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Performance attributes relevant to thermal comfort of hip protective garments

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Wiah Wardiningsih [1,2], Olga Troynikov[1]

[1]*School of Fashion and Textile, RMIT University, Melbourne, Australia*
[2] *Polytechnic of Textile Technology, Ministry of Industry, Bandung, Indonesia*

Introduction

The present study aimed to investigate the influence of hip protective pads on performance attributes of hip garment relevant to the thermal comfort of the wearer. This study also investigated the influence of different material for the hip protective pads. Performance attributes relevant to the thermal comfort of the wearer that was investigated were thermal resistance and evaporative resistance. Three typical hip impact protective garments were used. Objective evaluation of thermal resistance and evaporative resistance of these hip protective garments was carried out by means of a thermal manikin. It was found that different comprising materials of protective pad produced different outcomes in thermal resistance and evaporative resistance of hip protective garment.

Methods

Three typical hip protective garments were used for this study (Table 1). Three protective pads that made of different materials were investigated as part of garments in this study, for its performance attributes relevant to the thermal comfort of the wearer. The thermal resistance and evaporative resistance of three hip protective garments were evaluated using a heated sweating manikin in steady conditions. The thermal manikin has 20 zones. For the analysis, three groups weighted averages were defined: “hip zones group”; “hip and stomach zones group”; and “all zones group”.

Table 1. Physical properties of experimental hip protective garments

Hip Protective garment	Garment			Protective Pad form	Mean Protective Pad Volume, mm^3	Mean Protective Pad thickness, mm
	Fabric Construc-tion	Fibre Compo-sition, %	Fabric thickness, mm			
A	single jersey;	Cotton 25, Polyester 55, Elastane 20	0.75	Polyurethane foam covered by clear plastic film	792,000	16
B	single jersey	Cotton 58, Polyamide 36, Elastane 6	0.96	4 layers Polyester spacer fabrics	621,600	16
C	Single jersey	Polyamide 80 Elastane 20	0.64	Segmented hexagonal Polyethylene foam	520,200	9

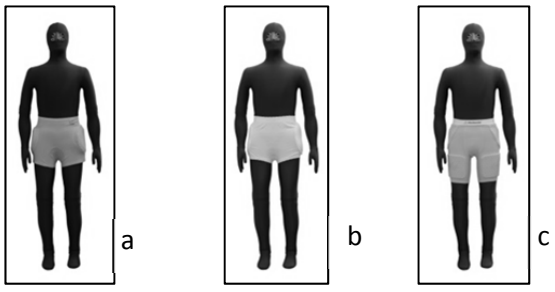

Figure 1. a) Hip protective garment A; (b) Hip protective garment B; (c) Hip protective garment C

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Results and discussion

Figure 2 present the thermal resistance (IT) and evaporative resistance (ReT) of hip protective garments. In "all zones group", the differences between IT and ReT values of all hip protective garments were significant (p Value<0.05). It indicated that the addition of hip protective garment into manikin influenced the IT and ReT in "all zones group". However from Tukey method grouping it could be seen that hip protective garments A and B had similar value while only hip protective garments C had a reliably different value. The addition of hip protective garment C significantly influenced IT and ReT values of all zones manikin. The reason for this probably due to the knee length style of this garment covered four zones out of 20 zones in the manikin. This implied that hip protective garment style would influence on IT and ReT values of" all zones group" in the manikin.

The differences between the IT and ReT of hip protective garment A, B and C in manikin "hip zones group" were significant (p value< 0.05). Hip protective garment A had the highest IT and ReT values probably because it had the highest volume of protective pads that made of foam that had high resistance to the transmission of heat.

Hip protective garment C had the lowest IT and ReT values. This occurred probably because protective pads had gaps or openings between the segments of the segmented foam pad that was filled with air since the still air is known to have good thermal resistance properties. However when the person is performing an activity such as walking, the thermal and evaporative resistance of clothing will decrease [1,2]. Most likely due to the openings in the garment, the still air layer in the opening will be disrupted by the movement and the wind. Hip protective garment B had lower IT and ReT values than hip protective garment A. This occurred probably because protective pads of Hip Protective Garment B made of a spacer fabric that had voids so that moisture could escape into the environment.

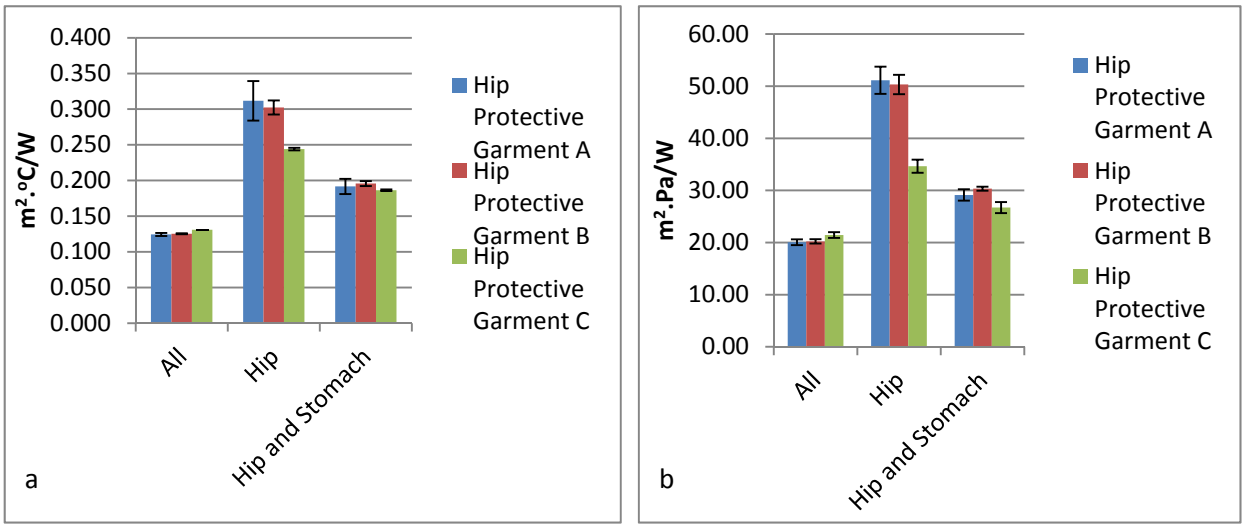

Figure 2. a)Mean Thermal Resistance (IT); b) Mean Evaporative Resistance (ReT)

Conclusions

It was apparent from the results that the usage of hip protective garments style and pad materials in manikin influenced the thermal resistance and evaporative resistance of the manikin.

References

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