Inspiratory muscle training and its effect on oxygen saturation and perceptions of effort and dyspnoea during a trek to Everest Base Camp

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AIM: To evaluate the effects of inspiratory muscle training (IMT) on oxygen saturation (SaO_2), rating of perceived exertion (RPE) and rating of breathlessness (RB) during exercise in normobaric hypoxia (NH) and then an 11-day trek to 5300 m

Introduction

Increasing ascent during high-altitude expeditions is typically associated with a significant 16% decrease in SaO_2 and inspiratory muscle strength (MIP) which can exacerbate breathlessness (1). Weaker inspiratory muscles are associated with greater inspiratory muscle fatigue (2) which exacerbates physiological and perceived stress during exercise (3). IMT has been shown to attenuate the fall in MIP with ascent to 5050 m altitude and reduced breathlessness associated with daily activities (4). Resting SaO_2 between 4800 and 5550 m altitude was 6% higher following IMT compared to placebo, but RB at rest was not different between groups (5). Increased SaO_2 during high-altitude expeditions following IMT may attenuate physiological and perceptual stress during exercise.

Methods

Participants: 3 M, 6 F (age 34.8 ± 10.0 years)

Exercise Protocol: Bassey's self-paced walking test was completed three times (slow, normal and fast) in normoxia (NORM) and twice in normobaric hypoxia [NH1 (PIO_2 = 104.1 mmHg, 3440 m altitude) and NH2 (PIO_2 = 85.9 mmHg, 4930 m altitude]. RPE, RB and SaO_2 interpolated to 4.8 km·h^{-1}).

Matched on baseline MIP, randomised to IMT (n=4) or placebo (P, n=5)

Seven weeks, twice daily
IMT: 30 efforts @ 50% MP
P: 60 efforts @ 15% MIP

Repeat exercise protocol

Expedition

Daily measurements of SaO_2 MIP and repeat of exercise protocol at 3400 m altitude (HH).

Findings

MIP

P: 3.52 ± 9.84%

IMT: 5.56 ± 8.34%

Not different between groups (P=0.887)

Completion of training
P: 68.1 ± 16.7%
IMT: 78.8 ± 13.5% (NS)

No training effects in NORM

No change in MIP at 3440 m

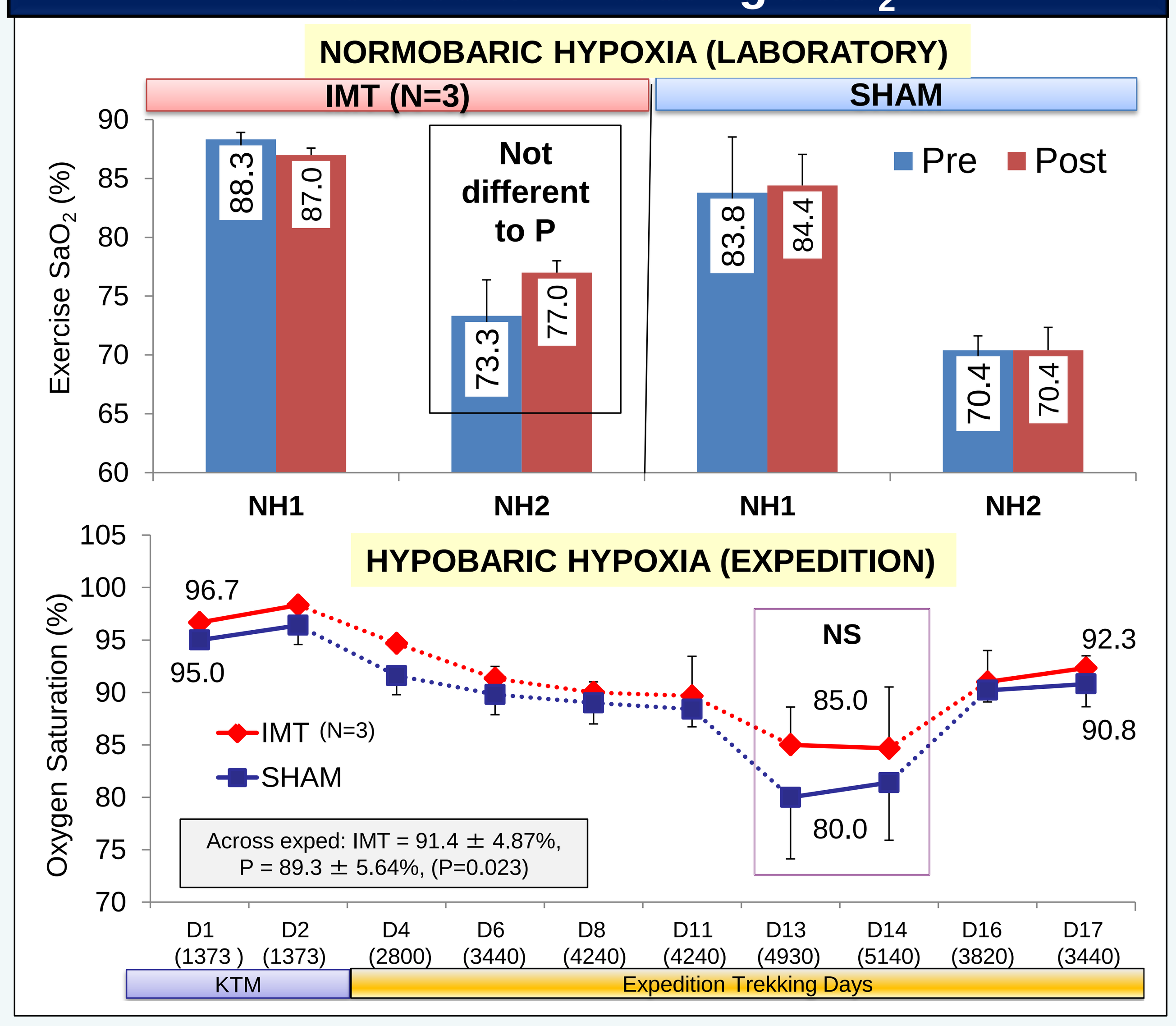
Exercise RB, SaO_2 and RPE in NH1 and HH (3400 m)

RB:
IMT (n=3): ↓ from NH1 pre-training to HH of 0.30 ± 0.60 RB units
P: ↑ from NH1 pre-training to HH of 0.70 ± 1.50 RB units

RPE:
IMT (n=3): ↓ from NH1 pre-training to HH of 0.67 ± 0.58 RPE units
P: ↑ from NH1 pre-training to HH of 2.60 ± 2.41 RPE units

SaO_2:
No change across NH1 trials and HH for either group

Exercise and Resting SaO_2



Conclusions

IMT may attenuate the expected decrease in resting SaO_2 with ascent to altitude above 4900 m similarly to previous research. Large variability and small sample sizes, along with sub-optimal completion of IMT may have negated the training response. Further research should evaluate effects of IMT on exercise SaO_2 and other responses during trekking expeditions above 4900 m altitude. Supervised IMT may enhance the training response.

References

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