EFFECTS OF TWO KINDS OF CLOTHING WITH DIFFERENT PROPERTIES FOR
MOISTURE ON THERMOPHYSIOLOGICAL RESPONSES AND HEART RATE
DURING INTERMITTENT EXERCISE AT AN AMBIENT TEMPERATURE OF 24°C

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INTRODUCTION
Although there are several publications concerned with the influences of textile materials on human
thermophysiological responses (1,2,3), it seems to be far from the systematic understanding of the
relationship. It seems necessary to collect much more data on textile materials and human
thermophysiological responses under various kinds of environmental conditions. Therefore, the effects of
two kinds of clothing with different properties for moisture on thermophysiological responses and heart
rate were studied during intermittent exercise at an ambient temperature (T_a) of 24°C.

MATERIALS AND METHODS
Two kinds of clothing ensemble, of similar insulative values (C:1.24 clo, E: 1.25 clo), tested were 1) cotton T-shirt with short sleeves and cotton long sleeved working dress with trousers (C), and 2) polyester
T-shirt with short sleeves and polyester long sleeved working dress with trousers (E). Physical properties
of experimental clothing materials are shown in Table 1. Five female adults, 21-32 yrs, served as
subjects. These experiments were conducted at a T_a of 24°C, 50% RH, and 0.14 m s⁻¹ air velocity. The
subject wearing either C or E repeated 10 min exercise by a cycle ergometer at an intensity of 30% V0₂max and 10 min rest for four times. Rectal, several different skin temperatures and clothing
microclimates were recorded by thermistor with accuracy of 0.01°C. Local sweat rate was recorded using
ventilated capsule method and heart rate was obtained from Sport Tester. All parameters were continuously
compared between C and E throughout the experimental period.

Table 1. Physical properties of experimental clothing materials.

<table>
<thead>
<tr>
<th>Fabrics</th>
<th>Weight (g m⁻²)</th>
<th>Thickness (mm)</th>
<th>Density (Wale, Course (no inch⁻¹))</th>
<th>Water absorbency (cm 10min⁻¹)</th>
<th>Moisture regain (%)</th>
<th>Moisture transfer (g m⁻² hr⁻¹)</th>
<th>Thermal conductivity (W cm⁻¹°C⁻¹)</th>
<th>Air permeability (cc cm⁻² sec⁻¹)</th>
</tr>
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<tbody>
<tr>
<td>(underwear)</td>
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<tr>
<td>cotton</td>
<td>133.9</td>
<td>0.667</td>
<td>37, 32</td>
<td>14.3, 9.0</td>
<td>7.2</td>
<td>435</td>
<td>4.6x10⁻⁴</td>
<td>268</td>
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<tr>
<td>polyester</td>
<td>131.4</td>
<td>0.417</td>
<td>43, 37</td>
<td>0.5, 1.7</td>
<td>0.4</td>
<td>465</td>
<td>2.8x10⁻⁴</td>
<td>300</td>
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<tr>
<td>(Working garments)</td>
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<tr>
<td>cotton</td>
<td>141.4</td>
<td>0.24</td>
<td>118, 65</td>
<td>5.8, 4.4</td>
<td>6.1</td>
<td>435</td>
<td>2.7x10⁻⁴</td>
<td>24</td>
</tr>
<tr>
<td>polyester</td>
<td>158.9</td>
<td>0.26</td>
<td>113, 63</td>
<td>4.5, 2.0</td>
<td>0.4</td>
<td>434</td>
<td>2.9x10⁻⁴</td>
<td>21</td>
</tr>
</tbody>
</table>

RESULTS
The major findings are summarized as follows: 1) Rectal temperature rose significantly higher in E
(Fig.1). 2) The heart rate was higher in E both during exercise and rest (Fig.2). Clothing microclimate
humidity was apt to be or significantly higher in part in E. 4) Clothing surface temperature at the back
level was apt to be higher in C, especially near the end of the second, third and fourth exercise. 5) Four
out 5 subjects felt more wet in E during the latter half of the experiment.
CONCLUSION
The reduced thermal insulation due to the absorption of moisture in C significantly accelerated dry heat loss effectively, resulting in an inhibition of the increase in core temperature and heart rate.

REFERENCES
