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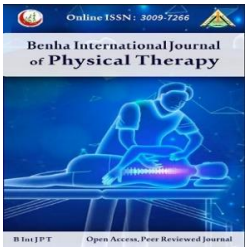

Original research

Management of Bronchial Asthma in Children and Physical Therapy Role: Review Article

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Abstract

Background: Bronchial asthma is described as a persistent inflammatory condition that disrupts the airways and respiratory system, leading to infrequent occurrences of wheezing, difficulty breathing, chest constriction, and coughing. The disease is on the rise globally; it is estimated that approximately 14% of children have experienced asthma symptoms that affect their activities of daily living. **Purpose:** This study aimed to explore bronchial asthma in children and the role of physical therapy in its management. **Methods:** The published studies in PubMed, LILACS, Google Scholar, and Cochrane Library Scholar that studied bronchial asthma were reviewed with the following keywords: obstructive airway disease, breathing exercise, inspiratory muscle training, physical training, and physical therapy in children. Studies that aligned with the scope of the current research were included, while those that did not align were excluded. **Results:** The recommended treatment of bronchial asthma is divided into 5 main categories that are widely used, like inspiratory muscle training (IMT), breathing exercises, manual therapy, stretching exercises, and physical training. **Conclusion:** The reviewed studies highlight that the management of bronchial asthma can be effectively addressed through four primary physical therapy approaches: inspiratory muscle training (IMT), breathing exercises, manual therapy, stretching exercises, and physical training. The literature review highlights the importance of these methods as complementary interventions in the comprehensive treatment of bronchial asthma.

Keywords: Breathing exercise, Inspiratory muscle training, Obstructive airway disease, Physical training, Physical therapy in children.

Introductionn

Bronchial asthma is a prevalent and complex heterogeneous condition that typically starts in early life and is marked by reversible airflow obstruction. The phenotypic variations observed in children with asthma can influence associated comorbidities and the selection of pharmacological treatments. [1]

The underlying mechanisms of asthma are complex, involving airway inflammation, intermittent airflow obstruction, and an exaggerated bronchial response, which are initiated by the presentation of antigens by dendritic cells and the subsequent response of lymphocytes and cytokines, ultimately triggering airway inflammation and asthma symptoms. [2]

Asthma arises from a complex interaction of immune, genetic, and environmental factors, causing chronic airway inflammation and hyper-responsiveness. Type 2 (Th2) responses, prominent in allergic asthma; involve cytokines like interleukin-4 (IL-4), interleukin-5 (IL-5), and interleukin-13 (IL-13), driving eosinophil activity and immunoglobulin E (IgE) production, while non-Th2 mechanisms with neutrophils play a role in severe cases. Airway remodeling, including muscle hypertrophy and fibrosis, exacerbates disease progression. [3] The primary pathological characteristics of asthma include inflammation and remolding of the airways, characterized by sub-epithelial fibrosis, globlet cell hyperplasia, mucosal gland hyperplasia, collagen deposition and smooth muscle hypertrophy. [4]

Childhood asthma may stem from atopy, airway size, or environmental factors like allergens, pollution, and smoking. High IgE levels worsen symptoms, while obesity increases severity. Although family history suggests a genetic link, the exact genes are unknown. More research is needed to understand this complex disease. [(5)] Bronchial asthma is allergic or non-allergic, with allergic asthma often triggered by allergens and involving Th2 responses, eosinophils, and IgE. Non-allergic asthma, common in women and overweight individuals, develops later and includes Th2 and non-Th2 subtypes linked to obesity, aging, and smoking. Non-allergic asthma is harder to manage, with Th2 linked to nasal polyps and aspirin sensitivity. [5]

Fine particles, Particulate Matter 2.5 micrometers (PM2.5), worsen asthma by deeply penetrating the lungs and irritating small airways critical for airflow. They are prevalent in polluted areas and indoor spaces with tobacco smoke or solid fuels. While PM2.5 exposure causes oxidative damage, its impact on improving small airway function through reduction remains unstudied. [6]

