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USERS' PERCEPTIONS ON COMFORT LEVEL OF CYCLING CLOTHING

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***Abstract**. In this study, based on user surveys related to ergonomic wearing comfort, thermal comfort, clothing design, construction, and purchasing preferences, the performance of existing cycling clothing that affects wearer comfort was investigated. Four casual and professional male cyclists were recruited for this study. A questionnaire was developed to address various main characteristics, such as freedom of physical activity, fit of clothing; clothing assembly; clothing aesthetics; and overall satisfaction. In order to infer whether the parameters are significant, statistical analysis including descriptive methods and chi-square test (x^2) is used, where the statistical significance is set to P = 0.05. The results show that cyclists are not very satisfied with the comfort of the equipment. Nighty four percent of respondents (88 men in total) experienced various discomforts. The fabric characteristics, design and size fit of the clothes are the most common reasons.*

***Keywords:** Subjective assessment, user comfort, cycling clothing, garment fit*

1. Introduction

Clothing as a near environment of the human body has an important role in achieving human comfort. Comfort can be a physical, a psychological sensation or both at the same time [1, 2]. Mainly the development of clothing should consider the anatomical features of individuals, biomechanical and functionality. [3]. These factors can overlay and correlate extensively with the subjective assessment performed and provided by the users.

As cycling sports performed in many different weather conditions, the expectations on sports clothing that cyclists have in terms of comfort have increased. Clothing designed especially for certain functionalities (i.e. garment worn next-to-skin) has been shown to cause heat stress, and decrease task efficiency of the wearer [4]. Knowing the minimum comfort characteristics of clothing is very important for the required applications. Therefore, the objective of this investigation is to identify the problems that cyclists experienced with their ensemble. Using customer survey, this can be evaluated in terms of purchasing preference with brands as well as garment comfortability and source of discomfort. Consequently, the findings will provide insight into design and the development of proper outfit design criteria that are needed to satisfy critical athlete's ergonomic desires and performance.

2. Materials and methods

2.1. Data collection

In order to collect demographic data, training characteristics and comfort related data on the current outfit. Questionnaire considered were relevant to the purposes the study.

Participants: All level of cycling cluster (elite/pro, recreational, amateur and junior cyclist) was invited and 94 Belgian cyclists were recruited.

2.2. Statistical Analysis

Use statistical software (SPSS V.21, IBM Corporation) to analyze the collected data, including descriptive methods and chi-square test (x^2). In order to conclude whether the parameter is significant, the p-value is checked. If the p-value of a parameter is greater than 0.05 ($p > 0.05$), the parameter is not significant and will not be investigated further.

2.3. Garment analysis

We bought four commercial clothes. All purchased garments are 100% polyester (PES) for Design DI, D-II, and D-VI, and short sleeve jerseys and medium size (M) with 80/20 polyamide/elastane (PA / EL) fiber composition) was D-III.

Size measurements:
Sizing charts provided by each retailer were taken from their respective websites [5] - [9] to determine the recommended fit. These charts show the wearer's recommended chest size for small, medium and large specimens. These were further observed to assess the impact of the recorded measurements and for the construction of selected sample. Each piece, measured for size and shape variation, according to four brands from DI to D-VI.

***Seam and stitch analysis*:** In addition, seam and stitch analyzes were carried out to highlight the differences between four brands and to show their influence on the comfort properties of the garment.

3. Results and discussions

3.1. Survey results (brand preference, cyclists overall comfort/discomfort experience)

From the data collected, issues with the most frequently selected cycling wear brands, buying preferences, and costumes were analyzed and validated as shown in Figures 1 and 2.

