

# The Effect of Asthma Education Program on Disease Management in Children with Asthma: A Retrospective Analysis

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## Abstract

**Aims/Background** As a common chronic respiratory disease, asthma may lead to airway inflammation and accelerated, progressive loss of lung function, if not well controlled, posing risks to patients' life and health. This study evaluates the impact of asthma education program on enhancing asthma control, quality of life, and pulmonary function in children, addressing gaps in existing management approaches.

**Methods** In this retrospective study, 60 patients who had undergone routine nursing mode at Beijing Shijitan Hospital affiliated to Capital Medical University from May 2022 to May 2023 were enrolled for the reference group; after excluding 3 patients, this study finally included 57 patients. Separately, 55 patients who had attended the child-oriented asthma education program on the basis of routine nursing care at the same hospital from May 2023 to May 2024 were enrolled for the observation group; after excluding 2 patients, this study eventually included 53 patients. The Childhood Asthma Control Test (C-ACT) score, the Pediatric Asthma Quality of Life Questionnaire (PAQLQ) score, pulmonary function index levels measured in terms of percentage of predicted forced vital capacity (FVC%), peak expiratory flow (PEF), forced vital capacity in one second/forced vital capacity (FEV1/FVC), and the disappearance time of clinical symptoms (dyspnea, chest tightness, cough, wheezing) were compared between the two groups.

**Results** Before the management, there were no differences in the C-ACT and PAQLQ scores between the two groups ( $p > 0.05$ ). After management, the C-ACT and PAQLQ scores of the observation group were significantly higher than those of the reference group ( $p < 0.001$ ). There were no differences in FVC%, PEF, and FEV1/FVC between the two groups before management ( $p > 0.05$ ). After management, the FVC%, PEF, and FEV1/FVC levels of the observation group were higher than those of the reference group ( $p < 0.001$ ). The disappearance time of clinical symptoms such as dyspnea, chest tightness, cough and lung wheezing in the observation group was shorter than that in the reference group ( $p < 0.001$ ).

**Conclusion** The child-oriented asthma education program is beneficial to the disease management in children with asthma, improving asthma control, quality of life, lung function indexes, and shortening the time of symptom disappearance.

**Key words:** child; education; asthma; disease management

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## Introduction

Asthma is a common respiratory disease with significant morbidity, mortality, and economic burden worldwide (Gans and GavriloVA, 2020; Ntontsi et al, 2021). Asthma is a result of heterogenous, complex gene-environment interactions with

variable clinical phenotypes, inflammation, and remodeling (Papadopoulos et al, 2022). It is characterized by wheezing, shortness of breath, and cough, which are usually triggered by multiple types of stimuli (Martin et al, 2022). A relevant study has shown that children are a high-risk group of asthma, experiencing more severe clinical symptoms and difficult-to-control condition (Seth et al, 2021). Without appropriate and optimal control, asthma may lead to airway inflammation and accelerated, progressive loss of lung function, posing risks to patients' life and health (Busse, 2023).

As asthma is a chronic respiratory disease that threatens the life and health of patients, comprehensive management and long-term treatment are needed (Alwarith et al, 2020). The management of childhood asthma entails three major strategies: drug therapy, treatment of potential complications, and compliance education for patients (Shipp et al, 2023). In addition, strengthening the management of exercise, nutrition and other lifestyle habits can effectively control asthma symptoms or improve the quality of life (Ding and Zhong, 2020; Lu and Forno, 2020). Since it is challenging for children to achieve the above requirements with the current routine care, along with suboptimal effect, new asthma disease management measures need to be explored. The child-oriented asthma education program is a fun, interactive and child-friendly program for improving the asthma knowledge and management ability of children with asthma and their parents. A relevant study has shown that asthma disease education can improve patients' compliance and long-term results of asthma treatment (Bosi et al, 2021). