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Exercise-Induced Bronchoconstriction in Athletes: A Narrative Review

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Abstract

Background:

Exercise-induced bronchoconstriction (EIB) is a prevalent respiratory condition among athletes, characterized by transient airway narrowing during or after physical exertion. While physical activity is generally health-promoting, the extreme ventilatory demands of elite sports, particularly in cold or polluted environments, impose significant stress on the respiratory system, leading to high rates of airway dysfunction.

Aim:

This narrative review aims to synthesize current knowledge regarding the pathophysiology, epidemiology, and clinical management of EIB in the athletic population, focusing on the challenges faced by elite competitors in high-risk environments.

Material and methods:

A comprehensive search of PubMed/MEDLINE and Google Scholar databases was conducted. The review analyzed systematic reviews, meta-analyses, and consensus statements from international and national organizations, such as the International Olympic Committee and the Polish Society of Allergology, focusing on elite endurance and winter sports athletes.

Results:

The prevalence of EIB in elite athletes (10–50%) significantly exceeds that of the general population (5–10%), with the highest risk observed in winter endurance sports. A distinct "sports-related asthma" phenotype was identified, characterized by a later age of onset and neutrophilic inflammation driven by repetitive epithelial injury. Clinical diagnosis based solely on self-reported symptoms is unreliable, requiring objective tests like Eucapnic Voluntary Hyperpnea (EVH). Management through inhaled corticosteroids (ICS), beta2-agonists (SABA/LABA), and non-pharmacological strategies (e.g., structured warm-ups, heat-moisture exchangers) effectively ensures performance neutrality while complying with WADA regulations.

Conclusions:

EIB is a major health concern in elite sports that remains frequently underdiagnosed. Objective diagnostic protocols and tailored therapeutic strategies are essential to maintain athletes' respiratory health and competitive integrity without compromising performance.

Keywords: exercise-induced bronchoconstriction, exercise-induced asthma, EIB, athletes, elite athletes, sports.

1. Introduction

Exercise-induced bronchoconstriction (EIB) is characterized by the transient narrowing of the lower airways during or immediately following strenuous physical activity (Côté et al., 2018; Weiler et al., 2016; Pigakis et al., 2022). Clinically, EIB is diagnosed by a post-exercise reduction in forced expiratory volume in one second (FEV1) of at least 10% compared to baseline (Côté et al., 2018; Mäki-Heikkilä et al., 2020; Pigakis et al., 2022). Current medical literature distinguishes two primary clinical entities: EIB with asthma (EIBA), occurring in individuals with pre-existing chronic asthma, and EIB without asthma (EIBwA), which affects individuals who are otherwise asymptomatic at rest (Côté et al., 2018; Pigakis et al., 2022; Ora et al., 2024).

While regular physical activity is a cornerstone of health maintenance, the extreme physiological demands of elite-level training impose significant stressors on the respiratory system (Boulet & O'Byrne, 2015; Côté et al., 2018; Jaeger et al., 2025). The epidemiological burden of EIB in the athletic community is substantial, with prevalence rates consistently exceeding those found in the general population, particularly among endurance and winter sports participants (Gawlik et al., 2019; Mäki-Heikkilä et al., 2020; Ora et al., 2024; Pigakis et al., 2022). These high rates are inextricably linked to extreme ventilatory demands, which can bypass the nasal passage's capacity to warm and humidify inspired air, leading to airway stress and subsequent dysfunction (Boulet & O'Byrne, 2015; Gawlik et al., 2019; Mäki-Heikkilä et al., 2020).

Identifying and managing EIB is of critical importance, as untreated airway impairment can limit exercise capacity and compromise long-term respiratory health (Boulet & O'Byrne, 2015; Ora et al., 2024; Pigakis et al., 2022). Despite its prevalence, EIB remains frequently underdiagnosed because many competitors adapt to chronic respiratory discomfort or remain asymptomatic despite fulfilling diagnostic criteria (Boulet & O'Byrne, 2015; Gawlik et al., 2019; Mäki-Heikkilä et al., 2020; Pigakis et al., 2022). Consequently, this narrative review aims to summarize current knowledge regarding the underlying mechanisms, epidemiological trends, and management strategies of EIB in the athletic population, with a particular focus on the challenges faced by elite competitors in high-risk environments (Siemianowski et al., 2025; Ora et al., 2024; Pigakis et al., 2022; Weiler et al., 2016).