Asthma is marked by wheezing, though it may not be present between episodes. Severe attacks can cause tachycardia, tachypnea, reduced airflow, and difficulty breathing, along with accessory muscle use and pulsus paradoxus. Extra-pulmonary symptoms may include swollen nasal mucosa, pale skin, atopic dermatitis, and nasal polyps. [7] Diagnosis involves identifying reversible and variable airway obstruction, intermittent symptoms such as wheezing, dry cough, breathlessness, and chest tightness, and recognizing triggers like allergens, irritants, stress, weather changes, hormonal shifts, or respiratory infections. Spirometry during episodes typically shows reduced Forced Expiratory Volume in one second (FEV1) or Peak Expiratory Flow (PEF).[4]

Children with bronchial asthma often experience impaired functional capacity, making physical fitness evaluation essential for assessing performance limitations and treatment effectiveness. Tests like the 6-minute walk test (6MWT) and shuttle tests measure endurance in children and teens with chronic respiratory issues. These assessments help track any decline in physical performance. [8]

Pulmonary function tests (PFTs) assess respiratory function, aiding in diagnosing and monitoring lung conditions. Their accuracy depends on patient effort and is most useful alongside clinical exams and medical history. PFTs help evaluate disease severity, progression, and treatment outcomes.[9] Spirometry, one of the pulmonary function tests, evaluates respiratory conditions, monitors disease progression, and assesses treatment effectiveness. A structured approach ensures accurate interpretation, with the forced expiratory volume in one second to forced vital capacity (FEV1/FVC) ratio indicating airway obstruction and aiding in diagnosing asthma, COPD, or restrictive patterns. FEV1 helps determine disease severity, though its thresholds are arbitrarily set without direct patient outcome evidence. [10]

This study aimed to explore the methods and impact of physical therapy in managing bronchial asthma in children. The published studies in the Google Scholar, PubMed, LILACS, and the Cochrane Library Scholar, which studied bronchial asthma, were reviewed, using the following keywords: bronchial asthma, breathing exercise, physical training, and inspiratory muscle training.

Physical Therapy Treatment of Bronchial Asthma

Children with asthma not only suffer from symptoms like coughing, wheezing, chest constriction, and breathlessness especially during night or early in the morning, but they also experience exercise-induced asthma.[11] So alongside drugs, physical therapy is regarded as a therapeutic approach for asthma. The primary physical therapies include inspiratory muscle training (IMT), breathing exercises, manual therapy, stretching exercise and physical training. breathing exercises, such as the Buteyko technique and Papworth * method, help asthmatic patients develop a more effective breathing pattern by promoting longer exhalations and slower respiratory rates, thus reducing hyperventilation and hyperinflation. IMT consists of three types: pressure threshold loading, normocapnic hyperpnea, and flow-resistive loading, designed to improve the power and endurance of the diaphragm and secondary inspiratory muscles. [12]

A) Breathing Exercises

1) Buteyko method

It aims to improve breathing by regulating both the volume and rate to better align with the body's metabolic needs, thereby preventing excessive breathing (chronic hyperventilation). Reducing over-breathing may help alleviate bronchospasm by sustaining higher concentration of carbon dioxide in the blood, as low CO_2 concentration contribute to the development of asthma symptoms like chest tightness and wheezing. [13] Before starting the technique, make sure that the patient is in sitting position, and relaxed as much as possible then give him instructions to do the following according to Vagedes et al [14] (Fig.1) [15] shows the procedures of Buteyko technique

1. Encourage the child to sit comfortably and to remain calm.

2. Instruct the child to inhale slowly and deeply using the diaphragm and hold it for 8-10 seconds.

1)Normal and deep breath in and out through the nose.

2)By using the index finger and thumb, close your nose, and keep your breath held as much as you can until you experience the urge to breath, then exhale

3)Breathe normally for about 10 seconds

4) Repeat the steps again

2)Papworth method according to Viyakappan et al [16]

It helps alleviate respiratory symptoms by offering several advantages: improving breath control and efficiency, lowering anxiety, and highlighting the importance of matching breathing patterns to physical activity. It may also reduce dependence on medication. These benefits result in an enhanced well-being, involving less reliance on medications and greater ability to perform everyday tasks. It combines diaphragmatic (abdominal) breathing with relaxation and specific breathing exercises to manage anxiety and respiratory conditions like asthma

Steps:

