Influence of osmoreceptors and baroreceptors on heat loss responses during a passive heat stress

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INTRODUCTION

Nonthermal factors have been shown to have a profound influence on heat loss responses of skin blood flow and sweating during heat exposure (1). For example, changes in osmoreceptor and baroreceptor activity have been shown to independently modulate skin blood flow and sweat rate (SR), but the combined effects of these stimuli have not been fully explored (2,3). Therefore, we evaluated the separate and combined effects of changes in blood osmolality and baroreceptor loading status on the onset thresholds and sensitivity (slope of SR to core temperature relationship) of the sweating response to passive heating.

METHODS

On 4 separate occasions, 4 males were passively heated to 1.0°C above baseline core temperature (T_{CO}) during: (i) normal resting condition (CON), (ii) a hyperosmotic state (i.e., infusion with 3.0% NaCl saline, HYP), (iii) application of lower body negative pressure (LBNP) under normal resting iso-osmotic state (infusion of 0.9% saline) , (iv) combined LBNP + HYP. Whole-body heating was performed using a liquid conditioned suit with water circulated at 48ºC within a temperature controlled chamber maintained at 40ºC.

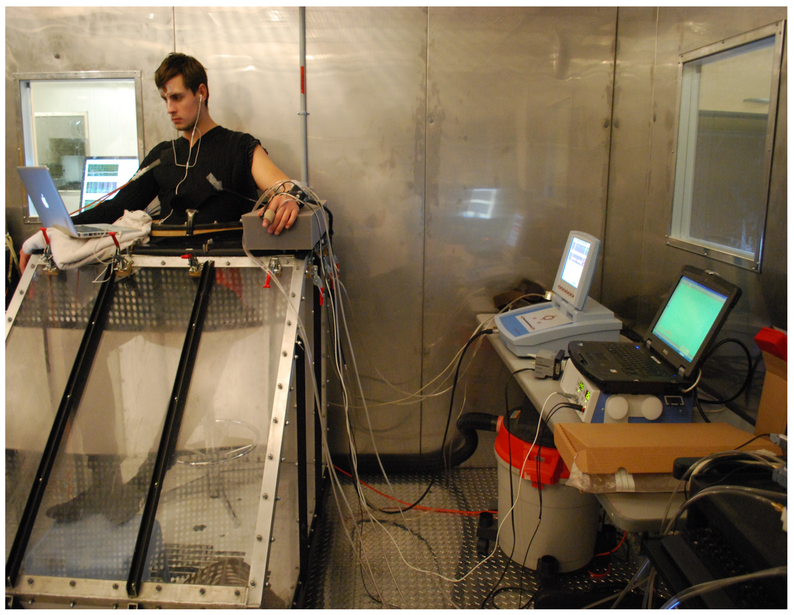

Fig. 2 Subject after being instrumented and infused with Saline, assuming supported standing position inside a pressure box sealed at the waist.

