Journal of Fiber Bioengineering and Informatics 17:3 (2024) 163–177

Cite as: H. Liu et al.
doi:10.3993/jfbim01722

Pressure Comfort Evaluation for Supportive Waist Protections

Han-Xin Liu [a], Xiao-Xin Yang [a], Yue Yin [a,b], Jing Guo [a,*]

[a] *Beijing Institute of Fashion Technology, Heping Street, Chaoyang District, Beijing 100029, China*

[b] *Donghua University, Tianshan Street, Changning District, Shanghai 200051, China*

Abstract

Supportive waist protection is the most used among various functional waist protection products. It achieves its supportive effect primarily through elastic-banded supportive strips, with their shape, number, and material influencing the level of support. This study assesses the subjective and objective pressure comfort of waist protection with different support strip designs, utilizing a combination of subjective pressure numerical representation and the Novel-appliance pressure testing system. The findings indicate that pressure from supportive waist protection is primarily concentrated in the posterior and lateral lumbar regions, with the lateral region experiencing greater pressure than the anterior and posterior centre regions. Moreover, pressure along the abdominal circumference line generally exceeds that along the waist circumference line. The comfortable pressure value in the posterior waist region exceeds that in the lateral and frontal regions. Finally, varying shapes, numbers, and materials of support strips result in different pressure intensities in the posterior waist region, with 4 strips of bionic material offering the best waist comfort and 4 strips of steel plate providing the least comfort.

Keywords: Supportive Waist Protection; Support Strip Design; Pressure Comfort; Subjective and Objective Evaluation

1 Introduction

Studies have shown that from 1990 to 2019, there has been a 50% increase in the global incidence, prevalence, and DALYs of low back pain, with China being one of the 3 countries experiencing the largest increases in these 3 items [1, 2]. People have gradually started paying attention to waist health problems as the waist region, which connects the upper and lower body and supports the body, plays a vital role [3]. Most of the waist protection products available today offer functions such as pressurization, treatment, support, heat preservation, and monitoring [4-7], and there is ongoing research into combining APP, sensors, and new materials to intelligently detect, adjust, and protect the waist [7-10]. With the progress of science and technology, the

*Corresponding author.
Email address: julia0224163@163.com (Jing Guo).

Sep. 2024

functionality of waist protection products is also improving to meet the increasingly diverse needs of people. Modern technology development enables these products to achieve a more personalized and precise functional design for individuals with waist problems.

Supportive waist protection products are extensively utilized for health maintenance, sports and fitness, and other applications [9-11]. These products achieve supportive waist protection by incorporating a built-in support strip with an elastic band that tightens the waist protection and applies binding pressure to produce upward and downward support on the waist, thus reducing vertical compression and supporting the human waist, alleviating bearing force, and relieving waist pain [12]. Studies focus on these supportive waist protection products' fabrics, performance, pressure, and comfort, including those used for health maintenance and postpartum binding belts [13-20]. Researchers have observed variations in the shapes, numbers, and material designs of support strips in existing supportive waist protection products on the market, leading consumers to feel confused and hesitant due to the plethora of choices. This study investigates how variations in the shape, number, and material of support strips in waist protection products affect waist protection pressure comfort. The findings from this study will serve as substantial references for waist protection product design by companies and assist consumers in making informed decisions when selecting and purchasing such products.

2 Method

2.1 Experimental Samples

Through the market survey, we compared and analyzed waist protection products available on the market. We selected and recorded two test samples, #1 and #2, which have similar comprehensive functions, fabric performance, and design and use forms of support strips. Sample #2 is a lumbar protection product with replaceable support strips, allowing for five test forms by replacing support strips made of different materials and in different quantities. These are recorded as #2-1, #2-2, #2-3, #2-4, #2-5.

Each waist protector sample offers 6 test forms, and Table 1 shows the comparison table for each factor of the support strips. Specifically, we contrasted #1 and #2-1 in terms of the shape of support strips; #2-3 and #2-5 in terms of the number of support strips; and #2-1, #2-2, #2-3, and #2-4 in terms of the material of the support strip.

Table 1: The sample parameters of the supportive waist protections

Number	Number of supporting strips/piece	Shapes of supporting strips	Materials of supporting strips
#1	4	Irregular	Bionic
#2-1	4	Strip	Bionic
#2-2	4	Strip	Memory support bone
#2-3	4	Strip	ABS Resin
#2-4	4	Strip	Steel plate
#2-5	2	Strip	ABS Resin