- Zipper pulls
 - Button hooks
 - Customized footwear
29. How much does **ease of care** (e.g., washing/ironing) impact your garment choices?
- A lot
 - Moderately
 - Rarely
30. Do you prefer garments with **minimal seams** to avoid irritation?
- Yes
 - No
31. How much would you be willing to spend on garments designed specifically for RA patients?
- Affordable (₹500–₹1,000)
 - Moderate (₹1,000–₹3,000)
 - Premium (₹3,000 and above)

Section D: Feedback on Existing Ergonomic Clothing

32. Have you used any **adaptive or ergonomic garments**?
- Yes
 - No
33. If yes, where did you purchase them?
- Online platforms
 - Local stores
 - Tailor-made
34. Rate the effectiveness of existing adaptive garments on a scale of 1–5:
- 1 (Poor) to 5 (Excellent): _____
35. What issues do you still face with current adaptive garments?
- Lack of style/design variety
 - Poor durability
 - High cost
 - Limited availability
36. Do you think ergonomic garments for RA patients are necessary in the market?
- Strongly agree
 - Agree
 - Neutral
 - Disagree
 - Strongly disagree
37. Rank the following **features** for RA clothing from most to least important (1 = most important):

- Front-open designs
- Lightweight, soft fabrics
- Easy closures (Velcro, magnets)
- Stretchable designs
- Loose or adjustable fit

38. What **improvements** would you like to see in ergonomic clothing?

39. Would you like to be involved in **design trials** for new ergonomic garments?

- Yes
- No

40. Any other **suggestions or comments** to improve clothing comfort for RA patients?

Thank You for Your Valuable Feedback!

Your responses will contribute to the development of clothing solutions that improve comfort and ease of dressing for RA patients.

Observation

1. Note the participant's mobility when performing simple dressing tasks.
2. Observe whether any particular areas (e.g., shoulders, elbows, knees) are particularly affected during movement.
3. Assess the participant's difficulty with fasteners, zippers, or other components that require.
4. Observe if participants struggle with common adaptive clothing features such as Velcro, elastic waistbands, or magnetic closures.
5. Identify specific pain points during dressing and undressing related to the ergonomic design.
6. Take note of any modifications the participant makes to existing garments to improve usability.

Thank you for sharing your insights and experiences. Your feedback will greatly contribute to improving ergonomic garment designs for people with rheumatoid arthritis.

Appendix-5

Informed Consent form for RA patients, doctors & providers

DEPARTMENT OF CLOTHING AND TEXTILE
FACULTY OF FAMILY & COMMUNITY SCIENCES
THE MAHARAJ SAYAJIRAO UNIVERSITY OF BARODA
VADODARA

STUDY TITLE: Ergonomic Garment Design for People with Rheumatoid Arthritis

INVESTIGATORS

Guide -Dr. Reena Bhatia
Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda
(M): +919376235666
Email Id: reenabhatia-ct@msubaroda.ac.in

Researcher - Ami Tanna
Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda
(M): 7623823257
Email Id: tanna.ami23@gmail.com

I invite you to take part in a research study, which seeks to gain insights into the ergonomic garment design for people with rheumatoid arthritis as a part of partial fulfillment of the master's degree program which is self-funded. Participation in this study is entirely voluntary. If you decide to participate, you must sign this form to show that you want to take part.

Purpose of the Research:

This research study is being done to develop and evaluate adaptive clothing solutions for individuals with rheumatoid arthritis, with the goal of improving comfort, mobility, and ease of use during daily activities.

Time Duration of the Procedures and Study:

Your participation in this study will last approximately September to April, and it would be a interaction at your convenience.

Procedures:

If you agree to participate in this study, you will be expected/asked to provide feedback on the requirement basis, general questions on day-to-day hurdles, garment design developed as part of this study, specifically regarding its comfort, functionality, and ease of use.

