

The Role of Physical Aerobic Activity in Controlling Exercise-Induced Bronchoconstriction in Children and Adolescents with Asthma

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Abstract

Asthma, one of the major widespread chronic disorders among children and adolescents, has become more prevalent recently. The common manifestations of this disorder are caused by inflammatory airways that lead to airway restriction and lung hypersensitivity causing dry coughing, wheezing, and shortness of breath, all of which are combined with sleep disturbance, impaired physical activity, and reduced quality of life. The main goal of this brief review was to identify the associated variables that affect the management of asthma disease in children and young adolescents and to identify the role of physical aerobic exercise in the treatment of asthmatic children. The current review was based on prior research published in English databases such as Google Scholar, PubMed, and Embase in scientific articles published between January 2010 and October 2021 with the keywords “asthma,” “children,” “adolescents,” “breathing episodes,” “physical activity,” and “physical exercise.” Regular physical aerobic exercise training with moderate intensity has been shown to improve pulmonary functions, life quality, psychological conditions, and reduce asthma symptoms and EIB in children and adolescents with bronchial asthma. (**International Journal of Biomedicine. 2021;11(4):484-487.**)

Key Words: asthma • children • adolescents • physical activity • exercise-induced bronchoconstriction

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Abbreviations

EIB, exercise-induced bronchoconstriction; **CPET**, cardiopulmonary exercise testing.

Asthma is a chronic airway inflammatory disorder that causes repeated sensitive and persistent bouts of pulmonary issues involving shortened breath, wheezing, and cough.⁽¹⁾ These issues may occur as mild, moderate, or severe breathing episodes that require admission to intensive or critical care units and cause a high rate of mortality and

morbidity. Numerous young asthmatics suffer disturbed quality of life, poor pulmonary functions, and impaired exercise tolerance.⁽²⁾

It has been documented that regular physical activities is one of the main elements that improve self-esteem, life quality, and psychological status in asthmatic children.⁽³⁻⁵⁾ It has also been reported that, compared with their peers, asthmatic children’s levels of physical activities are restricted. Asthmatics had a lower physical activity level than healthy peers in a study of physical activity in urban school-aged children with asthma in America;⁽⁶⁾ however, other studies

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reported that asthma disorder does not affect the children's participation in general exercise.^(7,8)

A recent systematic review of all available studies using a control group identified 11 studies (asthma sample = 32,606) reporting less physical activity in children with asthma, and 6 studies (asthma sample = 7824) reporting no difference, thus leading to the conclusion that people with asthma engage in less activity than do controls.⁽⁹⁾

The main goal of this brief review was to identify the associated variables that affect the management of asthma disease in children and young adolescents and to identify the role of physical aerobic exercise in the treatment of asthmatic children. The current review was based on prior research published in English databases such as Google Scholar, PubMed, and Embase in scientific articles published between January 2010 and October 2021 with the keywords "asthma," "children," "adolescents," "breathing episodes," "physical activity," and "physical exercise."

Exercise-induced bronchoconstriction

Asthma, one of the major widespread chronic disorders among children and adolescents, has become more prevalent recently.⁽¹⁰⁾ The common manifestations of this disorder are caused by inflammatory airways that lead to airway restriction and lung hypersensitivity causing dry coughing, wheezing, and shortness of breath, all of which are combined with sleep disturbance, impaired physical activity, and reduced quality of life.⁽¹¹⁾ Although regular physical activity is a vital component of well-being during childhood and adolescence,⁽²⁾ exercise-induced bronchoconstriction (EIB) can develop when airways narrow as a result of physical activity.⁽¹²⁾ EIB is the preferred term for what was known for years as exercise-induced asthma. As many as 90% of people with asthma also have EIB, but not everyone with EIB has asthma. This condition may occur also in 5% to 20% of healthy individuals.⁽¹³⁾ EIB is globally prevalent in 9% of adolescents and children, 12% in Asia and America, and 8% in European countries.⁽¹⁴⁾

EIB symptoms (shortness of breath or wheezing, decreased endurance, tightness in the chest, cough) typically appear within a few minutes after starting exercises and may continue for 10 to 15 minutes after ending the workout.⁽¹⁵⁾ Wheezing in children after physical activity is often the first symptom of asthma. EIB is defined as a forced expiratory volume in one second $\geq 10\%$ lower than the baseline value at 5, 10, 20, and 30 minutes after cardiopulmonary exercise testing (CPET).^(16,17) No clear mechanism has been documented for exercise-induced asthma; however, some associated variables, including dried and cooled airways during exercise, indicate the status of EIB.⁽¹⁸⁾ While physical exercise is the generating factor of bronchospasm, regular exercise training is documented as a primary element in asthma management. Previous meta-analysis and systematic reviews have shown that practicing physical exercise has improved life quality, increased cardiorespiratory performance, and reduced dyspnea in young asthmatics.⁽¹⁹⁻²²⁾

Because bronchial asthma is a common occurrence in adolescents and children, and EIB is identified as a great barrier to participating in physical and sports activities,⁽²³⁾ explaining the effects of physical activity on EIB may help in

the development of assessment and management guidelines for therapeutic exercise intervention in adolescents and children experiencing bronchial asthma.