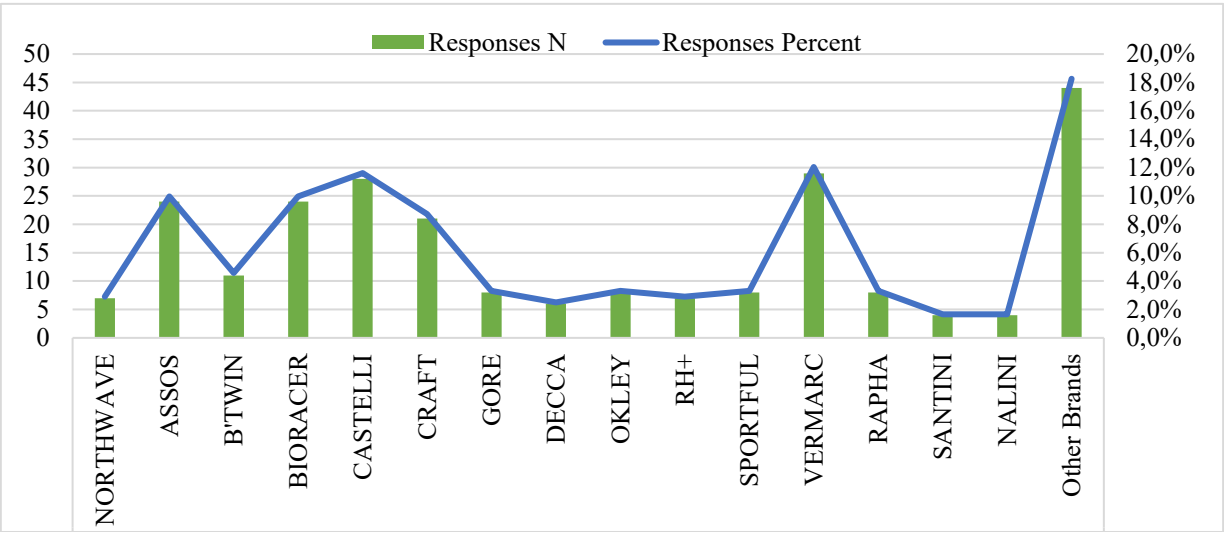

Figure 1 - List of sportswear brands selected by Belgian cyclists.

It can be seen from the results that Vermarc (29), Castelli (28), Bioracer and Assoss (all 24) and Craft (21) are common choices for most customers (Figure 1). Of the 94 respondents, 91% of cyclists were not loyal to a particular brand. Price, size, design, usability, aesthetics and quality are the main reasons for their preference. On the contrary, due to a mix of promotions, different clubs and discounts, cyclists are forced to change clothes.

In addition, cyclists are not very satisfied with the comfort of their clothes. Figure 2 shows the identified causes of discomfort and their impact on comfort during riding. Among the 94 respondents, 94% of cyclists

experienced different discomforts. Most of the problems are related to fabric characteristics. Heat and moisture management are considered to be the most common potential causes of discomfort. In addition, the design and size fit of the clothing are considered potential.

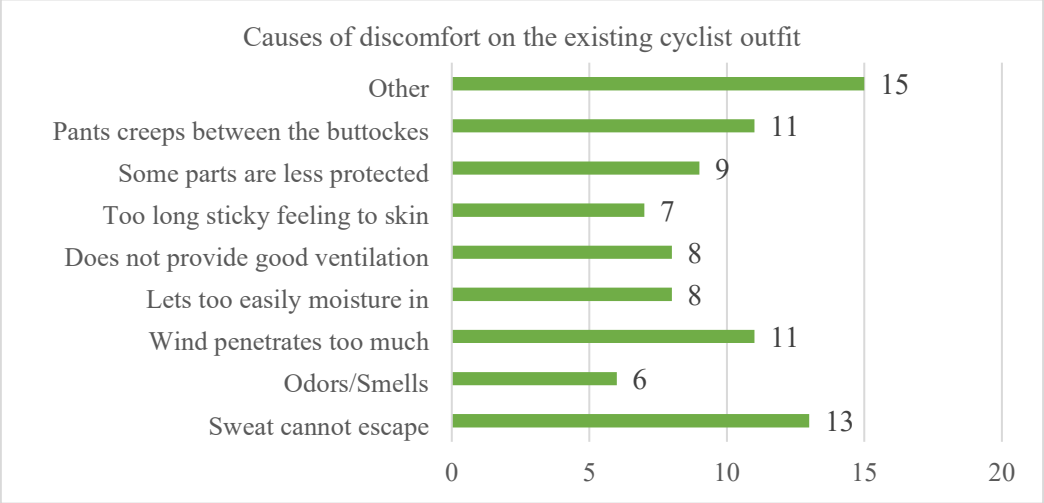

Figure 2 - Source of discomfort for the existing attire.

The result shown in Figure 3 shows that the fit (excellent-poor scale) of the garment correlates significantly with the breathability. Based on a chi-square analysis, garment fit was a statistically significant ($P < 0.001$) factor affecting comfort. It can therefore be concluded that the suction effect, which requires the comfort of clothing worn close to the skin, can be influenced by the breathability and the fit values of the clothing.

