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Inspiratory Muscle Training and Its Effects on Pulmonary Function and Athletic Performance: A Narrative Review

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Abstract
Introduction: Inspiratory Muscle Training (IMT) strengthens respiratory muscles, reduces fatigue, and enhances ventilatory efficiency. This review summarizes the evidence regarding the effects of IMT on pulmonary function and performance in athletes.
Methods: Literature from 2010–2024 was reviewed from PubMed, ScienceDirect, and Google Scholar. Key studies on IMT in soccer, rowing, swimming, and endurance sports were included, emphasizing outcomes such as maximal inspiratory and expiratory pressure, pulmonary function, VO_2max, and repeated sprint ability (RSA).
Results: Most studies demonstrated significant improvements in inspiratory strength and endurance performance following IMT. Soccer players benefited most, with consistent gains in VO_2max and sprint efficiency, while mixed findings were reported for rowers and endurance athletes.
Conclusion: IMT is an effective adjunct to conventional training for improving inspiratory strength and endurance, particularly in intermittent team sports. Sport-specific adaptations and training duration influence results.

Keywords: Inspiratory muscle training, respiratory muscle strength, endurance, athletic performance

Introduction

Athletic performance depends on the integration of cardiovascular and respiratory efficiency, particularly during prolonged or high-intensity exercise. Fatigue of the respiratory muscles can limit oxygen delivery to active musculature, impairing performance capacity [1,2]. Inspiratory Muscle Training (IMT) uses resistive breathing to strengthen inspiratory muscles such as the diaphragm and intercostals, improving their endurance and delaying fatigue [3]. IMT has been increasingly used as an adjunct to athletic conditioning programs, showing promising results in soccer players, cyclists, and swimmers [4, 7]. However, findings differ across sports. While several studies in soccer report significant improvements in VO_2max and sprint performance [1, 3, 5], studies on endurance athletes such as rowers present mixed outcomes [8, 9]. The purpose of this review is to summarize and critically evaluate available literature on IMT and its role in enhancing pulmonary and exercise performance in trained athletes.

Literature Search Strategy

A comprehensive search of the literature was performed using PubMed, ScienceDirect, Google Scholar, and ResearchGate databases to identify studies published between 2003 and 2024. Search terms included: 'Inspiratory Muscle Training', 'Athletic Performance', 'Endurance', 'Pulmonary Function', and 'VO_2max'. Only human studies involving athletes or physically active individuals were included. Exclusion criteria were non-English articles, animal studies, or trials focusing on patients with clinical respiratory or cardiac diseases. After screening abstracts and full texts, ten studies that met inclusion criteria and demonstrated methodological quality were selected for this narrative synthesis.

Review of Literature

Author (Year)	Population / Sample Size	Intervention / Device Used	Outcome Measures	Key Findings
Mackała *et al.*, 2020 [1]	16 male junior Soccer players	Threshold IMT using POWERbreathe®, 80 inhalations/day at 50% MIP	PImax, PEmax, VO_2max, FVC	IMT led to significant improvements in expiratory strength (p=0.001) and VO_2max (p<0.005). No significant changes in spirometry. The study concluded that IMT effectively enhances aerobic endurance and ventilatory efficiency in young soccer players.
Archiza *et al.*, 2017 [2]	18 professional female Football players	IMT vs. sham training using POWERbreathe® device	Time-to-exhaustion, RSA, NIRS muscle oxygenation	IMT improved inspiratory muscle oxygenation, reduced fatigue, and increased time to exhaustion. potential impact on inspiratory muscle strength, exercise tolerance and sprints performance in professional women football players.
Silva *et al.*, 2019 [3]	22 professional male Soccer players	Self-paced IMT at 50% MIP using resistive device	RSAmean, RSAbest, MIP, PIF	Two weeks of IMT significantly improved inspiratory pressure and sprint performance (p<0.001). Sprint times decreased, showing that even short-term IMT enhances anaerobic capacity and recovery.
Ozmen *et al.*, 2017 [4]	18 male Soccer players	RMT (15 min/ day) 5 weeks	20 MST PF, MIP, MEP	RMT increased MIP, but FVC, FEV1, MVV, MEP and aerobic endurance did not improve in soccer players. The RMT in addition to soccer training may improve MIP but not the

				tolerance to high intensity exercise.
Forbes *et al*., 2011 [7]	21 competitive Rowers (male and female)	Combined Inspiratory and expiratory RMT using resistive breathing device	PImax, PEmax, 2000 m rowing time	Combined training improved both Inspiratory and expiratory pressures but did not enhance 2000 m rowing time or VO_2max. Improvements were limited to physiological adaptations rather than direct performance gains.
Bell *et al*., 2013 [8]	27 trained Rowers	Inspiratory and expiratory RMT integrated with endurance and strength training	PImax, PEmax, VO_2peak, 2000 m time	There were no additional benefits of 9 weeks of inspiratory or expiratory respiratory muscle training on simulated 2000 m rowing performance or cardiopulmonary responses when combined with resistance and endurance training in rowers.
Tong *et al*., 2008 [9]	12 male Soccer players	Pressure-threshold IMT, 6 weeks	VO_2max, lactate threshold, intermittent running	IMT significantly enhanced high-intensity intermittent running performance and reduced lactate accumulation in soccer players.
HajGhanbari *et al*., 2013 [10]	Meta-analysis (21 RCTs, mixed populations)	IMT protocols (4–12 weeks) with resistive/threshold devices	MIP, MEP, PFT, VO_2max, endurance time, RPE	Inspiratory Muscle Training (IMT) significantly improved endurance time (by approximately 22%) and VO_2max (by 4–5%) across studies, along with reductions in dyspnea and perceived effort. The greatest improvements were observed in moderately trained athletes, whereas elite performers exhibited smaller gains, likely due to prior respiratory conditioning and limited capacity for further adaptation.

