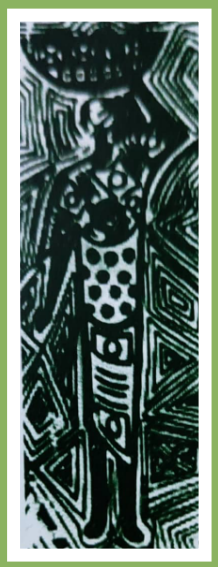
NIGERIAN JOURNAL OF PAEDIATRICS

https://www.njpaediatrics.com

PRINT: ISSN 0302-4660

ONLINE: ISSN 2814-2985

OFFICIAL JOURNAL
OF THE PAEDIATRIC
ASSOCIATION OF
NIGERIA



VOLUME 52
NUMBER 1
JANUARY – MARCH 2025

REVIEW ARTICLE

Nigerian Journal of Paediatrics 2025; Volume 52(1): 1-6.
https://dx.doi.org/10.63270/njp.2025.v52.i1.2000001

Exercise in Children with Bronchial Asthma: A Non-Pharmacological Adjunct to Bronchial Asthma Management

Uchenna Onubogu C.

Department of Paediatrics & Child Health, Rivers State University Teaching Hospital, 5-6 Harley Street, Old GRA, Port Harcourt, River State, Nigeria. E-mail: uchenna.onubogu@ust.edu.ng ;
ORCID - https://orcid.org/0000-0001-5954-4326

Abstract

Exercise in a child with bronchial asthma is a significant subject of interest to the child, physician and parents. Most children with asthma would like to engage in sports. However, fear, past experiences of physical restrictions from the disease, perception of family members, unfavourable institutional policies, the reluctance of school teachers to include children with bronchial asthma in sports and healthcare workers' advice that discourages physical exercise are barriers to vigorous physical activities in children with bronchial asthma. This leads to a sedentary lifestyle, which decreases their quality of life and increases obesity, thus worsening their asthma symptoms.

Bronchial asthma is a chronic inflammatory airway disease leading to variable airway obstruction and hyperresponsiveness. Exercise can trigger or aggravate bronchial asthma symptoms via physical and chemical mechanisms. Exercise-induced bronchoconstriction can also occur in children who have bronchial asthma. Exercise, however, reduces the severity of exercise-induced bronchial asthma, reduces airway inflammation and improves pulmonary function in patients with asthma. Regular physical activity improves bronchial asthma control and quality of life in patients with asthma; it also reduces the amount of medication required to control the disease. As a result of this, regular exercise is recommended as a non-pharmacological adjunct to the management of bronchial asthma. Exercises that do not require prolonged rapid breathing, like playing volleyball, badminton, or aerobics exercises, are least likely to cause exercise-induced bronchoconstriction. For a child with bronchial asthma to benefit from the effects of regular exercise, the choice of exercise, reasonable asthma control, and good prevention and management of exercise-induced bronchoconstriction are essential.

***Keywords**: Bronchial asthma, Bronchoconstriction, Exercise, Exercise-induced Asthma, Swimming.*

Introduction

Often, the physician is addressed with the question from a cautious mother of a child with bronchial asthma, "Is it safe for my child to engage in sports or outdoor games?" On the other hand, the doctor is also cautious about giving the all-clear decision of which sport is safe and which is not. On the other hand, children are usually unhappy being restrained from engaging in sports or outdoor games they are interested in. Children with bronchial asthma live a more sedentary lifestyle and are less involved in physical activity than the general population.[1] Studies have shown that barriers to engaging in physical activity and exercise in children with bronchial asthma include fear and past experiences of physical restriction from their illness, perception of their family members, unfavourable organizational policies, reluctance by school teachers to include a child with asthma in physical education activities and health care advice that discourages physical activities among children with bronchial asthma.[2–5] Support from healthcare professionals has been reported as a facilitator for physical activity in patients with

bronchial asthma.[5] However, the clinician's knowledge may be restricted on how and what guidance to give children with asthma on physical activity.[5,6] Bronchial asthma management aims beyond managing asthma symptoms, but it includes improving the quality of life of patients with asthma in the activity and emotional domain.[7] This review article will highlight exercises in the context of children with bronchial asthma and the role of exercise in the management of bronchial asthma. It would also mention the types of exercise that are advisable for children with bronchial asthma.