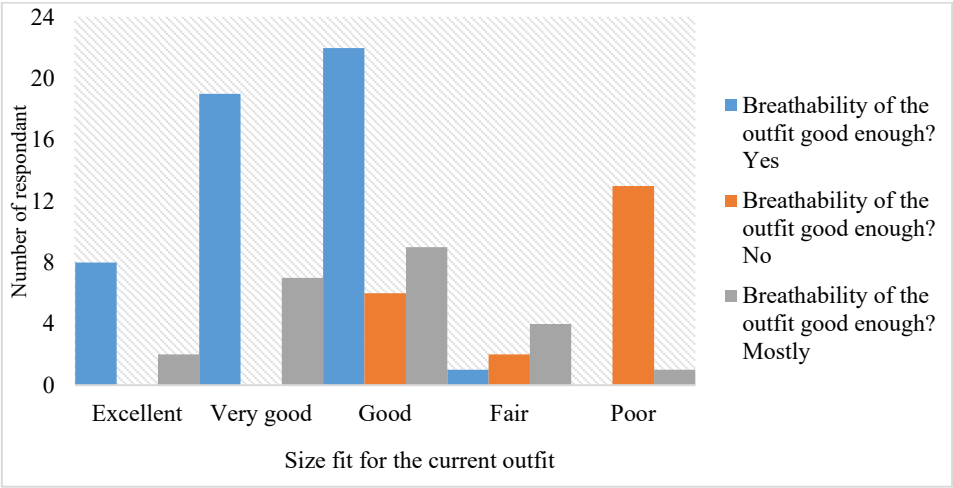

Figure 3 - The connection between fittings with moisture permeability.

Results showed that 59.7% of the respondents experienced with little sweat, and among these, 12 subjects were uncomfortable with the amount of sweating. Ninety-four subjects, 41.48% (39 responders) sweated a lot and about 44% (17) subjects) were uncomfortable with this sweating **(**Figure 4**)**.

From this result it can be concluded that 71.27% (53 in total) cyclists didn't sweat much while cycling and hence, their level of comfort was no affected by this amount of sweating. The connection between sweating rate and level of comfort experienced by respondents was limited, we posit that cyclist who train intensively expect a certain amount of sweating, and a large fraction cyclists dresses or behaves accordingly in order to remain comfortable.

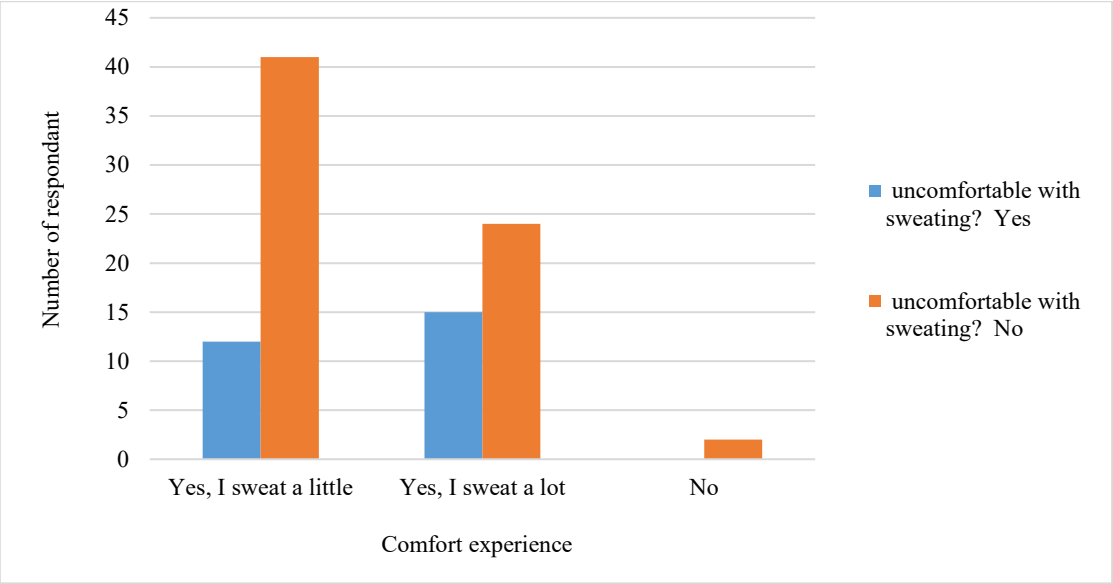

Figure 4 -Effects sweat on comfort sensation during cycling.

