ADAPTIVE SPORTSWEAR FOR WHEELCHAIR TENNIS PLAYERS IN INDIA

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Keywords

Adaptive, Sportswear, Wheelchair Tennis, Product Development, User-centric

Abstract

This article concentrates on the need for adaptive sportswear for wheelchair tennis players in India. Para sports are gaining recognition in India in some metropolitan cities and gradually drawing players' attention from rural areas. Wheelchair tennis is a para-sport encouraged in some cities by government and non-government organisations by arranging tournaments and providing designated regular practice spaces for the players. Differently abled players with impairment in legs with a working arm can play in the open class, whereas players with additional impairment in their arms can play in the quad class. The purpose of the study is to tap into the prerequisites of the player's sportswear requirements with the help of in-depth interviews and observations carried out at Karnataka State Lawn Tennis Association (KSLTA), Bengaluru. A pilot study was performed in 2019, and the regular wheelchair tennis players at KSLTA volunteered for this research. It was noticed that there is a need for adaptive sportswear for wheelchair tennis players in India as it is not readily available in the market. It was observed that clothing plays a significant role in developing the wheelchair player's growth and well-being. The aesthetic appeal of adaptive sportswear can boost confidence and influence the player to a great extent. The need and requirements of the players were studied using user-centric research. Hence, to design the concepts for adaptive sportswear, Lamb and Kallal's 1992 functional, expressive and aesthetic (FEA) model has been adopted and studied. The design concept of adaptive sportswear, both top and bottom wear for wheelchair tennis players, is proposed in this paper.

Introduction

In India, almost two per cent of the population is categorised as disabled as per the 2016 census data of the Government of India (GOI). It is a remarkably huge number and is a considerable part of the population that is under-represented and for whom attention is required. For Persons with Disabilities (PWD), it is a struggle in day-to-day activities to move freely because of the

lack of inclusivity of design in the infrastructure. There is still inadequate awareness created about differently-abled in the country. The Department of Empowerment of Persons with Disabilities, GOI, is responsible for launching an Accessible India Campaign (Sugamya Bharat Abhiyan). Creating awareness and finding more opportunities for the differently-abled is of utmost importance. In recent times, wheelchair tennis is one of the adaptive racquet sports that has been initiated in India in some metropolitan cities and tournaments are conducted following the All India Tennis Association's rules. Regular competitions are held every year to encourage the participants to compete in the international arena. In this particular adaptive sport, the dominant arm is used to clasp the racquet to knock the ball in the desired direction, and the other arm is used to control besides propelling the wheelchair rim for movement. There are two categories in Wheelchair Tennis, viz, Open Division and Quad Division. Players with impairment in legs with the functional arm can play in the Open Division (Paraplegic), whereas players with additional impairment in arms can play in the Quad Division (Tetraplegic) according to the International Tennis Federation's rules. The players who suffer from impairment in muscle power, ataxia, hypertonia, athetosis, and so on, are eligible to play this game. In the study, it was seen that the adaptive apparel available for wheelchair tennis players is very inadequate in the Indian market. During the pilot study at Karnataka State Lawn Tennis Association (KSLTA), it was found that wheelchair tennis players have concerns related to their current sportswear. The focus of creating clothing for the differently-abled should be for the fit, comfort, safety and security of the user. There are also other aspects like ease of use, being aesthetically appealing, avoiding stress and workability that need to be considered (Braganca et al., 2018). The literature also points out that users want to look similar to their peers. They do not want to be different in fashion styles, drawing attention to their disabilities.