2. Research materials and methods

This study was conducted as a narrative literature review. A comprehensive literature search was performed in the PubMed/MEDLINE and Google Scholar databases to identify relevant peer-reviewed publications. Systematic reviews, meta-analyses, and international consensus statements (e.g., from the International Olympic Committee and the Joint Task Force of the ERS/EAACI) were included. Special consideration was given to position papers from national societies, such as the Polish Society of Allergology. The search was conducted using a combination of keywords and Medical Subject Headings (MeSH) including: “exercise-induced bronchoconstriction”, “exercise-induced asthma”, “airway hyperresponsiveness”, “elite athletes”, “winter sports”, and “Nordic skiing”. The literature screening and selection were based on the hierarchy of evidence-based medicine.

2.1. Participants.

The population analyzed across the included studies primarily consists of elite and competitive endurance athletes. A significant focus is placed on winter sports participants, specifically cross-country skiers, biathletes, and ski-orienteers, who are habitually exposed to cold and dry ambient air during high-intensity training (Lennelöv et al., 2019; Persson et al., 2018; Eklund et al., 2018; Näsman et al., 2018; Mäki-Heikkilä et al., 2020; Mäki-Heikkilä et al., 2021; Mäki-Heikkilä et al., 2022; Jaeger et al., 2025; Sue-Chu, 2012). The studies also include data on indoor winter athletes, such as ice hockey players (Jaeger et al., 2025).

The participants represent a spectrum of respiratory profiles, ranging from athletes with established chronic asthma to those with asymptomatic exercise-induced bronchoconstriction (EIB) (Gawlik et al., 2019; Ora et al., 2024; Mäki-Heikkilä et al., 2022) . The inclusion criteria across the reviewed literature typically cover athletes competing at national or international levels, whose minute ventilation demands significantly exceed those of the general population (Boulet & O’Byrne, 2015). In terms of longitudinal data, the subjects include both youth and adult competitors, allowing for an analysis of airway dysfunction over prolonged periods of high-volume training (Mäki-Heikkilä et al., 2021; Mäki-Heikkilä et al., 2022).

3. Clinical presentation

The clinical manifestation of asthma and exercise-induced bronchoconstriction (EIB) in athletes often differs from the presentation seen in the general population, frequently remaining underdiagnosed despite significant airway impairment (Gawlik et al., 2019; Mäki-Heikkilä et al., 2020). The classic triad of symptoms includes dyspnea (shortness of breath), wheezing, and chest tightness, which typically occur during or shortly after strenuous physical exertion (Boulet & O'Byrne, 2015; Pigakis et al., 2022; Ora et al., 2024). However, in many elite competitors, especially those in endurance sports, the symptoms may be less specific, including excessive coughing, increased mucus production, or a feeling of "getting out of shape" that is disproportionate to the training load (Gawlik et al., 2019; Siemianowski et al., 2025).

In winter sports athletes, such as cross-country skiers, symptoms are often exacerbated by the inhalation of cold, dry air, which acts as a potent trigger for airway hyperresponsiveness (Sue-Chu, 2012; Mäki-Heikkilä et al., 2020; Mäki-Heikkilä et al., 2021). A characteristic feature of EIB is that symptoms usually peak 5 to 15 minutes after exercise cessation and typically resolve spontaneously within 30 to 60 minutes (Boulet & O'Byrne, 2015; Weiler et al., 2016; Ora et al., 2024).

