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Editorial | Open Access

Into "Thinner" Air: A Novel Strategy to Improve Clinical Outcomes and Support Weight Loss?

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Editorial

Despite well-intentioned health policy and research efforts, the obesity crisis continues to plague modern society. While multiple factors have been implicated, the source of this problem remains hotly debated, and one which is likely to continue for the foreseeable future. According to the World Health Organization, the majority of annual deaths among the populous are attributable to non-communicable chronic diseases (e.g., type 2 diabetes, cancer) [1], known to be intimately linked to excess adiposity and poor cardiorespiratory fitness [2]. It is generally felt that an overabundant caloric load coupled with insufficient physical activity is responsible. To this end, energy restriction and increased physical activity are recommended to support weight loss; however, long-term adherence is difficult and often met with limited success. As many have discovered, feelings of hunger and lethargy commonly arise during dieting which in some cases are exacerbated with concurrent exercise. Excluding surgical techniques, the ideal strategy to promote expeditious weight loss is through the collective influence of appetite suppression and increased energy expenditure. In the absence of disease, appetite suppression and increased energy expenditure are natural, adaptive responses to higher altitude (i.e., hypoxia). As of late, there is a growing interest in the therapeutic utility of exercise in hypoxic conditions for the purpose of improving a variety of clinical outcomes [3-5].

Travel to mountainous regions can be prohibitively expensive and may not be readily feasible for most. As such, high altitude can be simulated (i.e., normobaric hypoxia) by supplying a lower fraction of inspired oxygen (FiO_2) to a confined space. It is important to note that irrespective of altitude, our terrestrial atmosphere is ≈21% oxygen. For this reason, a FiO_2 of 15% at sea level is comparable to an altitude of ≈2,500 m. In hypoxic conditions, the resultant decrease in arterial oxygen saturation upregulates the cardiovascular system to maintain appropriate tissue perfusion and ensure oxygen delivery matches oxygen demands. Regarding therapeutic potential, the working premise is that exercise combined with intermittent normobaric hypoxia will stimulate a range of physiological adaptations, notably decreased ghrelin and increased energy expenditure, to aid weight loss. Since, hypoxia-inducible factor transactivates genes to enable adaptive responses to low oxygen conditions [6] the ensuing changes may translate to improved cardiovascular and metabolic health [7].

Of interest, Bailey and colleagues [8] investigated high-intensity interval exercise vs. moderate-intensity continuous exercise in normobaric hypoxia and normoxia (i.e., control) on markers of appetite. Their results indicated that acute exercise in hypoxia led to significantly lower acylated ghrelin and appetite suppression whereas exercise condition (interval vs. continuous) did not appear to influence appetite. Though the mechanisms of hypoxia-induced inhibition of ghrelin remain unclear, these data provide an opportunity for further inquiry. On the other hand, Gatterer et al. [9] recently performed a two-site randomized, placebo-controlled trial to compare weight loss in obese participants (n=32) exercising in either normobaric hypoxia or control conditions (i.e., normobaric normoxia). Following an 8-month period, during which participants exercised just twice per week, both groups exhibited significant weight loss. Although, exercise in hypoxia did not lead to greater weight loss (compared to control conditions), it is important to note that exercise intensity was matched for heart rate. Accordingly, participants randomized to the exercise +hypoxia condition performed less absolute work during each session. This outcome may have important health implications for individuals with limited mobility trying to lose weight, as the hypoxic stimulus could be an adjunct to promote sufficient exercise stimulus at a reduced workload (i.e., less mechanical strain).

While elite endurance athletes have been using some form of hypoxic training for decades, there are many unanswered questions concerning exercise and the optimal hypoxic 'dose' to elicit healthy adaptation in clinical populations. Investigations are needed to clearly define the frequency of exposure, exercise duration/intensity, magnitude of hypoxia, as well as, appropriate biomarkers to serve as the basis for useful guidelines [5]. Due to marked inter-individual variability, future work should also consider the influence of age, gender, race, and existing comorbidities on adaptive responses to exercise+hypoxia. Given the propensity for many to feel that more is always better, there certainly is a point of diminishing returns, as severe hypoxia can be exceedingly harmful. Nevertheless, this is an active area of obesity-related research with much to be learned.

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