3. Tell the child to exhale gently through pursed lips, ensuring the exhale takes twice as long as the inhale.

4. Perform this exercise for 30 seconds, repeating it 10 times. The total exercise time is 30 minutes.

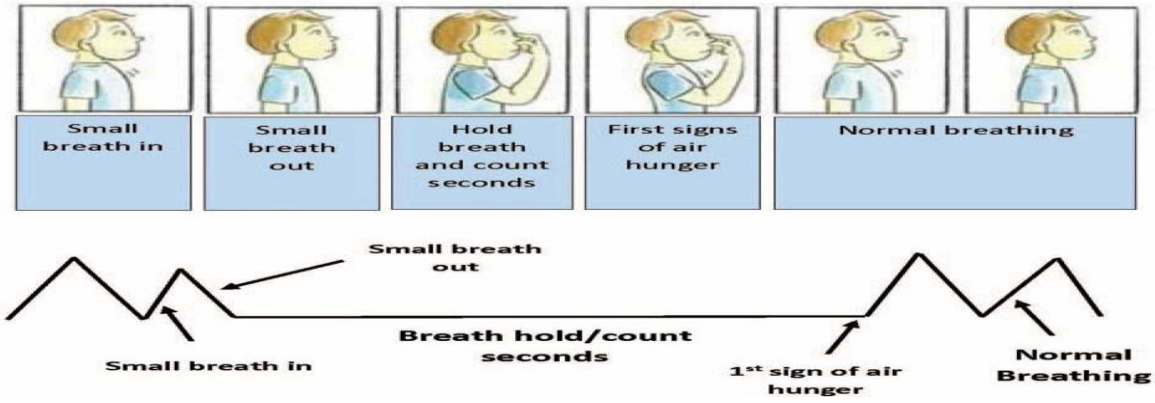

Figure 1: Procedures of Buteyko breathing

3)Pursed lip breathing

It is a technique where the child inhales slowly through the nose and exhales slowly through pursed lips, as though blowing out a candle. This method helps to extend the exhalation phase, generates positive airway pressure, and reduces the risk of airway collapse.

It can improve oxygen levels, ease shortness of breath, and aid in airway clearance by ensuring that the airways stay open during exhalation. This technique is particularly beneficial for individuals with respiratory conditions like asthma, as it helps optimize breathing efficiency and prevent air trapping.[17]

4) Diaphragmatic breathing exercise

Sallini et al.[18] reported that applying the diaphragmatic breathing exercise approach may improve oxygen levels in patients with asthma both pre and post the intervention. Steps of diaphragmatic breathing exercise conducted by Pathan etal. [19] as the following:

Instructions for the breathing exercises must be given before test using verbal commands to demonstrate the technique.

Step 1: Child must be relaxed as much as possible before starting test.

Step 2: He/she has to place hands slightly under the anterior costal border and physical therapist instruct the patient to breathe slowly and deeply through the nose in a calm manner.

Step 3: Child instructed to keep their shoulders not tensed, their upper chest still, permit only the abdomen to gently rise during inhalation, and then exhale slowly.

Step 4: Continue to take slow, deep breaths, aiming for six breaths per minute.

Step 5: Rest, then repeat steps again.

For adding resistance, exhale slowly through pursed lips or against slight external pressure, like using a small weight on the abdomen. This exercise strengthens the diaphragm and enhances respiratory efficiency, particularly helpful in managing asthma symptoms. [20]

B- Inspiratory muscle training (IMT)

In children with asthma, (IMT) can raise maximal inspiratory pressure (PImax), potentially reducing inspiratory motor drive by decreasing the recruitment of motor units, which may alleviate dyspnea. IMT can also induce diaphragm hypertrophy and enhance the size of muscle fibers in the external intercostals, potentially reversing or delaying the decline in inspiratory muscle function.