Crucially, self-reported symptoms are often poor predictors of the objective presence of the disease in elite populations (Mäki-Heikkilä et al., 2020; Weiler et al., 2016). Many athletes adapt to chronic respiratory discomfort, perceiving it as a normal consequence of near-maximal exertion, or they may remain asymptomatic despite fulfilling diagnostic criteria in objective lung function tests (Mäki-Heikkilä et al., 2020; Mäki-Heikkilä et al., 2022). Therefore, a clinical diagnosis based solely on history is considered unreliable without confirmatory objective testing (Mäki-Heikkilä et al., 2020; Boulet & O'Byrne, 2015).

4. Pathophysiology

The pathophysiology of exercise-induced bronchoconstriction (EIB) is primarily driven by the physical consequences of high-volume ventilation on the airway surface. The most widely accepted mechanism is the osmotic theory (water loss hypothesis), which states that increased ventilation leads to significant airway dehydration (Côté et al., 2018; Cockcroft & Davis, 2006). As water evaporates from the airway surface liquid to humidify the inspired air, the periciliary fluid becomes hyperosmolar (Côté et al., 2018). This hyperosmolarity triggers a cascade of events, including the release of pro-inflammatory mediators (such as histamine, cysteinyl leukotrienes, and prostaglandins) from mast cells and other inflammatory cells, which ultimately leads to airway smooth muscle contraction (Côté et al., 2018; Cockcroft & Davis, 2006).

Another contributing factor is the thermal theory, where the cooling of the airways during exercise is followed by rapid rewarming after cessation of activity, leading to reactive hyperemia and edema of the airway wall (Côté et al., 2018). Furthermore, airway hyperresponsiveness (AHR) in EIB consists of two distinct components: a transient, inducible component linked to acute airway inflammation, and a more persistent component associated with structural changes known as airway remodeling (Cockcroft & Davis, 2006). Chronic exposure to high ventilation rates, especially in cold or polluted environments, can cause epithelial injury and long-term structural alterations (Sue-Chu, 2012), making the airways more sensitive to both direct and indirect triggers (Côté et al., 2018; Cockcroft & Davis, 2006).

5.Epidemiology

The prevalence of exercise-induced bronchoconstriction (EIB) and asthma varies significantly across different athletic populations, consistently exceeding the rates observed in the general population (Gawlik et al., 2019; Boulet & O'Byrne, 2015). While the prevalence of asthma in the general adult population is estimated at approximately 5–10%, the frequency of EIB among elite athletes can range from 10% to over 50%, depending on the sporting discipline and environmental exposures (Gawlik et al., 2019; Ora et al., 2024; Pigakis et al., 2022).

5.1 Prevalence Across Sporting Disciplines

The risk of developing EIB is highly dependent on the type of exercise and the environment in which it is performed (Gawlik et al., 2019; Ora et al., 2024). Athletes can be categorized into risk groups based on these factors:

- Winter Endurance Sports: High-level endurance athletes training in cold and dry environments exhibit the highest prevalence of airway dysfunction (Mäki-Heikkilä et al., 2020; Jaeger et al., 2025). Competitive cross-country skiers, biathletes, and ski-orienteers show a physician-diagnosed asthma prevalence of approximately 21–25% (Mäki-Heikkilä et al., 2020; Siemianowski et al., 2025). Some studies involving elite skiers have reported EIB or bronchial hyperresponsiveness in up to 50–75% of participants (Mäki-Heikkilä et al., 2020; Mäki-Heikkilä et al., 2021).
- Ice-Based Sports: Athletes performing in indoor ice rinks are at elevated risk due to the inhalation of cold air and pollutants (e.g., nitrogen oxides) from ice-resurfacing

machines (Gawlik et al., 2019; Jaeger et al., 2025). The prevalence of asthma in elite ice hockey players is reported at approximately 14–19% (Jaeger et al., 2025).

- Water Sports: Elite swimmers experience high rates of EIB (approx. 14–25%) primarily due to chronic exposure to trichloramines and other chlorine byproducts in indoor pools, which act as potent airway irritants (Gawlik et al., 2019; Boulet & O’Byrne, 2015).
- Summer Endurance Sports: Athletes in sports such as cycling and long-distance running show a prevalence of EIB ranging from 15% to 20%, often exacerbated by exposure to ambient pollutants and aeroallergens (Gawlik et al., 2019; Pigakis et al., 2022).
- Low-Ventilation Sports: In disciplines characterized by lower minute ventilation, such as golf or weightlifting, the prevalence of EIB is similar to that of the general population (Gawlik et al., 2019).