Risks and Benefits:

There are no known risks associated with participating in this study. However, we hope that the information we gather from this study will help us gain insights into the specific clothing needs of people with rheumatoid arthritis, ultimately leading to the development of more adaptive and user-friendly garments.

Confidentiality:

All information collected during this study will be kept strictly confidential. Your name will not be used in any reports or publications resulting from this study. Your responses

will be assigned a unique identification number that will be used to identify your data.

Participation in this study is entirely voluntary. You may refuse to participate or withdraw from the study at any time without penalty or loss of benefits to which you are otherwise entitled.

Voluntary Participation:

Cost:

Participating in this study will entail no associated costs or charges.

Contact Information:

If you have any questions or concerns about this study, please contact Ami Tanna, Email address: tanna.ami23@gmail.com

Consent:

By signing this consent form, you are agreeing to participate in this study. You understand that you are free to withdraw from the study at any time without penalty. You also understand that your participation in this study is confidential.

Signature of participant

Investigator's Statement

I have explained the research procedures and the purpose of the study. The participant was given an opportunity to discuss these procedures and ask any additional questions.

Ami Tanna

Date:

Place:

Note: Please sign and return a copy of this consent form to confirm your participation in the study. Thank you for your willingness to contribute to this research.

Appendix-6

રૂમેટોઇડ આર્થ્રાઇટિસના દર્દીઓ, ડોક્ટરો અને પ્રદાતાઓ માટેની જાણકારી આધારિત સંમતિ ફોર્મ

વસ્ત્ર અને ટેક્સટાઇલ વિભાગ
પરિવાર અને સમુદાય વિજ્ઞાન ફેકલ્ટી
મહારાજા સયાજીરાવ યુનિવર્સિટી ઓફ બરોડા, વડોદરા

અભ્યાસ

રૂમેટોઇડ આર્થ્રાઇટિસના દર્દીઓ માટે
આર્કોષોમિક વસ્ત્ર ડિઝાઇન
માર્ગદર્શક - ડૉ. રીના ભાટિયા
વસ્ત્ર અને ટેક્સટાઇલ વિભાગ
પરિવાર અને સમુદાય વિજ્ઞાન ફેકલ્ટી
મહારાજા સયાજીરાવ યુનિવર્સિટી ઓફ બરોડા
(મોબાઇલ): +919376235666
ઇમેલ: reenabhatia-ct@msubaroda.ac.in

શીર્ષક:

શોધક - અમી તન્ના
વસ્ત્ર અને ટેક્સટાઇલ વિભાગ
પરિવાર અને સમુદાય વિજ્ઞાન ફેકલ્ટી
મહારાજા સયાજીરાવ યુનિવર્સિટી ઓફ બરોડા
(મોબાઇલ): 7623823257
ઇમેલ: tanna.ami23@gmail.com

મારા આ અભ્યાસમાં ભાગ લેવા માટે હું આપને આમંત્રિત કરું છું. આ અભ્યાસ રૂમેટોઇડ આર્થ્રાઇટિસ ધરાવતા લોકો માટે આર્કોષોમિક વસ્ત્ર ડિઝાઇન વિષે જરૂરી જાણકારી મેળવવાનો પ્રયાસ કરે છે, જે સ્વનિર્ભર ફંડ સાથે માસ્ટર્સ ડિગ્રી કાર્યક્રમનો ભાગ છે. આ અભ્યાસમાં ભાગ લેવો પૂર્ણતઃ સ્વૈચ્છિક છે. જો તમે ભાગ લેવાનો નિર્ણય કરો છો, તો કૃપા કરીને આ ફોર્મ પર સાઇન કરીને ભાગ લેવાની તમારી ઇચ્છા દર્શાવો.

શોધનો હેતુ:

આ અભ્યાસનું ધ્યેય છે કે રૂમેટોઇડ આર્થ્રાઇટિસ ધરાવતા વ્યક્તિઓ માટે અનુકૂળ અને ઉપયોગી વસ્ત્રોની રચના અને મૂલ્યાંકન કરવું, જેથી રોજિંદા કાર્યો દરમિયાન આરામ, યાલકતા અને ઉપયોગની સરળતા વધે.

