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REVIEW

Physical exercise in asthma adolescents: a concept review

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ABSTRACT

Background: Asthma is a frequent pathological condition during childhood and adolescence. Young asthmatics demonstrate decreased aptitude for physical activity and a limited exercise capacity. Lower hospitalisation rates, reduced school absenteeism, fewer medical examinations, and limited use of bronchodilators have been documented in children and adolescents with bronchial asthma who engage in physical exercise regularly. Structured physical exercise protocols should be encouraged as they can work as a synergistic therapeutic option in addition to regular pharmacologic treatment. This article outlines the most suitable exercise training techniques for young patients with bronchial asthma and their effects on health status.

Key words: childhood asthma; asthma in adolescence; physical exercise.

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Introduction

Physical activity is a physiological need for the human body. This crucial assumption is frequently neglected in the current lifestyle, particularly in children and teenagers with bronchial asthma. Bronchial asthma is a heterogeneous chronic inflammatory disease of the airways which is characterised by variable airflow limitation, wheezing, dyspnoea, sensation of chest tightness, and cough. These symptoms occur more frequently at night or early in the morning. The manifestation of these symptoms which are often reversible and can be due to several "triggers" [1] may vary in severity. Physical exercise is one of the most frequent triggers faced by young asthmatics and can contribute to progressive deconditioning and reduction of cardiorespiratory capacity. In other words, a vicious circle can be established: the occurrence of asthma symptoms leads to a reduction in physical activity and deconditioning. These factors may cause a progressive increase in asthma symptoms triggered by even lower physical efforts [2,3]. Furthermore, the limitation in sports activity significantly worsens the quality of life in young asthmatics. This is due to the reduction in muscular tone, sleep quality, cognition, and school performance. Emotional problems, such as frustration, sadness, anger, fear, shame, and difficulties in relational life are also frequent consequences [4]. Moreover, parents' fear that exercise might aggravate asthma symptoms or trigger a respiratory crisis frequently discourages many young asthmatics from exercising regularly or playing sport [3,5].

Despite the lack of specific guidelines, the current literature strongly recommends that asthmatic patients should practice regular physical activity because this improves wellness and reduces the incidence of exacerbations in young asthmatics. It has been demonstrated that exercise performed under medical supervision should be considered a highly valuable adjunct therapy in asthma treatment. Furthermore, regular physical activity is associated with a reduction in corticosteroid assumption [6,7]. Aerobic exercise improves cardiopulmonary health in asthmatics and has a positive effect on bronchial hyperreactivity and inflammation. Regular practice of aerobic activity since childhood or adolescence improves pulmonary development and causes a minor loss in lung function in adulthood [8,9].

Considering the data presented thus far, a rather important question arises: is regular daily physical activity enough to obtain specific benefits in health status?

The answer may be deduced by exploring the distinction between physical activity and exercise [10]:

- **Physical activity** is defined as any body movement produced by skeletal muscles that requires energy waste (World Health Organization -WHO) [11]. To obtain healthy benefits, it is necessary to practise aerobic physical activities at a moderate intensity for at least 150 min per week or, at least, 75 min per week at high intensity or an equivalent combination of both. Therefore, the most common daily activities such as walking at a leisurely pace, doing household chores, *etc*. are 'light intensity' physical activities which, although preferable to a total sedentary lifestyle, do not reach the threshold level of intensity of effort which correlates positively with healthy benefits. Therefore, physical activity does not qualify as rehabilitative therapy and should not be considered a specific "healthy" practice. However, it is an integral part of the activities that have an impact on health, and that's why it should be encouraged in the context of the promotion of a healthy lifestyle.
- **Exercise**, on the other hand, is a subset of physical activities, in which the exercises are well-defined through four parameters: quantity, duration, intensity, and frequency of repetition [10]. It is a type of physical activity which is planned, personalised and, therefore, structured to obtain specific outcomes for healthy purposes. Examples of physical exercise are personalised activity programs for rehabilitative or preventive purposes. In the context of chronic illnesses such as bronchial asthma physical exercise is effective in improving health status and it can be considered therapeutic exercise or "the drug of movement" [12]. Exercise is considered a healthy intervention which contributes, together with pharmacological therapy, to the prevention of exacerbations and to the maintenance of optimal health status in asthmatic patients [13]. However, physical exercise is rarely compared to pharmacological treatment. This is due to several reasons: i) insufficient awareness of the effectiveness of exercise practice on behalf of doctors and patients; ii) insufficient knowledge of the effect of exercise-based treatment on asthma; iii) lack of adequate doctors' theoretical and practical training; iv) inadequate description of exercise-based treatments in clinical trials and published reviews [14,15].

