# Fit Analyses of Bicycle Clothing in Active Body Poses

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***Introduction:*** Measurements vary when the body is in motion, and specifically for sportswear it is important to evaluate clothing fit and comfort at the most extreme body positions. However, there is a general lack of research devoted to applications of fit analyses of sportswear in active body poses. The aim of this research is to analyze fit of tight fitting bicycle clothing in active body poses using half scale fit models and air-pack compression sensors for fit evaluation.

Precise half scale forms developed from 3D scans are a new concept in dress forms, which have been successfully used in academia for pattern development through a process of draping, testing and perfecting the fit on the half scale forms, and then scaling patterns to full size using a CAD program. Ashdown, *et al* (2014) developed half scale forms in standing positions using scans of individuals, and investigated the methods for creating an in-house half-scale dress form for use as a firm's fit model. Vuruskan and Ashdown (2015) explored potential use of 3D body scanning for active body poses such as cycling, focusing on the development of a quick, practical and cost effective method (in comparison to 3D printing) for producing half scale models.

The main use of pressure garments is for medical therapy. The compressive properties of garments are also applied in sportswear to improve performance. The design of sportswear can benefit by creating the appropriate level of clothing pressure. In such cases, level of pressure is an important aspect in determining fit, comfort and function. Clothing pressure will vary according to the design, pose of the wearer, material properties, etc. (Seo, *et al.* 2007).

***Methods/Procedures:*** Based on an empirical methodology, researchers experimented with new approaches for fit analyses in active body poses, using half scale fit models made from 3D body scans and compression sensors. To conduct fit analyses of bicycle clothing, twenty-six volunteer cyclists were body scanned. Size representatives were selected from the participants, to take part in fit tests. A size set of real and half scale bicycle shorts and bib-shorts were produced to be used as test garments. Airpack pressure sensors from AMI Techno Co. Ltd, were integrated as a fit evaluation tool for cycling clothing in standing and active body poses. These sensors are able to measure both the living body (soft condition) and the half scale form (hard condition).[1] Eight sensor locations were identified to measure pressure for the shorts, and nine for bibshorts. Clothing pressure was measured at these locations for four participants each representing a different size, in standing and cycling positions. As a pilot test, 3D printed half-scale fit models in cycling and standing poses were created for one of the sizes, and the same pressure measurement procedures were carried out using this set of half scale forms (Figure 1).

[1]Brochures for airpack compression sensors provided by the company Ami Techno Co. Ltd. (2015)

Figure 1. Digital/3D printed forms in standing and cycling poses, and measuring pressure

***Results/Discussion:*** Pressure results obtained from the participants showed similar results, with low values, suggesting that such pressure measurement procedures are valuable for fit identification. Low values are expected to be more sensitive to environmental conditions and human factors, such as breathing. Most tension occurred at waistbands. Most pressure locations on the bent leg increased slightly in the cycling position in comparison to the standing position.

Pressure results using the half scale forms showed similar tendencies to the pressures encountered in actual use of shorts in full size. However; in general, pressure values from half scale forms were greater than the values from actual use. Some differences were noted that will be investigated to determine possible determinants. Increasing the number of repetitions and the variety of measurements will provide the data needed to analyze the affect of experimental conditions and reproducibility of the data. Producing forms for the remaining size categories will allow further testing. However, the development of a less costly and more environmental approach for producing half scale fit models would be desirable.

***Conclusions:*** This research is of value in that, for the first time, half scale dress forms in active body poses have been explored in academic literature, involving evaluations of the fit of bicycle clothing, using contemporary tools such as half scale forms, 3D body scanning and air-pack compression sensors. Planned future work includes the development of further forms in different sports categories, and using various tools to analyze fit.

## References

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