Advanced International Journal for Research (AIJFR)
E-ISSN: 3048-7641 ● Website: www.aijfr.com ● Email: editor@aijfr.com

A Narrative Review On Effectiveness of Inspiratory Muscle Training in Improving Physical Performance Among Healthy Athletes

Simran Jivrajika[1], Dr. Hamsalekha MC[2], Dr. Yashodeepa[3] Dr. Manjunatha[4]

[1]Intern, Akash institute of physiotherapy, Rajiv Gandhi University of Health Sciences, Bangalore
[2]Lecturer, Akash institute of physiotherapy, Rajiv Gandhi University of Health Sciences, Bangalore
[3]Principal and HOD, Akash Institute of Physiotherapy, Rajiv Gandhi University of Health Sciences, Bangalore
[4]Post graduate student (MPT-MSK), Akash Institute of Physiotherapy, Rajiv Gandhi University of Health Sciences, Bangalore

Abstract

Background: Athletic performance is influenced by multiple physiological factors, including respiratory muscle function. During prolonged or high-intensity exercise, inspiratory muscle fatigue may reduce oxygen delivery to the working muscles, resulting in decreased exercise capacity and athletic performance. Inspiratory Muscle Training (IMT) has emerged as a non-invasive intervention aimed at improving respiratory muscle strength and endurance.

Objective: To review the effectiveness of Inspiratory Muscle Training in improving physical performance among healthy athletes.

Methodology: A narrative review was conducted using articles published between 2015 and 2026. Electronic databases including PubMed, Google Scholar, and ResearchGate were searched using keywords related to inspiratory muscle training and athletic performance. Studies involving healthy athletes aged 18-35 years, including randomized controlled trials, systematic reviews, and meta-analyses, were included. Outcome measures included pulmonary function (FEV1, FVC, MVV/MSVC), maximal inspiratory pressure (MIP), VO2max, exercise capacity, Rating of Perceived Exertion (RPE), blood lactate concentration, respiratory muscle endurance, and sports performance.

Results: A total of 14 studies were included in this review. The findings consistently demonstrated that IMT significantly improves maximal inspiratory pressure, inspiratory muscle endurance, exercise tolerance, and sports-specific performance. Athletes also showed reduced respiratory muscle fatigue, dyspnea, blood lactate accumulation, and perceived exertion during exercise. Most studies reported minimal changes in resting pulmonary function, indicating that the performance benefits of IMT are mainly due to improved respiratory muscle function rather than changes in lung volumes.

Conclusion: Inspiratory Muscle Training is a safe, practical, and evidence-based intervention that enhances respiratory muscle strength, delays respiratory muscle fatigue, improves exercise tolerance, and optimizes athletic performance in healthy athletes. IMT can be incorporated into routine sports conditioning programmes by physiotherapists, coaches, and sports scientists to improve athletic performance. Further high-quality randomized controlled trials are recommended to establish standardized training protocols for different sporting disciplines.

Key Words: Athletic Performance, Exercise Capacity, Exercise Performance, Inspiratory Muscle Endurance, Inspiratory Muscle Training (IMT), Rating of Perceived Exertion (RPE).

1. Introduction

Athletic performance is a concept that reflects an athlete's ability to perform physical activities efficiently while maintaining optimal physiological function. Performance is influenced by several components, including muscular strength, endurance, power, flexibility, agility, neuromuscular coordination, cardiovascular fitness, metabolic efficiency, psychological preparedness and respiratory function 1,2. Traditionally, sports training has focused primarily on improving skeletal muscle strength and cardiovascular endurance. However, growing evidence suggests that the respiratory muscles also play an important role in determining exercise capacity and sports performance, particularly during prolonged or high-intensity exercise 1,4.

The respiratory muscles consist primarily of the diaphragm, external intercostal muscles, internal intercostals, abdominal muscles, sternocleidomastoid, scalene muscles, pectoralis major and minor, and other accessory muscles of inspiration and expiration. During exercise, these muscles work continuously to maintain adequate ventilation and meet the increasing oxygen demands of the body while facilitating the removal of carbon dioxide. During maximal exercise, respiratory muscles account for approximately 10-15% of total oxygen consumption and receive nearly 15% of cardiac output. Consequently, fatigue of these muscles may reduce oxygen availability to the exercising limb muscles, resulting in early fatigue and impaired athletic performance3,5.

