



Managing Exercise-Induced Bronchoconstriction: A Comprehensive Review of Strategies for Athletes to Maintain Fitness and Health

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Abstract: Exercise-induced bronchoconstriction (EIB) significantly impacts athletes by impairing their performance and overall health. Characterized by airway narrowing during or after physical activity, EIB affects the quality of training and competition. This study employs a qualitative descriptive research model based on a comprehensive literature review to evaluate EIB management strategies in athletes. We systematically collected data from trusted scientific databases – Scopus, Science Direct, and Google Scholar – using keywords such as "Exercise-Induced Asthma," "Athlete," and "Sport." Relevant articles were identified, and key terms related to EIB management were reviewed. The data, including study designs, research objectives, sample sizes, and findings, were compiled and analyzed to determine effective management approaches. Key findings indicate that accurate diagnosis using spirometry and bronchial provocation tests is essential. Pharmacological management primarily involves inhaled corticosteroids (ICS) to reduce inflammation and control EIB, while short-acting beta agonists (SABAs) offer only temporary relief. Non-pharmacological strategies include avoiding triggers, implementing proper warm-up routines, and using breathing techniques. Supervised aerobic exercise programs were shown to improve cardiovascular fitness without worsening EIB symptoms. The study also reviewed the impact of environmental factors, such as air pollution and post-COVID-19 conditions, on EIB. Recommendations include personalized asthma action plans, training for coaches on environmental triggers, and exercising in controlled conditions. This study highlights the need for a holistic approach combining pharmacological and non-pharmacological methods to manage EIB effectively and maintain athletic performance. Further research is warranted to develop tailored strategies for athletes with EIB.

Keywords: Asthma; Athlete; Bronchoconstriction; Exercise; Sport

Introduction

Exercise-induced bronchoconstriction, or Exercise-Induced Bronchoconstriction (EIB), is a significant health problem for athletes (Bougault et al., 2009). This condition affects not only sports performance, but also the general well-being of athletes involved in various sports (Amin et al., 2023; Chinta et al., 2024). EIB, which is characterized by narrowing of

the airways during or after physical activity, can affect the quality of training and competition. Research shows that the prevalence of EIB among athletes ranges from 20% to 70%, depending on the type of exercise and the intensity of the exercise (Ansley et al., 2013; Malewska-Kaczmarek et al., 2022). In sports that demand heavy and prolonged breathing, such as long-distance running and swimming, this figure can be higher (Al Zaki et al., 2023; Illahi et al., 2023). Given the huge impact EIB has

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on athlete health and performance, it is important to understand how to manage this condition effectively (Boden et al., 2020).

Proper diagnosis is a crucial first step in EIB management. The diagnosis process involves a thorough assessment that begins with a medical history and symptoms (Schwellnus et al., 2022). For an accurate diagnosis, pulmonary function tests such as spirometry and bronchial provocation tests are necessary. Spirometry is used to measure lung capacity and detect the presence of impaired respiratory function, while bronchial provocation tests help identify airway reactions to various triggers (Ansley et al., 2013). An accurate diagnosis allows for proper treatment and helps athletes avoid performance impairments caused by EIB symptoms. Without a proper diagnosis, athletes may experience symptoms that are not treated properly, resulting in decreased performance and quality of life (Burnett et al., 2016).

In terms of treatment, pharmacological and non-pharmacological therapies should be considered. Inhaled corticosteroids (ICS) are the main treatment for asthma and EIB. ICS works by reducing inflammation in the airways, thereby reducing the frequency and intensity of EIB attacks (Reier-Nilsen et al., 2023). Regular use of ICS under medical supervision can help manage symptoms effectively. In contrast, short-acting beta agonists (SABAs) are not recommended as a single treatment because they only relieve symptoms without addressing the underlying inflammation. SABAs can be used as an adjunct in certain cases, but they cannot replace the role of ICS in long-term management (Ainegren et al., 2020; Reier-Nilsen et al., 2023).

