

# Oxygen Cost of Breathing During Voluntary Eucapnic Hyperpnea Among Adults with Obesity After Inspiratory Muscle Strength Training

Natalie M. Zamora<sup>1</sup>, Christin Domeier<sup>1</sup>, Joseph D. Vondrasek<sup>1</sup>, Jonathan W. Hoch<sup>1</sup>, Mary E. Peck<sup>1</sup>, Ella C. Ashley<sup>1</sup>, Joseph C. Watso<sup>1-4</sup>, and Thomas G. Bissen<sup>1</sup>

<sup>1</sup>Cardiovascular and Applied Physiology Laboratory, <sup>2</sup>Institute of Sports Sciences and Medicine, <sup>3</sup>Institute for Successful Longevity, <sup>4</sup>Institute for Connecting Nutrition and Health

## INTRODUCTION

- Seven in ten of U.S. adults have obesity, which is a leading risk factor for cardiovascular disease.<sup>1</sup>
- Adults with obesity have less efficient inspiratory muscles, which may result in an increased oxygen cost of breathing ( $O_{2cost}$ ).<sup>2</sup>
- The increased  $O_{2cost}$  results in dyspnea (breathlessness), which can discourage participating in regular physical activity.<sup>3</sup>
- Fewer than 2 in 10 U.S. adults with obesity meet recommended physical activity thresholds.<sup>4</sup>
- Inspiratory muscle strength training (IMST) is a high-resistance breathing exercise that may improve inspiratory muscle efficiency and reduce  $O_{2cost}$  in adults with obesity.<sup>5</sup> However, no study to date has examined whether IMST improves  $O_{2cost}$ .

## PURPOSE & HYPOTHESIS

The purpose was to test the hypothesis that an 8-week IMST intervention would increase maximal inspiratory pressure (MIP) and, in turn, reduce  $O_{2cost}$  in younger adults with obesity. Further, we tested the hypothesis that IMST reduces dyspnea, given that it is linked with  $O_{2cost}$ .

## METHODS

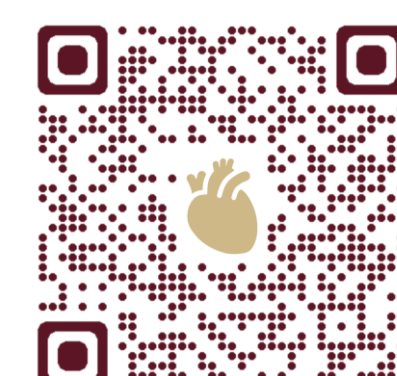
- Otherwise, healthy adults with stage 1 and 2 obesity (body mass index 30-40 kg/m<sup>2</sup>) were randomized into either an IMST group (daily training at 75% of MIP) or a SHAM-controlled group (daily training at 15% of MIP) for 8 weeks.
- $O_{2cost}$  was measured using indirect calorimetry during a 5-minute resting baseline and eucapnic voluntary hyperpnea (EVH) stages performed at 40 L/min and 60L/min with supplemental inhaled carbon dioxide supplemented to maintain eucapnia.
- $O_{2cost}$  calculated was calculated as the slope of oxygen uptake rate across the hyperpnea stages.
- Dyspnea was assessed using the Modified Borg Dyspnea Scale (0-10).
- We compared changes pre- to post-intervention between groups using Mann-Whitney U tests.

Table 1. Participant Characteristics	Median[IQR] or Mean±SD
Sex (Female/Male)	11 F/12 M
Age (years)	24[3]
Body Mass Index (kg/m <sup>2</sup> )	32[3]
Ethnicity	26% Latine
Race	4% Asian, 13% Black, 78% White, 4% Other
Baseline MIP (cmH <sub>2</sub> O)	113 ± 29
Compliance (%)	87[13]

## FUNDING SOURCES & LAB CONTACT INFORMATION

Funding: TB is supported by American Heart Association (26PRE1549557) CD is supported by the FSU Graduate School Legacy Fellowship. JCW was supported by the National Institutes of Health (K01HL160772) and the American Heart Association (23CDA1037938).

Disclosures: JWH provides education/coaching at Hoch Health and Wellness LLC. JCW provides education/consulting at Watso Health LLC.



