SWEAT DISTRIBUTION AND PERCEIVED WETNESS ACROSS THE HUMAN FOOT

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Investigations of intra-segmental sweat distribution at the foot (Taylor *et al.*, 2006; Smith *et al.*, 2013) consistently report sweat rates to be greatest from the dorsal surface compared to the plantar surface (~70% and ~30% respectively). However, detailed comparisons of foot sweat rates from existing literature are difficult due to differing ambient temperatures, heating techniques, exercise modes and socks/footwear used. In addition, the relationship between sweating on the foot and perceived skin wetness is unknown. This study investigated regional foot sweat distribution to aid footwear design and assessed the relationship between sweat distribution and perceived wetness.

14 trained female runners performed 60minutes of treadmill running with ambient conditions of 25°C, 50% RH. 35minutes of running were performed at a low intensity (55% maximal heart rate) followed by 25minutes at a higher intensity (75% maximal heart rate). Sweat rates from the right foot were measured at 14 zones using technical absorbent material and a 100% cotton sock applied during the last 5minutes of each work intensity. Local sweat rates were derived from changes in pad mass. Infrared images pre and post pad application were recorded to evaluate local and mean foot skin temperature. Wetness perception was assessed prior to pad application. Participants exercised in standardised clothing, socks and running shoes.

Heart rates averaged 134±3 bpm and 157±2 bpm during low and high exercise intensities respectively. Corresponding core temperatures were 37.8±0.2°C and 38.2±0.3. Participants presented evidence for a non-uniform distribution of sweating on the foot. Highest local sweat rates were observed from the medial ankle, medial dorsal and central dorsal. Lowest local sweat rates were observed from the toes. Sweat rate increased significantly with exercise intensity at the central dorsal, toe 3, lateral and medial ankle ($p<0.05$). Data from grouped zones indicated a similar sweat distribution pattern from low to high exercise intensity. Participants sensed differences in wetness at different zones (dorsal, toes, heel, sole; $p<0.01$) with wetness perception increasing significantly with exercise intensity ($p<0.05$). Despite the toes having the lowest sweat rates, they were perceived as being one of the wettest zones during both exercise intensities.

The present study provides a detailed view of sweating across the foot surface for trained female runners. In accordance with previous studies, sweat rates were greater from the dorsal surface compared to the plantar surface. However, previous reports of sweat rates levelling off with increased exercise intensity were not observed across all foot zones. Perceptions of wetness increased with exercise intensity across all zones but sensations of wetness did not correspond with areas of high sweat production. It is important to consider that footwear comfort may not be dominated by a single zone and possibly not the zone with the highest sweat production.