

# PROGRESS TOWARDS DEVELOPING AN INDUSTRY STANDARD FOR SUN-PROTECTIVE CLOTHING THAT INCORPORATES BODY SURFACE COVERAGE



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## AIM

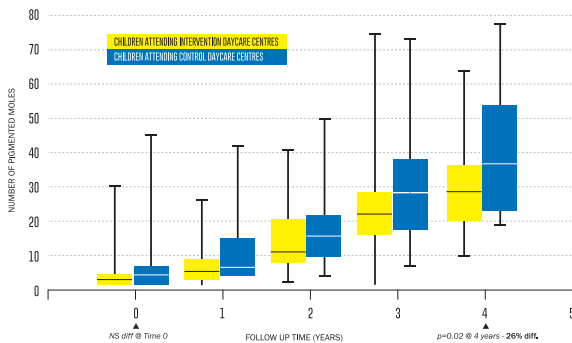
To develop a reproducible rating system for sun-protective clothing that incorporates the % of the body surface covered by the garment, in addition to the ultraviolet protection factor (UPF) of the fabric.

## BACKGROUND

Skin cancer is the most common form of cancer and typically affects sun-exposed body-sites. Number of pigmented moles is a major phenotypic risk factor for melanoma. Mole development is related to sun-exposure in Caucasian children. Clothes provide a barrier that reduces the amount of UVR reaching the skin. In 1996, Australia pioneered the relative ranking of the sun-protective capabilities of clothing based on the transmission of UVR through fabric. UPF measurement and labelling specifications are documented in the Australian and New Zealand Standard, AS/NZS 4399:1996, which has been adopted almost universally by the textile industry. Fewer moles develop in children on body-sites routinely covered by high UPF clothing thereby reducing future risk of melanoma (see Figure 1 below)

Figure 1

RCT intervention clothing (see Images 2-4 below); Harrison et al 2010



Images 2, 3 & 4

## THE ALGORITHM

Comparison of bands marked on the mannequin body surface determine the total surface area covered by the garment being tested. The protection provided by a garment may be expressed by the ratio:

$$GPF = C/U$$

GPF = Garment Protection Factor

C = Number of horizontal lines visible on the clothed mannequin

U = Number of horizontal lines visible on the unclothed mannequin.

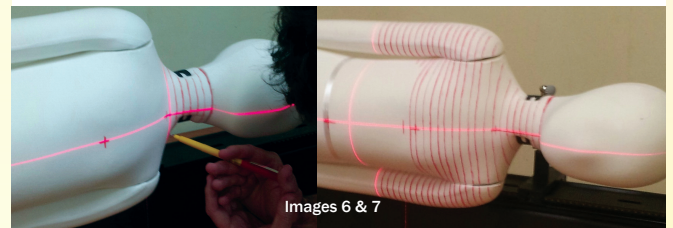
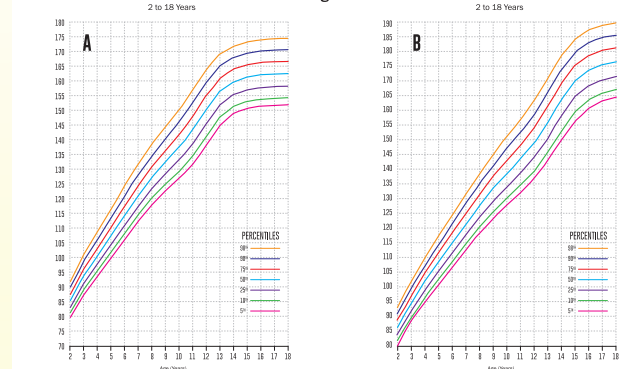
## METHODS

Mannequins matching median height of 1-10 year-old children (see Figure 5) were sourced.

Each mannequin was fixed to an optical bench and marked with horizontal lines at intervals separated by 1 cm with the aid of a laser level (see Images 6 & 7).

An image processing algorithm was developed to count the number of marked lines on clothed and unclothed mannequins.

Figure 5



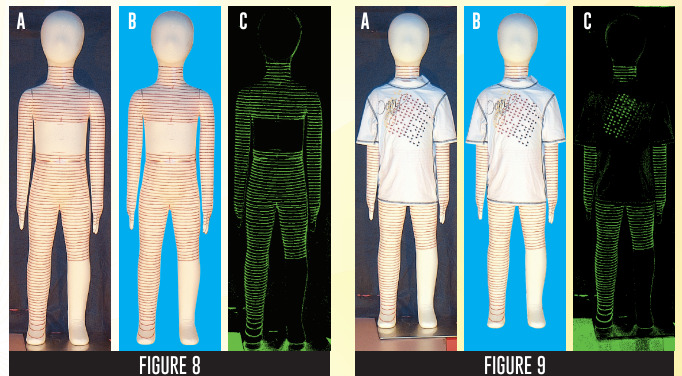
Images 6 & 7

## THE TESTING PROCESS

The body surface area covered by a garment is determined by comparing the number of horizontal lines visible on the clothed and unclothed mannequin of the correct size.

This is achieved by image processing of both the clothed and unclothed mannequin.

The mannequin is photographed in front of a neutral (black) non-reflective background using a camera with a 18-55mm zoom lens at f4.5 supported by a tripod, and positioned a fixed distance from the mannequin, such that a reference point marked on it was collinear with the camera's optical axis.



Creating a body surface template for the upper body. The marked mannequin is photographed (8A). The mannequin surface is framed by removal of the background image (8B). Image processing of the marked body surface is used to count line segments and highlight them in a false image colour (8C).

Measuring GPF is a 3-step process. The marked mannequin is fitted with a garment and photographed (9A). The mannequin surface is framed by removal of the background image (9B). Image processing of the marked line segments is used to show the surface of the body not covered by the garment (9C).

## CONCLUSIONS

GPF is able to be calculated for both upper and lower garments separately. Further work will determine whether it is more useful to report the GPF for garments separate to the UPF of the fabric, or whether a composite measure of the two quantities and a new rating system for sun-protective clothing should be developed.

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