અભ્યાસની પ્રક્રિયાનો સમયગાળો:

આ અભ્યાસમાં તમારી ભાગીદારી સપ્ટેમ્બરથી એપ્રિલ સુધી રહેશે અને તે તમારી અનુકૂળતાના આધારે થશે.

પ્રક્રિયાઓ:

જો તમે આ અભ્યાસમાં ભાગ લેવા માટે સંમતિ આપો છો, તો તમને જરૂર મુજબ પ્રતિસાદ આપવાની વિનંતી કરવામાં આવશે. રોજિંદા મુશ્કેલીઓ અને અભ્યાસનો હિસ્સો તરીકે બનાવેલા વસ્ત્ર ડિઝાઇન વિશે સામાન્ય પ્રશ્નો, ખાસ કરીને તેની આરામદાયકતા, કાર્યક્ષમતા અને ઉપયોગની સરળતા અંગે પ્રતિસાદ આપવો પડશે.

જોખમ અને લાભ:

આ અભ્યાસમાં ભાગ લેવાથી કોઈ જાણીતા જોખમો નથી. અમે આશા રાખીએ છીએ કે આ અભ્યાસમાંથી પ્રાપ્ત માહિતી અમને રૂમેટોઇડ આર્થ્રાઇટિસ ધરાવતા લોકોના વિશિષ્ટ વસ્ત્ર જરૂરિયાતો વિશે જાણકારી આપશે અને વધુ અનુકૂળ અને વપરાશકર્તા-મૈત્રીપૂર્ણ વસ્ત્રોના વિકાસ તરફ દોરી જશે.

ગુપ્તતા:

આ અભ્યાસ દરમિયાન એકત્રિત તમામ માહિતી સંપૂર્ણ ગુપ્ત રહેશે. આ અભ્યાસના પરિણામોમાં તમારું નામ ઉપયોગમાં લેવાશે નહીં. તમારો પ્રતિસાદ એક અનન્ય ઓળખ નંબર સાથે જોડાશે, જે તમારી માહિતીની ઓળખ માટે ઉપયોગમાં લેવાશે.

સ્વૈચ્છિક ભાગીદારી:

આ અભ્યાસમાં ભાગ લેવું સંપૂર્ણપણે સ્વૈચ્છિક છે. તમે કોઈપણ સમયે અભ્યાસમાંથી ભાગ ન લેવા અથવા સંમતિ પાછી ખેંચી શકો છો, અને તમને તેની કોઈ સજા અથવા લાભ ન ગુમાવવાનો છે.

કિંમત:

આ અભ્યાસમાં ભાગ લેવા માટે તમારી કોઈ કિંમત નહીં લાગે.

સંપર્ક માહિતી:

જો તમને આ અભ્યાસ વિશે કોઈ પ્રશ્નો અથવા ચિંતા હોય, તો કૃપા કરીને અમી તન્ના સાથે સંપર્ક કરો, ઇમેલ: tanna.ami23@gmail.com

સંમતિ:

આ સંમતિ ફોર્મ પર સાઇન કરીને, તમે આ અભ્યાસમાં ભાગ લેવાનો સંમતિ આપો છો. તમે સમજો છો કે તમે કોઈપણ સમયે અભ્યાસમાંથી બહાર નીકળી શકો છો અને તે માટે કોઈ સજા નહીં થાય. તમે આ બાબતને પણ સમજો છો કે આ અભ્યાસમાં તમારી ભાગીદારી સંપૂર્ણપણે ગુપ્ત રહેશે.

ભાગીદારની સહી:

શોધકનું નિવેદન:

મેં અભ્યાસની પ્રક્રિયા અને અભ્યાસનો હેતુ સમજાવ્યો છે. ભાગીદારને આ પ્રક્રિયાઓ પર ચર્ચા કરવાની અને કોઈપણ વધારાના પ્રશ્નો પૂછવાની તક આપવામાં આવી હતી.