Non-pharmacological approaches also play an important role in the management of EIBs. Avoiding known triggers, such as air pollution, cold air, or certain allergens, is essential to prevent the onset of symptoms. In addition, adequate warm-up before exercise can reduce the risk of bronchospasm. Good warming increases the temperature and humidity of the airways, which can help prevent airway constriction induced by physical activity (Ferdian et al., 2023). Breathing and relaxation techniques can also contribute to managing EIB. Regular breathing exercises help improve breathing control and reduce the anxiety that often accompanies asthma symptoms (Gatterer et al., 2021; Rossi et al., 2021).

Supervised exercise programs, especially aerobic exercise, can provide great benefits for athletes with EIB (Amawi et al., 2023). These exercises are designed to improve cardiorespiratory fitness and endurance without worsening EIB symptoms. An exercise program conducted at the appropriate intensity and under professional supervision can help athletes adapt their breathing capacity and improve their physical fitness

(Pitnawati et al., 2023; Rambe et al., 2024). Supervised exercise allows athletes to stay active and train consistently without compromising their health. With the right guidance, athletes can take advantage of aerobic exercise to improve performance while keeping EIB symptoms under control.

In conclusion, the management of asthma triggered by physical exercise requires a holistic and integrated approach. Accurate diagnosis, appropriate pharmacological treatment, as well as non-pharmacological strategies such as trigger avoidance and adequate heating are essential elements in EIB management. A supervised training program is also an important part of the strategy to maintain athletes' fitness and health. While the information available provides valuable insights into EIB management, there is still room for further exploration of strategies specifically designed for athletes. With the right approach and comprehensive management, athletes with EIB can continue to compete and reach their best potential in sports, while maintaining their health and well-being. Based on this background, researchers need to conduct a comprehensive literature review on the management of asthma triggered by physical exercise in athletes.

Method

This study uses a qualitative descriptive research model based on literature studies to review asthma management strategies triggered by physical exercise (EIB) in athletes. The process begins with the collection of literature from trusted sources through access to scientific databases such as Scopus, Science Direct, and Google Scholar with the keywords "Exercise-Induced Asthma," "Athlete," and "Sport." After collecting the literature, important terms related to EIB and their application to athletes are reviewed.

Furthermore, data from the relevant literature is compiled and analyzed. This data includes information such as author's name, year of publication, study design, research objectives, samples, instruments, and a summary of findings. Articles that meet the criteria are then filtered for further analysis. The documentation method is used to collect data by digging and searching for information from related literature. The data collected is compiled into one comprehensive document to answer research questions. Content analysis is used to evaluate the relevance and contribution of the study to the management of EIB. The conclusions of this analysis provide evidence-based recommendations regarding effective EIB management strategies for athletes. This methodology aims to provide in-depth insights into EIB management in the context of sport.

Result and Discussion

Managing exercise-induced asthma involves using pre-exercise bronchodilators, maintaining proper warm-up and cool-down routines, monitoring environmental triggers, and adhering to an asthma action plan. Athletes

should balance intense training with appropriate medication and adjustments to avoid symptoms, ensuring both fitness and overall health are maintained effectively. There are 10 articles that will be further analyzed in this literature review. For more details can be seen in Table 1.