5.2 Comparison with the General Population

A defining characteristic of asthma in endurance athletes is its later age of onset compared to the general population, with a median of 13.0 years versus 8.0 years (Mäki-Heikkilä et al., 2020, 2021). While "classical" asthma typically begins in childhood and is often associated with atopy, "sports-related asthma" frequently develops during years of intense training in early adulthood (Mäki-Heikkilä et al., 2021, 2022). Furthermore, several studies indicate that asthma is frequently underdiagnosed in athletes; many previously healthy individuals without prior symptoms are found to fulfill objective diagnostic criteria during screening (Gawlik et al., 2019; Mäki-Heikkilä et al., 2020).

5.3 Risk Factors and Pathophysiological Considerations

The high prevalence of EIB in elite athletes is attributed to the repetitive cycle of epithelial injury and repair caused by high minute ventilation, which can reach up to 200 L/min (Boulet & O'Byrne, 2015; Pigakis et al., 2022). Key risk factors identified in the literature include:

- Training Volume: High training loads (e.g., >20 hours per week) are significantly associated with an increased risk of non-allergic asthma phenotypes (Mäki-Heikkilä et al., 2022).
- Environmental Triggers: Frequent exposure to cold (Sue-Chu, 2012), dry air (osmotic theory) or chemical irritants (e.g., chlorine, exhaust fumes) triggers airway inflammation and remodeling (Gawlik et al., 2019; Ora et al., 2024).

- Type of Inflammation: In contrast to the primarily eosinophilic inflammation seen in allergic asthma, athletes often exhibit neutrophilic or mixed inflammatory profiles (Gawlik et al., 2019; Jaeger et al., 2025).

5.4 Individual and Biological Predispositions

Individual and biological characteristics play a pivotal role in modulating the development and severity of exercise-induced bronchoconstriction (EIB) among elite athletes (Gawlik et al., 2019; Jaeger et al., 2025). While many endurance competitors exhibit a "sports-related asthma" phenotype that is primarily non-atopic, the presence of underlying atopy and allergic rhinitis remains a major risk factor, significantly increasing the likelihood of severe airway impairment (Gawlik et al., 2019; Ora et al., 2024). Furthermore, frequent viral respiratory infections are potent triggers for transient increases in bronchial hyperresponsiveness (BHR) (Siemianowski et al., 2025; Jaeger et al., 2025). This susceptibility is often exacerbated by transient periods of relative immunosuppression that occur during high-volume training cycles and near-maximal exertion (Boulet & O'Byrne, 2015; Jaeger et al., 2025). Ultimately, the cumulative impact of these infections, combined with a repetitive cycle of epithelial injury and repair caused by high minute ventilation, can lead to long-term airway remodeling and chronic respiratory instability (Siemianowski et al., 2025; Sue-Chu, 2012)

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6. Phenotypes of Athletes' Asthma

Analysis of the collected research material allows for the differentiation of specific asthma phenotypes prevalent among elite athletes. The traditional dichotomy between allergic and non-allergic asthma is particularly applicable in this context, with a significant emphasis placed on the impact of the training environment on the pathogenesis of the condition (Gawlik et al., 2019; Boulet & O'Byrne, 2015).

6.1 Primary Asthma Phenotypes in Athletes

The literature identifies two predominant phenotypes, which differ in terms of the age of onset, underlying inflammatory profile, and association with atopy (Boulet & O'Byrne, 2015; Ora et al., 2024)

1. Classic (Early-Onset) Phenotype: Characterized by an onset typically in childhood, a strong correlation with atopy and allergies, and marked bronchial hyper-responsiveness (BHR). This is the constitutional form of asthma with which the athlete often enters their competitive career (Boulet & O'Byrne, 2015).