RESULTS

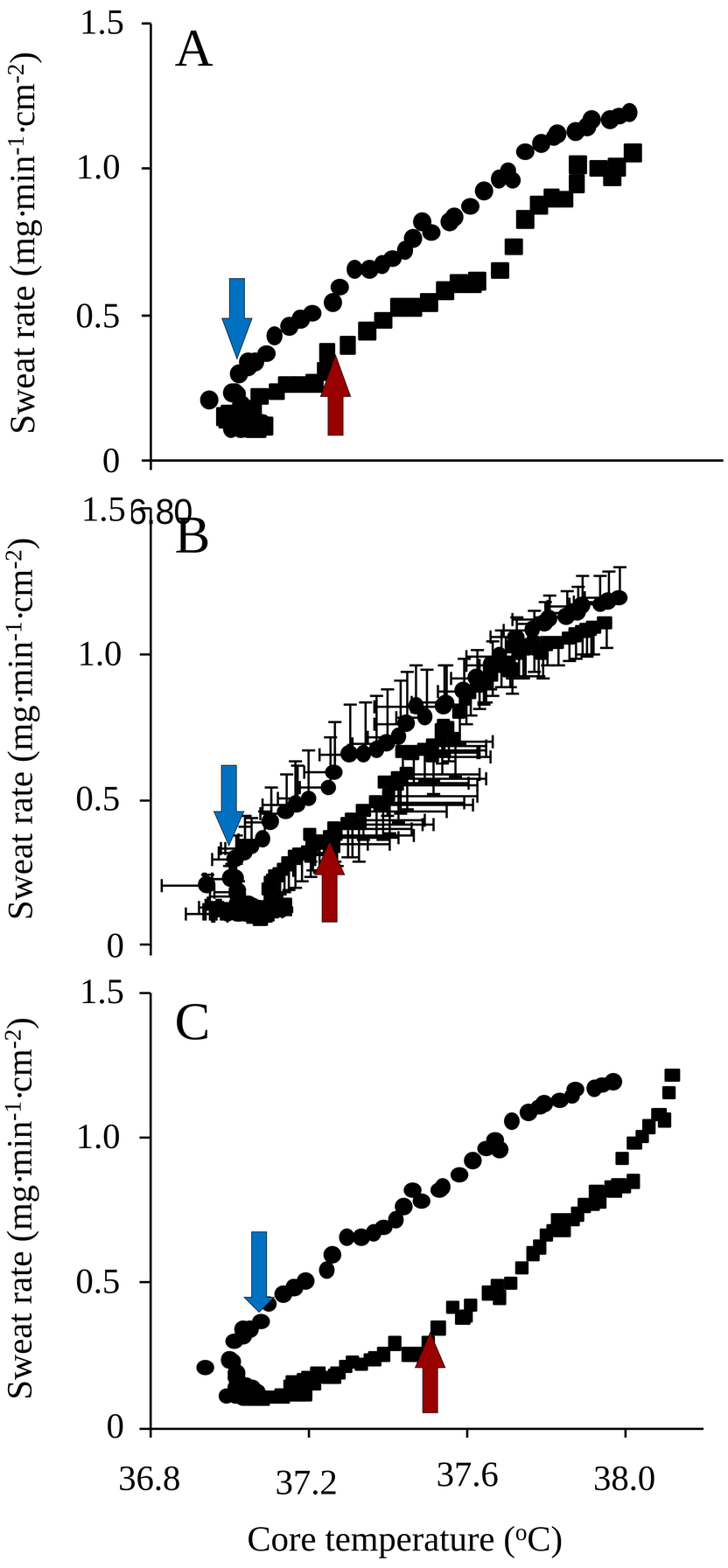

Fig. 1 Sweat rate as a function of increasing T_{CO}. A shows CON (●) and HYP (■); B shows CON (●) and LBNP (■); finally C shows CON (●) and HYP+LBNP (■). Arrow indicates onset of sweating (control blue, treatment condition red).

Table 1. Mean core temperature (T_{CO}) at the onset threshold and sensitivity (Slope SR-T_{CO})for sweating.

Condition	Resting T_{CO}	Onset T_{CO}	Δ T_{CO}	SEN (slope SR/T_{CO})
CON	36.91	37.06	0.15	1.55
HYP	36.97	37.25	0.28	1.52
LBNP	36.91	37.18	0.27	1.57
HYP+LBNP	36.94	37.41	0.47	1.31

Table 2. Mean blood osmolality (Osm) during the different conditions.

Condition	Resting	Post Infusion	0.5ºC T_{CO} Increase	1.0ºC T_{CO} Increase
CON	292	290	292	296
HYP	293	303	301	300
LBNP	292	294	294	295
HYP+LBNP	288	297	297	304

*Subjects drank 500 mL of water the night before and morning of each trial to ensure adequate hydration.

CONCLUSION

Both a hyperosmotic condition and baroreceptor unloading state delay the onset of sweating during passive heating. When combined, these non-thermal factors demonstrated an augmented effect on sweat rate and the onset threshold. Sweating sensitivities were not different between trials and were thus not affected by hyperosmotic conditions or LBNP when administered separately or combined.

References:

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3. Shibasaki M, Aoki K, Morimoto K, Johnson JM & Takamata A. *Am J Physiol Regul Integr Comp Physiol* 297: R1706-R1712, 2009.

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