# An interaction of morphology in the modulation of evaporative heat loss during exercise

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Regional sweat rates vary greatly among individuals. It is possible that some of this variability can be ascribed to differences in morphological configuration, specifically the ratio between the body surface area and body mass, and how it influences thermoeffector function. However, few have evaluated this interaction, particularly with regard to inter- and intra-individual differences in sudomotor function. Therefore, this investigation was aimed at testing the hypothesis that individuals with a smaller surface area-to-mass ratio (*i.e*. larger people) would, due to their reduced potential for dry heat loss, be more reliant upon evaporative cooling than would smaller subjects, when both groups exercised at rates eliciting equal heat loss requirements.

Local and whole-body sweat production was evaluated in two groups ($n$=10 per group) of males that varied significantly in their surface area-to-mass ratios (smaller: 280 $cm^2.kg^{-1}$ [±0.01]; larger: 240 $cm^2.kg^{-1}$ [±0.00]; $P$<0.05). Participants completed two trials, both under temperate-dry conditions (28°C; 30% relative humidity). Each trial consisted of three distinct periods, completed sequentially: 20 min seated rest, 45 min of semi-recumbent cycling at matched internal heat production rates (metabolic heat ±external work) for each subject (trial one: ~135 $W.m^{-2}$; trial two: ~200 $W.m^{-2}$), and 20 min seated recovery. Ventilated sweat capsules (3.16 $cm^2$) were used to simultaneously measure local sweat rates from four sites (dorsal hand, forearm, upper back, forehead). Gross mass changes before and after each period (corrected for fluid intake and respiratory loses) were used to determine whole-body sweat rates.

Between groups, neither the absolute mean body temperature during exercise, nor its change, differed significantly ($P$>0.05). However, local sweat rates ($mg.cm^{-2}.min^{-1}$) were greater in the low surface area-to-mass ratio group ($P$<0.05; Table). As expected, these also differed across sites within each group ($P$<0.05; Table; means±SE). Indeed, within trial one, the mean local sweat rate of the smaller individuals was <50% of that observed for the other group, and for trial two, it was <75%. Similarly, when whole-body sweat rates were normalised for variations in surface area-to-mass ratio, significantly greater sweat was produced by the larger participants (trial one: 8.8 [±1.1] *versus* 14.9 $g.cm^{-2}.min^{-1}$ [±0.8]; trial two: 25.9 [±2.6] *versus* 42.2 $g.cm^{-2}.min^{-1}$ [±4.0]; $P$<0.05).

| | Trial one: 135 $W.m^{-2}$ | | | | Trial two: 200 $W.m^{-2}$ | | | |
|---|---|---|---|---|---|---|---|---|
| | Hand | Forearm | Back | Forehead | Hand | Forearm | Back | Forehead |
| Smaller subjects | 0.40 ±0.09 | 0.14 ±0.04 | 0.20 ±0.06 | 0.33 ±0.11 | 1.65 ±0.13 | 1.00 ±0.14 | 1.10 ±0.15 | 2.11 ±0.37 |
| Larger subjects | 0.79 * ±0.11 | 0.39 * ±0.06 | 0.37 * ±0.06 | 0.72 * ±0.09 | 2.18 * ±0.17 | 1.39 * ±0.13 | 1.23 ±0.14 | 3.05 ±0.34 |

**Significant differences between groups are indicated by the symbol (*; P<0.05).*

It has been postulated that heat loss mechanisms might be coupled with one's surface area-to-mass ratio, with smaller individuals able to rely more upon dry heat exchanges under these conditions, due to a favourable morphological configuration, yet this appears not to have been systematically evaluated. The current observations, which come from an extensive examination of this hypothesis across men and women, are consistent with this theory, and show that individuals with a lower surface area per unit mass must maintain greater rates of sweat secretion to achieve an equivalent requirement for heat loss.