Asthma pathophysiology

Bronchial asthma is a Type 2 immune response to antigens presented to the airway, which leads to chronic inflammation, variable airflow obstruction and bronchial hyperresponsiveness. Chronic airway inflammation occurs when antigens are presented by dendritic cells to activated TH2 lymphocytes. They produce an inflammatory response with the release of interleukins (3,4,5,9 and 13), GM-CSF and IgE production. They also cause infiltration of mast cells, eosinophils and T lymphocytes in the airway, which release mediators of inflammation like histamines, prostaglandins and leukotrienes, sustaining the inflammatory response. The presence of these cells contributes to airway hyperresponsiveness such that there is an exaggerated bronchoconstriction response to stimuli such as cold air, allergens, viruses, exercise and irritants. The recurrent smooth muscle contraction along the airways results in wheezing, coughing, breathlessness and chest tightness. [8–10] The airway obstruction in asthma is variable, and it occurs due to bronchoconstriction, airway oedema and a thick mucus plug that is made up of serum proteins and cell debris. In long-standing airway inflammation, there could be airway remodelling, which could lead to fixed airway obstruction and consequential decreased expiratory flow rate, air trapping and increased work of breathing. [9]

Exercise and asthma relationship

Among the many triggers of bronchial asthma, exercise is unique in that it could trigger or aggravate asthma symptoms; at the same time, appropriate regular exercise is beneficial in the management of children with bronchial asthma. [11]Exercise induces asthma via physical mechanisms such as cooling and drying the airway. It also induces asthma via a chemical mechanism from the metabolic acidosis that occurs during exercise. During exercise, the rapid breathing of air causes heat and water loss. The air is relatively dry and cold compared to inspired air in a rested state, which is normally heated to 37^0C and saturated with water vapour from the airways.[12] Cooling of the airway by the inspired cool air during exercise triggers cholinergic receptors. This leads to increased airway smooth muscle tone and production of secretions such that there is reflex bronchoconstriction. [12,13] At the end of the exercise, rebound vasodilation occurs in the airway, leading to mucosal oedema and airway narrowing.[12,13] Furthermore, the hyperventilation involved in exercise leads to airway drying with an increase in the osmolarity of the liquid layer. This leads to the release of mediators like prostaglandins, leukotrienes and histamines, causing bronchoconstriction and reduced mucociliary clearance.[13]

Exercise-induced bronchoconstriction (EIB) is a known variant of asthma which occurs in individuals who have bronchoconstriction when they exercise or engage in vigorous physical activity, particularly in cold outdoors.[9] It can occur in children who have asthma, those who already have other manifestations of atopy like allergic rhinitis or in otherwise healthy persons without a history of atopy. In healthy individuals, there is a fall in forced expiratory volume in 1 second (FEV_1) of not more than 5% during the exercise; in EIB, however, this is higher, with the diagnostic criteria being a fall greater than or equal to 10%. [14] The global prevalence of EIB was reported by a meta-analysis of 66 studies to be 9%, making an

estimated 16.5 million children with EIB globally. In contrast, EIB's global prevalence was 46% in those with bronchial asthma.[15] Kuti *et al.* reported a prevalence of 87% of EIB among Nigerian children with controlled, physician-diagnosed asthma, [16] while Mtshali *et al.* reported that 23% of healthy South African children had EIB.[17] The symptoms in children with EIB include cough, wheezing, breathlessness, chest tightness or chest pain, depending on how the patient expresses their discomfort. [16,18] These symptoms make patients with bronchial asthma avoid exercise or physical exertion; this avoidance has the tendency to lead to obesity, social isolation and poor health.[18]

Benefits of exercise in asthma management

Paradoxically, physical exercise has been shown to reduce the severity of EIB, improve pulmonary functions and reduce airway inflammation in patients with bronchial asthma.[18] Physical exercise leads to increased production of anti-inflammatory cytokines and decreased pro-inflammatory mediators and cells, airway remodelling and fractional exhaled nitric oxide (an indicator of eosinophilic airway inflammation).[13,19] Regular physical activity improves bronchial asthma control, lung function and quality of life in patients with asthma.[20] In a meta-analysis, aerobic exercise significantly improved the percentage of predicted forced vital capacity, maximum mid-expiratory flow, and quality of life measures in paediatric asthma patients.[21] Lung expansion, which is demonstrated in deep breathing and aerobic exercise, has a bronchodilator effect on the lungs. [22] Regular aerobic exercise leads to physiologic adaptations that improve pulmonary functions in children with bronchial asthma. The ability of the children to participate in physical activities and enjoy the social interaction of group exercise or sports improved their quality of life.[21] Physical activity also reduces school absenteeism from asthma-related symptoms, reduces the strength of medications required to achieve bronchial asthma control and reduces unscheduled hospital visits for exacerbated asthma symptoms.[23] In addition, avoidance of physical activities and exercise would lead to obesity, both of which are independent contributors to poor outcomes in patients with bronchial asthma.[24,25]

Exercise options for children with asthma

Counselling on engagement in physical activity has been recommended as an adjunct to the pharmacological management of asthma.[26] Knowing the optimal regime and right exercise prescription that health workers can integrate into bronchial asthma management is of interest to researchers.[20,27] Given the interplay of exercise in children with asthma, addressing the understandable concerns over exercise in children with bronchial asthma is about following the right guidelines to utilize exercise and harness its beneficial effect as a non-pharmacological tool in managing bronchial asthma. The GINA Guidelines on the recommendation of physical activity as a non-pharmacological adjunct to management states that people with bronchial asthma should be encouraged to engage in regular physical activity, although GINA did not recommend a particular form of physical exercise over another in patients with asthma.[20] Balantoni *et al.* reported that soccer, cycling, swimming, dancing, running, gymnastic workouts, volleyball, walking, handball, basketball, skating, table tennis, and hockey were regular sporting activities of primary school children with asthma in Hungary.[2]

Hughes, however, stated that exercises that cause prolonged rapid breathing are most likely to cause asthma symptoms in children who have EIB.[12] Exercises that require prolonged rapid breathing include long-distance running, soccer, ice skating, paddling, cycling and dancing. On the other hand, exercises that do not require prolonged, rapid breathing were least likely to cause symptoms in children with bronchial asthma. These included volleyball, softball, baseball, taekwondo, non-competitive basketball, long jump, and playing as a

goalkeeper in soccer.[12] He also highlighted that the type of warm-up exercises a person engages in, like running laps before a baseball game, could also cause symptoms.

Swimming is a good sporting activity for children with bronchial asthma because it is usually done in a moist, warm environment, making it well tolerated and improving lung functions and cardiopulmonary fitness. [12,20] However, prolonged swimming, which requires prolonged rapid breathing, like in races or exposure to chlorine in the pool, could be problematic for children with bronchial asthma. [13,28,29] The Nigerian hand clap and step games, badminton, and moderate rope jumping do not require prolonged rapid breathing and could be properly tolerated by children with asthma. Aerobic exercises are physical activities that use large groups of muscles rhythmically or repetitively; examples of aerobic exercises are cycling, swimming, walking, rope jumping, playing tennis, dancing and running. Studies have shown that regular moderate aerobic exercise is beneficial in patients with asthma as it has been demonstrated to improve lung function. [20]

Management of Exercise-Induced Bronchoconstriction

A discuss of exercise in children with asthma may be incomplete without describing how to manage or prevent exercise-induced bronchoconstriction. The management of EIB in patients with bronchial asthma follows the same principle of asthma management: avoiding known environmental triggers and stepwise treatment of asthma to achieve good asthma control. It is important to state that sports are not contraindicated in patients with EIB.[13,20] If an acute asthma attack occurs during exercise, the treatment is to remove the child from the sport and treat the acute asthmatic exacerbation using standard guidelines.[20] However, the optimal treatment for EIB is to prevent asthma symptom flare-ups during exercise. [20,30] Steps to prevent EIB include non-pharmacological and pharmacological strategies. The non-pharmacological strategies include a pre-exercise warm-up. [13,20] High-intensity interval pre-exercise warm-up significantly reduces EIB, with its effect lasting up to 12 hours as opposed to continuous and intermittent pre-exercise warm-up. [13,31] The use of a face mask is recommended for warming up, especially if exercising in cold dry weather. This would help humidify the inspired air. [13] Breathing through the nose is recommended instead of the mouth breathing so that the nose can humidify the inspired air.[32] For pharmacological strategies, pre-exercise medications are recommended to prevent EIB. Short-acting beta-agonists (e.g. salbutamol, pirbuterol, levalbuterol) can be administered 15 to 30 minutes before vigorous exercise; Long-acting beta-agonists (e.g., formoterol) can also be administered 30 to 60 minutes before exercise and mast cell stabilizers (e.g., cromolyn sodium) can be taken 15 to 20 minutes before exercise.[20,30] The benefits of daily use of inhaled corticosteroids as part of maintenance therapy stem from long-term use and not from a single dose to prevent EIB. Leukotriene receptor antagonists (e.g. montelukast) can be taken two hours before exercise as part of the prevention of EIB. [20,30]

