

Appendix 2. Example of the development of an extreme heat policy for the Australian Open Grand Slam Tennis tournament. This policy was driven by Drs Ollie Jay and Carolyn Broderick and first implemented in 2019.

#1 Environmental Monitoring considerations																											
Courtside conditions were monitored within all 3 main stadium courts + two external courts (east and west) to account for potential differences in microclimates.																											
An environmental measurement unit (EMU) was designed and manufactured at the University of Sydney and deployed at each of the courts (Figure 1) to obtain true measures of all 4 environmental parameters (air temperature, mean radiant temperature, air velocity, and humidity).																											
Placement of EMU at each location ensured representative surface, sun exposure, and air ventilation in which competitors played.																											
Online dashboard to monitor and plot live conditions was developed.																											
#2 Define Physiological/Physical parameters																											
The Australian Open Heat Stress Scale (AO-HSS) utilises a combination of two heat stress risk: 1) rate of rise in core temperature, and ii) rate of dehydration.																											
Metabolic rate and clothing in AO-HSS model was defined by literature ^[184] and measurements on a thermal (sweating) manikin. ^[185]																											
The 4 environmental parameters measured by EMUs served as live inputs.																											
No adjustments for sex as modest differences in heat production would be offset by opposing differences in the maximum sweat rate ^[186,187] and duration of matches are typically shorter for women																											
Differences in body size were applied for junior competitors, and the maximum sweat rate was reduced for wheelchair athletes. ^[170]																											
Competitors were assumed to be heat-acclimated. ^[169]																											
The Australian Open is often contested under very hot and dry (arid) conditions. Heat loss will therefore often be limited by sweat rate rather than the climate, so maximum sweat rates were integrated into the model.																											
#3 Define the level of heat stress risk that is acceptable																											
The same level of net physiological heat strain was associated with a given AO-HSS threshold for all groups as all participants are elite athletes.																											
The same net AO-HSS score can be attained with different combinations of temperature, radiation, wind speed and humidity.																											
Generation of an AO-HSS score for each of the 5 courts monitored, and the highest of these 5 scores is displayed to ensure that maximum protection is provided.																											
#4 Generate a risk assessment format that is easy to understand and respond to																											
The AO-HSS output is scaled to a colour-coded 1 to 5 scale (Figure 1).																											
Scale scores are reported to one decimal place for players to assess the proximity of the current conditions to thresholds above and below the present one.																											
To avoid the potential confusion of displaying different AO-HSS outputs for the different group, the threshold at which different actions/interventions were altered for each classification group (Table).																											
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#5 Incorporate evidence-based heat stress mitigation strategies that are feasible and implementable																											
AO-HSS ≥ 2.0 : players are encouraged to increase their fluid intake during breaks in play, as opposed to drinking ad libitum. ^[188]																											
AO-HSS ≥ 3.0 : players are instructed to apply cooling strategies during the standard mandated breaks in play (i.e., 90 s after the completion of every odd-numbered game, and 120 s after the completion of every set) from the start of play in advance of developing hyperthermia. The specific strategy advocated and supplied at scale at the Australian Open is ice towels (~3 kg of crushed ice wrapped in a damp towel) as this has been demonstrated to reduce the elevation of rectal temperature during a lab-simulated tennis match by ~0.5°C in both very hot and dry (45°C, 6%RH) ^[39] and hot and humid (36°C, 55%RH) ^[37] conditions.																											

AO-HSS ≥ 4.0 : a 10-minute cooling break is allowed after the completion of the second set in women's and junior singles matches, and a 15-minute break is permitted in wheelchair singles matches after the second set. For men's singles matches, a 10-minute break is allowed after the completion of the third set of the match.

AO-HSS of ≥ 5.0 : the tournament referee can suspend the start of matches on outside courts and suspend all matches in progress after the completion of an even number of games in the current set, or the completion of a tie-break that is underway. Matches on stadia courts briefly stop after the completion of an even number of games or a tie-break if it is underway, and the stadium roof is closed, and air-conditioning is turned on for the remainder of the match.