



## Insights on the apparel needs and limitations for athletes with disabilities: The design of wheelchair rugby sports-wear



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### ARTICLE INFO

#### Article history:

Received 14 July 2017

Received in revised form

1 September 2017

Accepted 7 September 2017

#### Keywords:

Inclusive design

Sports-wear

Wheelchair rugby

### ABSTRACT

Wheelchair rugby is a sport that has been gaining popularity with athletes with disabilities. However, as it is relatively new and not played by the masses, market specific sports-wear is not available for this sport, which impacts directly on performance and clothing satisfaction of the athletes. Therefore, the main objective of this research was to identify the problems that wheelchair rugby players face with the sports-wear they use for playing the game. The data was collected using a focus group and a questionnaire with 61 wheelchair rugby players in the United Kingdom. Based on their suggestions, on the team expertise, and on the literature, a set of design recommendations was proposed for the upper body garments (tops), lower body garments (bottoms), and gloves. The results demonstrated that the gloves currently available negatively impact on players' ability to participate with satisfactory levels of protection and comfort. Moreover, tops and bottoms also present issues, mainly in the fit and ability to regulate the core body temperature. Hence, the recommendations proposed can provide designers with key information on the specific sports-wear requirements and allow them to design and develop products that can satisfy real needs of specific end-users. This paper intends to raise awareness of the needs of sports-wear for those playing wheelchair rugby and promote the inclusivity of athletes with disabilities.

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### 1. Introduction

Environments and products that are adapted to wheelchair users' needs facilitate their interaction with the surroundings and promote better mobility, accessibility and comfort (Kratz et al., 1997). Clothing for people with some kind of disability is a topic that has been explored, but not in a manner that encompasses all users – especially when it comes to very niche markets, like sports-wear. According to Curteza et al. (2014) clothing for people with disabilities can be classified as functional clothing and thus, should

be developed to enhance the users' quality of life. The authors state that the design of these functional garments should take into consideration several scientific and technical domains (e.g. medicine, biotechnology, nanotechnology, physics, computing) in order to meet the intricate and complex requirements of the users.

The basic information designers use to create products should be derived from the real end-users, to assure that their real needs are being met and the problems are being solved. This is a more challenging way of creating novel solutions but it optimizes commercial success (Bruseberg and McDonagh-Philp, 2001). Many designers see design for disability as part of engineering and human factors (Pullin, 2009). The human factors and ergonomics hierarchical approach to design gives preference to environmental design to fit the human; selecting or training people to fit the environment is only an option when there is no other alternative (Hignett, 2013).

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The psychological aspect of clothing should also be considered, as apparel and fashion can be regarded as an expression of self-esteem (Shim and Bickle, 1994; Fowler, 1999). This is especially important for wheelchair users as assistive technologies, such as wheelchairs, often act as symbols of stigma, i.e. the social interactions created when people are thought not to meet expectations of “normal” (Elliott et al., 1982; Bispo and Branco, 2008; Carrington et al., 2014). Shinohara and Wobbrock (2011) suggest that these issues of perception and social acceptance can be mitigated if people with disabilities use mass-market products that support inclusivity. Wheelchair users have special requirements that common clothing does not satisfy, however, there are not many clothing brands that are dedicated to this segment of the population. In fact, some of these clothes are designed taking in consideration the measurements and body shape of able-bodied people in the sitting position (which, according to Kozey and Das (2004), are significantly different). This situation causes the clothes not to fit these specific users properly, since they do not fit into the existent size systems due to the differences in their body shape and size (Thorén, 1996). As such, many wheelchair users consider that obtaining suitable clothing is a very difficult task (Chang et al., 2009). Clothing design problems create barriers in community participation and reduce the social inclusion, which might cause wheelchair users to miss out on important and everyday life events, due to clothing-related problems (Kabel et al., 2017). Nonetheless, the clothing items for this population should also be aesthetically pleasing, comfortable to wear, practical, and easy to put on and take off (Clulow, 1974). It is very important that the clothes do not cause pain or discomfort.

There are several characteristics that should be present when designing clothing for people with disabilities. By resorting to focus groups, interviews, and questionnaires, some authors defined specific wheelchair users' needs and requirements. Table 1, which is based on the studies of Curteza et al. (2014), Lucero-Duarte et al. (2012), and Gonzalez et al. (2012), identifies these characteristics, divided into general considerations, characteristics of the upper body garments, characteristics of the lower body garments, and characteristics of the materials used.