(અમિ તન્ના)

તારીખ:

સ્થળ:

કૃપા કરીને આ સંમતિ ફોર્મ પર સાઇન કરીને અભ્યાસમાં ભાગ લેવાની તમારી ઇચ્છા દર્શાવો. આ સંશોધન માટે તમારું યોગદાન આપવા બદલ ધન્યવાદ.

Appendix-7

Patient Evaluation Form—Wear Trial for Ergonomic Garments

Researcher: Ms. Ami Tanna, Sr. M.Sc. (F.C. Sc.)

Department/Faculty: Clothing and Textiles, Family and Community Sciences

University: The Maharaja Sayajirao University of Baroda, Vadodara

Guide: Dr. Reena Bhatia

This evaluation form is a part of my research study entitled '*Ergonomic Garment Design for People with Rheumatoid Arthritis*' guided by Dr. Reena Bhatia. Your valuable feedback will contribute to fulfilling one of my research objectives.

Objective: To evaluate the effectiveness of the newly designed garments through user testing and feedback.

Thank you for your time and valuable input. Your responses will help enhance the ease of use and comfort of ergonomic clothing for individuals with rheumatoid arthritis.

Sampling method:

Purposive sampling will be used, and participants were selected based on their deformity.

Tools to be used: observation, wear trial evaluation form.

1. Participant name
2. Date of evaluation
3. Type of garment
4. Type of deformity
5. **How comfortable do you feel while wearing the garment?**
 - Very Comfortable
 - Comfortable
 - Neutral
 - Uncomfortable
 - Very Uncomfortable
 -
6. **Does the garment cause any pressure points or discomfort during wear?**
 - Yes
 - No

7. How would you rate the overall comfort (while dressing) of this garment?

1	2	3	4	5
<input type="radio"/>				

8. How would you rate the overall comfort (while undressing) of this garment?

1	2	3	4	5
<input type="radio"/>				

9. Does the garment contribute to overall ease and relaxation?

- Yes
- No

10. Fit and Adjustability

1	2	3	4	5
<input type="radio"/>				

11. Does the garment allow you to move freely without restrictions?

- Yes
- No

12. How soft does the fabric feel?

1	2	3	4	5
<input type="radio"/>				

13. Have you experienced any irritation or discomfort from the fabric?

- Yes
- No

14. Does the garment fit you properly without feeling too tight or too loose?

- Yes
- No

15. Are the closures (e.g., Velcro, Zippers, tie string) easy to manage?

- Yes
- No

16. How would you rate your overall preference for this garment?

1	2	3	4	5
<input type="radio"/>				

17. **Would you recommend this garment to other caregivers or patients?**

- Yes
- No

18. **Overall satisfaction: comfortable, ease of use, mobility**

1	2	3	4	5
<input type="radio"/>				

19. **What improvements would you suggest for this garment?**

- a) Fabric choice
- b) Design adjustments
- c) Additional features
- d) No improvements needed

20. **Additional Comment**

21. Which garment do you prefer most?

- G1
- G2
- Both

Thank you for your participation!

Google form link

https://docs.google.com/forms/d/e/1FAIpQLSeN_UPPnaTwMGNErixm_g0Vm90kO1ImD66qeE07M2D0Yuhxw/viewform?usp=header



Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda
Pratapgunj, Vadodara, Gujarat-390002
Ph: (+91-0265)2795522

Date: 06-03-2025

To, Dr. Ripal Shah

Subject: Request for Permission to conduct Research interviews with Rheumatoid Arthritis patients, Doctors, health providers and management team for research on "Ergonomic Garment Design for People with Arthritis"

Dear Sir/Madam

I am writing to request your kind permission to facilitate a research study being conducted by one of master's student Ms. Ami Tanna at our department under my supervision. The research is titled "Ergonomic Garment Design for People with Rheumatoid Arthritis" and aims to develop adaptive clothing that enhances comfort, mobility, and ease of use for individuals affected by rheumatoid arthritis.