The diaphragm at rest performs only a small fraction of the body's total metabolic work, but as ventilation rises during heavy exercise the oxygen cost of breathing increases disproportionately. Because the diaphragm and intercostal muscles are ordinary skeletal muscle, sustained high-intensity contraction can produce measurable fatigue, particularly in events lasting more than several minutes 3.

IMT applies an external resistive or pressure-threshold load to the diaphragm and accessory inspiratory muscles during inhalation. Unlike general aerobic or resistance conditioning, IMT selectively targets the ventilatory pump, so it can be layered onto an athlete's existing programme without materially adding to peripheral training load 2. IMT is most commonly delivered through handheld pressure-threshold or resistive-flow devices that create an inspiratory load the athlete must overcome with every breath, typically for a fixed number of maximal efforts once or twice daily. Voluntary isocapnic hypercapnia (VIH) is an alternative, endurance-based approach that combines high-frequency breathing with partial carbon dioxide rebreathing to maintain normocapnia.

A central mechanism linking IMT to improved performance is the inspiratory muscle metaboreflex (IMM): as metabolites accumulate in fatiguing inspiratory muscles, type III and IV phrenic afferents trigger sympathetically mediated vasoconstriction in the limbs, redirecting blood flow toward the diaphragm and away from exercising skeletal muscle. This can accelerate peripheral fatigue and impair performance. By strengthening the inspiratory muscles and delaying the onset of fatigue, IMT is thought to postpone activation of this reflex and thereby preserve oxygen delivery to the working limb muscles.

Across the studies reviewed, protocols generally span four to eight weeks, performed three to six times weekly, with one to two sessions per day of approximately 30 inspiratory efforts, starting at roughly 30-50 percent of MIP and progressing to 60-80 percent of MIP as strength improves. Meaningful gains in MIP have been reported within as little as four weeks, though longer blocks of six to eight weeks tend to produce more consistent transfer to performance outcomes.

The most widely adopted chronic IMT protocol consists of 30 inspiratory breaths performed twice daily at 50% of maximal inspiratory pressure (MIP), 5-7 days per week for 6-8 weeks, with progressive increase in resistance as inspiratory muscle strength improves. In contrast, the acute inspiratory muscle warm-up (IMW) protocol, commonly used before training or competition, involves two sets of 30 breaths at 40% MIP separated by one minute of rest.

2. Need of Study

Athletic performance depends not only on cardiovascular and musculoskeletal fitness but also on the efficiency of the respiratory muscles, particularly during prolonged and high-intensity exercise. Respiratory muscle fatigue can impair ventilation, increase the perception of dyspnea, activate the inspiratory muscle metaboreflex, and reduce blood flow to the working limb muscles, ultimately compromising exercise performance.

A focused up-to-date narrative synthesis is therefore needed to consolidate this recent evidence on IMT benefitting performance of athletes in various disciples, and give physiotherapists and sports scientists a practical, evidence-based framework for incorporating IMT into athletic conditioning.

Objective

To review the effectiveness of Inspiratory Muscle Training (IMT) in improving the physical performance among healthy athletes

Methodology

Study Type: Narrative Review
Search Strategy: Sources of Data: PubMed, Google Scholar, ResearchGate,

Key Words: Respiratory Muscle Training, Inspiratory Muscle Warm-up, Inspiratory Muscle Endurance, Athletic Performance, Sports Performance, Exercise Performance, Exercise Capacity

Outcome Measures: Pulmonary Function (FEV1, FVC, MVV/MSVC), Exercise Capacity (VO2max), Rating of Perceived Exertion (RPE), Blood Lactate Concentration.

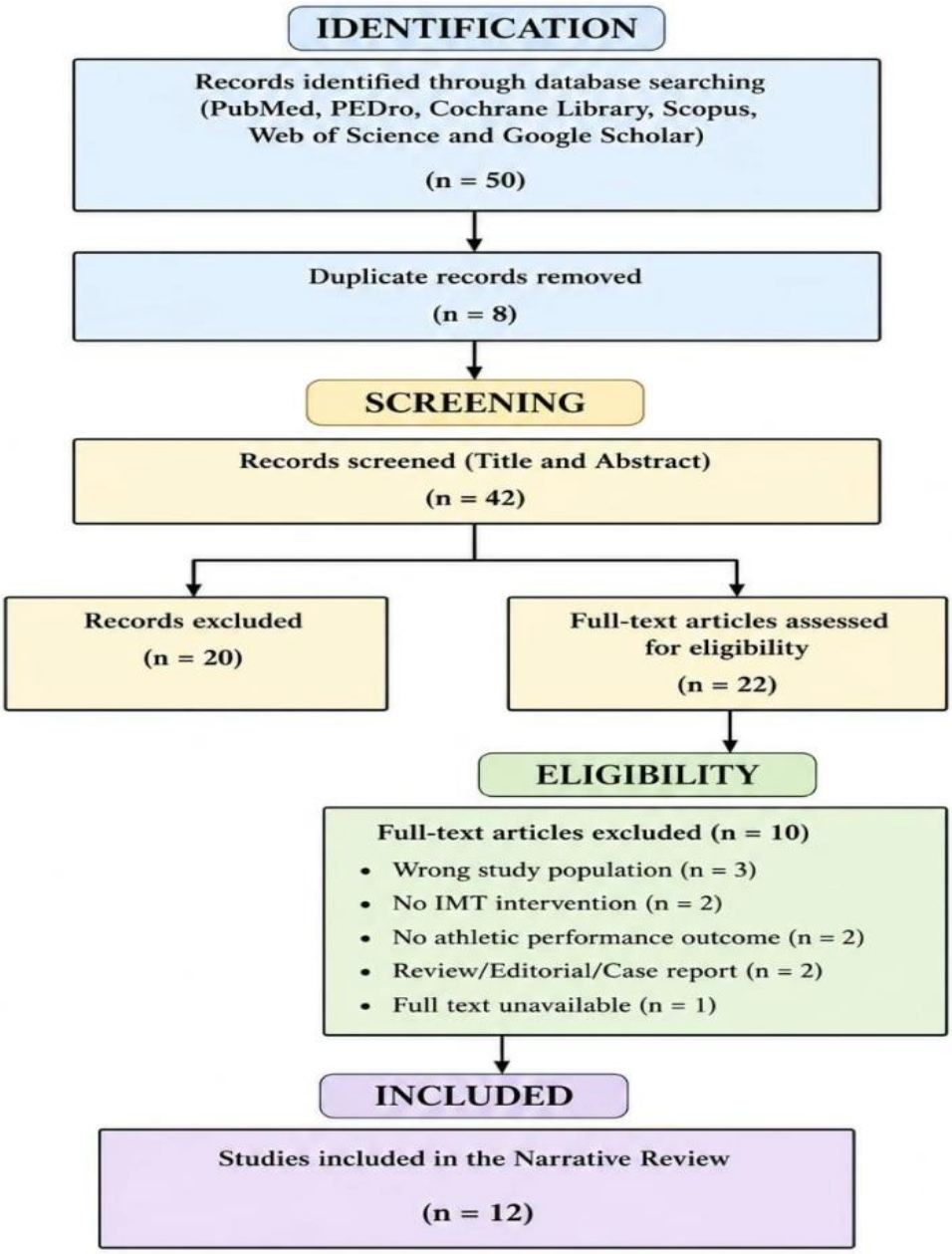
Inclusion Criteria

- Studies published in English between 2015 and 2026 with full-text availability.
- Studies involving healthy male and female athletes aged 18-35 years.
- Studies involving athletes from endurance, team, racquet, combat, aquatic, strength, power and mixed sports.
- Studies evaluating Inspiratory Muscle Training (IMT) using pressure-threshold devices, resistive breathing devices, electronic inspiratory muscle trainers, voluntary isocapnic hyperpnea (VIH), or inspiratory muscle warm-up (IMW).
- Studies in which IMT was administered alone or in combination with routine sports training.
- Studies reporting outcomes related to athletic performance, including maximal inspiratory pressure (MIP), inspiratory muscle endurance, VO2max, exercise capacity, time to exhaustion, time-trial performance, peak power output, pulmonary function, respiratory muscle fatigue, rating of perceived exertion (RPE), dyspnea, and recovery following exercise.
- Studies based on PRISMA guidelines Systematic review, Meta analysis, Randomised controlled trials (RCTs), systematic reviews, and meta-analyses.

Exclusion Criteria

- Studies involving athletes below 18 years or above 35 years.
- Studies evaluating expiratory muscle training alone, diaphragmatic breathing or general exercise programmes without a structured inspiratory muscle training component.
- Studies that did not report athletic performance or exercise performance outcomes.
- Studies that are non-English, full text publications.