3.2. Fabric analysis

The fabric analysis of the four sample garments purchased was confirmed, including fiber composition, structure and air permeability (Figure 5). Polyamide (or nylon) is a strong fiber that has greater elastic recovery behavior after stretching [10]. On the other hand, polyester is characterized by maintaining its structural stability, heat resistance, good moisture transport and low cost [11]. However, in garments that need to be stretched, polyamide is better than polyester, and for good stability, polyester is better than polyamide.

The structural characteristics and raw materials of knitted fabrics affect the transmission characteristics of air, water and water vapor. Because of the tests conducted, the interlock of the D-II garment made of polyester with the 1x1 rib knit type has the highest air permeability value. The results show that polyester and nylon fabrics made of fabrics with similar knitted structures have different air permeability values, and nylon fabric has the highest air permeability value.

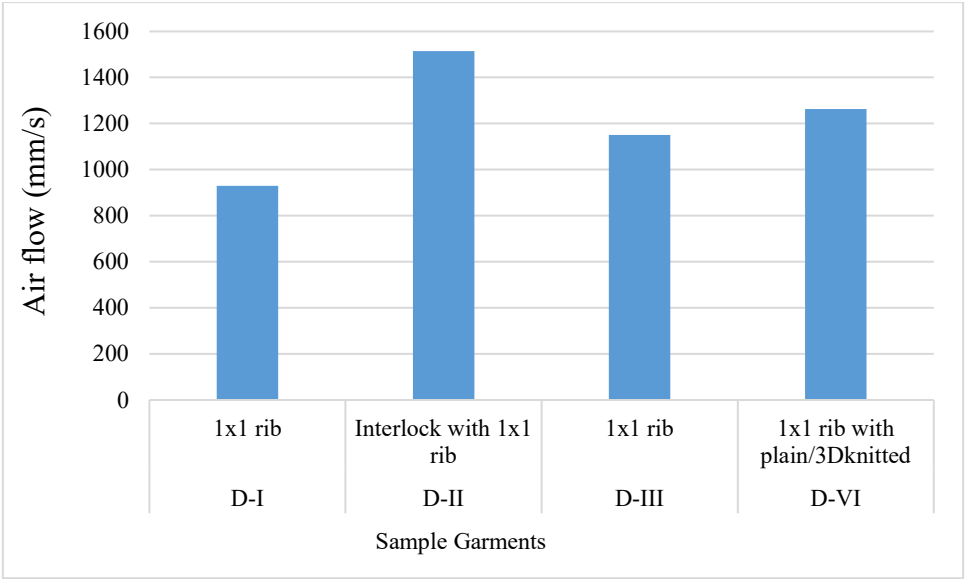

Figure 5 - Effect of fabric structure on amount of air flow (ISO 9237:1995 (en), 100 Pa pressure difference).

3.3. Garment analysis

We compared DI to D-VI test garments based on construction details for four brands, designs, and sizes. As shown in Figure 6, each type has its own design variations.

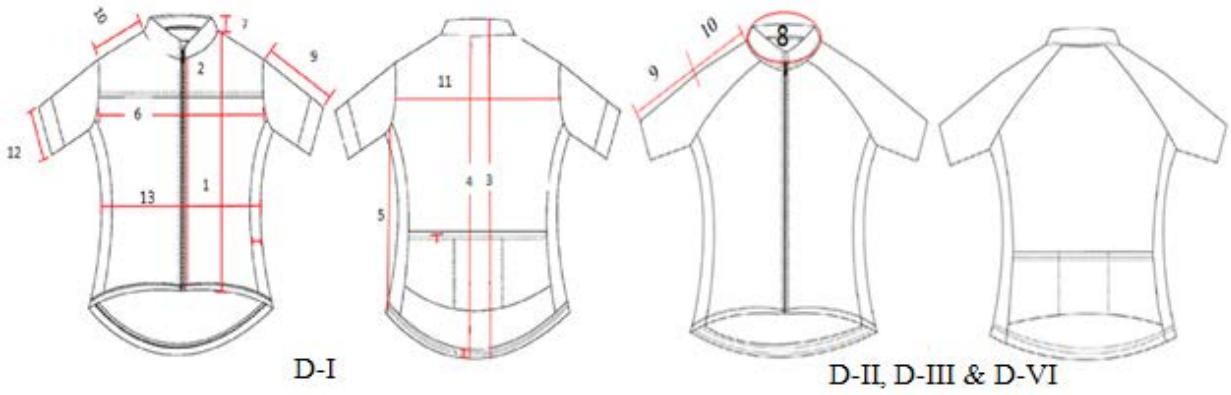

Figure 6 - Seam positioning and panels of each sample garment.

