

Inspiratory Muscle Training in Healthy Adults: A Treatment Efficacy Study

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- The significance of respiratory muscle fitness and the effectiveness of respiratory muscle training have been explored for the past thirty years.
- Recent studies have supported the value of specific inspiratory muscle training.
- COPD patients: IMT resulted in increased inspiratory muscle strength and endurance, decreased dyspnea during daily activities, and improved health-related quality of life.
- Patients with neuromuscular disorders: IMT improved inspiratory muscle strength, improved endurance, and stabilized vital capacity.
- Patients with decreased glottal area (due to laryngeal papillomas), abductor vocal fold paralysis, and paradoxical vocal fold motion: IMT resulted in increased inspiratory muscle strength and decreased dyspnea during exercise and speech.
- Highly trained athletes: IMT resulted in decreased inspiratory fatigue, increased inspiratory muscle strength, improved perception of respiratory effort during training, improved breathing pattern during exercise performance, and improved sports performance.
- While IMT appears to be a promising technique, the efficacy of the IMT treatment regimen must be demonstrated. This includes developing stable and reliable training devices, as well as comparing the outcome measures of treatment vs. placebo participants.

PURPOSE: The purpose of this study was to determine if inspiratory muscle training results in increased inspiratory muscle strength and improvement in measures of maximal exercise effort in healthy young adults.

METHOD

Participants:

- Healthy undergraduate students
- 13 participants (7 females, 6 males) randomly assigned to experimental group
- 10 participants (5 females, 5 males) randomly assigned to placebo group

Tests:

- Subjects underwent three testing sessions: week 0, 4 & 6. Each test session lasted approximately 45 minutes.
- **Respiratory Muscle Strength.** Measured at mouth using a Fluke min-max voltmeter connected to a mouthpiece with a two-way valve. After exhaling as completely as possible, subject inhaled as forcefully as possible. Maximum inspiratory pressure (MIP) measurements were repeated until three were obtained within 5% variability; largest MIP value was recorded. (MIP=indicator of inspiratory muscle strength.)
- **Measures of Maximal Exercise Effort.** Maximal graded exercise tests completed using a Quintron treadmill and Parvo metabolic analysis system. Modified Balke protocol—160 m.min⁻¹ with 2% grade increments every 3 minutes to volitional fatigue. [Minute ventilation (VE), oxygen consumption (VO₂), respiratory rate (RR), and respiratory exchange ratio (RER).]
- **Maximal Voluntary Ventilation (MVV)** Volume of air expired in a specified period during repetitive maximum respiratory effort (spirometric measure).

Inspiratory Muscle Training:

- Using custom-made inspiratory muscle strengthening device: mouthpiece and a solenoid valve that opens when sensor detects negative (inspiratory) pressure exceeding a threshold level. Valve remains open for exhalation.
- Participant trained 5 days per week for 6 weeks.
- IMT session: 5 sets of 12 training breaths at designated threshold level. One-minute rest period between sets. Each session approximately 30 minutes.
- IMT threshold levels based on MIP measurements; hence, threshold levels were adjusted according to MIP findings at baseline and end of fourth week of training.
- Experimental group trained two days at 50% MIP; trained at 75% MIP for remainder of IMT sessions.
- Placebo group trained at 25% MIP for all sessions.

RESULTS

Mean Maximum Inspiratory Pressure (in cm H₂O) and Standard Deviations (SD)

	Baseline	Week Four	Week Six
Experimental Group			
Mean	105.1	142.9	160.1
SD	48.0	59.3	59.5
Placebo Group			
Mean	91.7	107.5	114.2
SD	31.3	41.7	48.9

Significant differences occurred across time for all groups, except for week 4 vs week 6 in the placebo group. At the end of IMT the experimental group mean MIP was significantly greater than that of the placebo group.

[t-test(w/in) experimental group: wk 0 vs wk 4 p=.0004;

Wk 0 vs wk 6 p=.0002; wk 4 vs wk 6 p=.0085

t-test(w/in) placebo group: wk 0 vs wk 4 p=.0507;

Wk 0 vs wk 6 p=.0350; wk 4 vs wk 6 p=.1091

t-test(btw) at week six: p=0.058]

Maximum exercise measures, particularly VO₂ max, and MVV measures revealed no significant differences within groups across testing periods and no significant differences between groups.

DISCUSSION AND CONCLUSIONS

Inspiratory muscle training increased the strength of inspiratory muscles in both the experimental and placebo groups. The placebo group trained at only 25% MIP, since research had suggested that training at 30% MIP (or lower) would not result in a training effect. The changes in placebo MIP across IMT phases may be associated with a minimal training effect, and perhaps test practice. The significantly greater changes in those participants working at higher threshold levels support the validity of the IMT procedure. Our results are consistent with other studies showing that there is not a large functional transfer from IMT to standard exercise performance measures.