However, factors such as the degree of hyperinflation, airway obstruction severity, and training frequency and duration can influence the effectiveness of IMT. Before beginning IMT, the child must first spend 25 minutes practicing diaphragmatic breathing and pursed-lip breathing, both in a seated and supine position, with each exercise performed in sets of 10 repetitions. Following this, IMT is conducted for 25 minutes. [21]

1) Flow-Resistive Loading

It applies external resistance to the respiratory muscles by using a variable diameter opening during breathing. Traditionally, this is done with analog devices that have adjustable dials, with modifiable size of the opening, thus altering the airflow and the corresponding load. For a specific flow rate, as the orifice becomes smaller, the load increases though pressure also changes with airflow. [22]

2) Normocapnic hyperpnoea

It is a training method in which individuals breathe at a high percentage of their maximum voluntary ventilation for a set duration, utilizing complex rebreathing systems to maintain stable carbon dioxide levels. Its application in patients has been limited due to the need for specialized, intricate equipment to prevent hypocapnia and the physically demanding nature of the exercise. This technique aligns with endurance training as it emphasizes high airflow with low pressure. During normocapnic hyperpnea, both inspiratory and expiratory muscles are engaged. In contrast, flow-resistive loading and

pressure-threshold loading specifically target the inspiratory muscles, enhancing their strength and performance. [21]

3) Pressure-Threshold Loading

This device adds external resistance to the respiratory muscles by forcing ventilation through an opening that remains closed by a spring-loaded switch or similar mechanism until a certain pressure is achieved. At the beginning of inhalation, the valve stays closed, requiring the user to generate enough pressure against the spring-loaded mechanism to overcome the resistance and allow airflow. During exhalation, a one-way valve opens, permitting unrestricted airflow. The system provides a steady, pre-determined pressure, unaffected by the user's breathing pattern or flow rate. [22]

Threshold loading is the most commonly used method for inspiratory muscle training (IMT) due to its portability and simplicity. However, while different IMT techniques have been evaluated in a systematic review of healthy individuals, no evidence suggests that one method is superior to another for managing asthma. [21] **(Fig. 2)**[23] illustrates the changes in the chest wall's tidal volume across the three evaluation stages (QB, Load, and Rec) and with the use of both inspiratory resistance devices (pressure threshold and flow resistance).

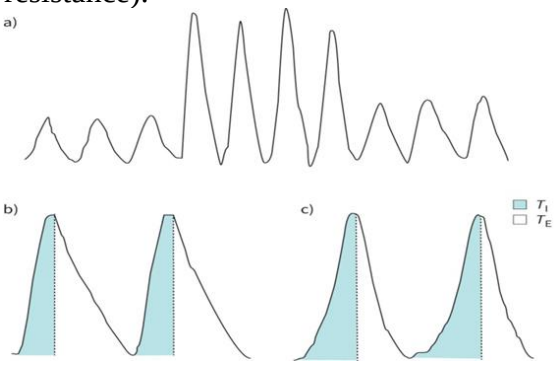

Figure 2: a) Illustration of tidal volume changes during quiet breathing, inspiratory load, and recovery periods. Comparison of volume curves as the load increases with b) pressure threshold and c) flow resistance devices. TI: inspiratory time; TE: expiratory time.

C- Manual therapy

Different manual therapies are employed to help alleviate asthma symptoms. Chiropractic and osteopathic methods focus on enhancing mobility of the rib cage and spine to support better lung function and circulation. Additional techniques involve chest percussion, vibrations, and specific postures to aid in loosening and expelling mucus. Massage therapy is also commonly applied. These methods are practiced by various professionals, including chiropractors, physiotherapists, osteopaths, and respiratory therapists. [24]

1) Percusiion, vibration, and postural drainage

Chest percussion involves positioning the patient to assist in draining secretions from a specific lung lobe or segment, while the chest is clapped (Fig.3)[25] with cupped hands to loosen and mobilize the retained mucus, which can then be either expectorated or drained. While effective, this technique can be uncomfortable and exhausting for the patient. Alternatives to manual chest percussion include mechanical vibrators and inflatable vests, which can provide similar benefits without direct hand contact. [26]

Vibration, in a similar way, increases airflow and aids in breaking down mucus, particularly in the smaller airways. The technique involves delivering rhythmic pressure (Fig.3)[25], which helps to dislodge mucus from the walls of the airways. Postural drainage, meanwhile, relies on positioning the body to use gravity in draining mucus from specific lung areas. The postures used in postural drainage are tailored according to the lung regions targeted and the patient's condition. Proper body positioning directs mucus toward larger airways, where it can be more easily cleared (Ramirez-Sarmiento, 2002). Both vibration and postural drainage are personalized to the patient's specific needs, ensuring effective mucus removal and enhanced airway clearance. [27]