Procedure


IDENTIFICATION
Records identified through database searching (PubMed, PEDro, Cochrane Library, Scopus, Web of Science and Google Scholar)
(n = 50)
Duplicate records removed
(n = 8)
SCREENING
Records screened (Title and Abstract)
(n = 42)
Records excluded
(n = 20)
Full-text articles assessed for eligibility
(n = 22)
ELIGIBILITY
Full-text articles excluded (n = 10)
Wrong study population (n = 3)
No IMT intervention (n = 2)
No athletic performance outcome (n = 2)
Review/Editorial/Case report (n = 2)
Full text unavailable (n = 1)
INCLUDED
Studies included in the Narrative Review
(n = 12)

3. Review of Literature

S. No.	Author (Year)	Study Design	Studies Included (Sample)	Intervention	Outcome Measures	Major Findings
1	Liu S et al. (2025)	Systematic Review & Meta-analysis	10 studies (230 competitive swimmers)	Inspiratory Muscle Training (50-80% MIP for 6-8 weeks)	Swimming performance, Maximal Inspiratory Pressure (MIP), Pulmonary function	IMT significantly improved inspiratory muscle strength, respiratory efficiency, pulmonary function, and swimming performance.
2	Xavier DM et al. (2025)	Systematic Review & Meta-analysis	25 studies (522 athletes)	Respiratory Muscle Training (30-90% MIP/MEP)	MIP, MEP, FEV1, FVC, VO2max, Sports performance	Respiratory muscle training significantly improved inspiratory muscle strength, pulmonary function, exercise capacity, and athletic performance.
3	Akinci B et al. (2024)	Systematic Review	8 studies involving 108 para-athletes	Threshold IMT, resistive loading and normocapnic hyperpnea	Respiratory muscle strength, Respiratory muscle endurance, Exercise capacity	Respiratory muscle training improved respiratory muscle strength and endurance; however, evidence regarding improvement in sports performance remained limited.

S. No.	Author (Year)	Study Design	Studies Included (Sample)	Intervention	Outcome Measures	Major Findings
4	Fernández-Lázaro D et al. (2023)	Systematic Review & Meta-analysis	11 studies	PowerBreathe Inspiratory Muscle Training	MIP, MEP, Spirometry, Sports performance	PowerBreathe inspiratory muscle training significantly improved inspiratory muscle strength, respiratory pressures, spirometric parameters, and athletic performance.
5	Cirino C et al. (2023)	Systematic Review	31 studies	Inspiratory Muscle Warm- up	Dyspnea, Rating of Perceived Exertion (RPE), Respiratory parameters, Exercise performance	Inspiratory muscle warm-up reduced respiratory muscle fatigue and dyspnea while improving respiratory readiness and high-intensity exercise performance.
6	Fernández-Lázaro D et al. (2021)	Systematic Review & Meta-analysis	6 studies	PowerBreathe Inspiratory Muscle Training	MIP, VO2max, Blood lactate, Exercise tolerance	Inspiratory muscle training significantly increased inspiratory muscle strength, VO2max, exercise tolerance, and athletic performance while reducing blood lactate accumulation.

S. No.	Author (Year)	Study Design	Studies Included (Sample)	Intervention	Outcome Measures	Major Findings
7	Lorca-Santiago J et al. (2020)	Systematic Review	10 Randomized Controlled Trials (218 athletes)	Inspiratory Muscle Training	MIP, Dyspnea, Rating of Perceived Exertion (RPE), Sports performance	Inspiratory muscle training significantly improved inspiratory muscle strength, reduced dyspnea and perceived exertion, and enhanced sports-specific performance.
8	Ribeiro Lemos J et al. (2020)	Systematic Review	17 studies	Respiratory Muscle Training based on FITT principle	Pulmonary function, MIP, MEP, Respiratory muscle endurance, VO2max	Respiratory muscle training significantly improved pulmonary function, inspiratory muscle strength, and respiratory muscle endurance, although improvements in VO2max were inconsistent.

S. No.	Author (Year)	Study Design	Studies Included (Sample)	Intervention	Outcome Measures	Major Findings
9	Cunha M et al. (2019)	Randomized Controlled Trial	Elite swimmers	Pressure-threshold Inspiratory Muscle Training	Swimming performance, MIP, Pulmonary function	Inspiratory muscle training significantly improved inspiratory muscle strength, pulmonary function, respiratory efficiency, and swimming performance.
10	Karsten M et al. (2018)	Systematic Review & Meta-analysis	25 studies involving athletes from different sports	Linear pressure-threshold Inspiratory Muscle Training	MIP, Pulmonary function, Cardiopulmonary responses, Sports performance	Inspiratory muscle training significantly improved inspiratory muscle strength and athletic performance. No significant improvement was observed in pulmonary function or maximal expiratory pressure.

S. No.	Author (Year)	Study Design	Studies Included (Sample)	Intervention	Outcome Measures	Major Findings
11	Shei RJ (2018)	Systematic Review	Studies involving healthy athletes	Respiratory Muscle Training	Respiratory muscle strength, Exercise performance	Respiratory muscle training improved diaphragm function, respiratory efficiency, inspiratory muscle strength, and endurance performance in healthy athletes.
12	Sales ATN et al. (2016)	Systematic Review & Meta-analysis	20 studies	Inspiratory Muscle Training and Isocapnic Hyperpnea	Respiratory muscle endurance, MSVC, MVV, Inspiratory muscle strength, Exercise performance	Respiratory muscle training significantly improved respiratory muscle endurance, delayed respiratory muscle fatigue, improved exercise tolerance, and enhanced athletic performance in both athletes and non-athletes.

4. Result

A comprehensive literature search identified relevant studies evaluating the effects of Inspiratory Muscle Training (IMT) on athletic performance. Following the application of the inclusion and exclusion criteria and the study selection process, 14 studies were included in this narrative review. These studies consisted of systematic reviews, meta-analyses, randomised controlled trials and experimental studies involving athletes from various sporting disciplines, including football, cycling, rowing, swimming, middle-distance running and other endurance and intermittent sports.

The findings consistently demonstrated that inspiratory muscle training significantly improves maximal inspiratory pressure (MIP), inspiratory muscle endurance, exercise tolerance and overall athletic performance across different athletic populations. Most studies reported improvements in endurance performance, time-trial performance and sport-specific performance following structured IMT programmes. Several studies also found reductions in respiratory muscle fatigue, perceived exertion (RPE) and dyspnea during exercise, allowing athletes to sustain higher exercise intensities for longer durations.

Among the included studies, systematic reviews and meta-analyses provided strong evidence supporting the effectiveness of IMT as an ergogenic aid. These reviews concluded that IMT improves inspiratory muscle strength regardless of sporting discipline and contributes to enhanced exercise performance, particularly in endurance-based sports. However, most studies reported minimal or no significant changes in resting pulmonary function parameters such as forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and maximal expiratory pressure, suggesting that the performance benefits are primarily related to improved respiratory muscle function rather than changes in lung function.

Randomised controlled trials conducted in football players, swimmers, cyclists, rowers and middle-distance runners consistently demonstrated that athletes receiving inspiratory muscle training achieved greater improvements in inspiratory muscle strength, exercise capacity, and sports performance than control groups. These studies also reported improved respiratory efficiency, delayed onset of respiratory muscle fatigue, and better tolerance to prolonged or high-intensity exercise. Athletes experienced lower ratings of perceived exertion and reduced breathlessness during exercise, contributing to improved overall performance.

The inspiratory muscle training protocols used across the included studies were generally consistent. Most interventions involved 30 inspiratory breaths performed once or twice daily, 5-7 days per week, over 4-8 weeks, using pressure-threshold or resistive breathing devices. Training intensity commonly ranged from 30% to 80% of maximal inspiratory pressure (MIP), with progressive increases in resistance throughout the intervention period. Acute inspiratory muscle warm-up protocols performed immediately before exercise also demonstrated beneficial effects on respiratory muscle activation and subsequent exercise performance.

This narrative review indicates that inspiratory muscle training is a safe, practical and effective adjunct to conventional athletic conditioning. Regular IMT enhances inspiratory muscle strength, delays respiratory muscle fatigue, attenuates the inspiratory muscle metaboreflex, improves oxygen delivery to the working limb muscles and contributes to better exercise capacity and athletic performance. The findings support the incorporation of inspiratory muscle training into routine sports conditioning programmes for athletes participating in endurance, intermittent and high-intensity sports.

5. Discussion

The present narrative review aimed to evaluate the available evidence regarding the effectiveness of Inspiratory Muscle Training (IMT) in enhancing athletic performance. A total of 14 studies, including systematic reviews, meta-analyses, randomised controlled trials were included in this review. The

overall findings indicate that IMT is an effective adjunct to conventional sports training and has a positive influence on inspiratory muscle strength, exercise capacity, respiratory efficiency, and athletic performance.