In order to carry out this study, it is essential to gather insights from healthcare professionals and patients. We respectfully seek your approval to allow my student to conduct interviews and collect data from doctors, management and patients at your esteemed hospital. These interactions will provide critical data to ensure that the garment designs are practical and beneficial to those experiencing mobility challenges due to rheumatoid arthritis.

The research will be conducted with strict adherence to ethical guidelines, and informed consent will be obtained from all participants. I assure you that the confidentiality and privacy of all individuals involved will be rigorously protected, and the data collected will be used solely for academic purposes.

We would be grateful for your collaboration in this academic endeavour, which aims to contribute significantly to the well-being of people living with rheumatoid arthritis. If you have any specific guidelines or conditions for permitting such research at your hospital, we would be more than willing to comply.

Thank you for your consideration of this request. Please feel free to contact me if you need any further details or clarification.

Sincerely and Best Regards,

Dr. Reena Bhatia
I/C Head and Guide
Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda

happy to participate

Dr. Ripal Shah M.D.
G 15032
Rheumatologist
412 TRIVIA, Nakulnha Circle
Race Course, Vadodra-7
265 2987000, 99294 77377



Department of Clothing and
Textiles Faculty of Family and
Community Sciences The Maharaja
Sayajirao University of Baroda
Pratapgunj, Vadodara, Gujarat-390002
Ph: (+91-0265)2795522
Date: 13-12-2024

Disclosure Letter

07-02-2025

To, *Dr. Namisha Patel*

Subject: Disclosure Letter for Research Participation

Dear Sir/Ma'am

I am writing to request your kind permission to facilitate a research study being conducted by one of master's student Ms. Ami Tanna at our department under my supervision. The research is titled "Ergonomic Garment Design for People with Rheumatoid Arthritis" and aims to develop adaptive clothing that enhances comfort, mobility, and ease of use for individuals affected by rheumatoid arthritis.

In order to carry out this study, it is essential to gather insights from healthcare professionals and patients. We respectfully seek your approval to allow my student to conduct interviews and collect data from doctors, management and patients at your esteemed clinic. These interactions will provide critical data to ensure that the garment designs are practical and beneficial to those experiencing mobility challenges due to rheumatoid arthritis.

The research will be conducted with strict adherence to ethical guidelines, and informed consent will be obtained from all participants. I assure you that the confidentiality and privacy of all individuals involved will be rigorously protected, and the data collected will be used solely for academic purposes.

The research will be conducted with strict adherence to ethical guidelines, and informed consent will be obtained from all participants. I assure you that the confidentiality and privacy of all individuals involved will be rigorously protected, and the data collected will be used solely for academic purposes. We would be grateful for your collaboration and No personal or identifying details of the patients involved will be recorded, shared, or disclosed. All data collected will remain confidential and anonymized. Selected participants will be asked about clothing challenges and may try garment prototypes. Participation is voluntary, and they can withdraw anytime without explanation. The study adheres to strict ethical guidelines, ensuring privacy, comfort, and informed consent from all participants.

in this academic endeavour, which aims to contribute significantly to the well-being of people living with rheumatoid arthritis. If you have any specific guidelines or conditions for permitting such research at your clinic, we would be more than willing to comply.

Thank you for your consideration of this request. Please feel free to contact me if you need any further details or clarification.

Sincerely and Best Regards,

N. Patel

Dr. Reena Bhatia
IC Head and Guide
Department of Clothing and Textiles
Faculty of Family and Community
Sciences
The Maharaja Sayajirao University of Baroda

Dr. NAMISHA PATEL
Reg. No. G-5876 ^{MD}
Consultant Rheumatologist
CITY CLINIC
Laxmi Bhuvan, Pradhan Marg,
Opp. Lakdi Pool,
VADODARA-390001.



