Effects of an Overnight, 8-Hour Low Oxygen Exposure on Energy Intake and Resting Energy Expenditure in Healthy, Normal Weight Adults

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Objectives: Individuals who travel to high altitude (≥5,000 ft) are exposed to hypobaric hypoxic (HH) conditions (i.e., low pressure, low oxygen). Extended exposure to HH conditions often results in body weight loss. This body weight loss is the result of an increase in resting metabolic rate (RMR) due to alterations in the sympathetic and parasympathetic nervous system (PNS), and a decrease in energy intake due to appetite suppression. However, it is unknown if an acute bout of normobaric hypoxic (NH) exposure (i.e., normal pressure, low oxygen) at sea level induces similar changes in energy expenditure and intake. The objective of the current study was to determine the effects of a single overnight exposure to NH on RMR, heart rate variability (HRV), and energy and macronutrient intake compared to an overnight exposure to normobaric normoxia (NN) in normal-weight adults.

Methods: In this randomized crossover trial, normal-weight adults ($n = 20$; 22.7 ± 1.7 kg/m^2, 24.5 ± 3.9 y) slept 8 h in a tent maintained at either 15% oxygen (∼8500 ft) or 20% oxygen (∼1000 ft). The following morning, HRV was measured inside the tent using electrocardiography and RMR was measured outside the tent using indirect calorimetry. Energy and macronutrient intake were assessed in the morning outside the tent with an ad-libitum breakfast buffet and a self-reported dietary record kept for the remainder of the day.

Results: Overnight oxygen saturation was lower in NH (mean ± SD: $88 \pm 2\%$) compared to NN ($96 \pm 1\%$; $P < 0.0001$). Following overnight exposure to NH, RMR was elevated (1537 ± 264 kcal/d) compared to NN (1491 ± 184 kcal/d; $P = 0.018$. Heart rate was higher in NH (64.2 ± 10.2 bpm) compared to NN (59.7 ± 10.9 bpm; $P = 0.003$). PNS activity [i.e., the root mean square of successive RR interval differences (RMSSD) and high frequency activity 0.15–0.4 hz (HF)] was lower following NH (47.7 ± 19.5 ms and 524 ± 335 ms^2, respectively) compared to NN (58.3 ± 22.6 ms, $P = 0.034$ and 748 ± 476 ms^2, $P = 0.052$, respectively). Energy and macronutrient intake did not differ between conditions.

Conclusions: One-night exposure to NH increases RMR and reduces PNS activity without impacting energy or macronutrient intake when compared to one-night NN exposure. Future studies should evaluate whether overnight NH exposure is an effective adjunct to traditional weight loss interventions.

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