Sports-wear is a specialist segment of the clothing industry that should also promote the inclusivity of people with disabilities and take into consideration user-centred design principles. In the sports-wear field, users search for comfort, quality, durability, and

style, but comfort and fit are presumably the two most important features in this type of clothing (Fowler, 1999). Kratz et al. (1997) present the findings of an experiment that compared the wheelchair users' experience of wearing specially adapted clothes and non-adapted clothes for some sports. Their study found that there was an overall positive significant difference in comfort when the participants were wearing the adapted clothes. The authors finish by saying that further studies are needed to enhance the sports experience within the wheelchair users' community. A more recent preliminary study also showed that there is a lack of availability of sports-wear for disability sports, which compromises the athletes' satisfaction, comfort and performance, giving the premise of the need to act and develop more specialised garments to satisfy this population (Braganca et al., 2018).

Wheelchair Rugby, also called quad rugby or murder ball, is a relatively new sport that was designed as a team sport for male and female athletes with a disability (even though many non-disabled people are also participating). According to the International Wheelchair Rugby Federation (IWRF, 2015) the aim of the sport is to score goals by crossing the opposing team's goal line while in possession of the ball – the team scoring the most goals by the end of the game is declared the winner. This sport has few similarities with traditional rugby, it looks more like basketball without a basketball hoop and is becoming increasing popular even amongst nations that are not recognised as “rugby nations” (Kell et al., 2008). As in many other sports, athletes are always looking to improve their performance. In wheelchair rugby, the athletes' performance is influenced by both individual components – acceleration, manoeuvrability, movement accuracy – and team components – combination of individual components to score points for the team (Chua, 2013). Evaluating athletes' performance is crucial for both coaches and athletes, as it allows for better planning of the training session to improve athletes' weaknesses and for a continuous improvement of the athlete and the wheelchair-user interface (Chua, 2013; Sasaki et al., 2008; Usma-Alvarez et al., 2010).

The purpose of this paper is to identify the problems that wheelchair rugby users have with the sports-wear they use for playing the game. Additionally, this paper presents a set of design recommendations that can be used by designers to create new sport-specific garments, specifically for three important items of wheelchair rugby sports-wear: tops, bottoms and gloves.

**Table 1**  
Necessary characteristics to be present on clothing for people with disabilities (based on Curteza et al. (2014), Lucero-Duarte et al. (2012), and Gonzalez et al. (2012)).

<b>General characteristics</b>	<ul style="list-style-type: none"> <li>- Be aesthetically pleasing</li> <li>- Provide safety</li> <li>- Be beneficial from a physical and psychological point of view</li> <li>- Help to socially integrate</li> <li>- Provide moral and psychological comfort</li> </ul>	<ul style="list-style-type: none"> <li>- Allow to visit the toilet independently</li> <li>- Provide freedom of movements</li> <li>- Have easy fastening systems (zips, Velcro and elastic bands)</li> <li>- Have specific openings to facilitate the put on and take off processes</li> <li>- Avoid friction between clothes and chair</li> <li>- Provide freedom of movements</li> </ul>
<b>Upper body</b>	<ul style="list-style-type: none"> <li>- Allow maximum use of chest and upper limbs</li> <li>- Have increased space in back and sleeves</li> <li>- Avoid exposure of the back areas</li> </ul>	<ul style="list-style-type: none"> <li>- Be loose fitting in neck, chest, and abdomen</li> <li>- Have longer lengths at the back of shirts, sweaters, jackets and coats</li> </ul>
<b>Lower body</b>	<ul style="list-style-type: none"> <li>- Have increased body rise in the back</li> <li>- Have decreased body rise in the front</li> <li>- Be adjusted to the leg length</li> <li>- Have longer lengths at legs</li> <li>- Be loose fitting in buttocks and legs</li> </ul>	<ul style="list-style-type: none"> <li>- Avoid accumulation of excess fabric in the stomach area</li> <li>- Avoid thick and hard seams, especially in areas exposed to high pressures (i.e. back and buttocks)</li> </ul>
<b>Materials</b>	<ul style="list-style-type: none"> <li>- Have low levels of electrostatic charge</li> <li>- Be absorbent</li> <li>- Be durable and resistant</li> <li>- Be easy to maintain and clean</li> <li>- Assure adequate thermal isolation</li> <li>- Protect against hot and cold environments</li> <li>- Assure moisture management in the areas that sweat the most (buttocks, chest, dorsal, lumbar, neck and abdomen)</li> </ul>	<ul style="list-style-type: none"> <li>- Assure the minimum body odour retention (use of natural fibres and/or anti-bacterial treatment/finishing)</li> <li>- Have increase cloth durability in areas subject to friction</li> </ul>

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