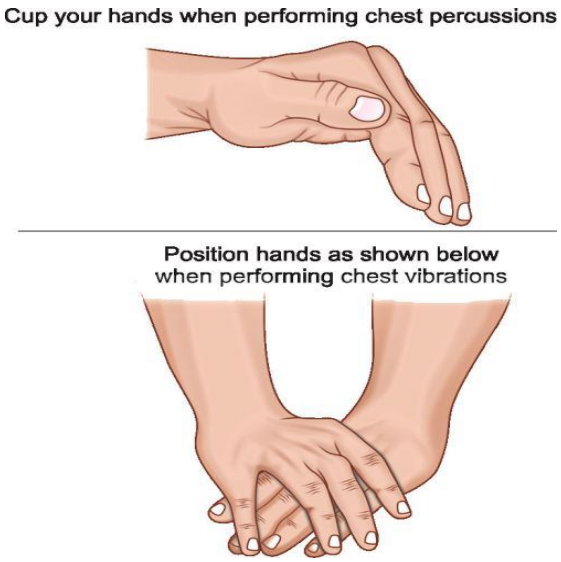

Figure 3: Hand position of percussion and vibration technique.

2) Massage therapy

A study by Hondras.,etal revealed that children who received a nightly at least 20-minute massage from their parents before bedtime or by therapist, involving stroking and kneading in the following areas—face/head/neck/shoulders, arms/legs, and back—experienced an immediate reduction in anxiety-related behaviors and cortisol levels. Additionally, their attitudes toward asthma, peak airflow, and other lung functions showed improvement throughout the study. For older children who participated in the massage therapy, their anxiety levels dropped right after the massage, their attitude toward asthma improved over time, and one indicator of pulmonary function, forced expiratory flow between 25% to 75% (FEF25-75), also improved. [28]

Steps of massage according to Sefton et al [29] as the following:

Face, Head, Neck, and Shoulders:

1. Begin with general gliding strokes over the neck and shoulders using cream for 2 minutes.
2. For the face and head, perform gentle stroking, pressure point massage, kneading, and a scalp scrub without cream for 2 minutes.
3. Perform unilateral strokes: circular friction and direct pressure from the occiput to the mastoid process for 5 minutes.
4. Perform bilateral strokes: kneading the upper trapezius, levator scapula, and scalenes, with circular friction and deep gliding friction on the scalenes, and direct pressure on key areas, for 5 minutes.
5. Finish with general gliding strokes over the neck and shoulders for 2 minutes.

Arms and Legs:

- Left Arm: Apply gliding strokes with cream, followed by gentle shaking at the shoulder joint, and kneading on the arm and hand for 5 minutes.
- Left Leg (Then Right Leg): Apply gliding strokes with cream over the front of the leg, knead the lower and upper leg, and manipulate the foot and toes for 5 minutes.
- Right Arm: Repeat the same steps as the left arm for 5 minutes.
- Right Leg (Then Left Leg): Perform gentle compressions on the gluteal muscles, gliding strokes over the back of the leg, kneading the lower and upper leg, and foot manipulation for 5 minutes.
- Left Leg: Repeat the same steps as the right leg for 5 minutes.

Back:

1. Perform gentle gliding strokes over the back with cream.
2. Use kneading motions to relax the muscles.
3. Apply friction techniques (either circular or transverse) over the erector spinae muscles.
4. Perform kneading and trigger point work around the scapula and along the trapezius as needed.

D) Stretching exercise according to Leonés etal [30]

Stretching is widely utilized because of its numerous benefits and minimal contraindications. A diaphragm stretching technique has demonstrated positive effects on respiratory function as well as thoracic and spinal mobility in healthy children. The impact of diaphragm stretching (Fig.4)[31] on pulmonary function and respiratory pressures in healthy children revealed a significant improvement in forced vital capacity, forced expiratory volume in the first second, and respiratory muscle strength immediately following the technique.