Department of Clothing and
Textiles Faculty of Family and Community
Sciences The Maharaja Sayajirao
University of Baroda Pratapgunj,
Vadodara, Gujarat-390002
Ph: (+91-0265)2795522

Date: 13-12-2024

To, Dr. Pradip Prajapati

Subject: Request for Permission to conduct Research interviews with Rheumatoid Arthritis patients, Doctors, health providers and management team for research on "Ergonomic Garment Design for People with Arthritis"

Dear Sir/Madam

I am writing to request your kind permission to facilitate a research study being conducted by one of master's student Ms. Ami Tanna at our department under my supervision. The research is titled "Ergonomic Garment Design for People with Rheumatoid Arthritis" and aims to develop adaptive clothing that enhances comfort, mobility, and ease of use for individuals affected by rheumatoid arthritis.

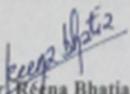
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We would be grateful for your collaboration in this academic endeavour, which aims to contribute significantly to the well-being of people living with rheumatoid arthritis. If you have any specific guidelines or conditions for permitting such research at your hospital, we would be more than willing to comply.

Thank you for your consideration of this request. Please feel free to contact me if you need any further details or clarification.

Sincerely and Best Regards,


Dr. Reena Bhatia
I/C Head and
Guide
Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda


Dr. Pradipkumar V. Prajapati
Consultant Rheumatologist
Reg. No. G-16347 M.D. (Med.)
ARODA ARTHRITIS CLINIC
F-35-36-37, Emerald One Complex,
Talpur Road, Vadodara - 390 020.



Department of Clothing and
Textiles Faculty of Family and Community
Sciences The Maharaja Sayajirao
University of Baroda Pratapgunj,
Vadodara, Gujarat-390002
Ph: (+91-0265)2795522

Date: 30/12/2024

To, Dr. Hema Dave

Subject: Request for Permission to conduct Research interviews with Rheumatoid Arthritis patients, Doctors, health providers and management team for research on "Ergonomic Garment Design for People with Arthritis"

Dear Sir/Madam

I am writing to request your kind permission to facilitate a research study being conducted by one of our student Ms. Ami Tanna at our department under my supervision. The research is titled "Ergonomic Garment Design for People with Rheumatoid Arthritis" and aims to develop adaptive clothing that enhances comfort, mobility, and ease of use for individuals affected by rheumatoid arthritis.

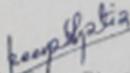
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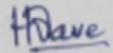
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We would be grateful for your collaboration in this academic endeavour, which aims to contribute significantly to the well-being of people living with rheumatoid arthritis. If you have any specific guidelines or conditions for permitting such research at your hospital, we would be more than willing to comply.

Thank you for your consideration of this request. Please feel free to contact me if you need any further details or clarification.

Sincerely and Best Regards,


Dr. Keena Bhatia
IC Head and
Guide
Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda


Dr. Hema R. Dave
Consulting Physiotherapist
V-One Society, Baroda.



Accredited Grade "A+" by NAAC

Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda
Pratapgunj, Vadodara, Gujarat-390002
Ph: (+91- 0265)2795523
Date: 27/09/2024

To,
Dr. Ranjan G. Aiyer
Medical Superintendent
S.S.G Hospital, Jail Road
Anandpura Vadodara - 390001

Subject: Request for Permission to conduct Research interviews with Rheumatoid Arthritis patients, Doctors, health providers and management team for research on "Ergonomic Garment Design for People with Arthritis"

Dear Sir/Madam

I am writing to request your kind permission to facilitate a research study being conducted by one of master's student Ms. Ami Tanna at our department under my supervision. The research is titled "Ergonomic Garment Design for People with Rheumatoid Arthritis" and aims to develop adaptive clothing that enhances comfort, mobility, and ease of use for individuals affected by rheumatoid arthritis.

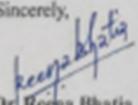
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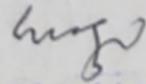
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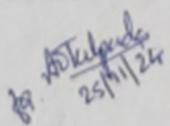
We would be grateful for your collaboration in this academic endeavour, which aims to contribute significantly to the well-being of people living with rheumatoid arthritis. If you have any specific guidelines or conditions for permitting such research at your hospital, we would be more than willing to comply.