Sports can inspire differently-abled people and advance their growth as well as giving them a distinguished social life (Velde et al., 2018). In recent times, more differently-abled are coming forward, choosing a better and healthier life by indulging in various parasports as recreation as well as competitive sport (Wu and Williams, 2001). Two aspects are essential for differently-abled sportsmen: (1) monitoring the athlete, and (2) augmenting their performance. Sportswear acts as a catalyst to help the sportsperson to improve their performances (Lee & Jin, 2019). Inclusive sportswear designs have surfaced, focusing on differently-abled customers in multiple brands worldwide. However, adaptive sportswear is still limited in the Indian market. In the study, it was found that apart from comfort and safety, wheelchair tennis players need to enhance their self-esteem with fashion wear to look attractive on the court while they are playing. To be acceptable to the society they live in, clothing plays a crucial role. Sportswear is the most fast-moving category in terms of innovation and technology and is expected to grow by 6.7 per cent in 2026, according to the study led by Sports Global Market Report 2022. To participate in sports activities and wear sportswear for recreation has been a trend for quite some time (Bruun and Langkjær, 2016). Fitting issues can create dilemmas for the users, and, as a result, it can prevent them from playing effectively (Braganca et al., 2018). As shown with the aid of a mind map in Figure 1, the literature indicates the various aspects of Adaptive Clothing, like the design process, theoretical framework, historical facts, sportswear and so on, that can cohere the path to structure Adaptive Sportswear (Bairagi and Bhuyan, 2020).

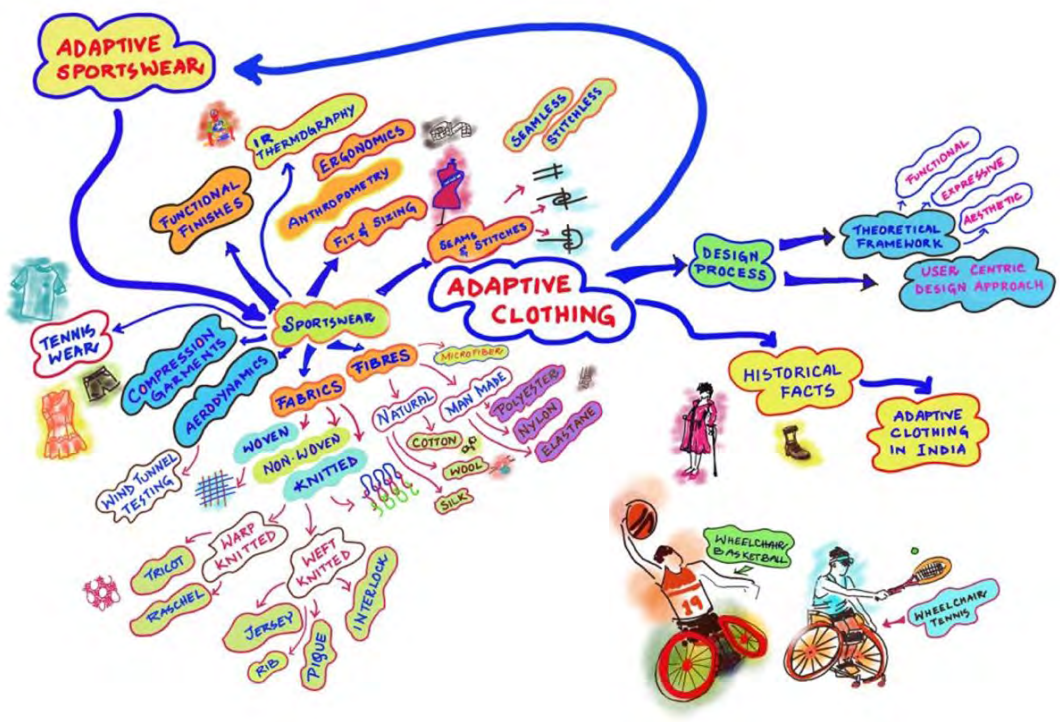


Figure 1. Mind map of Adaptive Clothing and Adaptive Sportswear

(Bairagi and Bhuyan, 2021)

Objective

The main objective of this research paper is to develop designs for adaptive sportswear for wheelchair tennis players in India, taking into account the needs and requirements of the players.

Methodology

To study the specific requirement of the Wheelchair Tennis players with ethnographic research in the initial phase (Fig. 2). The ethnographic research was conducted at Karnataka State Lawn Tennis Association (KSLTA), Bengaluru, with women and men wheelchair tennis players who volunteered for the study. This study was carried out in a real set-up by means of a user-centric approach. During the research, the FEA consumer needs model (Lamb and Kallal, 1992) was used. ‘Functional’, ‘Expression’ and ‘Aesthetic’ are significant in designing any apparel, including clothing for special needs. Functional factors deal with how the garment is operational for the user concerning fit, safety, ease of movement and so on. Expression is the symbol of communicating oneself through apparel, and Aesthetic is the visual appeal of the garment, which every individual would prefer.

