Evaluating Thermal Comfort of Fabrics for Nurses' Uniforms

Keywords: nursing uniform, knitted fabric, thermal, water vapor

The National Sample Survey of Registered Nurses (2008) reported that more than three million licensed registered nurses worked in the United States in 2008. The growth of the nursing population has led to issues related to the development of nurses' uniforms in the medical industry. The primary issue mentioned is fabric comfort. In the textile industry, a variety of functional and technological fabrics have been developed and applied to develop efficient nurses' uniforms.

Several previous studies (Sampath, Anton, Senthilkumar, & Nalankilli, 2012) have found that the attributes and structures of a fabric largely influenced the thermal comfort level in nurses' uniforms. Nurses' current uniforms are predominantly made using woven fabrics containing natural and synthetic fabrics (Yin, Rachel, Megan, Annette, & Jane, 2011). However, current research has stated that knitted fabric offers better thermal comfort, especially thermal resistance and water-vapor resistance, compared to woven fabric (Scheurell, Spivak, & Hollies, 2011).

Therefore, the goals of this study are to (1) examine the thermal resistance (R_{ct}) and water-vapor resistance (R_{et}) values of woven fabrics used in current uniforms and knitted fabrics with a similar fiber content as the current uniform fabric and (2) compare woven fabrics and knitted fabrics in terms of thermal comfort values. Two hypotheses were developed for this study:

H1: A significant difference in R_{ct} and R_{et} exists between woven and knitted constructions.

H2: A significant difference in R_{ct} and R_{et} exists among fabrics.

The Sweating Guarded Hot-Plate (SGHP) was used to measure the thermal properties of the fabrics. The five woven fabrics currently used for nurses' uniforms—W65C35P (65% cotton and 35% polyester), W65P35R (65% polyester and 35% rayon), W55C42P3S (55% cotton, 42% polyester, and 3% spandex), W100C (100% cotton), and W100P (100% polyester)—were selected for fabric samples. In addition, five knitted fabrics with the same fabric content combinations of nurses' current uniforms were tested: K65C35P (65% cotton and 35% polyester), K65P35R (65% polyester and 35% rayon), K50C48P2S (50% cotton, 48% polyester, and 2% spandex), K100C (100% cotton), and K100P (100% polyester). Each fabric sample was cut into 12-inch by 12-inch squares for the fabric tests. A minimum of three test samples for each fabric were cut and conditioned in the room temperature and humidity for 12 hours in accordance with ISO 11092 standards.

The result of the *t*-test showed significant differences in both R_{ct} (t (19.87) = -4.49, p < .01) and R_{et} (t (28) = 3.37, p < .01) between woven fabrics and knitted fabrics. Thus, Hypothesis 1 was supported. Based on the result of the ANOVA, a significant difference among

the ten different fabrics was found in both R_{ct} (F (9, 20) = 41.78, $p < .00$) and R_{et} (F (9, 20) = 11.54, $p < .00$). Thus, Hypothesis 2 was also accepted. A post-hoc LSD test was conducted to determine group differences; the result identified three groups in each R_{ct} and R_{et}. Group "C" (K65C35P, K100C, and K100P) was significantly higher than group "A" (W65C35P, W55C42P3S, W65P35R, W100C, and K65P35R) and group "B" (W100P and K50C48P2S) in the R_{ct} results. Thus, K65C35P, K100C, and K100P, which had the higher R_{ct}, were better at maintaining heat. In addition, the R_{et} results showed that group "A" (W65P35R, K65C35P, K65P35R, K100C, and K100P) was lower than both groups "B" (W100C and W100P) and "C" (W65C35P, W55C42P3S and K50C48P2S). As a result, group "A," which had the lowest R_{et}, was the most comfortable fabric for moisture permeability.

The results of this study indicated that knitted fabrics, which have the same fabric content as woven fabrics but different fabric constructions, provide better thermal comfort in both R_{ct} and R_{et} aspects. Thus, nurses' current uniforms should be redesigned to increase thermal comfort by using knitted fabrics. This study also contributes to the future of manufacturing nurses' uniforms.

References

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