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Physical activity as an element of non-pharmacological asthma therapy

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ABSTRACT
Asthma is a chronic inflammatory airway disease that is marked by variable airflow limitation and hyperresponsiveness of the airways. Although pharmacologic management remains the mainstay of asthma therapy, physical exercise and other non-pharmacologic treatments are increasingly found to have an adjunctive function in the disease control. The present review collates available information on the role of physical training as an add-on therapy in the treatment of asthma. It focuses on how proper regular exercise can enhance pulmonary function, reduce symptom burden, and improve quality of life. Particular attention is given to the swimming environment and its multidirectional interaction with asthma, such that exposure to chlorinated by-products can enhance airway inflammation even as the activity has beneficial physiological effects. The article also addresses the physiological mechanisms of exercise-induced asthma (EIA), recommended exercise modalities and intensities, and assessment of physical activity in asthmatic patients.

The overall results point to the necessity of individualized, multidisciplinary management encompassing both medical and lifestyle intervention in the treatment of asthma.

Introduction: Asthma is a chronic disease caused by variable airway obstruction and bronchial hyperresponsiveness. This article provides a primer focusing on current treatment especially non-pharmacological. [1] The goals of treatment are prevention of fatalities, hospitalizations, and emergency department visits, along with achieving good long-term control of asthma, with reduction of symptoms, maintenance of normal activity level, prevention of exacerbations and accelerated loss of pulmonary function (forced expiratory volume in the first second of expiration [FEV_1]), and avoidance of harm from therapies. [2] Studies have shown that asthma is most commonly first diagnosed in childhood. Physical activity plays an essential part in normal childhood growth and development. However, exercise is a common trigger for bronchoconstriction in children with asthma. Factors that can affect activity in these children include negative self-efficacy, child and parental health beliefs, and poor asthma control. Many studies suggest that routine exercise is very safe in children with asthma as long as there is adequate asthma control. [3] Asthma control is the main goal of therapy and is achieved when the disease results in minimal or no symptoms, normal sleep and activities, and optimal pulmonary function. Such control can be obtained with patient education, avoidance of environmental triggers, individualized pharmacotherapy and regular follow-up [4]

Aim of study: This essay aims to explore and discuss the current body of research on the use of physical activity as an adjunct, non-pharmacologic intervention in the management of asthma. The article attempts to explore how physical activity, when regularly performed, can influence asthma symptoms, lung function, and the quality of life in individuals with asthma. In addition, the study aims to identify recommended exercise modes and intensities, potential dangers, and practical tips on exercising safely in asthmatic individuals.

Keywords: asthma, physical activity, exercise induced asthma

Asthma

According to the World Health Organization asthma is a chronic lung disease affecting people of all ages. It is caused by inflammation and muscle tightening around the airways, which makes it harder to breathe. Typical symptoms are the following: persistent cough-especially at night, dyspnea, wheezing, shortness of breath, chest tightness.

The most common predisposing factors are:

- air pollution- outdoor air pollutants, diurnal temperature range, pollens, RV, and influenza increased exacerbations.
- allergens-recognition of more cockroach allergens with higher allergen-specific IgE levels was associated with asthma and rhinitis.
- exposure to microbial products- distinct nasal airway microbiotas of asthmatic children alter likelihood of exacerbation, RV, and respiratory illnesses.
- intake of paracetamol- early acetaminophen was associated with reduced lung function at age 18 y.

- intake of antibiotics- reduction in asthma incidence was associated with decreasing antibiotic use in infancy. Early increasing α-diversity of the gut microbiota was associated with reduced childhood asthma.
- Obesity-childhood obesity may increase susceptibility to asthma symptoms when exposed to classroom NO_2. [5]

Asthma is often associated with various comorbidities such as rhinitis, sinusitis, gastroesophageal reflux disease, obstructive sleep apnea, hormonal disorders, depression, hypertension, diabetes, ischemic heart disease, degenerative joint disease, cardiac arrhythmia, cancer, congestive heart failure, cerebrovascular disease.