One of the most consistent findings across the included studies was the significant improvement in maximal inspiratory pressure (MIP) following IMT. Increased inspiratory muscle strength enhances the ability of athletes to generate greater inspiratory pressures during exercise, thereby reducing the work of breathing and delaying respiratory muscle fatigue. Systematic reviews by Illi et al. (2012), HajGhanbari et al. (2013) and Karsten et al. (2018) consistently demonstrated that IMT significantly improves inspiratory muscle strength and contributes to enhanced endurance performance in healthy athletes. These findings suggest that stronger respiratory muscles improve ventilatory efficiency and support better exercise performance during prolonged or high-intensity activities.

Ten studies also reported improvements in exercise tolerance, endurance performance and sports-specific performance following IMT. Randomised controlled trials conducted among football players, swimmers, cyclists, rowers and middle-distance runners demonstrated that athletes who underwent IMT showed superior performance compared with control groups. These improvements may be attributed to delayed respiratory muscle fatigue, reduced oxygen cost of breathing and improved oxygen availability to the working skeletal muscles. Enhanced respiratory muscle endurance allows athletes to sustain higher exercise intensities for longer durations while experiencing lower levels of fatigue.

Another important finding of this review is the beneficial effect of IMT on the inspiratory muscle metaboreflex. Several studies included in this review suggested that IMT delays activation of the inspiratory muscle metaboreflex, thereby preserving blood flow to the limb muscles and improving endurance performance. This physiological adaptation is considered one of the primary mechanisms responsible for the ergogenic effects of IMT.

The review also demonstrated that IMT reduces the perception of dyspnea and rating of perceived exertion (RPE) during exercise. Athletes reported improved breathing comfort and reduced respiratory effort after completing structured IMT programmes. Lower perceived exertion enables athletes to maintain higher training intensities and may contribute to improved overall sports performance.

Eight included studies implemented IMT protocols using pressure-threshold or resistive breathing devices with training intensities ranging from 30% to 80% of maximal inspiratory pressure typically performed for 30 breaths per session, once or twice daily, over 4-8 weeks. Despite minor variations in training intensity and duration, positive improvements in inspiratory muscle strength and athletic performance were consistently reported suggesting that IMT is an effective intervention across different sports and training programmes.

Although improvements in athletic performance were consistently observed seventeen studies reported minimal or no significant changes in resting pulmonary function parameters, including forced vital capacity (FVC) and forced expiratory volume in one second (FEV1). This indicates that the primary benefits of IMT arise from improved respiratory muscle function and neuromuscular adaptations rather than changes in lung volumes or pulmonary mechanics.

Overall, the findings of this narrative review support the inclusion of inspiratory muscle training as an adjunct to conventional athletic conditioning programmes. IMT appears to be a safe practical and cost-effective intervention that enhances respiratory muscle performance, delays fatigue, improves exercise tolerance and contributes to better athletic performance across a wide range of sporting disciplines.

Inspiratory muscle training (IMT) has therefore gained increasing attention as a non-invasive, sport-specific intervention to improve respiratory muscle function and optimize athletic performance1,3.
This narrative review consolidates the available evidence on the effectiveness of inspiratory muscle training programmes in reducing respiratory muscle fatigue and improving respiratory muscle function, exercise capacity and athletic performance.

6. Conclusion

Based on the evidence presented in this narrative review, it can be concluded that Inspiratory Muscle Training (IMT) is an effective and evidence-based intervention for enhancing athletic performance in healthy athletes. The findings from the included studies consistently demonstrate that IMT improves inspiratory muscle strength, respiratory muscle endurance, exercise tolerance and sports-specific performance while reducing respiratory muscle fatigue, dyspnea and perceived exertion during exercise.
The review also highlights that the physiological benefits of IMT are primarily mediated through improved respiratory muscle efficiency and delayed activation of the inspiratory muscle metaboreflex, which helps preserve oxygen delivery to the exercising limb muscles during prolonged or high-intensity physical activity. These adaptations contribute to improved endurance, delayed fatigue and enhanced athletic performance. Most studies utilized structured IMT protocols involving pressure-threshold or resistive breathing devices with progressive loading over 4-8 weeks demonstrating that IMT can be easily integrated into existing sports training programmes without significantly increasing overall training load.

