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The Role of Physical Activity in Asthma Outcomes: A Review of Recent Studies

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ABSTRACT

Purpose of Research: Bronchial asthma is a chronic disease with a growing global prevalence, significantly affecting public health and quality of life. This review aims to synthesize evidence on the effects of physical activity, a non-pharmacological intervention, on asthma control, pulmonary function, inflammation, and overall well-being.

Research Materials and Methods: To conduct this review, a systematic literature search was performed in the PubMed database, covering studies published within the past six years. The search was conducted using the following keywords: *Asthma outcomes, Physical activity and asthma, Exercises and asthma, Asthma pathophysiology, Non-pharmacological interventions in asthma.* Original clinical studies, meta-analyses, and systematic reviews assessing the impact of physical activity on asthma progression were included. The analysis encompassed studies investigating both physiological and psychosocial effects of regular physical activity in asthma patients. The final selection of publications was based on their methodological quality and relevance to the scope of this study.

Basic Results: Regular physical activity improves cardiorespiratory fitness, reduces airway inflammation, and enhances quality of life in asthma patients. Aerobic and interval training, along with breathing exercises, may reduce the need for inhaled corticosteroids, minimizing medication side effects. Despite concerns about exercise-induced bronchoconstriction, tailored exercise programs are safe and well-tolerated.

Conclusions: Physical activity should be integral to asthma management due to its positive effects on asthma control and quality of life. Future research should focus on optimizing exercise modalities and their long-term impact on disease progression.

Keywords: asthma, physical activity, exercise, pulmonary function, airway inflammation, non-pharmacological interventions

1. Introduction

Bronchial asthma is a chronic respiratory disease that poses a significant global health challenge. According to the Global Initiative for Asthma (GINA, 2024) report, asthma is defined as a heterogeneous condition characterized by chronic airway inflammation and a range of

symptoms, including wheezing, dyspnea, chest tightness, and cough. These symptoms can be exacerbated by physical exertion, exposure to allergens, infections, or air pollution [1].

According to the Global Burden of Disease Study 2019, asthma accounted for 23 million disability-adjusted life years (DALYs). Furthermore, it is responsible for at least 400,000 deaths annually and affects approximately 300 million individuals worldwide. Its prevalence continues to rise, particularly in regions with limited access to advanced diagnostic and therapeutic strategies. The high variability of symptoms and the functional limitations associated with asthma contribute to a substantial burden on both individuals and healthcare systems [3].

In the context of asthma management, increasing attention is being directed toward non-pharmacological interventions, particularly physical activity, which may play a crucial role in improving symptom control and enhancing patients' quality of life. Regular exercise has been shown to have beneficial effects on respiratory and cardiovascular function, as well as overall physical fitness [4]. Additionally, physical activity promotes a reduction in systemic inflammation and enhances psychosocial parameters in individuals with asthma.

The aim of this review is to analyze the impact of physical activity on asthma progression, particularly its role in symptom management, quality of life improvement, and long-term physiological adaptations. This study also considers the barriers that limit physical activity engagement among asthma patients and explores strategies to support the implementation of regular exercise in this population.

2. Epidemiology

Epidemiological data indicates that asthma currently affects approximately 300 million individuals worldwide, with this number projected to exceed 400 million in 2025 [3]. Asthma represents a global health issue, particularly in low- and middle-income countries. According to the Global Burden of Disease Study 2019, asthma was responsible for approximately 23 million disability-adjusted life years (DALY) worldwide in 2019, and it was the cause of over 400,000 deaths during the same period. The highest burden of asthma was observed in regions with limited access to healthcare, particularly in South Asia and Sub-Saharan Africa. In Eastern Europe, the total DALY rate was 0.8 million [2].

The incidence of asthma is further exacerbated by environmental factors, such as air pollution, which significantly affect disease progression and patients' quality of life. While in developed countries the asthma-related DALY rates have stabilized or decreased, a rising trend is seen in developing regions. This is associated with limited access to modern therapies and disparities in disease diagnosis and management.

Additionally, physical inactivity in individuals with severe asthma often coexists with obesity, extended periods of sedentary behavior, and symptoms of anxiety and depression. Interventions targeting these issues may offer substantial clinical benefits [5].

3. Pathophysiology

Respiratory epithelial cells express receptors on their surface that enable them to respond to various external stimuli by releasing chemokines and cytokines [6]. These substances initiate a localized immune response, the clinical manifestation of which is an "asthmatic attack." Asthma exacerbation can be divided into two phases [7]: in the early phase, IgE antibodies play a central role, being released in response to inflammatory factors acting on plasma cells. These antibodies activate mast cells and basophils, leading to the release of mediators such as histamine, prostaglandins, and leukotrienes, which cause smooth muscle contraction in the airways and the development of inflammation. Additionally, upon recognition of the allergen, Th2 lymphocytes secrete interleukins (IL-4, IL-5, IL-13), which support inflammatory processes, including the synthesis of IgE and increased mucus secretion, and contribute to tissue remodeling in the airways [8]. In the late phase, there is an influx of inflammatory cells (eosinophils, basophils, neutrophils, and T lymphocytes) into the lungs, which intensifies the inflammatory response and leads to further narrowing of the airways [7]. Recurrent inflammatory episodes can result in structural changes in the airways, such as an increase in smooth muscle mass, fibrosis, and thickening of the basement membrane, which can consequently lead to permanent airflow limitation in the airways. A hallmark of asthma is bronchial hyperresponsiveness, particularly to inflammatory mediators, which is associated with an increase in smooth muscle mass and heightened parasympathetic tone. These phenomena contribute to impaired lung function and increase the risk of disease exacerbations [7].