The research methods used for this study are based on the human-centred design research methods, or user-centred design methods, as classified by Hanington (2003) in three categories: traditional, adapted, and innovative approaches. The conventional methods include market

research, focus groups, surveys, and interviews. The data acquired through these methods provide an excellent overall view of the design field. In the preliminary studies on user needs and wheelchair tennis sportswear-related problems, this method has been implemented. The research questions framed were: Do you wear special needs clothes while playing tennis? If yes, what type? Do you have any problem with the existing sportswear?

Please specify. Do you try to alter the sportswear according to your needs? Do you feel comfortable in it? If not, why? Does it fit well? What kind of fabrics would you prefer to wear? Do you like sportswear that is fashionable and stylish? What motivates you to play wheelchair tennis? The methodology consists of the following different phases:

1. Identification of players' needs and requirements for the conceptualisation of design.
2. Identification of material for the development of adaptive sportswear.
3. Identification of players' preferences.

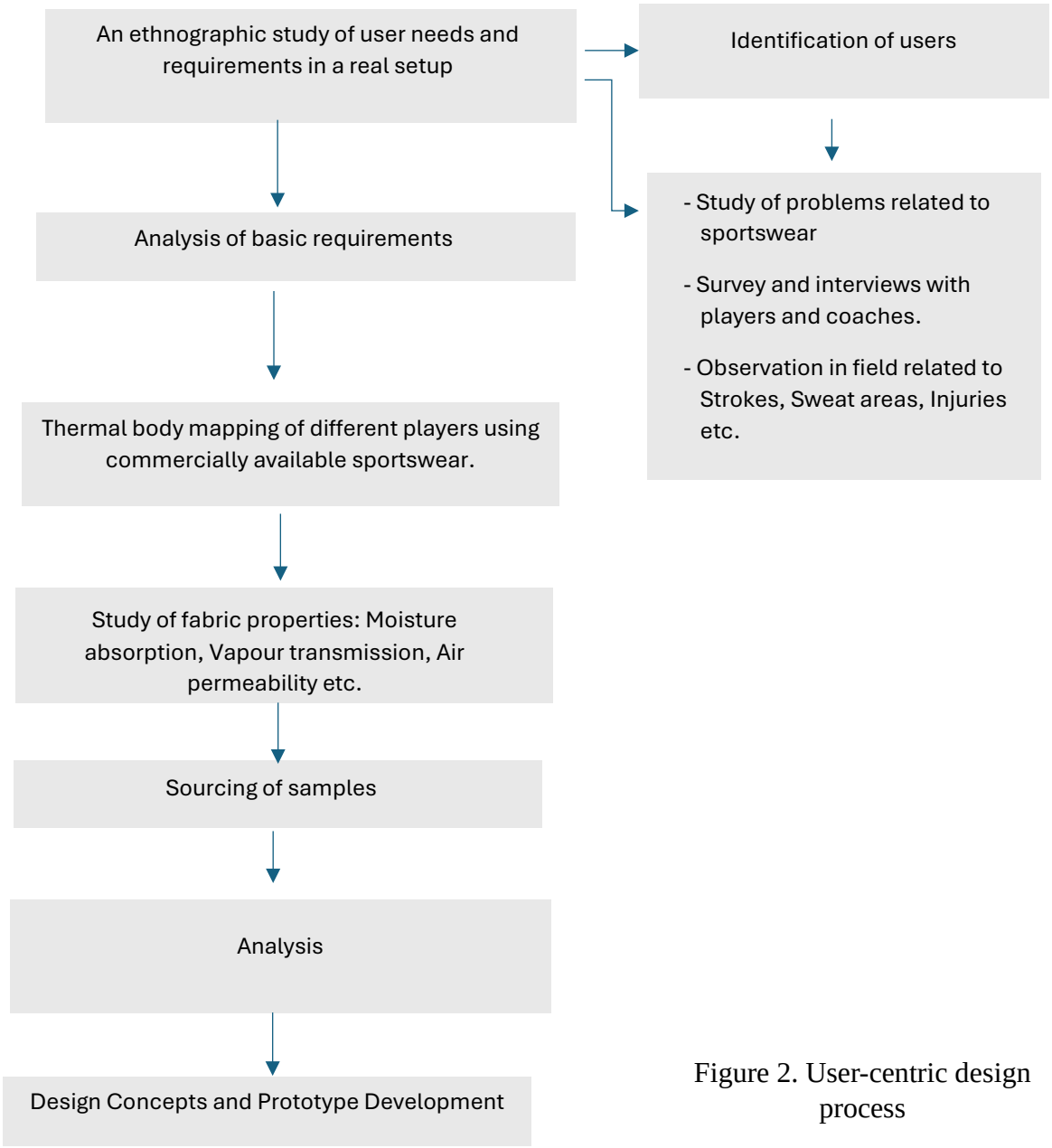


Figure 2. User-centric design process

Profiles	Wheelchair Tennis Players
Male/ Female	6/4
Age	28 to 48 years
Disability	Poliomyelitis, amputation, Scoliotic deformity of the spine etc.
Dominant hand	Right-handed
Practice per week	4 hours to 10 hours

Table 1. Wheelchair tennis players

The respondents voluntarily came forward for the survey with their collective profiles presented in Table 1. In-depth focus group interviews were conducted with observation/participation and audio/video recording with the wheelchair tennis players at KSLTA. Anthropometric data was collected from the respondents through the manual measurement method. At this point, a co-design process was exercised, and various solutions were derived from actual users. During co-design or participatory design processes, the ultimate users of the product judged the newly designed products to point out the advantages and disadvantages of the product. Following elements were considered during the study:

1 real user's involvement
2 design ideas that were shared
3 co-designing areas
4 relationship between the user and the design activity.