2. Sports-Induced (Late-Onset) Phenotype: Also referred to as "Sports Asthma," this phenotype develops during the course of an intensive sporting career. It is highly prevalent in endurance disciplines (e.g., cross-country skiing, swimming) and is characterized by a weaker association with atopy. Its pathogenesis is primarily driven by respiratory epithelial damage resulting from environmental stressors and high ventilatory demands (Ora et al., 2024; Mäki-Heikkilä et al., 2022). Furthermore, EIB in elite athletes can often be entirely asymptomatic, meaning that significant airway narrowing may occur without the athlete experiencing or reporting recognizable respiratory symptoms (Pigakis et al., 2022; Sue-Chu, 2012)

6.2 The Influence of Discipline on Phenotype

Evidence suggests that in cross-country skiers, the non-allergic phenotype predominates, largely due to high training volumes performed in cold, dry air conditions (Mäki-Heikkilä et al., 2022). High training loads (e.g., >20 hours per week) are specifically associated with an increased risk of this non-atopic phenotype (Mäki-Heikkilä et al., 2022). Conversely, summer athletes more frequently exhibit exacerbations of the allergic phenotype following exposure to aeroallergens and ambient pollutants (Gawlik et al., 2019; Boulet & O'Byrne, 2015).

In the specific case of "Skier's Asthma," the inflammatory processes within the airways differ from the typical eosinophilic inflammation seen in classic asthma; instead, athletes often exhibit a neutrophilic or mixed inflammatory profile (Mäki-Heikkilä et al., 2020; Jaeger et al., 2025). Histological changes include significant goblet cell hyperplasia and increased expression of tenascin in the epithelial basement membrane, which serve as markers of chronic airway injury and remodeling (Mäki-Heikkilä et al., 2020; Sue-Chu, 2012)

Airway Limitation and Physiological Demands

High-level endurance exercise, particularly in disciplines like cross-country skiing, imposes extreme demands on the cardiorespiratory system, with minute ventilation reaching up to 200 L/min (Boulet & O'Byrne, 2015). In athletes with uncontrolled asthma, the subsequent airway narrowing (EIB) leads to increased expiratory airflow limitation, which can significantly impair maximal oxygen uptake (VO2max) and overall exercise capacity (Boulet & O'Byrne, 2015; Mäki-Heikkilä et al., 2022). According to the systematic review by Mäki-Heikkilä et al. (2020), the prevalence of physician-diagnosed asthma in competitive skiers is approximately 21% (95% CI 14–28%), highlighting that a substantial portion of the elite population must manage respiratory limitations to remain competitive (Mäki-Heikkilä et al., 2020).

7. Performance Neutrality in Controlled Athletes

A critical finding across the literature is that when asthma is well-controlled, it does not necessarily restrict exercise performance (Boulet & O’Byrne, 2015). Evidence suggests that many Olympic-level athletes with asthma or EIB have successfully competed at the highest levels, often outperforming healthy peers (Boulet & O'Byrne, 2015). Regular exercise training itself has been shown to improve asthma symptoms, quality of life, and pulmonary function, while simultaneously reducing airway responsiveness (Boulet & O'Byrne, 2015) .

8. Therapeutic Impact

Pharmacological management, particularly the use of inhaled b2-agonists (SABA/LABA) and inhaled corticosteroids (ICS), is aimed at protecting the airways and maintaining "performance neutrality" (Gawlik et al., 2019; Pigakis et al., 2022). When utilized according to WADA guidelines, these medications attenuate the post-exercise drop in FEV1 (Weiler et al., 2016). This allows the athlete to perform near their physiological ceiling without gaining an unfair ergogenic advantage over healthy competitors (Boulet & O’Byrne, 2015; Gawlik et al., 2019; Pigakis et al., 2022).

9. Management Strategies and Prevention

The management of exercise-induced bronchoconstriction (EIB) and asthma in athletes requires a multimodal approach that combines pharmacological interventions with non-pharmacological strategies to maintain peak performance while ensuring long-term respiratory health.