Adults with asthma had significantly more comorbidities than the general population, such as respiratory infections, allergic rhinitis and high impact/high prevalence chronic conditions such as depression (found in one out of four adults with asthma). However, children with asthma had a lower comorbidity burden than adults, but 12.6% had an associated chronic medical condition. [6]

Rhinitis may influence asthma through various mechanisms, including: the release of mediators into the airways or peripheral circulation; neural reflexes; increased production of bone marrow progenitors of inflammatory cells; increased lower respiratory tract exposure to airborne contaminants from mouth breathing. Rhinitis is also common in nonallergic asthma, and it is actually underdiagnosed, especially in primary care. [7]

Pharmacologic therapy

According to GINA's recommendations the most important long-term goals are symptoms control and risk reduction. The purpose is to reduce asthma-related death, exacerbations, airway damage, and medication side effects. The basis of treatment is application inhaled corticosteroids (ICS)- even those with infrequent symptoms, to reduce risk of exacerbations. ICS should be combined with formoterol or SABA. Studies shown that ICS-formoterol reduces the frequency of exacerbations compared with SABA-based treatment. Short-acting-beta$_2$-agonists removes bronchoconstriction; however, airway inflammation is found in most patients with asthma. Therefore, asthma therapy should be started with low dose ICS- formoterol as the reliever.

Staging asthma treatment can be divided into 5 steps. Transferring treatment to a higher level occurs when symptoms are not adequately controlled. Asthma symptom control is considered inadequate if the patient experiences daytime symptoms more than twice per week, night waking due to asthma, uses a reliever inhaler more than twice per week, or has any activity limitations related to asthma. Short term step up is recommended during vital respiratory infections or allergens exposure. Stepping down is suggested if the following conditions are met asthma is well controlled at least 2-3 months.

STEP 1 – Initial or very mild asthma

Preferred treatment: As-needed low-dose ICS–formoterol. Recommended for patients with symptoms less than twice a month and no risk factors for exacerbations. Reduces the risk of severe asthma attacks compared to SABA-only treatment.

STEP 2 – Mild asthma
Preferred treatment: Continue as-needed low-dose ICS–formoterol. Equally or more effective in preventing exacerbations than daily ICS + SABA, and preferred due to improved adherence and simplicity.
Alternative: Daily low-dose ICS with as-needed SABA. Still better than SABA alone, but adherence tends to be poor in real-world settings.

STEP 3 – Moderate asthma
Preferred treatment: Maintenance-and-reliever therapy (MART) with low-dose ICS–formoterol. Involves taking the same inhaler daily and as needed for symptoms. Shown to significantly reduce severe exacerbations compared to traditional regimens.
Alternatives: Daily low-dose ICS-LABA with as-needed SABA, or medium-dose ICS alone. LTRA is a possible option but is less effective.

STEP 4 – More severe or uncontrolled asthma
Preferred treatment: Medium-dose ICS–formoterol as MART. The maintenance dose is increased while still using the same inhaler for symptom relief.
Appropriate for patients whose asthma remains uncontrolled on Step 3 therapy.
Alternatives: Medium- or high-dose ICS-LABA + as-needed SABA. Add-on LAMA (e.g., tiotropium) if symptoms persist. Consider sublingual immunotherapy (SLIT) for dust mite allergy if lung function is sufficient (FEV1 >70%).

STEP 5 – Severe or difficult-to-treat asthma
Referral to a specialist is strongly recommended. Assess for asthma phenotype (e.g., eosinophilic, allergic) to tailor biologic treatments. Add-on options: LAMA (triple therapy).
Biologics:

- Anti-IgE (omalizumab) – for allergic asthma.
- Anti-IL5 (mepolizumab, reslizumab) or IL5R (benralizumab) – for eosinophilic asthma.
- Anti-IL4R (dupilumab), Anti-TSLP (tezepelumab) – broader use in severe asthma.
- Azithromycin 3x/week (anti-inflammatory effect, with resistance risk).
- Oral corticosteroids (OCS) – used only as a last resort due to serious side effects. [8]

Non-pharmacological therapy
In addition to medications, other therapies and strategies may be considered where relevant, to assist in symptom control and risk reduction. Some examples with consistent high-quality evidence include: smoking cessation advice, investigation for occupational asthma or aspirin-exacerbated respiratory disease.
Some common triggers for asthma symptoms (e.g. exercise, laughter) should not be avoided.
During the COVID- 19 pandemic, Asthma exacerbations and influenza-related illness declined in several countries. possibly as a result of handwashing, masks and social/physical distancing, which reduced the incidence of other respiratory infections, including influenza.

Physical activity

People with asthma ought to be encouraged to engage in regular physical activity because of its general health benefits. It may also have a minor advantage for asthma control and lung function. [8]

Systematic review and meta-analysis provides an informative summary of the effectiveness of aerobic exercise training in adults with asthma, which may guide clinical discussions and decisions. It should be noted that asthma severity in the included studies was generally moderate to severe with an ICS dosage of 700–1118 $\mu g \cdot day^{-1}$, which indicate that aerobic exercise is a good adjuvant asthma therapy. Exercise training and control interventions had a median length of 12 weeks. Interventions included both supervised and unsupervised exercise training. Modes of training included indoor cycling, treadmill running, walking, mixed aerobic exercise and unspecified aerobic exercise. Additionally, the patients in the included studies were aged 20–50 years, overweight or obese and predominantly female [9]

Many studies focused on children also suggest that better fitness can improve asthma symptoms, control, and quality of life, in addition to the known benefits for cardiovascular health –although it is less clear whether it leads to consistent improvements in lung function or exercise-induced bronchoconstriction. It is recommended that training programs should last at least 3 months (at least 2 sessions/week), with a personalized training intensity goal of a ventilatory threshold or 80% of the maximum heart rate. More recently, a systemic review of exercise training on nocturnal asthma symptoms. Aerobic exercise programs reduced the prevalence and frequency of nocturnal symptoms. In a 10-week randomized controlled trial (RCT) of aerobic exercise in 38 children with asthma, Abdelbasset et al found significant improvements in VO2max, pulmonary function including FEV1 % predicted, FVC % predicted, and all measures of quality of life (QOL) in the exercise group compared to control. While evidence points to the positive effects of exercise on asthma outcomes, it is unclear if a particular form of exercise would be more beneficial than others. A systematic review by Lahart et al summarized the physiological effects of swimming in non-elite or noncompetitive swimmers. Their meta-analysis revealed significant improvements in VO2max and peak expiratory flow (PEF) but not any other lung function measures. Other studies have reported significant reductions in exercise-induced bronchoconstriction, methacholine challenge testing and maximal inspiratory and expiratory pressures.

A RCT of three different exercise interventions (swimming, football and basketball) and a control group in 41 children with asthma reported a significant improvement in FVC % predicted across all three exercise groups compared to control, as well as significant increase in PEF in the swimming group. Additionally, the swimming group had significant improvements in their asthma symptoms and general wellbeing compared to the other groups. [3]

As part of overall health maintenance, overweight or obese patients should be counseled on weight reduction, and all patients should be encouraged to consume a healthy diet. Interventional studies have demonstrated improvement in asthma severity and control with weight reduction, with magnitude in the order of 10 to 15 kgs.[10]

Regular exercise does have physical and psychological benefits for the asthmatic child. Decreases in medication requirements, asthma symptom frequency and severity, as well as school absenteeism, have been documented.

Sport is also an important avenue of social development. It would seem reasonable, therefore, to permit the asthmatic child to lead as normal a physical and sporting life as possible, especially as effective medication exists for both the prevention and treatment of attacks of exercise-induced asthma. [11]

Athletes with asthma

Recent data have confirmed the high prevalence of exercise-induced bronchospasm among athletes and raise concern that many of these athletes may be unaware of this diagnosis. [12] Exercise may increase ventilation up to 200 L/min for short periods of time in speed and power athletes, and for longer periods in endurance athletes, such as long-distance runners and swimmers. The risk of asthma is especially increased among competitive swimmers, of which 36% to 79% show bronchial hyperresponsiveness to methacholine or histamine. The risk of asthma is closely associated with atopy and its severity among athletes. A few studies have investigated occurrence of exercise-induced bronchospasm among highly trained athletes. Mild eosinophilic airway inflammation has been shown to affect elite swimmers and cross-country skiers. Track and field athletes and, to some extent, swimmers are extensively exposed to many pollen allergens in spring and summer. When the ventilation level exceeds about 30 L/min there is a shift from nose breathing to combined mouth and nasal breathing. This shifting results in a greater deposition of airborne allergens and other inhaled particles to the lower airways. in addition, incompletely conditioned air may reach the mucous membranes of the lower airways. In the 1976 and 1980 Olympic Games, 9.7% and 8.5% of the Australian Olympic athletes reported asthma in a physical examination. Most of the athletes with asthma were swimmers. In the 1992 Spanish Olympic team, 4.4% of the athletes reported asthma. Recently, Weiler et al reported that 15.3%of the US Olympic team athletes in 1996 Summer Olympic Games had a previous diagnosis of asthma, and 13.9% had used antiasthmatic medication. Swimming pools are usually chlorinated with hypochlorite or chlorine gas, both of which release chemical by-products such as chloramines, formaldehyde, chloroform, and volatile organic compounds. These chemicals produce irritation of the respiratory tract, which gives rise to mucous membrane inflammation and edema. Due to their high training volumes and exposure to chlorinated atmospheres, competitive swimmers are especially susceptible to these airborne irritants. Experiments have shown that chloroform concentrations in swimmers' breath and blood have been found to correlate with pool water concentration, swimmer number, and training duration and intensity.