Research Findings and Analysis

Adaptive sportswear can aid in augmenting the player's performance by fitting the garment well along with proper utility of the garment. In Table 2 below, some problems and difficulties as expressed by the player are discussed along with proposed design interventions.

Study of user needs and design intervention

	Sl. No.	**Problems and difficulties**	**Design needs**	**Design Intervention**
General requirement	1	Basic designs, limited colour range	Fashionable with the latest colour co-ordinates to give psychological satisfaction	Colours of the season. Fashionable coordinates
	2	Lower garments does not have provision to accommodate the braces/calipers	Track pants to accommodate braces/ calipers	Wide legged track pants with zippers/ Velcro/ snap closures at the outseam. (Fig. 6)

	3	Necklines creating problem in donning and doffing	Appropriate neckline opening for easy donning and doffing	Wider neckline opening for easy donning and doffing. Zipper on the shoulder to widen the neckline while donning and doffing. Front/ Back/ Side open necklines with snap button. (Fig. 5)
	4	The sharp edges of the braces/ calipers tear off the lower garment and create holes	Built the area durable to avoid holes in the pants	Extra patch in the area the holes are made. Pleats (box) in the area.
	5	Styles that are confusing to the user and is a hassle to handle the same	Easy to understand and uncomplicated styles required	Less tie ups and straps Closures strategically placed
	6	Fasteners that are not easily accessible	Fasteners should be strategically placed so that handling is stress-free	Easy reach to closures. (Fig. 5)
	7	Wrinkles in the tummy area. Wrinkles at the buttock due to back pockets	Wrinkle free patterns specially designed for seated users. Also, to avoid patterns that harm the skin when pressed hard.	Back pockets to be removed which are specially designed for standing users. Mattresses/ cushions that can prevent decubitus
	8	Sportswear that hinders accessibility to washrooms	Sportswear design that is trouble free to use while accessing washrooms in between the matches	Track pant with outseam closures using zipper/ velcro/ magnetic buttons. Sportswear that is reversible Too long length track pants that can tend to stumble
	9	Bulky seams on the garments can lead to pressure sores.	Should be flat as possible	Seamless/ stitchless sportswear Flat cover stitches to avoid protruding ends

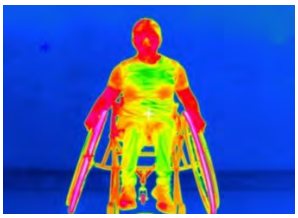
Thermophysiological Requirement  Figure 3: InfraRed Thermography of a player	10	Back upper garment raising up and exposing the back skin while playing. Exposed skin gets abraded against the back seat of the wheelchair	To cover the modesty of the player and to avoid skin abrasion and irritation. Design required to have unrestricted swing of the arm.	Back pattern of the upper garment should be longer than the front pattern
	11	Increases fatigue without adequate wicking of the sportswear in the specific zones of the upper torso to enable thermoregulation.	Adequate wicking of the sportswear in the specific zones of the upper torso to reduce fatigue and enable thermoregulation. In order to perform better during matches	Mesh fabrics used in hot zones of the body. Coolmax fabrics used to keep the body cool
Biomechanical Requirement  Figure 4: Line diagram	12	Hand bleeds or rashes formed due to wheelchair propulsion	Hand cover to evade bleeding or rashes	Gloves for the palm/ elbow
	13	Sportswear that does not give the fullest movement of trunk and upper limbs while wheelchair propulsion and hitting the ball. The ill fitted upper garments.	Sportswear sizes that fits well and increase efficiency	Racer back t-shirts Raglan sleeved t-shirts. (Fig. 5)
	14	Loose armhole and sleeves obstructing the serve of the player	Well fitted sleeves and armhole. Fitted sportswear that reduces muscle tremors	Customised sleeves and armholes
	15	Back lower garment slippage that can turn uncomfortable	High back rise that prevents the modesty of the user and avoid friction	Back rise of the track pant pattern should be more than the back rise used for standing user. Increase of crotch length

Table 2. Design Intervention as per requirements

Figures 5 and 6 are the sketches of some of the prototypes for wheelchair tennis players. The fasteners like a zipper, velcro, and magnetic buttons can be attached to the side seam and shoulder areas for stress-free donning and doffing. Raglan-sleeved designs and a racer back top allow for trouble-free arm movement while playing wheelchair tennis. The side view of the track pants are shown in Figure 6, showcasing the side zippers to accommodate orthoses worn by the players with wider bottom hem. The detachable design is demonstrated with zippers above the knee for effortless wearing and taking off.