Conclusion

Exercise is an essential adjunct to bronchial asthma management; avoidance of exercise and physical activity is common among children with asthma both at personal, parental and institutional levels. This needs to be actively addressed by clinicians managing children with bronchial asthma. Physical exercise improves the overall health of children with asthma; it improves their pulmonary functions and quality of life. Strategies to successfully incorporate exercise in children with bronchial asthma include health education and counselling on the benefits of physical activity and exercise, the selection of sports that the children enjoy and do not require prolonged rapid breathing, doing pre-exercise warm-ups, intentionally breathing through the nose and not the mouth to encourage inspiration of warm humidified air,

attaining good asthma control by use of daily maintenance medications and timely use of pre-exercise medication to prevent exercise-induced bronchoconstriction.

References

1. Bajer WA, Majewska-Pulsakowska M, Paprocka-Borowicz M, Wytrychowski K, Taradaj J, Ptaszkowski K. Assessment of Exercise Capacity in Patients Diagnosed with Moderate and Severe Bronchial Asthma: Preliminary Prospective Observational Study. *J Asthma Allergy*. 2024;17:1247–58. https://doi.org/10.2147/JAA.S458717
2. Balatoni I, Kiss T, Balla G, Papp Á, Csernoch L. Assessment of the Physical Activity of Children with Asthma Bronchiale. Sports. 2024;12:114. https://doi.org/10.3390/sports12040114
3. Williams B, Powell A, Hoskins G, Neville R. Exploring and explaining low participation in physical activity among children and young people with asthma: a review. *BMC Fam Pract* 2008;9:40. https://doi.org/10.1186/1471-2296-9-40
4. Liu J, Lambert EG, Kelley T, Zhang J, Jiang S. Exploring the Association Between Work-Family Conflict and Job Involvement. *Int J Offender Ther Comp Criminol* 2020;64:791–817. https://doi.org/10.1177/0306624X19896463
5. Guerrero PDU, Oliveira JM, Lewthwaite H, Gibson PG, McDonald VM. Key Considerations When Addressing Physical Inactivity and Sedentary Behaviour in People with Asthma. *J Clin Med. Basel*, 2023;12:5998. https://doi.org/10.3390/jcm12185998
6. Kahwash BM, Gregory KL, Sharp LK, Nyenhuis SM. Results From a National Survey of Asthma Provider Beliefs and Practices Regarding Exercise and Asthma: A Work Group Report of the AAAAI Committee on Sports, Exercise, and Fitness. *J Allergy Clin Immunol Pract.* 2022;10:1778–83. https://doi.org/10.1016/j.jaip.2022.04.028
7. Pande V, Thakur M. Emphasis on Quality of Life in Children and Adolescents With Bronchial Asthma. Cureus. 2024;16:e68762. https://doi.org/10.7759/cureus.68762
8. Louise E. Understanding asthma: Pathophysiology, symptoms, and management. Afr J Resp Med 2024;19(5). https://doi.org/10.54931/1747.24.19.43
9. Asthma: Practice Essentials, Background, Anatomy. 2024 [cited 2025 Feb 7]; Available from: https://emedicine.medscape.com/article/296301-overview
10. Barbas CSV. Editorial: Asthma: physiology and pathophysiology. *Front Physiol* 2024;15:1403211. https://doi.org/10.3389/fphys.2024.1403211
11. Zhao Y, Meng X, Wang S. Establishment of a physical exercise evaluation index system for school-age children with asthma. *PLoS ONE*. 2025;20:e0312398. https://doi.org/10.1371/journal.pone.0312398
12. Hughes D. Childhood asthma and exercise. *Paediatr Child Health* 2014;19:467–8.
13. Klain A, Giovannini M, Pecoraro L, Barni S, Mori F, Liotti L, *et al.* Exercise-induced bronchoconstriction, allergy and sports in children. *Ital J Pediatr.* 2024;50:47. https://doi.org/10.1186/s13052-024-01594-0
14. Exercise Induced Asthma - an overview | ScienceDirect Topics [Internet]. [cited 2025 Feb 8]. Available from: https://www.sciencedirect.com/topics/medicine-and-dentistry/exercise-induced-asthma
15. de Aguiar KB, Anzolin M, Zhang L. Global prevalence of exercise-induced bronchoconstriction in childhood: A meta-analysis. *Pediatr Pulmonol* 2018;53:412–25. https://doi.org/10.1002/ppul.23951
16. Kuti BP, Kuti DK, Teague WG. Determinants of severe exercise-induced bronchoconstriction in Nigerian children with asthma. *Pediatr Pulmonol* 2020;55:S51–60. https://doi.org/10.1002/ppul.24609
17. Mtshali BF, Mokwena KE. The prevalence of exercise-induced asthma among school children. *South Afr Fam Pract* [Internet]. 2009 [cited 2025 Feb 8];51. Available from:

https://www.ajol.info/index.php/safp/article/view/50076

18. Gerow M, Bruner PJ. Exercise-Induced Bronchoconstriction. StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 [cited 2025 Feb 8]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK557554/
19. Fernandes P, de Mendonça Oliveira L, Brüggemann TR, Sato MN, Olivo CR, Arantes-Costa FM. Physical Exercise Induces Immunoregulation of TREG, M2, and pDCs in a Lung Allergic Inflammation Model. *Front Immunol* 2019;10:854. https://doi.org/10.3389/fimmu.2019.00854
20. 2024 GINA Main Report - Global Initiative for Asthma - GINA [Internet]. [cited 2024 Oct 13]. Available from: https://ginasthma.org/2024-report/
21. Ma Q, Lu M, Yang Q, Gong F, Zhou L, Xu D. Effects of aerobic exercise-based pulmonary rehabilitation on quality of life in pediatric asthma: A systematic review and meta-analysis. *Heart Lung J Crit Care*. 2025;69:11–30. https://doi.org/10.1016/j.hrtlng.2024.09.005
22. Kuder MM, Clark M, Cooley C, Prieto-Centurion V, Riley I, Siddiqi A, et al. A Systematic Review of the Effect of Physical Activity on Asthma Outcomes. *J Allergy Clin Immunol Pract*. 2021;9:3407-3421.e8. https://doi.org/10.1016/j.jaip.2021.04.048
23. Welsh L, Kemp JG, Roberts RGD. Effects of Physical Conditioning on Children and Adolescents with Asthma. *Sports Med*. 2005;35:127–41. https://doi.org/10.2165/00007256-200535020-00003
24. Yawn BP, Rank MA, Bertram SL, Wollan PC. Obesity, low levels of physical activity and smoking present opportunities for primary care asthma interventions: an analysis of baseline data from The Asthma Tools Study. *NPJ Prim Care Respir Med*. 2015;25:15058. https://doi.org/10.1038/npjpcrm.2015.58
25. Freeman AT, Hill D, Newell C, Moyses H, Azim A, Knight D, et al. Patient perceived barriers to exercise and their clinical associations in difficult asthma. Asthma Res Pract. London, United Kingdom: *BioMed Central*; 2020;6:1–11. https://doi.org/10.1186/s40733-020-00058-6
26. Nyenhuis SM, Kahwash B, Cooke A, Gregory KL, Greiwe J, Nanda A. Recommendations for Physical Activity in Asthma: A Work Group Report of the AAAAI Sports, Exercise, and Fitness Committee. *J Allergy Clin Immunol Pract*. 2022;10:433–43. https://doi.org/10.1016/j.jaip.2021.10.056
27. Kahwash BM, Nyenhuis SM. Exercising with Asthma: A Slow Burn or a Quick HIIT? *J Allergy Clin Immunol Pract*. 2022;10:2605–6. https://doi.org/10.1016/j.jaip.2022.07.019
28. Bernard A, Carbonnelle S, de Burbure C, Michel O, Nickmilder M. Chlorinated pool attendance, atopy, and the risk of asthma during childhood. *Environ Health Perspect*. 2006;114:1567–73. https://doi.org/10.1289/ehp.8461
29. Bougault V, Boulet L-P. Is there a potential link between indoor chlorinated pool environment and airway remodeling/inflammation in swimmers? *Expert Rev Respir Med*. 2012;6:469–71. https://doi.org/10.1586/ers.12.51
30. Exercise-Induced Asthma: Practice Essentials, Background, Anatomy. 2024 [cited 2025 Feb 10]; Available from: https://emedicine.medscape.com/article/1938228-overview
31. Stickland MK, Rowe BH, Spooner CH, Vandermeer B, Dryden DM. Effect of Warm-Up Exercise on Exercise-Induced Bronchoconstriction. *Med Sci Sports Exerc* 2012;44:383. https://doi.org/10.1249/MSS.0b013e31822fb73a
32. Weiler JM, Bonini S, Coifman R, Craig T, Delgado L, Capão-Filipe M, et al. American Academy of Allergy, Asthma & Immunology Work Group report: exercise-induced asthma. *J Allergy Clin Immunol.* 2007;119:1349–58. https://doi.org/10.1016/j.jaci.2007.02.041