Figure 4: Stretching technique for diaphragm

Steps of stretching technique:

1. Position the child in an upright, seated position.
2. The therapist stands behind the child and gently wraps their hands around the child's thoracic cage.
3. The therapist carefully slides their fingers under the child's costal margin.
4. To relax the rectus abdominis, the child is asked to slightly round their trunk.
5. As the child exhales, the therapist gently grasps the lower ribs and costal margin, applying a downward (caudal) pressure.
6. Maintain the stretching tension for 5–7 minutes.
7. Perform the stretching once during the session

D- Physical Activity

The Global Initiative for Asthma (GINA) and other health authorities emphasize the importance of incorporating exercise into asthma management for children. Exercise, especially when conducted in controlled environments and timed around the administration of prescribed asthma medication, offers significant benefits. Engaging in aerobic exercise helps reduce asthma-related symptoms such as chest restriction, wheezing, and breathlessness by enhancing lung capacity improving oxygen exchange, and strengthening respiratory muscles. Additionally, regular physical activity can contribute to better overall fitness, increased endurance, and a reduced risk of asthma exacerbations, ultimately leading to higher life satisfaction for children with asthma.[32]

Exercise training can enhance lung function and asthma management in children with asthma. Swimming, in particular, has been shown to be beneficial for these children. Study conducted by Carew and Cox [33] demonstrated that swimming-based exercise programs are more effective at improving peak flow readings compared to other sports activities such as basketball or football.

Conclusion

Bronchial asthma is a common health concern in children, and its management continues to be a topic of discussion. Several treatment options are available for managing the condition. Physical therapy plays a significant role in treating children with asthma, with approaches such as inspiratory muscle training (IMT), breathing exercises, manual therapy, stretching, and physical training proving to be highly effective in managing asthma in children.

Conflict of interest

The authors assert that there are no competing interests.

References

1. Shipp CL, Gergen PJ, Gern JE, Matsui EC, Guilbert TW. Asthma management in children. J Allergy Clin Immunol Pract 2023;11(1):9-18. doi: 10.1016/j.jaip.2022.10.031.
2. Morris MJ. Asthma guidelines. Medscape 2024.
3. Habib N, Pasha MA, Tang DD. Current understanding of asthma pathogenesis and biomarkers. Cells 2022;11(17):2764.
4. Bereda G. Bronchial asthma: etiology, pathophysiology, diagnosis, and management. Austin J Pulm Respir Med 2022;9(1):1085.
5. Hammad H, Lambrecht BN. The basic immunology of asthma. Cell 2021;184(6):1469-85.
6. Cui X, Li Z, Teng Y, Barkjohn KK, Norris CL, Fang L, et al. Association between bedroom particulate matter filtration and changes in airway pathophysiology in children with asthma. JAMA Pediatr 2020;174(6):533-42. doi: 10.1001/jamapediatrics.2020.0140.
7. Hashmi MF, Cataletto ME. Asthma. In: StatPearls [Internet]. StatPearls Publishing 2024. doi: https://www.ncbi.nlm.nih.gov/books/NBK430901/
8. Lanza FC, Santos J, Selman JP, Crispim AO, Nascimento KS, Souza GM, et al. The PAY test: a new approach for assessing functional performance in children and adolescents with asthma. J Pediatr 2023;99:597-603.
9. López-de-Uralde-Villanueva I, Candelas-Fernández P, de-Diego-Cano B, Mínguez-Calzada O, Del Corral T. The effectiveness of combining inspiratory muscle training with manual therapy and a therapeutic exercise program on maximum inspiratory pressure in adults with asthma: a randomized clinical trial. Clin Rehabil 2018;32(6):752-65.
10. Langan RC, Goodbred AJ. Office spirometry: indications and interpretation. Am Fam Physician 2020;101(6):362-8.
11. Urtado PR, Maciel ÁCC, Barbosa RRT, Silva AAMD, Freitas DA, Mendonça KMPP. Association between quality of life, severity of asthma, sleep disorders, and exercise capacity in children with asthma: a cross-sectional study. Braz J Phys Ther 2019;23(1):12-8.
12. Zhang W, Wang Q, Liu L, Yang W, Liu H. Effects of physical therapy on lung function in children with asthma: a systematic review and meta-analysis. Pediatr Res 2021;89(6):1343-51.
13. De Mendonça KMPP, Collins S, Santos TZ, Chaves G, Leite S, Santino TA, Monteiro KS. Buteyko method for people with asthma: a protocol for a systematic review and meta-analysis. BMJ Open 2021;11(10):e049213.
14. Vagedes J, Helmert E, Kuderer S, Vagedes K, Wildhaber J, Andrasik F. The Buteyko breathing technique in children with asthma: a randomized controlled pilot study. Complement Ther Med 2021;56:102582. doi: 10.1016/j.ctim.2020.102582.
15. Elnaggar RK, Shendy MA. Efficacy of noninvasive respiratory techniques in the treatment of children with bronchial asthma: a randomized controlled trial. Bull Fac Phys Ther 2016;21:1-10.
16. Viyakappan B, Jayashree K, Vijayaraghavan R, Krishnan MA.

