

# Barrier-Free Integrated Wheelchair Trousers Design<sup>\*</sup>

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## Abstract

To address the challenges faced by wheelchair users living alone when it comes to wearing trousers, this paper aims to enhance the design of existing trousers by focusing on adaptive structure design and wearing convenience. It also proposes a design concept for wheelchair trouser integration.

For adaptive structure design, the structure of the trousers is adapted to the corresponding parts of the wheelchair to obtain an enhanced trouser pattern. Through clo3d virtual fitting verification, the pressure distribution effect of trousers in a sitting posture improved. The connection between the back of the pants and the wheelchair seat is designed to achieve optimal stabilisation. The U-shaped opening design of the wheelchair seat allows for proper storage of the front of the pants, enabling quick circulation and enhancing the independence of wheelchair users.

A wear trial experiment was conducted to evaluate the convenience of the prototype trousers. This involved calculating the wearing time and independent coefficient, which provided evidence that the proposed integrated wheelchair trouser design significantly improves wearing convenience.

*Keywords:* Wheelchair Trousers Integration; Wheelchair users Living Alone; Adaptive Structure Design; Functional Trousers Design

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## 1 Introduction

There are 85 million disabled people in China, with 24.72 million suffering from lower limb paraplegia [1]. Every year, approximately 80,000 more people are afflicted with paraplegia, and 47% choose to live alone. Many people with paraplegia in both lower limbs can care for themselves, especially young or middle-aged paraplegic people.

“Barrier-free clothing design” applies the barrier-free design concept to clothing [2]. This study addresses the challenges of wheelchair users with paraplegia in the lower limbs when wearing trousers [3].

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This paper improves the structural and functional design of trousers for wheelchair users who have difficulty lifting their hips with the proposed design of the trousers combined with a wheelchair seat. The connection between the back trousers and the wheelchair seat optimizes stabilization. Furthermore, the U-shaped opening design of the wheelchair seat accommodates the front of the trousers, making it easy to take off and put on [4].

This paper conducts life research for wheelchair users living alone, summarizes their needs for trousers, and provides a theoretical basis for developing clothing for wheelchair users living alone [16].

This paper introduces a novel integration product that combines the functionality of a wheelchair with the convenience of trousers, aiming to enhance the independence of wheelchair users in dressing and meeting their living needs. Additionally, a new evaluation method is proposed to assess the convenience of trousers combined with the difficulty coefficient and independent index, providing a fresh approach to evaluating the ease of putting on and taking off clothes for wheelchair users.

## 2 Methodology

### 2.1 Questionnaire Survey and Result Analysis

Compared to non-wheelchair users, individuals with paraplegia (wheelchair users) often face additional challenges, particularly when no assistance is available for dressing. To gain insights into the dressing habits and daily activities of wheelchair users living alone, a survey is conducted on young and middle-aged individuals with a certain level of self-care ability. The findings from this survey will serve as a reference for the next experiment. This paper surveys young and middle-aged wheelchair users with certain self-care abilities. The questionnaire's content includes the gender, age, types of obstacles and other identity information of the respondents, as well as some basic information such as the time of using the wheelchair, the frequency of using the wheelchair, self-care ability, and the convenience of taking off trousers [5].

The questionnaire was distributed to the “China Disabled Persons’ Federation Voluntary Association” online distribution and 20 valid questionnaires were available. After statistical analysis of the questionnaire data, the conclusions are as follows:

Due to the focus of this study on wheelchair users with a certain level of self-care ability (living alone), 26 questionnaires were initially screened, and ultimately, 20 questionnaires met the criteria for inclusion in the study.

The findings revealed that most participants were between 18 and 30, and most had been using a wheelchair for 1-5 years. Additionally, the participants could independently perform daily activities using their wheelchairs for extended periods. The majority of participants reported living alone on an occasional basis.

The questionnaire found that 70% of participants required assistance from tools or others when putting on and taking off trousers, while 30% could independently wear trousers. Furthermore, 40% of the participants spent 5-15 minutes putting on the fitting trousers, whereas 60% spent 15-30 minutes, indicating notable resistance and difficulty in this task. These findings suggest that the participants still face significant challenges when wearing fitting trousers.