Aerobic exercise training and asthma

Haskell et al.⁽²⁴⁾ found that moderate-intensity physical exercise at least 30 min 5 times a week or high-intensity physical exercise at least 20 min 3 times a week are required to control and prevent diseases. It was documented that the most beneficial modality of physical activity is moderate-intensity physical exercise for a longer time than high-intensity physical exercise.^(25,26)

Aerobic exercise, sometimes known as "cardio" exercise, stimulates the heart to pump oxygenated blood to deliver oxygen to working muscles. The oxygen inhaled and demanded is needed to maintain vital physiological mechanisms in the human body during activities. It was documented that moderate-intensity aerobic training improves pulmonary inflammatory markers in an asthmatic mouse model.⁽²⁷⁾ A six-minute walk test in school-aged asthmatics found that moderate-intensity physical exercise improves life quality, lung functions, and exercise tolerance.⁽²⁾

Different studies have demonstrated that various intensities of aerobic and active play exercises may improve life quality, lung volumes, functional capacity, sleep disturbances, cardiac output, immunity, and psychological condition in different respiratory and cardiovascular diseases at different age stages.⁽²⁸⁻³²⁾

Children and adolescents with asthma should be encouraged to engage in regular physical activity.⁽³³⁾ Recent reviews have endorsed the positive influences of physical exercise on asthma symptoms, maximal oxygen uptake, cardiorespiratory fitness, and life quality in adults experiencing bronchial asthma, without adverse impacts on pulmonary functions.^(21,34-36) Regular aerobic exercise improved asthma symptom management, lung function, physical capacity, body composition, and mental health in children with asthma.^(37,38)

In addition, it was observed that aerobic exercise alone or combined with resistance exercise can improve the exercise tolerance of abdominal muscles in obese adolescents.⁽³⁹⁾ Similarly, it was reported that airway obstructions have been reduced and inspiratory muscle strength has been increased in asthmatic adults following an aerobic exercise program.⁽⁴⁰⁾

In a population-based study conducted in Greece by Anthracopoulos et al.,⁽⁴¹⁾ free-running exercise challenge tests were employed in the evaluation of children 10-12 years of age. The authors found that the prevalence of EIB and the total energy expenditure were higher in the children who were moderately active or inactive than in those who were active, regardless of body mass index or asthma symptoms.

Lu et al. found that increased sedentary time is associated with worse asthma outcomes.⁽⁴²⁾ In a study performed by Sousa et al.,⁽⁴³⁾ the level of moderate physical activity was found to be comparable between children with and without asthma, even when those with severe asthma were included, although EIB was not evaluated in that study.

Vahlkvist et al.⁽⁴⁴⁾ showed that poorly controlled asthma was associated with reduced physical activity and cardiovascular fitness. Faleiro et al.⁽³³⁾ evaluated 20 patients with severe

refractory asthma and 19 controls. In the sample as a whole, the mean age was 12.9±0.4 years. Among the patients, authors observed isolated EIB in 30%, isolated physical deconditioning in 25%, physical deconditioning accompanied by EIB in 25%, and exercise-induced symptoms not supported by the CPET data in 15%. The authors concluded that physical deconditioning (alone or accompanied by EIB) was the determining factor in reducing exercise tolerance in patients with severe refractory asthma and was not therefore found to be associated with a lack of asthma control.

A meta-analysis of 17 randomized controlled trials, including 599 children and adult asthmatics, also reported that exercise training led to a significant improvement in days without asthma symptoms.⁽⁴⁵⁾ A clinical review performed by Panagiotou et al.⁽¹⁶⁾ showed that higher adherence to physical activity was associated with favorable clinical outcomes, such as improved lung function, asthma control, exacerbation rate, and healthcare use.

Conclusion

In general, regular physical aerobic exercise training with moderate intensity may improve pulmonary functions, life quality, psychological conditions, and reduce asthma symptoms and EIB in children and adolescents with bronchial asthma. Regular physical aerobic exercise training should be conducted in combination with pharmacological asthma treatment to achieve significant asthma control in children and adolescents.

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Competing Interests

The authors declare that they have no competing interests.

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