More deep and widespread knowledge of the preventive and therapeutic role of physical exercise should be encouraged as it would represent another effective medium and long-term option for young asthmatics. As it is directed to the prevention of exacerbations and delaying asthmatic evolution, it would be synergistic with the appropriate pharmacological treatment. However, it should be underlined that the simple prescription of "physical exercise", without any further detail, is an absolutely insufficient indication and it is useless for the achievement of specific outcomes in young asthmatics [16].

Although contraindications to prescribing physical exercise are limited in patients with bronchial asthma, an adequate assessment of clinical conditions and of lung function should be carried out before starting any exercise program. Furthermore, it is always recommended to dedicate some time to inform patients and his/her parents about the components and the steps of the exercise program, besides the potential benefits. It is also important to listen to the patient's concerns and preferences in order to implement strategies that would increase long-term adherence to treatments and outcomes. Finally, it is fundamental to agree with the patient and/or with the patient's parents on the most personalised therapeutic program that is considered the most adequate to his/her cognitive, cultural, socio-economic, and environmental characteristics [12,17].

Can exercise stop asthma symptoms?

Though asthma inflames the airways, regular exercise can actually decrease inflammation. Some types of exercise can reduce or prevent asthma symptoms. They work by making the lungs stronger without worsening inflammation. Specifically, these activities minimize symptoms because they:

- **Increase endurance.** Over time, working out can help the airways build up tolerance to exercise. This makes it easier for the lungs to perform activities that usually make the subject winded, like walking upstairs [19].
- **Reduce inflammation.** Though asthma inflames the airways, regular exercise can actually decrease inflammation. It works by reducing inflammatory proteins, which improves how airways respond to exercise [20].
- **Improve lung capacity.** The more the subject works out, the more the lungs will get used to optimally utilise oxygen. This decreases the effort exerted in breathing on a daily basis [18,21].

- **Strengthen muscle.** When his muscles are strong, the body functions work more efficiently during everyday activities [22].
- **Improve cardiovascular fitness.** Exercise improves the overall conditioning of the heart, improving blood flow and the delivery of oxygen [23].

In addition to physical activity, breathing exercises can also reduce asthma symptoms. These methods help by opening the airways, moving fresh air into the lungs, and reducing the effort required for breathing.

Examples of breathing exercises for asthma include:

- diaphragmatic breathing
- nasal breathing
- pursed lip breathing

However, it's still important to take pharmacological medications as directed. This is the best way to control asthma symptoms, especially during exercise [22].

The physical exercise program: from processing to performance

Although there are no specific evidence-based guidelines for physical exercise in young patients with bronchial asthma, structured protocols are available for adapted physical activity. Some systematic reviews and meta-analyses suggest that an exercise program that increases significantly in asthma-free days, improves aerobic capacity, maximum muscle work capacity, exercise tolerance, and lung minute ventilation [24].

A single Cochrane review [25] concerning the role of exercise training in asthmatic patients is available. All the studies included in this review suggest that exercise improves asthma-related symptoms and cardiopulmonary wellness [22]. Other studies demonstrate that the increase in physical activity obtained by exercise training leads to the reduction of ventilatory requirements induced by mild-to-moderate exercise, thus reducing the likelihood of exercise-induced asthma [7]. Moreover, a 12-week aerobic training programme demonstrated significant reductions in bronchial hyperresponsiveness and serum pro-inflammatory cytokines that were associated with an improvement in the quality of life (QoL) questionnaire and with a reduction of asthma exacerbations in patients with moderate-to-severe persistent asthma [20].