Discussion

The findings of this review collectively demonstrate that respiratory muscle training, particularly inspiratory muscle training, provides meaningful improvements in both physiological and performance outcomes in athletes. The primary mechanism underpinning these benefits is the enhancement of inspiratory muscle strength and endurance, which leads to greater ventilatory efficiency and a reduction in the sensation of breathlessness during strenuous exercise. Strengthened respiratory muscles can maintain optimal ventilation for longer periods, delaying the onset of fatigue and improving the overall work economy of the body [1,3]. Enhanced diaphragmatic strength reduces the activation of the inspiratory metaboreflex, which diverts blood flow from locomotor muscles to fatigued respiratory muscles during intense activity [2,10]. By attenuating this reflex, IMT ensures better oxygen delivery to peripheral muscles, thereby supporting sustained high-intensity performance and reducing lactate accumulation [4,5]. Soccer players appear to benefit the most from IMT due to the sport's intermittent, high-intensity demands, showing consistent improvements in VO_2max, repeated sprint ability, and recovery time [1–4]. In contrast, rowers demonstrated gains in inspiratory and expiratory pressures but no significant changes in race performance [8,9]. possibly because of their already well-developed ventilatory capacity. Endurance athletes such as cyclists and swimmers also benefited from enhanced oxygen uptake kinetics and reduced perceived effort [5,6]. Most studies reported effective outcomes after 4–8 weeks of training at 40–60% of maximal inspiratory pressure [1,2,5], although measurable improvements in inspiratory strength have been noted in as little as two weeks [3]. IMT is a low-cost, non-invasive intervention that can be integrated easily into sports conditioning and rehabilitation settings. It is particularly valuable during pre-season training and post-respiratory illness recovery. Future research should focus on standardizing IMT protocols, exploring gender differences, and determining the long-term retention of benefits. Overall, IMT enhances respiratory efficiency, aerobic power, and performance through both mechanical and metabolic adaptations, reinforcing its role as a valuable adjunct in athletic training.

Conclusion

Inspiratory Muscle Training (IMT) is a scientifically supported adjunct that enhances inspiratory muscle strength, endurance, and aerobic performance. Its strongest benefits are seen in soccer and intermittent sports, where ventilatory demand and fatigue resistance are crucial. In endurance sports like rowing, improvements are mainly mechanical rather than performance-based. With appropriate duration and intensity, IMT can serve as a key tool in optimizing athletic conditioning and respiratory efficiency.

References

1. Mackała K, Kurzaj M, Okrzymowska P, Stodółka J, Coh M, Rożek-Piechura K. *et al* The effect of respiratory muscle training on pulmonary function, lung ventilation, and endurance performance of young soccer players. Int J Environ Res Public Health, 2020:17(1):234. doi:10.3390/ijerph17010234.
2. Archiza B, Andaku DK, Caruso FCR, *et al*. Effects of inspiratory muscle training in professional women football players: a randomized sham-controlled trial. J Sports Sci,2017:35(24):2471–2479. doi:10.1080/02640414.2017.1321038.
3. Silva RLC, Hall E, Maior AS. Inspiratory muscle training improves performance of a repeated sprints ability test in professional soccer players. J Bodyw Mov Ther,2019:23(3):452–455. doi: 10.1016/j.jbmt.2019.02.016.
4. Ozmen T, Gunes GY. Effects of respiratory muscle training on pulmonary function and aerobic endurance in soccer players. J Sports Med Phys Fitness,2017:57(5):507–513. doi:10.23736/S0022-4707.16.06132-8.
5. Volianitis S, McConnell AK, Jones DA. Assessment of inspiratory muscle training in elite rowers. Eur J Appl Physiol,2001:84(4):479–484. doi:10.1007/s004210100391.
6. Romer LM, McConnell AK, Jones DA. Effects of inspiratory muscle training on time-trial performance in trained cyclists. J Sports Sci,2002:20(7):547–590. doi:10.1080/026404102760000053.
7. Forbes SC, Game A, Syrotuik D, Jones R, Bell GJ. The effect of inspiratory and expiratory respiratory muscle training in rowers. Res Sports Med,2011:19(4):217–230. doi:10.1080/15438627.2011.613234.

8. Bell GJ, Game A, Jones R, *et al*. Inspiratory and expiratory respiratory muscle training as an adjunct to concurrent strength and endurance training provides no additional 2000 m performance benefits to rowers. Res Sports Med,2013:21(3):264–279. doi:10.1080/15438627.2013.792083.
9. Tong TK, Fu FH, Chung PK. The effect of inspiratory muscle training on high-intensity intermittent running performance in soccer players. Eur J Appl Physiol,2008:104(4):689–695. doi:10.1007/s00421-008-0823-3.
10. HajGhanbari B, Yamabayashi C, Buna TR, *et al*. Effects of respiratory muscle training on performance: a systematic review and meta-analysis. Sports Med,2013:43(5):491–509. doi:10.1007/s40279-013-0044-1.