

Review of Research Progress and Clinical Application of Non-pharmacological Intervention in Children with Bronchial Asthma

Jijing Han, Ying Guo*

Department of Hepatobiliary Surgery, Affiliated Hospital of Hebei University, Baoding 071000, Hebei, China

**Author to whom correspondence should be addressed.*

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Abstract: Childhood bronchial asthma is a common chronic airway inflammatory disease in pediatrics. Long-term use of inhaled steroids alone has practical problems such as insufficient compliance, parents' concerns about adverse hormone reactions, and inadequate seizure control. Non-pharmacological intervention, as a synergistic means of drug therapy, can reduce airway hyperresponsiveness, decrease the frequency of acute attacks, and improve lung function and quality of life in children from multiple perspectives, including environmental control, respiratory rehabilitation, exercise regulation, psychological counseling, nutritional microecology, traditional Chinese medicine external treatment, and digital health management. This article provides a comprehensive review of the mechanisms of action, latest research evidence, and stratified clinical application scenarios of various non-pharmacological interventions. This article looks forward to the development direction of precision, family-oriented, and integrated intervention of traditional Chinese and Western medicine, providing evidence-based reference for the standardized comprehensive management of pediatric asthma.

Keywords: Childhood bronchial asthma; Non-pharmacological intervention; Respiratory training; Airway management; Collaboration between Traditional Chinese Medicine and Western Medicine

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1. Introduction

The main characteristics of bronchial asthma include chronic airway inflammation, airway hyperresponsiveness, reversible airflow limitation, and airway remodeling ^[1]. Its clinical manifestations mainly include recurrent wheezing, shortness of breath, and possible accompanying symptoms such as chest tightness or cough. The cumulative prevalence of asthma among children aged 0–14 in China has reached 3.02%, with moderate to severe cases experiencing 4–7 acute attacks per year, severely affecting growth and development, campus activities, and the burden of family care ^[2]. At present, the global guidelines for

the prevention and treatment of childhood asthma all consider inhaled corticosteroids as the first-line long-term control plan, but the control rate of standardized medication in China is insufficient. The main obstacles include multiple factors such as children's resistance to inhalation devices, parents' excessive concern about hormone suppression height, repeated aggravation induced by comorbidities such as anxiety and obesity, and continuous exposure to environmental allergens. Single-drug treatment is difficult to cover the entire chain of risk factors for asthma. Non-pharmacological interventions, with their advantages of non-invasiveness, safety, and long-term implementation at home, have gradually become the fundamental module of comprehensive management systems. In recent years, multiple network meta-analyses have confirmed that the combination of environmental control, respiratory muscle training, personalized aerobic exercise, acupoint therapy, psychological intervention, and medication can reduce the number of acute attacks, while simultaneously increasing the forced expiratory volume in one second (FEV₁), peak expiratory flow rate (PEF), and the Children's Asthma Quality of Life Questionnaire (PAQLQ) score^[3-5]. At present, the evidence levels of various intervention methods are uneven, and there is a lack of standardized implementation pathways at the grassroots clinical level. This paper systematically summarizes various non-drug intervention mechanisms and clinical adaptation populations, and provides evidence-based support for the clinical construction of drug-non-drug integrated long-term management programs.

2. Environmental source prevention and control interventions

2.1. Precise control of indoor allergens

Dust mites, pet dander, and mold are the main inhaled triggers of asthma in preschool children. This type of intervention is a universal basic intervention for all children with asthma, which runs through the entire course of the disease^[6]. The existing unified evidence-based plan includes a complete set of mite resistant bedding covering, stable indoor humidity maintenance of 40% to 60%, regular high-temperature cleaning of fabrics, reduction of carpet, fabric and soft furnishings, and prohibition of indoor breeding of furry pets such as cats and dogs^[7]; Wet kitchens and bathrooms are equipped with dehumidification devices to prevent mold growth; In autumn and winter, air purifiers that meet national standards are activated to filter PM2.5 and pollen particles continuously. Wu Qingcui's research shows that standardized implementation of home allergen control can effectively improve the lung function of children, reduce the probability of disease occurrence, and improve the treatment effect of asthma in children through self-management^[8]. For children with aggravated pollen season, wearing a closed mask when going out and changing their outer clothing and cleaning their nasal cavity when returning home can significantly reduce the burden of airway allergens.

2.2. Air pollution and avoidance of irritants

Tobacco smoke, kitchen fumes, and volatile organic compounds (formaldehyde, benzene) from decoration can directly damage the airway epithelial barrier, amplifying inflammation and airway hyperresponsiveness^[9]. Clinical management requires families of children with asthma to prohibit smoking completely, use strong smoke exhaust equipment throughout cooking, and allow newly renovated houses to ventilate and sit for at least 6 months before long-term residence^[10]. During periods of heavy outdoor pollution, children with asthma should reduce prolonged outdoor activities. School-aged children should prioritize conducting physical education classes during periods of good air quality. In view of the high incidence of coal-fired heating and haze in the northern winter, the community combined with pediatrics to carry out family

environment screening intervention, and follow-up confirmed that continuous avoidance of stimulants can reduce the annual emergency visit rate.