Of particular interest, their findings indicated that asthma occurrence was highest in athletes with endurance sports, such as cycling, swimming, or rowing. Highly trained athletes (swimmers, speed and power athletes, and long-distance runners) and control subjects were assessed using respiratory symptom questionnaires, skin prick tests, resting flow-volume spirometry, and histamine challenge tests. Of the swimmers, 50% had atopy (at least 1 skin prick test reaction), and 36% showed increased bronchial responsiveness to histamine.

Current asthma (increased bronchial responsiveness to histamine and exercise-induced bronchial symptoms monthly during the last year) was found in 26% swimmers, and total asthma (current asthma or asthma diagnosed previously by a physician) in 29% of swimmers. Airway inflammation in athletes has been studied only in swimmers and cross-country skiers.

Sputum from swimmers showed significantly higher differential cell counts of eosinophils and neutrophils compared with control subjects. Airway inflammation was shown to correlate significantly with clinical data. The swimmers with exercise-induced bronchial symptoms had significantly higher sputum eosinophil cell counts (mean 7.6%) than the symptom-free swimmers (mean 0.7%).

The asthma like symptoms were significantly associated with allergies. Training indoors caused respiratory symptoms more often than training in cold, dry weather or during the pollen season. [13]

Exercise induced asthma (EIA)

Exercise-induced asthma is the phenomenon of transient airflow obstruction, typically 5 to 15 minutes after physical exertion. The increased airway resistance produces a 15% or greater decrease in the forced expiratory volume in 1 second, or in peak expiratory flow rate. Exercise-induced asthma occurs in 90% of individuals with asthma, representing 12% to 15% of the population world-wide. [14]

Seventy to eighty percent of people with asthma develop airflow limitation after vigorous exercise. This is known as exercise-induced asthma.[11] The occurrence and severity of EIA depends on the level of ventilation attained and sustained during exercise, the water content of inspired air during exercise, and the interval between exercise and a previous episode of EIA. Nearly 90% of patients with chronic asthma and 35% to 40% of allergic non asthmatic patients experience EIA. During EIA, airflow obstruction is maximal 5 to 15 minutes after exercise stops, and spontaneous return to baseline airflow is slow, taking 20 to 60 minutes. Some patients also seem to experience secondary obstructive episodes 4 to 10 hours after the initial bronchospasm. Along with airway obstruction, exercise induces transient hyperinflation and arterial hypoxemia in most patients with asthma. Although the underlying mechanisms responsible for the changes in pulmonary function associated with exercise-induced asthma (EIA) have not yet been fully elucidated, some researchers believe that thermal events in the intrathoracic airways play an important role.[15] Under normal resting conditions the nasal airway helps to warm inhaled air so that air reaching the alveolae is near body temperature and fully saturated with water. During exercise, ventilation increases, and nasal breathing gives way to mouth breathing. Loss of nasal function is associated with cooler, drier inhaled air. Furthermore, increases in ventilation exacerbate the loss of water and heat from the airway during exhalation. [13]

GINA 2024 has introduced a revised diagnostic flow chart for assessing children aged 6 to 11 years and adolescents who present with recurrent or chronic respiratory symptoms. While documenting bronchodilator reversibility remains the gold standard for diagnosing asthma, it may be impractical in real-world clinical settings due to inconsistency in the availability of spirometry devices and a lack of adequate training among healthcare personnel regarding the correct technique and interpretation of spirometry results.[16]

Difficulty in interpreting the results of spirometry was considered as a significant barrier by 8% of pediatricians, likely indicative of broader challenges faced in clinical practice, and 19% reported difficulties in performing the procedure.[17] In such resource constrained settings, peak flow meters emerge as a viable alternative for assessing bronchodilator reversibility through peak expiratory flow (PEF) measurements. The benefits of physical fitness are innumerable.[18] Physical conditioning has been shown to improve exercise tolerance but not EIB, bronchial responsiveness, or asthma. In patients with persistent asthma, anti-inflammatory medication remains the most effective method. [19,20,21]

Conclusion

After asthma has been brought under good control, exercise is not just harmless but indeed beneficial-both in children and adults with moderate to severe asthma. There is evidence available which suggests that structured aerobic exercise training programs can improve symptom control, improve ventilatory efficiency, and reduce the frequency of exacerbations. On that note, however, the interplays between exercise and asthma are multifaceted, particularly concerning exercise-induced asthma (EIA) and environmental exposure to irritating substances. Because of the variability of individual response to different exercise forms and environments, individualized management based on severity of asthma, comorbid conditions, and environmental factors is required. Furthermore, combining exercise with optimized pharmacologic intervention, regular follow-up, and patient education optimizes the results of asthma management. Long-term effects of different forms of exercise and interaction between environmental variables and airway function in patients with asthma will have to be studied in the future.

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