The mechanisms by which a physical exercise program would be of therapeutic value in young patients suffering from bronchial asthma are reported below [4,23].

- The improvement in lung function with a consequent reduction of dyspnoea;
- The stimulation of the immune system, which in turn reduces the vulnerability to colds or other respiratory infections that are known to be asthma triggers.
- An increase in the levels of endorphins, thus contributing to improving mood, reducing stress, and containing depressive and/or anxious state.
- It contrasts a sedentary lifestyle and unhealthy weight, often related to poor asthma control (Table 1).

The personalised training session

The treatment based on therapeutic physical exercise protocols adapted to young patients suffering from bronchial asthma stems from aerobic exercises, intended to: i) improve the degree of tolerance to a continuous effort – that is similar to daily activities; ii) improve joint mobility, in particular of the shoulder girdle, humeral and rib cage; iii) increase muscular resistance by means of exercises affecting muscle strength, and muscle relaxation. It is possible to start with 10-15 min of specific or variable intensity warm-up, in order to induce a "refractory period" during which the occurrence of exercise-induced bronchoconstriction is limited [21,26]. The principles of prescribing physical exercise in young asthmatics are based on: frequency (how often); intensity (how demanding); time (how long); type (mode); total volume (total quantity); progression (the way you grow): the combination of these parameters defines the principle of exercise prescription (FITT-VP) [27] (Table 2).

Table 1. Steps of a physical exercise intervention.

Evaluate
- Analysis of reports and collection of information on the health status
- Assessment of motor skills through entrance tests
Establish
- The short- and long-term goals
Decide
- The most suitable exercise program

Table 2. Recommendations of the FITT model for subjects with asthma.

	Aerobic exercises	Resistance exercises	Flexibility exercises
Frequency	3-5 days/week	2-3 days/week	>2-3 days/week, more effective if daily
Intensity	Start with moderate intensity (40-59% of FRC or of Vo2 R). If well tolerated, increase after one month to 60-70% of FRC or of Vo2 R	Force: 60-70% of 1RM for those who start exercising with weights; 80% for those who have been doing it for some time. Resistance: <50% of 1 RM.	To the point of a feeling tightness or mild discomfort
Duration	Gradually increase up to at least 40 min per day	Strength: 2-4 series, 8-12 repetitions Resistance: <2 series, 15-20 repetitions	10-30 s duration for static stretch; 2-4 repetitions of each exercise
Type	Aerobic activity using the major muscle groups (walking, running, etc.)	Weight-lifting machines, free weights or natural load exercises	Static and dynamic elongation and PNF technique

1RM, maximum single repetition; FCR, reserve heart rate; PNF, proprioceptive neuromuscular facilitation; FITT-VP, frequency-intensity-time-type–Total volume-progression.

Methods of exercise

Aerobic exercises should be first proposed through walking and common specific tools should be used, such as the treadmill, the bike, and the ergometer. The specialist's evaluation of compliance in terms of intensity workload, duration, frequency and type of activity, is crucial. The procedure may initially provide a constant load intensity, which can be gradually increased, at such point, the interval training technique might also be used (Figure 1).

Joint mobility exercises can be performed with a stick or with graduated elastic bands which are important for maintaining the correct posture and for performing thoracic respiratory dynamics more efficiently, as well as avoiding any damage and joint stiffness. Dynamic and isometric free body resistance exercises can be performed by means of dumbbells, medicine balls, and graduated elastic bands, in order to improve the tone and muscular trophism of the limbs. Exercises for specific muscle districts and general movements that simulate daily activities can be performed in order to improve muscle strength. Stretching exercises are also useful for maintaining a correct posture, avoiding the condition of muscle hypertonia, reducing anxiety, and promoting breathing [22,29].