Table 1. Summary of data descriptions

Author	Topic	Results
(Zügel et al., 2021)	The ELSA trial: single versus combinatory effects of non-prohibited beta-2 agonists on skeletal muscle metabolism, cardio-pulmonary function and endurance performance – study protocol for a randomized 4-way balanced cross-over trial Martina	Findings from the study show that inhaled beta-2 agonists, such as salbutamol and formoterol, do not significantly enhance endurance performance in trained athletes at the doses permitted by WADA. These results suggest that current therapeutic use of beta-2 agonists in athletes with asthma is unlikely to provide a performance edge, thus informing anti-doping regulations and practices.
(Moseley et al., 2024)	Catastrophic injuries and exertional medical events in lacrosse among youth, high school and collegiate athletes: longitudinal surveillance over four decades.	Asthma management in lacrosse, though not covered in the research, is crucial. Athletes should have a personalized action plan, keep rescue inhalers accessible, and adhere to medication guidelines. Coaches must be aware of environmental triggers, ensure proper ventilation, and educate staff on asthma management and emergency response.
(Augustine et al., 2024)	Right ventricular assessment of the adolescent footballer’s heart	The study found 3.3% of male footballers aged 13-18 had T-wave inversion, with higher prevalence in black players. Despite high right ventricular parameters, 0.2% met criteria for definite arrhythmogenic right ventricular cardiomyopathy. No cardiomyopathy was confirmed. Asthma management for athletes involves proper diagnosis, medication adherence, and regular monitoring.
(Rasmussen et al., 2023)	The COVID-19 in athletes (COVA) study: a national study on cardio-pulmonary involvement of SARS- CoV-2 infection among elite athletes	Research on elite athletes post-COVID-19 showed 2% had cardiac and 12% had pulmonary involvement. Asthma, often prevalent in athletes, may be exacerbated by COVID-19. Differentiating between asthma and postviral symptoms is crucial. Effective asthma management post-COVID involves regular monitoring, spirometry, and tailored treatment to maintain performance and health.
(Börjesson et al., 2022)	Symptoms and ECG changes precede sudden cardiac death in hypertrophic cardiomyopathy – A nationwide study among the young in Sweden	In a study of young individuals with hypertrophic cardiomyopathy (HCM) in Sweden, 38 cases of sudden cardiac death were analyzed. Many showed cardiac symptoms before death, and 58% had abnormal ECGs. Family history was significant. Asthma management in some cases revealed potential misdiagnosis, underscoring the need for accurate symptom evaluation.
(Hodgson et al., 2021)	The Diamond League athletic series: does the air quality sparkle?	Research on elite 5km runners at Diamond League events revealed that air quality, particularly O3 and NO2, significantly affects performance. For athletes with asthma, poor air quality can exacerbate symptoms, impacting performance and health. Effective asthma management is crucial to mitigate these effects and optimize athletic outcomes.
(Ainegren et al., 2020)	Breathing resistance in metabolic systems: Its effects on pulmonary ventilation and oxygen uptake in elite athletes with high aerobic power	The study compared high and low resistance breathing systems in elite athletes, finding no difference in VO2, performance, or time to exhaustion between conditions. While ventilation and expired gas fractions varied with breathing resistance, asthma was not a factor, so asthma

Author	Topic	Results
(Goossens et al., 2023)	Activation of epithelial and inflammatory pathways in adolescent elite athletes exposed to intense exercise and air pollution	management was not directly addressed in this research. The study found that elite athletes exposed to intense exercise and air pollution showed increased airway inflammation and epithelial damage. With a 9% incidence of exercise-induced bronchoconstriction (EIB), asthma management includes monitoring symptoms, using bronchodilators, and avoiding high-pollution areas to prevent exacerbations and optimize performance.
(Reier-Nilsen et al., 2023)	Unsupervised field-based exercise challenge tests to support the detection of exercise-induced lower airway dysfunction in athletes	The study of 60 athletes with exercise-induced lower airway dysfunction (LAD) found 67% were from winter sports and 43% had asthma. It emphasized accurate LAD diagnosis through tests and the need for tailored therapy. Management includes avoiding pre-test triggers and discontinuing certain medications, following international guidelines.
(Malewska-Kaczmarek et al., 2022)	Adolescent Athletes at Risk of Exercise-Induced Bronchoconstriction: A Result of Training or Pre-Existing Asthma?	The study found high rates of exercise-induced bronchoconstriction (EIB) among adolescent athletes, including those without prior asthma symptoms. Proper diagnosis and management are crucial, as symptoms may be underreported. Athletes with EIB were treated with salbutamol, emphasizing the need for better awareness and management of EIB in this group.

Recent research on the management of asthma in athletes shows a variety of approaches and challenges that are important. A study by Zügel et al. (2021) found that inhaled beta-2 agonists such as salbutamol and formoterol did not confer a significant improvement in endurance performance in trained athletes, highlighting that therapeutic use of beta-2 agonists may not provide the expected performance advantage, as well as affect anti-doping regulation. The research of Moseley et al. (2024) emphasizes the importance of asthma management in lacrosse sports, with advice to have a personalized action plan and ensure the accessibility of rescue inhalers as well as the coach's understanding of environmental triggers. Augustine et al. (2024) highlighted that although 3.3% of adolescent soccer players showed T-wave inversions, no confirmed cardiomyopathy, emphasizing the need for accurate diagnosis and regular monitoring for athletes with asthma. Research by Rasmusen et al. (2023) shows that 2% of elite athletes experience cardiac involvement and 12% pulmonary involvement after SARS-CoV-2 infection, so post-COVID asthma management should involve tailored monitoring and treatment.