## RESULTS

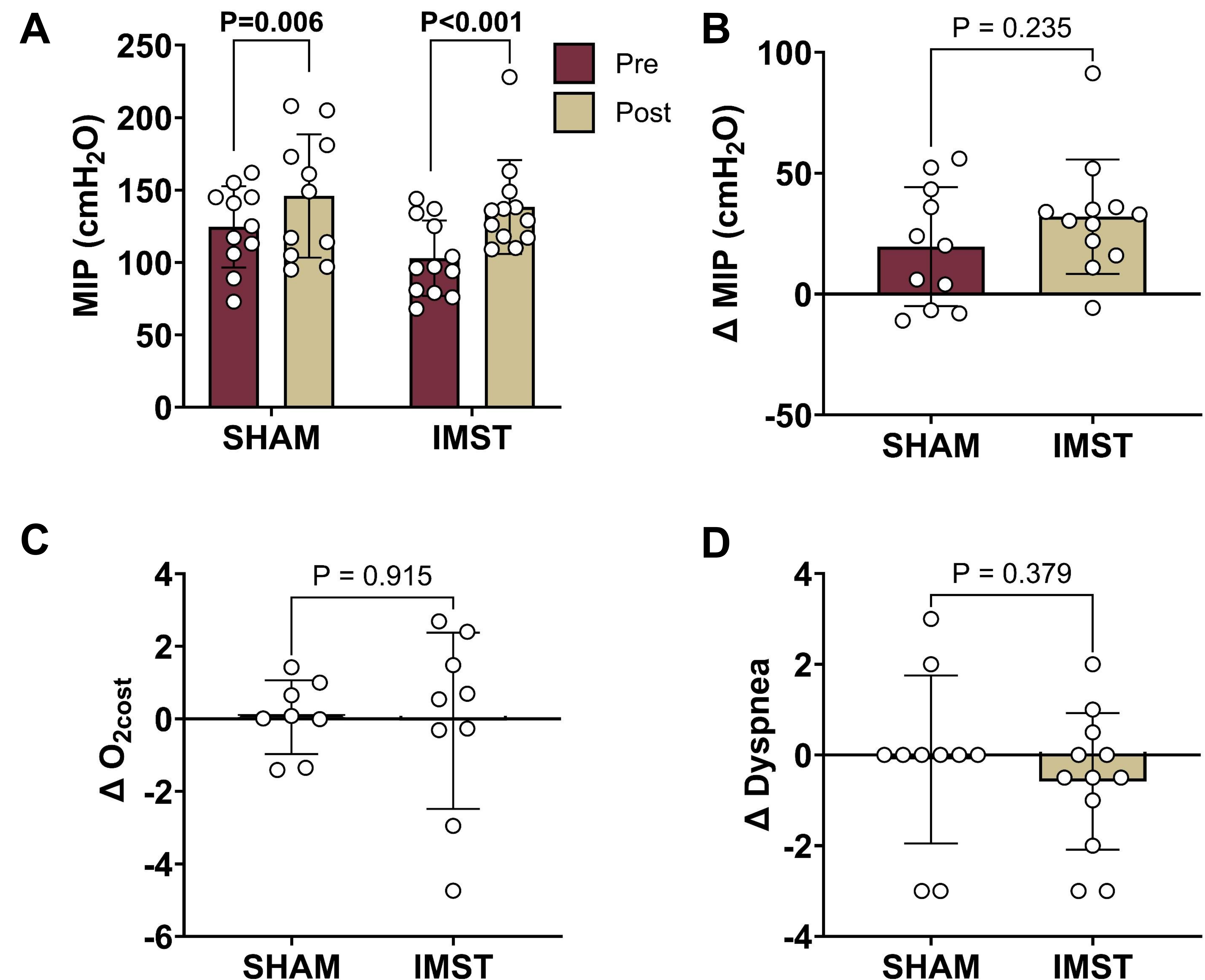


Figure 1: Maximal inspiratory pressure (MIP) increased from pre to post (A) with increases and no difference between groups (B). Despite there was no change in oxygen cost of breathing ( $O_{2cost}$ ) (C) or dyspnea (D).

## CONCLUSION

These preliminary findings showed that inspiratory muscle strength training increased maximal inspiratory pressure in both groups. However, inspiratory muscle strength training did not reduce oxygen cost of breathing or dyspnea in younger adults with obesity.

## REFERENCES

- Hurt, Ryan T., et al. "Obesity epidemic: overview, pathophysiology, and the intensive care unit conundrum." *JPEN Journal of Parenteral and Enteral Nutrition* 35.Suppl 5 (2011): 4S-13S.
- Caicedo-Trujillo, Saúl, et al. "Inspiratory muscle training in patients with obesity: a systematic review and meta-analysis." *Frontiers in Medicine* 10 (2023): 1284689.
- Langer, Daniel, et al. "Inspiratory muscle training reduces diaphragm activation and dyspnea during exercise in COPD." *Journal of Applied Physiology* 125.2 (2018): 381-392.
- López-Gil, José Francisco, et al. "Trends in adherence to physical activity guidelines from 1997 to 2018 among adults with obesity: An analysis from the US National Health Interview Survey." *Obesity Reviews* 26.3 (2025): e13866.
- Edwards, A. M., et al. "Efficacy of inspiratory muscle training as a practical and minimally intrusive technique to aid functional fitness among adults with obesity." *Respiratory Physiology & Neurobiology* 234 (2016): 85-88.