Overall, the available evidence supports the use of inspiratory muscle training as a safe, practical and effective adjunct to conventional athletic conditioning. Physiotherapists, sports scientists, athletic trainers and coaches may consider incorporating IMT into routine training programmes to optimize respiratory muscle function and improve athletic performance in competitive and recreational athletes. However, variations in training protocols, participant characteristics and outcome measures among the included studies indicate the need for further high-quality randomized controlled trials using standardized IMT protocols across different sporting disciplines. Future research should also investigate the long-term effects of inspiratory muscle training, optimal training intensity and duration and its influence on performance in adolescent athletes, and sport-specific populations.

References

1. Xavier DM, Miranda JP, Figueiredo PHS, Lima VP. The effectiveness of respiratory muscular training in athletes: A systematic review and metaanalysis is. J Bodmeta analysyw Mov Ther. 2025:42:777-792. doi:10.1016/j.jbmt.2025.01.010.
2. Akinci B, Cilbir CE, Kocyigit A, Aslan GK. Respiratory muscle training in para-athletes: A systematic review on the training protocols and effects on reported outcomes. J Sport Rehabil. 2024;33(6):387-395. doi:10.1123/jsr.2023-0301.

3. Fernández-Lázaro D, Gallego-Gallego D, Corchete LA, Fernández-Zoppino D, González-Bernal JJ, García-Gómez B, et al. Effects on respiratory pressures, spirometry biomarkers, and sports performance after inspiratory muscle training in a physically active population by PowerBreathe®: A systematic review and meta-analysis. Healthcare (Basel). 2023;11.
4. Cirino C, Marostegan AB, Hartz CS, Moreno MA, Gobatto CA, Manchado-Gobatto FB. Effects of inspiratory muscle warm-up on physical exercise: A systematic review. Biology (Basel). 2023;12(2):333.
5. Notter DA, Verges S, Renggli AS, et al. Similar effects on exercise performance following different respiratory muscle training programs in healthy young men. Sci Rep. 2023;13:16135.
6. Fernández-Lázaro D, Gallego-Gallego D, Corchete LA, Fernández-Zoppino D, González-Bernal JJ, García-Gómez B, et al. Inspiratory muscle training program using the PowerBreathe®: Does it have ergogenic potential for respiratory and/or athletic performance? A systematic review with meta-analysis. Int J Environ Res Public Health. 2021;18(13):6703.
7. Ribeiro Lemos J, Cunha FA, Lopes AJ, Guimarães FS, Vasconcellos FVA, Vigário PDS. Respiratory muscle training in non-athletes and athletes with spinal cord injury: A systematic review of the effects on pulmonary function, respiratory muscle strength and endurance, and cardiorespiratory fitness based on the FITT principle of exercise prescription. J Back Musculoskelet Rehabil. 2020;33(4):655-667. doi:10.3233/BMR-181452.
8. Lorca-Santiago J, Marín PJ, Marín-Cascales E, Alcaraz PE. Inspiratory muscle training in intermittent sports modalities: A systematic review. Int J Environ Res Public Health. 2020;17(12):4448.
9. Cunha M, Mendes F, Paciência I, Rodrigues F, Moreira A, et al. The effect of inspiratory muscle training on swimming performance, inspiratory muscle strength, lung function, and perceived breathlessness in elite swimmers. Porto Biomed J. 2019;4(6):e49.
10. Hartz CS, Sindorf MAG, Lopes CR, Batista J, Moreno MA. Effect of inspiratory muscle training on performance of handball athletes. J Hum Kinet. 2018;63:43-51. doi:10.2478/hukin-2018-0005.
11. Karsten M, Ribeiro GS, Esquivel MS, Matte DL. The effects of inspiratory muscle training with linear workload devices on the sports performance and cardiopulmonary function of athletes: A systematic review and meta-analysis. Phys Ther Sport. 2018;34:92-104.
12. Shei RJ. Recent advancements in our understanding of the ergogenic effect of respiratory muscle training in healthy humans: A systematic review. J Strength Cond Res. 2018;32(9):2665-2676.
13. Sales ATN, Fregonezi GAF, Ramsook AH, Guenette JA, Lima INDF, Reid WD. Respiratory muscle endurance after training in athletes and non-athletes: A systematic review and meta-analysis. Phys Ther Sport. 2016;17:76-86. doi:10.1016/j.ptsp.2015.08.001.