Börjesson et al. (2022) found that many cases of sudden cardiac death in young individuals with hypertrophic cardiomyopathy show symptoms earlier, emphasizing the importance of proper evaluation and avoiding asthma misdiagnosis. Research by Hodgson et al. (2021) revealed that poor air quality at Diamond League events can worsen asthma symptoms, so effective asthma management is important to mitigate its impact. Ainegren et al. (2020) did not find a

significant difference in performance between the respiratory system with high and low resistance, suggesting that asthma was not a major factor in this study. Goossens et al. (2023) found that elite athletes exposed to air pollution and intensive exercise showed airway inflammation, with an incidence of exercise-triggered bronchoconstriction (EIB) of 9%, so asthma management should include monitoring and use of bronchodilators. The research of Reier-Nilsen et al. (2023) emphasizes the need for an accurate diagnosis for exercise-induced lower airway dysfunction, with an emphasis on tailored therapy and pre-test trigger avoidance. Finally, Malewska-Kaczmarek et al. (2022) showed that many adolescent athletes experience EIB, even without previous asthma symptoms, emphasizing the need for better awareness and management for EIB.

Overall, the study highlights the importance of an integrated approach to asthma management, with a focus on proper diagnosis, regular monitoring, and adjustments to environmental conditions to ensure optimal athlete health and performance. Research on the management of asthma in athletes is very important because this condition can significantly affect the performance and health of athletes. Asthma, if not managed properly, can hinder athletes' ability to train and compete optimally. This study helps in identifying the effectiveness of existing therapies, such as beta-2 agonists, and evaluating their impact on athletes' performance. In addition, the study also explores how environmental factors such as air quality and pollution can worsen asthma symptoms, as well as offer strategies to reduce its impact. It is also important to ensure early

detection and accurate diagnosis of conditions such as exercise-triggered bronchoconstriction (EIB), so that athletes can avoid exacerbations and still compete well. Recommendations from the study include the implementation of a personalized and accessible asthma action plan for athletes, as well as increased awareness and education for coaches and staff regarding environmental triggers and early signs of asthma. Athletes should avoid high-pollution areas and train in controlled environmental conditions to reduce the likelihood of exacerbations. For athletes who have been infected with COVID-19, routine cardiopulmonary monitoring and tailored care are essential to differentiate between post-viral symptoms and asthma. Thus, this study provides valuable insights for the development of more effective and tailored asthma management strategies, in order to maintain optimal health and performance of athletes

Conclusion

This study highlights the importance of a holistic approach to the management of exercise-triggered asthma in athletes. EIB can interfere with athletes' performance and well-being by causing airway constriction during or after physical activity. From the various studies analyzed, it appears that the management of EIB requires a combination of pharmacological and non-pharmacological strategies for optimal effectiveness. The findings of the study suggest that ICS is the main therapy for reducing airway inflammation and the frequency of EIB attacks. While SABAs can provide short-term relief, they do not replace the role of ICS in long-term management. In addition, non-pharmacological approaches such as avoiding environmental triggers, adequate warming, and breathing techniques can help prevent and manage EIB symptoms. Supervised exercise programs have also been shown to be beneficial for improving cardiovascular fitness and endurance without worsening EIB symptoms.

The study also demonstrates the need for accurate diagnosis and periodic monitoring, especially for athletes who have been infected with COVID-19, as such infections can worsen EIB symptoms. Key recommendations include the implementation of a personalized asthma action plan, training for trainers and staff on environmental triggers and early symptoms of asthma, as well as exercise in controlled environmental conditions to reduce the likelihood of exacerbations. Overall, this study provides important insights for the development of more effective and tailored asthma management strategies, to ensure optimal health and performance of athletes. However,

there is still a need for further research to explore more specific strategies for athletes with EIB.

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Conflict of Interest

The content of this article does not create a conflict of interest.

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