

## Females Have an Increased Sensitivity to Thermal Stress during Matched Exercise Metabolic Heat Production

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### ABSTRACT

Females report greater sensitivity in pain and cold exposures. **PURPOSE:** It is unclear how thermal sensitivity is affected when the change for internal temperature ( $\Delta T_{in}$ ) and metabolic heat production ( $MH^{prod}$ ) are matched during exposure to hot conditions. This project tested the hypothesis that females have enhanced sensitivity to thermal stress during exercise hyperthermia when  $\Delta T_{in}$  and  $MH^{prod}$  is matched. **METHODS:** Twenty-two healthy active (7 day activity:  $8620 \pm 3008$  steps/day;  $VO_2max$ :  $49 \pm 10$  mL/kg/min) adults (11M/11F,  $22.4 \pm 4.9$ y,  $169 \pm 7.6$ cm,  $68.3 \pm 13$ kg) exercised at similar  $MH^{prod}$  (M:  $7.1 \pm 1.5$  W/kg, F:  $6.9 \pm 1.4$  W/kg;  $P=0.32$ ) for 60 min (cycle ergometer) in cool ( $24.0 \pm 0.0^\circ C$ ;  $14.4 \pm 3.6\% Rh$ ) and hot ( $42.3 \pm 0.2^\circ C$ ;  $27.9 \pm 5.5\% Rh$ ) conditions in random order separated by at least 7 days. The  $\Delta T_{in}$ , heart rate ( $\Delta HR$ ), and thermal stress indices for comfort (TC, -4 very cold to +4 very hot), sensation (TS, -4 very cold to +4 very hot), perception (TP, 1 so cold I am helpless to 13 so hot I am sick), feeling (TF, +5 very good to -5 very bad), and focus (F, 0 internal focus [bodily sensations] to 100 external focus [external environment]) were measured every 10 minutes. A 2-way repeated-measures analysis of variance on area under the curve was used to examine Interaction (I) and Main Effect (ME) for condition  $\times$  sex. Values are expressed as means  $\pm$ SD with significance set at  $P < 0.05$ . **RESULTS:** Males and females had similar increase in hot compared to cool for  $\Delta T_{in}$  (Cool:  $\Delta 0.5 \pm 0.1^\circ C$ , Hot:  $\Delta 1.5 \pm 0.6^\circ C$ ; ME: condition;  $P < 0.0001$ ) and  $\Delta HR$  (Cool:  $58 \pm 15$  b/min, Hot:  $71 \pm 15$  b/min; ME: condition;  $P < 0.01$ ). Females reported that TC and TS felt hotter in both conditions (ME: sex;  $P < 0.0001$ ) and both groups increased in hot compared to cool (ME: condition;  $P \leq 0.04$ ). Females reported that TS was elevated compared to males in cool compared to hot (I: condition  $\times$  sex;  $P < 0.005$ ). TP felt hotter in the cool but similar increase in hot for females compared to males (I: condition  $\times$  sex;  $P < 0.02$ ). Females reported TF was more positive compared to males in hot (I: condition  $\times$  sex;  $P < 0.0001$ ). Females reported greater external focus in cool compared to males (ME: sex;  $P < 0.0002$ ). **CONCLUSION:** These data indicate that sex differences exist for thermal stress. Females perceive thermal stress in hot and cool conditions to a greater extent than males exercising at similar metabolic heat production.