9.1 Pharmacological Management

The primary goal of pharmacological treatment is to prevent EIB symptoms and ensure that asthma control does not limit the athlete's exercise capacity (Gawlik et al., 2019; Boulet & O’Byrne, 2015).

Beta2-Agonists: Short-acting beta2-agonists (SABA), such as salbutamol, remain the first-line treatment for acute prevention when administered 10–15 minutes before exercise (Boulet & O’Byrne, 2015; Weiler et al., 2016). However, data indicate that daily use of SABAs can lead to tachyphylaxis (reduced effectiveness) and a rebound effect (Boulet & O’Byrne, 2015; Weiler et al., 2016; Pigakis et al., 2022).

Inhaled Corticosteroids (ICS): For athletes with persistent symptoms or underlying asthma, ICS are the cornerstone of long-term therapy (Gawlik et al., 2019; Boulet & O’Byrne, 2015). Studies show that regular ICS treatment significantly reduces airway inflammation and the severity of EIB (Weiler et al., 2016; Ora et al., 2024). In a meta-analysis of cross-country skiers, approximately 23% (95% CI: 19–26%) of athletes reported regular use of asthma medication, reflecting the high necessity for maintenance therapy in cold-weather endurance sports (Mäki-Heikkilä et al., 2020).

Leukotriene Receptor Antagonists (LTRA): Montelukast has been shown to be effective in attenuating EIB, particularly in environments with high particulate matter or cold air (Gawlik et al., 2019; Siemianowski et al., 2025). It can be used as an add-on therapy or as an alternative for athletes who prefer oral medication (Ora et al., 2024; Pigakis et al., 2022).

Anti-Cholinergics: Ipratropium bromide has been investigated for its effect on exercise-induced cough, particularly in winter athletes, where it may provide relief by modulating parasympathetic activity (Gawlik et al., 2019; Ora et al., 2024).

9.2 Non-Pharmacological and Preventive Strategies

Non-pharmacological and preventive strategies for managing exercise-induced bronchoconstriction (EIB) focus on environmental protection, physiological preparation, and comprehensive athlete education (Côté et al., 2018; Gawlik et al., 2019). A structured pre-exercise warm-up is considered one of the most effective non-pharmacological methods to attenuate airway narrowing (Weiler et al., 2016; Côté et al., 2018). This preparation can induce a "refractory period" lasting between 1 and 4 hours (typically 2 hours), during which subsequent exercise bouts result in significantly diminished bronchoconstriction (Weiler et al., 2016; Côté et al., 2018). Research suggests that high-intensity interval or variable-intensity warm-ups are more reliable in providing this protection compared to continuous low-intensity protocols (Weiler et al., 2016; Côté et al., 2018).

Environmental management is a decisive factor in preventing respiratory symptoms (Gawlik et al., 2019; Siemianowski et al., 2025). Athletes are advised to minimize training in extreme conditions, such as temperatures below -15°C to -20°C, or in environments with high levels of ozone, particulate matter, and allergens (Boulet & O'Byrne, 2015; Siemianowski et al., 2025). In aquatic sports, improving pool ventilation and maintaining rigorous personal hygiene can help reduce exposure to trichloramines, which are potent epithelial irritants (Gawlik et al., 2019; Boulet & O'Byrne, 2015). Heat and moisture exchangers (HMEDs), often in the form of face masks, help to rewarm and humidify the inspired air, thereby reducing the osmotic and thermal stress on the airway surface (Sue-Chu, 2012; Boulet & O'Byrne, 2015; Siemianowski et al., 2025). While these devices provide significant airway protection, some athletes may find them difficult to use during high-intensity exercise due to increased breathing resistance (Siemianowski et al., 2025).

Physiological and dietary considerations also play a supplementary role in prevention (Gawlik et al., 2019; Weiler et al., 2016):

- Hydration: Frequent fluid replenishment is essential to avoid dehydration, a primary mechanism that triggers hyperosmolar stress in the airways (Boulet & O’Byrne, 2015; Côté et al., 2018).
- Dietary Supplements: Nutritional interventions such as omega-3 fatty acid (fish oil) supplementation, low-sodium diets, and vitamin C have been investigated, but the clinical evidence supporting these measures remains inconclusive or weak (Gawlik et al., 2019; Weiler et al., 2016).
- Regular Training: Regular aerobic exercise is beneficial as it improves asthma-related quality of life and may lower the minute ventilation required for a specific workload (Côté et al., 2018).

