

# Universal Fashion Design on the Leg Warmer for the Lower Limb Dysfunctional People<sup>\*</sup>

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## Abstract

In order to promote the development of universal fashion design, this paper designs and develops leg warmer, which meets the special demands for the people with lower limb dysfunction, with regards to warmth, style, aesthetics and convenience. It refers to two types of them, namely polio and spinal cord injury. First, through literature review and experimental research on thermal imaging camera temperature measurement, the paper finds people with lower limb dysfunction more sensitive to low temperature and their objective body surface temperature is lower than that of people who do not have a disability. Furthermore, the size between the legs is usually different. The survey and interview together with the research on existing products, revealed that there is a large demand for the special structure and function of the leg warmers due to the movement obstacles which are yet prevalent. The product, with the focus on close fitting, flexibility and warmth, uses light-weight fabrics and warm keeping materials which tend to be active or good at preserving the warmth. Finally, combined with the circumstances where it is used, three design schemes are proposed, including the inner closed leg warmer, the outer open close leg warmer and the outer combined waist warmer and leg warmer. After, one of them use the functional yarn which is called full-spectrum heat storage polyamide 6 fiber yarn (77.8dtex/48-68F) to make finished products and then be tested. Also, this paper proposes the design concept of multiple sizes and general adaptability of the same double leg warmer. Moreover, the sample of leg warmers is completed. The research of this paper is of fundamental importance and valuable for the future development and application of leg warmer for the people with lower limb dysfunction.

*Keywords:* Lower Limb Dysfunctional People; Questionnaire and Interview; Leg Warmer Design; Infrared Temperature Measurement

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## 1 Introduction

According to the latest statistics released in 2010, the World Disability Report had estimated that the global population of persons with disabilities, in the past 40 years, accounted for about 15% of the world's total population, and 2% to 4% of them face severe functional impairment [1]. Among them, lower limb disabled people accounted for 45.61% [2]. China Disabled Persons' Federation released the second national sample survey of disabled people and the total number was 85.02 million, of which 29% were physically disabled, accounting for 24.72 million [3]. Among the causes of physical disability, congenital diseases or developmental disorders were 17%, injury factors were 31%, and disease factors were 48% [4]. The data deduces that the number of people with lower limb disabilities is very large, a large number of disabled persons are accompanied by lower limb dysfunction. Lower limb dysfunction is mainly caused by various diseases caused by lower limb muscle spasm and body control dysfunction [5].

The concept of “universal design” was born in the architecture circles at the beginning of the 20th century. This new architectural design method uses modern technology to construct and transform the environment to provide a convenient and safe space for people with dysfunction include disabilities to move and create an “equality and participation” surroundings [5]. In the past 30 years, universal design has begun to enter the field of fashion. In the field of foreign universal fashion, most of them are individual designer studios and clothing brands for R&D and sales, some provide customized services, and there are also college R&D teams. Brands that provide universal fashion include American brand Adrian Closet, Tommy Hilfiger and Dignity by Design, German brand Rollimoden, British brand Able2 Wear, Russian brand BezGraniz Couture. The Massachusetts Institute of Technology launched the Open Style Lab in 2014, a 10-week interdisciplinary public service project that teaches accessible fashion courses. In China, there are universal fashion from personal clothing design studios, and small batch production of products developed by universities, but most of these products have not been widely used in real life. In 2006, the Hong Kong Polytechnic University Department of Textiles and Clothing established Lingzhi Health Clothing Center. In September 2018, with the support of China Disabled Persons' Federation and Beijing Disabled Persons' Federation, Beijing Institute of Fashion Technology established the “Universal Fashion Lab”, which is the first institution in China that specializes in clothing research for the disabled. In 2020, Wang Q had proposed a new universal fashion design model named BAP [6].

In summary, the domestic and foreign populations of disabled persons are huge. The development of barrier-free clothing abroad is ahead of China and has generally been marketed. However, in China, there are few barrier-free clothing R&D institutions, as well as the degree of marketization is also low. It is necessary to speed up filling this vacancy. For universal groups, the protective gear is even rarer. This article focuses on the issue of lower limb warmth for people with lower limb dysfunction, and aims to find effective ways to solve the needs of such special groups.

Literature review together with interviews and questionnaire surveys on the physiological characteristics of the lower limb dysfunctional people, showed that they have a very high demand for lower limb warmth. Most people hoped to have appropriate leg warmer. Regarding the style, they require the version of leg warmer to conform to the sitting position, in order to increase the wearing comfort. In terms of heat preservation, they have higher requirements on thermal function than people who do not have a disability, and they hope to use active heating materials. In terms of aesthetics, they want the product to be thinner and lighter. However, after consulting