

Reply to “Letter to the Editor: Combined effects of hypoxia and heat: importance of hypoxic dose”

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REPLY: We thank Sotiridis and colleagues for their interest in our research (2) and welcome the opportunity to respond to their letter to the editor. As detailed in our paper, the primary purpose of our study was “to examine the addition of a daily hypoxic stimulus on the time course and magnitude of adaption to heat” (2). Thus, while we do not discount their hypothesis that hypoxic acclimation was confounded by heat, this was not our research question. Nevertheless, this is a question worthy of future research. Sotiridis et al. also raise the possibility that the hypoxia-induced increase in erythropoietin was insufficient or confounded by heat. Interestingly, at the group level, we demonstrated increased plasma erythropoietin over our 11-day heat acclimation program irrespective of the addition of hypoxia, although there was considerable interindividual variation (21% to 92%). The observation that exposure to heat is erythropoietic, with or without hypoxia, is important and our subsequent (unpublished observations; Rendell RA, Prout J, Costello J, Massey HC, Tipton MJ, Young JS, Corbett J.) research has shown the erythropoietic effect is absent when similar exercise is undertaken in cool-normoxic conditions, indicating that this effect is due to the environmental stressors and not a “training” effect. Because our research question did not require a hypoxia-only condition, we cannot be certain that the erythropoietic effect of hypoxia was not attenuated by heat, but again, we suggest that future studies should consider this research question.

We do accept that our participant number may have impacted on our ability to detect increases in total hemoglobin mass (tHbmass). However, we did not power our study based on the anticipated tHbmass responses, given that this was not a primary outcome variable in the present study, although the crossover design that we employed will have meant that our study has similar statistical power to a parallel groups design with ~16 participants. Likewise, we acknowledge the possibility that the hypoxic dose (duration and severity) that we employed may have provided a relatively modest stimulus for expanding tHbmass, particularly when compared with individuals habituating at high altitude. However, the duration of intervention was consistent with that recommended for heat acclimation, which was our primary focus. Moreover, the severity of hypoxia was sufficient to reduce overnight SpO₂ and is in keeping with manufacturer recommendations for utilizing hypoxic tents as an ergogenic aid while minimizing the confounding influence as disturbed sleep (altitudedream.com). Importantly, our data demonstrate that this additional hypoxic dose did not interfere with the hypervolemic response to heat exposure, a key index of heat acclimation and one that has been hypothesized to be integral to the purported ergogenic effect of heat acclimation under temperate-normoxic conditions (1). Indeed, our secondary

aim was to examine whether the additional hypoxic stressor impacted on any ergogenic effect of adaption to heat when performance was examined in temperate-normoxia. Although no additive effect was observed with this hypoxic “dose,” importantly, there was no negative effect noted either. Finally, Sotiridis et al. conclude by suggesting that “prospective studies should perhaps ensure that a measurable degree of acclimation has occurred.” We find this assertion difficult to reconcile given that we clearly demonstrated that our intervention elicited a heatacclimated phenotype. Nevertheless, we are in agreement that future studies should consider the effect of heat and hypoxia on acclimation to hypoxia, and, in the absence of any practical or logistic considerations, that careful thought should be given to the hypoxic dose required for such studies.

GRANTS

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DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

AUTHOR CONTRIBUTIONS

R.A.R., M.J.T., and J.C. drafted manuscript; R.A.R., M.J.T., and J.C. edited and revised manuscript; R.A.R., M.J.T., and J.C. approved final version of manuscript.

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