Finally, athlete education is the cornerstone of successful management, training competitors to recognize symptoms, use correct inhaler techniques, and follow an asthma action plan (Côté et al., 2018; Gawlik et al., 2019)

10. Doping Regulations and Compliance

Management must strictly adhere to the World Anti-Doping Agency (WADA) guidelines. Inhaled glucocorticoids are not prohibited when used within the manufacturer’s licensed doses and therapeutic indications. However, specific dosages for inhaled beta2-agonists are capped. For example, inhaled salbutamol is limited to a maximum of 1600 micrograms over 24 hours in divided doses not to exceed 600 micrograms over 8 hours starting from any dose. Proper documentation and, when necessary, Therapeutic Use Exemptions (TUE) are essential for competitive athletes (World Anti-Doping Agency, 2024).

11. Discussion

The analysis confirms that elite athletes, particularly in winter and endurance sports, face a significantly higher risk of exercise-induced bronchoconstriction (EIB) than the general population (Gawlik et al., 2019; Ora et al., 2024). The identified "sports-related asthma" phenotype, characterized by a late age of onset and neutrophilic inflammation, results from chronic airway epithelial injury caused by high ventilatory demands and environmental triggers like cold, dry air (Boulet & O’Byrne, 2015; Sue-Chu, 2012). A major diagnostic challenge remains the unreliability of self-reported symptoms, leading to frequent underdiagnosis among competitors (Mäki-Heikkilä et al., 2020; Weiler et al., 2016). Nevertheless, management strategies combining pharmacological protection (ICS/SABA) with non-pharmacological methods—such as structured warm-ups and heat-moisture exchangers—effectively ensure "performance neutrality" while maintaining compliance with WADA regulations (Gawlik et al., 2019; Siemianowski et al., 2025; Weiler et al., 2016).

Conclusions

Exercise-induced bronchoconstriction is highly prevalent in elite sports and requires objective diagnostic testing (e.g., EVH) due to the poor predictive value of clinical history (Boulet & O'Byrne, 2015; Mäki-Heikkilä et al., 2020). The pathogenesis is uniquely linked to extreme physiological demands and environmental exposures, necessitating specialized preventive protocols (Côté et al., 2018; Sue-Chu, 2012). Well-controlled EIB does not limit athletic performance, allowing competitors to reach their physiological potential (Boulet & O'Byrne, 2015; Mäki-Heikkilä et al., 2022). Proper management, including athlete education and adherence to anti-doping standards, is essential for maintaining both respiratory health and competitive integrity (Gawlik et al., 2019; World Anti-Doping Agency, 2024).

Disclosure

The authors declare that there are no financial or personal relationships that could have inappropriately influenced the work reported in this paper.

Author Contributions

J.D. conceptualized the study, formulated the review framework, and drafted the manuscript as the corresponding author. **J.D.**, **W.K.**, **M.M.-Z.**, **J.J.**, and **K.P.** performed the comprehensive literature search and database screening across PubMed/MEDLINE and Google Scholar. **F.K.**, **T.K.**, and **M.M.** analyzed the gathered bibliographical data and drafted the initial sections on epidemiology and pathophysiology. **Z.G.** and **D.S.** contributed to the critical synthesis of asthma phenotypes, text editing, and the alignment of management strategies with WADA regulations. **M.P.** acted as the project supervisor, provided critical intellectual content, and performed the final review of the manuscript. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest.

Declaration of generative AI and AI-assisted technologiesIn preparing this work, the authors used ChatGPT for the purpose of improving academic English language, clarity, readability, consistency, and text formatting. After using this tool, the authors have reviewed and edited the content as needed and accept full responsibility for the substantive content of the publication.

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