Investigating a methodology to measure moisture in skin-textile friction experiments.

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Introduction

During running, foot skin is subjected to continuous pressure and repeated shearing, along with high levels of humidity due to perspiration and heat (Baussan et al. 2010). Moisture content in the stratum corneum skin layer and presence of moisture in the skin-fabrics interface can strongly influence the available friction (Tomlinson et al. 2011, Kenins 1994).

This pilot study was conducted as part of a wider study to examine the friction between human skin and sock textiles and the potential effect of moisture both in the contact and within the textile and skin layers. The objectives of this study are: (i) to establish a moisture control protocol for textiles, using a commercially available device, the Corneometer® 825 and (ii) to assess the protocol in a participant study. Corneometer readings were given in arbitrary units (AU) ranging from 0 to 120 AU.

Materials

Two different types of socks were selected due to their differing fabric composition: (i) "cotton-rich" (70% cotton, 29% nylon, 1% elastane); and (ii) "wool-rich" (40% wool, 31% cotton, 19% nylon, 8% elastane). Both socks are approximately 2 mm in thickness and are knitted in terry jersey.

First experiment: Establishing a moisture control protocol for sock textiles

Methods

Three specimens of each cotton-rich and wool-rich sock were prepared. The socks were mounted on a metal plate and water was applied to the inside of the plantar region of the sock materials using a calibrated spray. The water was sprayed directly onto a targeted area of 40 mm radius. Each spray delivered approximately 1.4±0.1 ml of water on average. Five Corneometer measurements were taken in dry conditions and also after applications of 1, 2, 3, 5, and 10 sprays. The averages of the Corneometer measurements are displayed in Figure 1 below.

Results

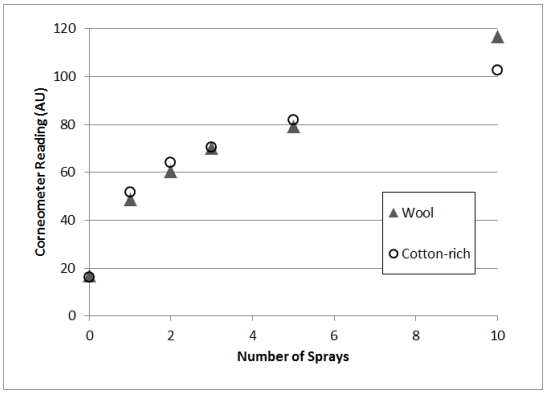

Figure 1. Corneometer readings in relation to the number of sprays.

In dry conditions, both sock materials gave similar Corneometer readings, indicating that the results were not influenced by differing capacitances of the materials themselves. The Corneometer readings steadily increased with the number of sprays and showed a similar trend for both types of socks. These findings suggested that the Corneometer® 825 can be

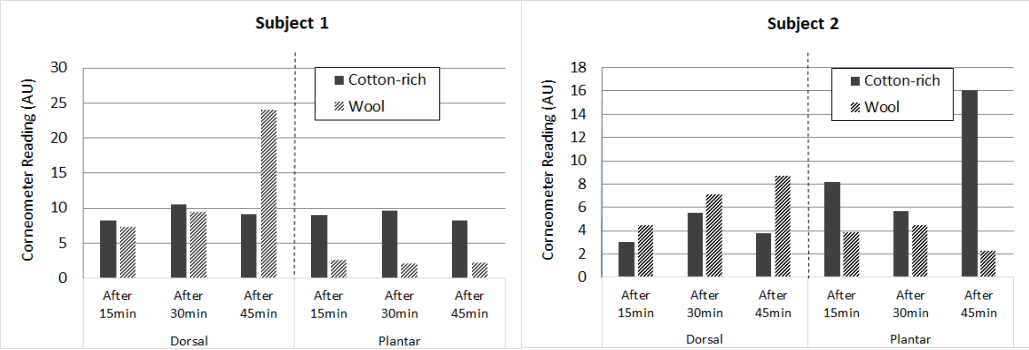

Figure 2. Corneometer readings of sock materials after the running bouts.

used as a reliable indicator to quantify the amount of moisture in these sock materials.

Second experiment: Assessing the protocol in a participant study

Methods

In order to assess the suitability of the moisture control protocol for future studies, two healthy subjects (1 female aged 26 and 1 male aged 31) were recruited to complete a running session that included three running bouts of 15, 30 and 45-minutes duration.

Prior to running, subjects were asked to clean their feet with water and let them acclimatise to the laboratory conditions (room temperature of 23.4°C and relative humidity of 32.7%) for 15 minutes. Subjects were then required to wear a cotton-rich sock on one foot and a wool-rich sock on the other. Both feet were wrapped with cling film and plastic bags to induce maximum sweating throughout the running duration. A total of 10 Corneometer measurements were taken on the dorsal and plantar regions of the socks, before and after each running bout.

Results

From Figure 2, it can be seen that the moisture levels of the sock materials were at the lower end of the Corneometer scale even after the 45 minute run. In addition, Subject 1 produced higher moisture level on the dorsal part of the sock as opposed to Subject 2, which suggests that different individuals vary in the way they regulate moisture within a shoe environment.

Conclusion

The Corneometer shows promise as a methodology to monitor the moisture level of sock materials. In addition, this current study provides valuable insights into the amount of moisture content accumulated in sock fibers in real world situations. These values can be replicated using the established control protocol for future studies, including those examining foot skin-sock friction. More participants are required before any definitive conclusions can be drawn at this stage.

References

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