Comparative study to assess the effectiveness of Papworth method vs active play exercise on respiratory outcome and biochemical parameters among asthmatic children. J Pediatr 2023;12(10):3685-93.
17. Tripathi AK, Sankari A. Postural drainage and vibration. In: StatPearls [Internet]. StatPearls Publishing 2024.
18. Salini NKS, Astriani NMDY, Dewi PIS, Marthasari NKP. The effect of diaphragmatic breathing exercise technique on increasing oxygen saturation in asthma patients. J Nurs Health 2023;4(1):1-9.
19. Pathan FKMM, Pandian JS, Shaikh AIM, Ahsan MP, Nuhmani S, Iqbal AM, et al. Effect of slow breathing exercise and progressive muscle relaxation technique in individuals with essential hypertension: a randomized controlled trial. Medicine (Baltimore) 2023;102(47):e35792.
20. Hamasaki H. Effects of diaphragmatic breathing on health: a narrative review. Medicine (Baltimore) 2020;7(10):65. doi: 10.3390/medicines7100065.
21. Silva IS, Fregonezi GAF, Dias FAL, Ribeiro CTD, Guerra RO, Ferreira GMH. Inspiratory muscle training for asthma. Cochrane Database Syst Rev 2013 ;(9):CD003792. doi: 10.1002/14651858.CD003792.pub2.
22. Bhammar DM, Jones HN, Lang JE. Inspiratory muscle rehabilitation training in pediatrics: what is the evidence? Can Respir J 2022;2022:5680311.
23. da Fonsêca JDM, Aliverti A, Benício K, de Farias Sales VS, da Cunha Lima LFS, et al. Breathing pattern and muscle activity using different inspiratory resistance devices in children with mouth breathing syndrome. ERJ Open Res 2022;8(2).
24. Hondras MA, Linde K, Jones AP. Manual therapy for asthma. Cochrane Database Syst Rev 2005;(2):CD001002. doi: 10.1002/14651858.CD001002.pub2.
25. Annamma J, Jadhav T, Rekha R. Oxygenation. In: Clinical Nursing Procedures: The Art of Nursing Practice. 3rd ed. Jaypee Digital; 2015. p. 26.
26. Kaur R, Dass B, Ejaz AA, Singh A. Chest physiotherapy in acute muco-obstructive lung disease. Cureus 2020;12(2):e7056. doi: 10.7759/cureus.7056.
27. Tripathi AK, Sankari A. Postural drainage and vibration. In: StatPearls [Internet]. StatPearls Publishing 2024.
28. Hondras MA, Linde K, Jones AP. Manual therapy for asthma. Cochrane Database Syst Rev 2000;(2):CD001002. doi: 10.1002/14651858.CD001002.
29. Sefton JM, Yarar C, Berry JW. Massage therapy produces short-term improvements in balance, neurological, and cardiovascular measures in older persons. Int J Ther Massage Bodywork 2012;5(3):16-27. doi: 10.3822/ijtmb.v5i3.152.
30. Leonés-Macías E, Torres-Sánchez I, Cabrera-Martos I, Ortiz-Rubio A, López-López L, Valenza MC. Effects of manual therapy on the diaphragm in asthmatic patients: a randomized pilot study. Int J Osteopath Med 2018;29:26-31.
31. Chen Y, Li P, Wang J, Wu W, Liu X. Assessments and targeted rehabilitation therapies for diaphragmatic dysfunction in patients with chronic obstructive

pulmonary disease: A narrative review. Int J Chron Obstruct Pulmon Dis 2024;19:123-135.
32. Global Initiative for Asthma (GINA). Global strategy for asthma management and prevention (GINA report) 2024.
33. Carew C, Cox DW. Laps or lengths? The effects of different exercise programs on asthma control in children. J Asthma 2018;55(8):877-81. doi: 10.1080/02770903.2017.137380.