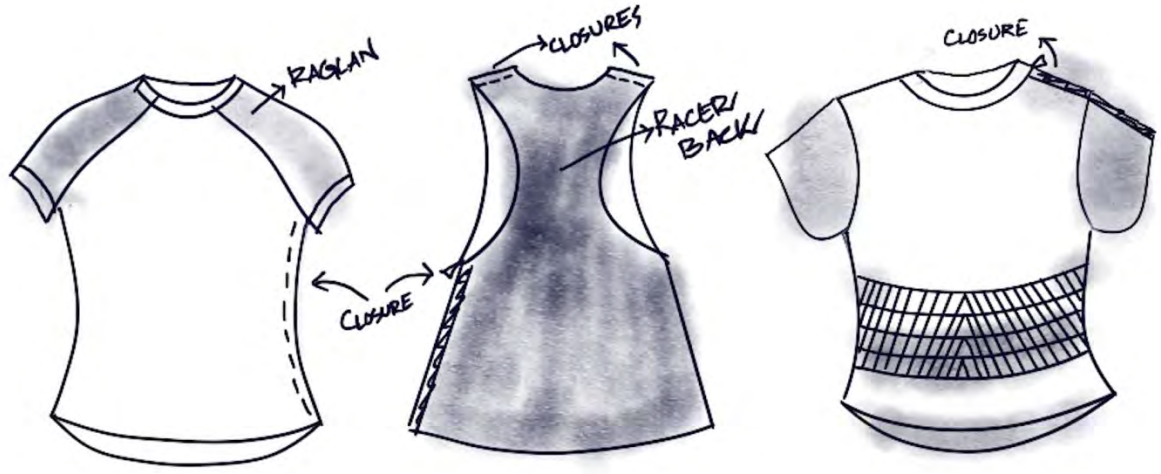


Figure 5. Sketch of t-shirts

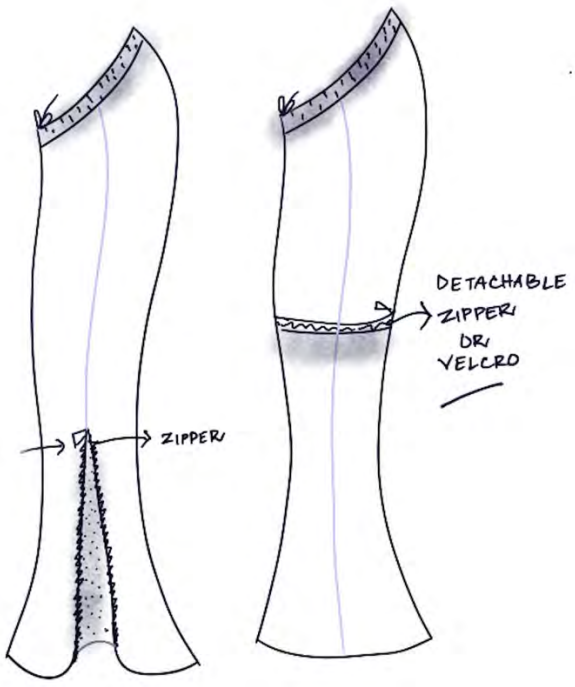


Figure 6. Side view sketch of track pants

Development of prototype

During the observation of the match, it was noticed that the back part of the t-shirt is likely to shift up while playing. It may be due to the shorter length, or the garment might not fit the player well. A button strap attached to the T-shirt hem, as shown in Figure 7, can be secured with the track pant to prevent the t-shirt from lifting and exposing the skin, to avoid abrasion. The prototype (Figure 7) is a hybrid t-shirt made out of 128 GSM knitted polyester fabric. The weight of the t-shirt is 0.083 kg. It has a laser cut-out at the upper back for air circulation. The bottom hem of the t-shirt is elasticated with a strap to fasten it with lower wear to prevent it from moving upward. The attachment of the front panel, finishing of the back cut-out, elasticated bottom hem and sleeve hem are made with stitch-free technology. A heated adhesive bonding using seam sealing tape has been applied to attach two panels.

Figure 7: T-shirt example with button strap to be fastened to the track pant

User Feedback

A wheelchair sportsperson's wants, and needs are distinct from a standing/ able sportsperson's prerequisites. The respondents are a small group of people with whom the survey was conducted. The prototype was user-tested and co-designed, taking feedback from the wheelchair tennis players. The elasticated hemline with button straps helped the players to hold the top to the lower garment preventing the lifting of the top and revealing the skin that gets abraded. The players found the feature beneficial while playing. The players emphasized on the neck opening that is easy for the user to don and doff with strategically placed closures.

Conclusion

This research paper focuses on wheelchair tennis players' desires and requirements that are very different from able-bodied tennis players to design adaptive sportswear through ethnographic study. It shows that adaptive sportswear is necessary for wheelchair tennis players to play and compete in the international para-sport. It can give them confidence, as well as respectability and boost their self-esteem. The adaptive sportswear prototype has been developed keeping in mind the Functional, Expressive and Aesthetic model of Lamb and Kallal, 1992. In this paper, user-centric research has been adopted to explore the needs and requirements of wheelchair tennis players in India. The co-creation or co-design of adaptive sportswear can essentially tap into the critical necessities of the users because they understand the problem more than anyone else. Adaptive sportswear can provide fit, comfort and safety to users. It can enhance social inclusion among the players enriching group membership. The design concepts are developed for the benefit of the users concentrating on the attitude, sentiments, conviction etc., while using a user-centric design approach. Specific design features of the prototype that were considered are an Infrared thermographic study to find out the heat zones of the body, stitch-free operations to provide a flat seam, manipulation of the patterns like a more extended back pattern, elasticated and strapped upper garment to prevent it from mounting, easy-to-operate fasteners, and so on. Giving importance to the under-represented and bringing change concerning sportswear can help in the well-being of wheelchair tennis players. In this research paper, however, fabric details are not included.

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