Posture and balance

- Exercises oriented to maintain posture should be of progressive difficulty. For example, attempting to shift from the bipodalic support with semi-spread legs to the bipodalic support with the feet aligned one in front of the other, to the monopodalic support.
- Make movements that "stimulate" the centre of gravity. For example, by walking in a straight or circular line.
- Stress the postural muscles. For example, by walking on the forefoot, or on the heels.
- Reduce the sensory information that controls balance. For example, walking with eyes closed attempting to maintain one's equilibrium, thus eliminating visual interference [29] (Figures 2 and 3).

Breathing exercises

Breathing exercises are also widely used in clinical practice as part of asthma management in children and adolescents. However, it is quite difficult to quantify its effect in this population because in the available studies, these techniques were never used alone but in conjunction with other exercise types. Inspiratory muscle training (IMT) seems to improve inspiratory and expiratory muscle strength, but its utilisation in the paediatric population is not a standard procedure. It has been shown that IMT in children with asthma can improve the strength of inspiratory and expiratory muscle, even if the clinical improvement post-treatment is still uncertain given the lack of specific literature about this intervention in paediatric populations [30]. Finally, in adolescents with bronchial asthma education in terms of correct breathing is essential for optimising respiratory dynamics. From this point of view, it is necessary to pay attention to the coordination between inhalation and exhalation manoeuvres, also using semi-closed labial breathing and thoracic and diaphragmatic breathing techniques in order to increase ventilation and to achieve a correct automatism of in- and expiratory muscles. In our experience, the value of respiratory training is mirrored by a better perception of the respiratory effort, a lower degree of dyspnoea, a more efficient voluntary management of breathing during exercise and during asthma attacks, and a lower degree of anxiety.

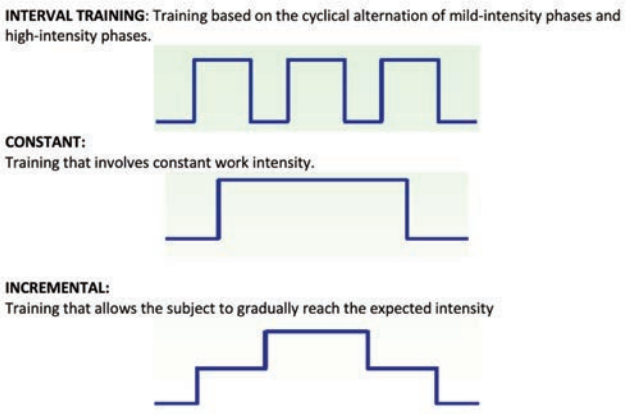

Figure 1. The training mode.

Figure 2. Correct posture in children.

Figure 3. When carrying a backpack, it is important to keep it on both shoulders in order to balance the load.

Techniques to reduce exercise-induced asthma

Exercise-induced asthma (EIA) usually occurs within the first 5 to 10 min of physical exercise and is more likely to occur during or after regular-paced activities in cold, dry air [15,31]. Therefore, some general and practical tips have been proposed intended to reduce EIA impact in young individuals that are summarised hereafter:

- warm-up and cool-down before and after exercise.
- choose activities that do not require exposure to cold, dry air.
- participate in activities with short bursts of exercise (such as tennis and football) rather than exercises involving long-duration pacing (such as cycling, soccer, and distance running).
- breathe through a scarf or through the nose. This helps warm up the airways when exercising in cold air.
- use any prescribed medications as directed.

Conclusions

Asthma is a frequent pathological condition during childhood and adolescence that affects up to 25% of children in Western urban environments. It is a widespread perception that young asthmatics have a reduced aptitude to physical activity and a limited exercise capacity. Although there is no definitive evidence in the literature, lower hospitalisation rates, lower school absenteeism, a reduced need for medical examinations, and reduced use of bronchodilators have been reported in asthmatic children and adolescents who are regularly practising physical exercise regardless of the pharmacological therapy used. Comparative and controlled research in physical exercise should be reinforced and should encourage the adoption of physical exercise protocols in young asthmatics. This is a valuable therapeutic option that is synergic with the effects of regular pharmacological treatment.

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