Garment size measurements:
Four samples were manually measured to show the difference in size and shape of the four brands. The measurements listed show the difference between ready-made garments of the same size. The numbers shown in Figure 6 indicate the measurement points for the garment. Based on the collected data, the coefficient of variation in size measurements between the DI, D-II, D-III, and D-VI samples was calculated, and it was shown that there are differences between the sizes of different brands (Figure 7).

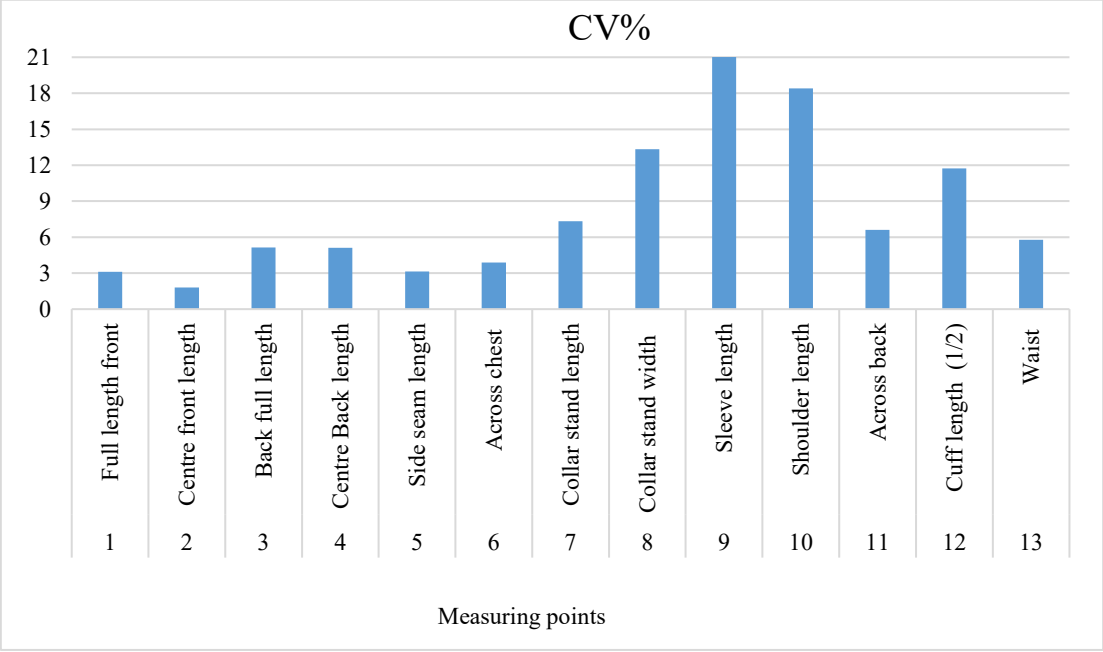

Figure 7-Coefficient of variation in size measurements among the samples.

It is believed that this large size difference between different brands that have the same recommended bust and waist size affects the fit of the garment. These measurement differences between garments underscore the need for more detailed sizing guidelines for wearers to ensure a proper fit. It is also believed that these changes in grading will have an impact on the pressure distribution over sizes. Therefore, it should be borne in mind that only one medium-sized sample was measured for each brand. It helps to bring out the differences between the garments when consumers buy them.

Seam and stitch Analysis: The design of the garment affects its fit and, as a result, the wearing comfort. When choosing a material and pattern, you should consider the most suitable way of stitching the product.

Stitch type: the stitch used in the garment samples were analyzed and the following five different types of stitch were identified in the garment: (1) 301 - two-thread locking seam; (2) a locking stitch of 304 yarn; (3) 406 - cover; (4) 504 - three-thread overlock; (5) 514 - four-thread overlock.

Seam: the regular sleeve D-I pattern contains many components on the front of the garment. In addition, this specimen differed in the location of the seam. While the others were similar in regards to the seam placement of the raglan sleeve, except that the sleeve of sample D-III was made from an open hem.

4. Conclusions

From the above findings, the main causes of discomfort are breathability and sweating speed when wearing these clothes while riding a bicycle. In addition, according to the size measurements performed, there are differences between samples of the same size. It is clear that there are differences in ready-to-wear between brands. The size charts currently available are not yet clear, so providing users with more detailed size information may help overcome these differences. Based on the findings, we concluded that we need to improve existing products and prioritize design and new features.

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