Thank you for your consideration of this request. Please feel free to contact me if you need any further details or clarification.

Sincerely,


Dr. Reema Bhatia
I/C Head and Guide
Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda


Medical Superintendent
S.S.G. Hospital, Vadodara.


25/9/24

Head
Anandpura
Vadodara
Gujarat

Institutional Human Ethics Committee

CDSCO Registration No. EC.R/28/Inst/GJ/2014-24 Approved upto 15 / April / 2029
 NECRBHR Provisional Registration No. ECINEWINST/2021/GJ/0016 Approved upto 15/November/ 2026
 GMERS Medical College & Hospital, Gotri, Vadodara – 390021, Gujarat, India
 Phone: (0265) 2398008, Fax:(0265) 2398009,Email: ihecmcgv@gmail.com

Annexure I (A)- IHEC Application form for Academic Project of faculty/PG/UG students.

For Office Use
Received Date: 20/11/2024
IHEC No:
Returned after IHEC evaluation:
Received after revision:
IHEC Approval Date:



Proposal Title: ERGONOMIC GARMENT DESIGN FOR PEOPLE WITH RHEUMATOID ARTHRITIS

Investigators details:

	Name, Qualifications & Designation	Address, Mobile & Email ID	Signature
Faculty/Student	Ms. Ami Tanna Sr. M.sc. Student	301, sai stuti apartment, Near kalyanparty plot, Beside olx auto, behind baskin robins, Vasna road, Vadodara, Gujarat 390007 Mo.- +91 7623823257 Email ID- tanna.ami23@gmail.com	
Co-I/Guide	Dr. Reena Bhatia I/c Head, Department of Clothing and Textiles President, Alumni Association of Clothing and Textile Department Assistant Professor	Clothing And Textiles Department, Faculty of Family And Community Sciences, The Maharaja Sayajirao University of Baroda, Vadodara -390002 Mo.- +91 9376235666 Email ID-reenabhatia-cs@msubaroda.ac.in	

Minimal Risk

Yes / No

Checklist for attached documents:

- | | |
|---|---|
| 1. IHEC Application form | Yes <input checked="" type="checkbox"/> |
| 2. Curriculum Vitae Principal Investigator | Yes <input type="checkbox"/> |
| 3. GCP Certificate | Yes <input type="checkbox"/> / No <input checked="" type="checkbox"/> / NA <input type="checkbox"/> |
| 4. Approval of departmental scientific committee/Institutional scientific board | Yes <input checked="" type="checkbox"/> |
| 5. Proposal (Introduction, Review & Justification, Objectives, Methodology, Outcome measures, Plan for data analysis) | Yes <input checked="" type="checkbox"/> |
| 6. Case Record Form and / or questionnaires | Yes <input checked="" type="checkbox"/> |
| 7. Patient information sheet (Dardi Mahiti Patrak) in English | Yes <input type="checkbox"/> / No <input checked="" type="checkbox"/> / NA <input type="checkbox"/> |
| 8. Patient information sheet (Dardi Mahiti Patrak) in vernacular language | Yes <input type="checkbox"/> / No <input checked="" type="checkbox"/> / NA <input type="checkbox"/> |
| 9. Informed Consent form (Dardi Sahmati Pratrak) in English | Yes <input checked="" type="checkbox"/> / No <input type="checkbox"/> / NA <input type="checkbox"/> |
| 10. Informed Consent form (Dardi Sahmati Pratrak) in vernacular languages | Yes <input checked="" type="checkbox"/> / No <input type="checkbox"/> / NA <input type="checkbox"/> |

Date: 20/11/2024

Name & Signature of Faculty/Student

AMI TANNA

Principal Investigator

Name & Signature of Co-I/Guide

Dr. REENA BHATIA

Guide