4. Results

4.1 Impact of Physical Activity on Physical Fitness

Physical activity plays a crucial role in maintaining health by reducing the risk of non-communicable diseases. Regular exercise improves cardiovascular fitness, glycemic control, musculoskeletal health, and cognitive functions. Additionally, it reduces the risk of premature mortality and enhances quality of life [4]. For instance, in a meta-analysis conducted by Valkenborghs, Sarah R., et al., 45 publications were included, comprising results from 39 studies with 2,135 participants aged 22 to 71 years, all suffering from asthma of varying severity. The most commonly employed forms of exercise were aerobic exercises, performed alone or

combined with resistance, breathing, or stretching exercises. The typical program involved supervised moderate-to-high-intensity aerobic training lasting 30-45 minutes, three times a week. The analyses revealed significant benefits for individuals participating in the training programs. Improvements were observed in cardiovascular and respiratory fitness
(a 3.1 mL/kg/min increase in V̇O2peak), functional capacity (a 41-meter increase in the walking distance) and overall health condition [9].

4.2 Impact on Lung Structure and Function

There is limited evidence from human studies indicating positive changes in lung size in response to regular physical training. An exception may be highly trained swimmers, who, based on cross-sectional studies, appear to have larger lungs and greater surface area for gas exchange. However, the question remains whether these observations are the result of structural changes in the lungs induced by training or a consequence of selection related to athletic success and specialization in such sports. Currently, most evidence suggests that physical training does not lead to an increase in lung size, indicating that adaptive changes related to training likely occur through other mechanisms, which may warrant further investigation in future studies [10]. Regardless of the type of activity, physical exercise has a positive effect on pulmonary function outcomes [11].

A meta-analysis involving 2,155 asthma patients, conducted by Shuangtao Xing, Shijie Feng, et al., particularly highlights the beneficial effects of aerobic and respiratory exercises, as well as yoga, on lung function in adults [12].

4.3 Impact on Quality of Life

Quality of life in patients with asthma is negatively affected by factors such as advanced age, increased disease severity, poor asthma control, low educational level, and low socioeconomic status [13]. There is a substantial body of evidence indicating that physical activity contributes to the improvement of quality of life in asthma patients across all age groups [11, 14, 15, 16, 17, 18]. However, the impact varies, with aerobic exercises appearing to generate the most significant improvements [9].

4.4 Impact on Medication Dosage

A randomized controlled trial conducted by Anders Pitzner-Fabricius, Christian H. Dall, et al., demonstrated that the introduction of regular interval training over a period of six months in individuals with asthma who had not previously engaged in systematic physical activity significantly and persistently reduced the need for inhaled corticosteroids (by up to 24% compared to baseline) without worsening disease control [15]. In a randomized study

comparing the effects of aerobic training with breathing exercises in asthma patients, Evaristo and colleagues showed that both types of physical activity reduced the number of days requiring rescue medication among participants. Specifically, a greater proportion of the aerobic exercise group reported a reduction in the number of days needing rescue medication compared to the breathing exercise group (34% vs 8%; P = 0.04) [19].

4.5 Impact on Inflammatory Process

The goal of interventions in asthma patients should be to inhibit the pathophysiological mechanisms that lead to airway remodeling. This would help prevent epithelial damage, hyperplasia of goblet cells and smooth muscle cells in the bronchi, excessive mucus production, and the deposition of extracellular matrix proteins. These changes contribute to tissue dysfunction, asthma exacerbations, hypersensitivity, and physical limitations, posing the greatest challenge in disease management [20]. Research supports the health benefits of physical activity in reducing inflammation [21]. In a study by Renilson Moraes-Ferreira et al., the effect of supervised aerobic training (SAT) on airway inflammation and pulmonary fibrosis mediators was assessed in patients with intermittent and mild asthma. After 12 weeks, chronic airway inflammation and levels of profibrotic biomarkers (VEGF, TSL) were reduced, while levels of antifibrotic biomarkers (relaxin-3, klotho) increased both in the lungs and in the bloodstream, suggesting that aerobic exercise may inhibit the immune response responsible for airway remodeling. It was also shown that aerobic exercise can limit the infiltration of eosinophils and macrophages in the airways, which is typical in severe asthma forms [20]. However, other studies do not provide such definitive results. A meta-analysis and systematic review conducted by Erik Soeren Halvard Hansen et al. negated the link between physical activity and a reduction in lung inflammation [22]. Three out of six studies described by Margaret M. Kuder et al. showed a reduction in at least one inflammatory marker, with the only one consistently reduced across all studies being IL-6. The remaining three studies did not show significant differences in markers [16]. An additional issue to consider is asthma coexisting with obesity. Obese individuals often exhibit higher levels of pro-inflammatory cytokines that influence airway inflammation, potentially exacerbating asthma symptoms [23]. There is no clear evidence whether, in this case, physical activity reduces inflammation directly related to asthma or inflammation resulting from excess adipose tissue, suggesting that further research is needed to address this issue in the future [21].

4.6 Selection of Appropriate Exercises

Determining which types of physical activity most significantly contribute to improvements in asthma outcomes is challenging due to the heterogeneity of available studies. Diverse training regimens, varying patient age groups, different stages of disease progression, distinct methods of outcome monitoring, and the varied number of studies documenting specific types of activity make reliable comparisons between different forms of physical activity currently unfeasible. Nevertheless, the majority of available evidence suggests a positive impact of physical activity on the improvement of at least some asthma-related parameters among participants. Below, we present three of the most studied types of physical activity and their associated benefits. This comparison is qualitative, as a quantitative comparison of these activities is currently unreliable. Most studies focus on the positive effects of aerobic exercise on disease progression [9, 11, 16, 17, 22, 24]. Potential benefits of this type of training include improvements in quality of life, cardiovascular and respiratory fitness, and lung function.

Studies focusing on interval training have demonstrated possible positive effects, including improved quality of life, increased cardiovascular and respiratory fitness, reduced doses of inhaled corticosteroids, and decreased airway inflammation [14, 15, 24]. It is worth noting that interval training is safe and well-tolerated by asthma patients [26].

Breathing exercises are the only type of physical activity recommended in the GINA 2024 report with the highest level of evidence (Evidence A) as a complement to pharmacotherapy, alleviating symptoms, and improving quality of life. Additionally, breathing exercises may have positive effects on lung function [11, 27]. However, due to significant methodological differences in studies on this topic, the quality of evidence is at best moderate [27].

4.7 Barriers and Risks Associated with Physical Activity in Asthma Patients

The reasons for avoiding exercise and physical activity among asthma patients are likely complex and multifactorial [5]. Reluctance to engage in physical exertion may stem from disease-specific barriers, primarily the fear of exacerbating disease symptoms. It has been demonstrated that individuals who maintain intense physical activity are at an increased risk of triggering asthma symptoms [28]. In highly active children, the risk of exercise-induced bronchoconstriction is higher [29].

Available studies do not provide a definitive answer regarding whether asthma in the pediatric population contributes to reluctance to exercise, or if the reverse relationship exists – where a lack of physical activity in children promotes the development of asthma [30]. Additionally,

there is no evidence linking low physical activity in early childhood with the development of asthma later in life [31].

Patients with asthma, as well as parents and caregivers of children with the condition, should be aware that the health and therapeutic benefits of regular physical activity far outweigh the associated risks [28]. Education that addresses the unique needs of the child in asthma management and the adjusting of appropriate physical activity is essential.

5. Non-Pharmacological Interventions in Asthma Treatment

It has been demonstrated that aerobic exercise as part of pulmonary rehabilitation significantly contributes to improving lung function and quality of life in the pediatric population suffering from asthma. These findings suggest that appropriately designed physical activity programs can serve as a valuable non-pharmacological alternative in asthma therapy, while also emphasizing the need for further research into their efficacy [32]. A promising strategy appears to be the promotion of physical activity in schools, where children spend a significant portion of their time [33].

Comprehensive behavioral interventions have proven effective in increasing physical activity among patients and improving asthma control, anxiety symptoms, and sleep quality in individuals with moderate to severe asthma. Behavioral counseling may serve as a sufficient or supplementary method to support physical activity [5].

Current asthma management guidelines include physical activity in various forms: pulmonary rehabilitation (which includes aerobic training) for patients with limited exercise tolerance, and breathing exercises as an adjunct to pharmacotherapy to further improve quality of life and reduce disease symptoms [1]. However, studies suggest that regular physical activity should be recommended for all asthma patients [1, 16].

6. Conclusions

Regular physical activity plays a crucial role in the comprehensive management of asthma, offering significant health benefits in both physiological and psychosocial aspects. Aerobic, interval, and breathing exercises can lead to improvements in cardiovascular and respiratory endurance, reduction in inflammation, and enhancement of patients' quality of life. Moreover, consistent physical activity allows for the reduction of medication doses, such as inhaled corticosteroids, thereby decreasing the risk of adverse effects associated with pharmacotherapy. Despite patients' concerns regarding the potential exacerbation of symptoms during physical exertion, appropriately tailored exercise programs are safe and well-tolerated. It is essential that

strategies for increasing physical activity take into account the individual needs of patients, as well as barriers such as fear and limited knowledge regarding the benefits of exercise.

Both healthcare providers and patients should consider physical activity as an integral component of asthma management. Its implementation in daily life can not only improve disease control but also enhance overall quality of life, thereby reducing the burden on healthcare systems. Future research should focus on precisely identifying the most effective forms of physical activity and their impact on long-term health outcomes in asthma patients.

Disclosure

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