2.3. Pre-protection against respiratory infections

Viral infection is the primary cause of acute asthma attacks in children, accounting for over 65% of the triggering factors ^[11]. Basic intervention measures include timely completion of influenza and pneumococcal vaccination; Wearing masks in crowded places during seasonal changes and developing standardized hand washing habits; and isolating family members with colds to avoid cross-infection. Microecological and nutritional interventions can be used as auxiliary means to enhance respiratory mucosal resistance and reduce asthma exacerbations induced by infections.

3. Respiratory rehabilitation and exercise intervention

3.1. Graded respiratory muscle training

Respiratory training adjusts respiratory rhythm, strengthens diaphragm and intercostal muscle strength, corrects shallow and rapid chest breathing commonly found in children with asthma, reduces end-expiratory airway depression, and alleviates symptoms of wheezing and chest tightness. It is suitable for children over 4 years old who can cooperate with instructions ^[12]. The mainstream training programs are divided into three categories: abdominal deep breathing, pursed lip breathing, and inspiratory muscle resistance training. Young children use gamified abdominal breathing techniques (such as blowing bubbles or balloons) to enhance their coordination; Children over 8 years old can use a portable inspiratory muscle training instrument, training 10–15 minutes a day for 8 weeks as a complete course of treatment. Research by Ye Fang shows that respiratory training can effectively improve lung function in children with asthma, increasing forced vital capacity (FVC), maximum expiratory volume in the first second (FEV1%), and peak expiratory flow rate (PEF) ^[13]. This intervention has no adverse reactions and can be implemented daily at home, making it the most valuable rehabilitation method for grassroots promotion.

3.2. Individualized aerobic exercise program

There is a cognitive misconception in previous clinical practice that “children with asthma should not exercise”. The existing guidelines clearly state that moderate-intensity exercise can improve cardiopulmonary reserve, reduce airway inflammation, and alleviate exercise-induced wheezing. Its core lies in layered adaptation of exercise types and durations. Children with mild control can engage in aerobic exercises such as jogging, swimming, cycling, etc. 3–5 times a week for 20–30 minutes each time; Children with moderate to severe uncontrolled conditions should avoid vigorous exercise in cold air or pollen environments. 10 minutes before exercise, they should inhale short-acting vasodilators preventively and gradually increase the intensity of exercise. Swimming is the preferred exercise for children with asthma because warm and humid air reduces airway irritation. Chen Qiong et al. confirmed in their 3-month exercise intervention cohort study that under appropriate management and monitoring, moderate-intensity aerobic exercise has good safety and effectiveness, and can improve the exercise ability and quality of life of children with asthma ^[14].

4. Psychological intervention and mind-body coordination therapy

4.1. Anxiety counseling for children and parents

Chronic recurrent asthma attacks can easily cause fear, inferiority, and separation anxiety in children. During long-term parental care, the child develops persistent anxiety and depression. Negative emotions increase vagal tone through the neural-airway reflex pathway, inducing bronchial smooth muscle spasms and forming a vicious cycle of “emotion-wheezing”. Clinical interventions include cognitive-behavioral therapy (CBT), parent-child synchronous psychological counseling, and game guidance. This study conducted emotion recognition training for children aged 6 and above, guiding parents to avoid overprotection and exaggerating disease risks, which can cause psychological burden on the children ^[15].

4.2. Music-assisted respiratory therapy

Music therapy belongs to low-threshold physical and mental interventions. It relies on soothing music combined with rhythmic breathing to synchronously regulate the autonomic nervous system, calm anxiety, and regulate breathing patterns ^[16]. Young children receive a combination of nursery rhymes, musical instrument playing, and abdominal breathing training; school-aged children listen to soothing instrumental music for 15 minutes daily. Comparative experiments have confirmed that the music exhalation method can significantly improve the PAQLQ quality of life score of pediatric patients and reduce the frequency of waking up and wheezing at night. It is suitable for outpatient assistance and daily family relaxation intervention ^[17].

5. Nutritional regulation and intestinal microbiota intervention

5.1. Individualized regulation of dietary structure

The core of dietary intervention is divided into two parts: avoiding allergenic foods and supplementing anti-inflammatory nutrients. This requires precise avoidance of allergenic ingredients through skin pricking and serum-specific IgG screening. In daily life, children should reduce their intake of high-sugar, fried, and artificially added foods; Increase intake of deep-sea fish, flaxseed, Omega-3 unsaturated fatty acids, fresh fruits and vegetables, and vitamins; and inhibit chronic airway inflammation. For children with low serum levels of 25-hydroxyvitamin D, we should add egg yolks and deep-sea fish to their diet, and if necessary, supplement vitamin D in a standardized manner. Several reviews have confirmed that only the vitamin D deficiency subgroup can significantly reduce the risk of asthma exacerbation. Obese children with asthma should strictly control their total calories, and weight loss interventions can significantly improve symptoms of airflow limitation and wheezing.

5.2. Probiotics and immunomodulators

The theory of the gut-airway axis promotes the rapid development of microecological intervention. During the neonatal period, exclusive breastfeeding for ≥ 6 months can shape a stable gut microbiota and reduce the risk of childhood asthma in the long term ^[18]. For children diagnosed with asthma, targeted supplementation of specific strains of probiotics and bacterial lysates can regulate Th1/Th2 immune imbalance and reduce the risk of recurrent respiratory infections leading to acute asthma attacks.

6. Traditional Chinese medicine characteristics of external treatment of non-drug intervention

6.1. Acupoint application and moxibustion therapy

Based on the theory of “treating winter diseases in summer and eliminating latent phlegm as the chronic root cause”, the application of Sanfu/Sanjiu acupoint plaster is the most widely used traditional Chinese medicine external treatment method in pediatrics in China. It selects acupoints such as Feishu, Danzhong, Dingchuan, and other acupoints to warm yang and dissolve phlegm, regulate the lungs and spleen. It is suitable for children with cold asthma and repeated winter exacerbations. Standardized application for three consecutive years is a complete conditioning cycle, which can reduce wheezing attacks in autumn and winter seasons. Mild suspended moxibustion and indirect moxibustion can also reduce airway hyperresponsiveness, but young children need to control the temperature to avoid burns strictly. Warm moxibustion interventions are not suitable for treating febrile asthma (yellow phlegm, sore throat). Zhang Jianxiu pointed out in his research that the use of traditional Chinese medicine acupoint application for winter and summer treatment of childhood asthma has a more significant therapeutic effect and can improve lung function in children^[19]. It can improve the lung function of children, improve the level of inflammatory factors, promote the disappearance of various symptoms, help to control the disease, and promote the early recovery of children.

6.2. Pediatric Tuina conditioning

Tuina stimulates meridians and acupoints to regulate the internal organs and qi, and eliminate phlegm. Regarding this, infants and young children aged 0–6 have a high degree of cooperation. It does not cause trauma and is easy for parents to study at home. During the relief period, the main method is to strengthen the spleen and supplement the lungs. During the attack period, it is supplemented by anti-asthmatic and soothing operations. The therapy is performed 3 to 5 times per week. Continuous intervention for 3 months can reduce nighttime coughing and wheezing, improve appetite and physical fitness. A summary analysis of over 1656 pediatric patients confirmed that pediatric massage therapy has significant therapeutic effects on chronic remission of asthma. It can not only improve lung function of children, but also effectively prevent asthma attacks^[20].

7. Digital health management intervention

7.1. Home monitoring and online health education

The intelligent peak flow velocity meter, asthma management mini program, and short video science popularization platform constitute a digital intervention system. The child should keep a daily record of PEF values and a wheezing diary at home. The child has regular online follow-up visits, and medical staff remotely push age-specific medication, respiratory training, and environmental control science popularization content. Compared with traditional outpatient follow-up, digital management can improve medication compliance by 37%, significantly enhance parents' disease awareness, and provide continuous standardized guidance for children in remote areas at the grassroots level.

7.2. Real-time monitoring of smart wearables

The new wearable device can synchronously monitor respiratory rate, heart rate, and nighttime blood oxygen saturation, warn of the risk of early wheezing attacks, and timely push intervention reminders. It is currently

used in high-risk children with moderate to severe and frequent nighttime attacks. However, due to high equipment costs, there are limitations to grassroots popularization. Lightweight and low-cost monitoring equipment is the development direction for the future.

8. Conclusion

Non-pharmacological intervention for childhood bronchial asthma is not a drug replacement plan, but a basic collaborative management measure that runs through the entire cycle of acute, remission, and stable phases. At present, there are still shortcomings in this field, such as incomplete individualized stratification schemes, insufficient grassroots promotion support, and weak evidence-based interventions. Future research can focus on three directions: One is to conduct large sample, long-term stratified RCTs, clarify the optimal combination intervention mode for children of different ages, allergy types, and severity, as well as construct a standardized clinical pathway; The second is to promote the integration of traditional Chinese and Western medicine, unify the operation norms of syndrome differentiation, establish a community family linkage home intervention guidance system, and reduce the long-term implementation threshold; The third is to rely on artificial intelligence and intelligent wearable devices to create a full cycle digital precision management platform, realizing the integration of risk warning and remote rehabilitation guidance. Clinical physicians need to shift their single medication mindset and incorporate non-pharmacological interventions into the routine content of initial diagnosis evaluation and long-term follow-up. They need to simultaneously carry out systematic health education for parents, promote the deep integration of drug and non-drug interventions, build a safe, long-term, and accessible comprehensive prevention and treatment system for childhood asthma, and continuously improve the overall control level of childhood asthma in China.

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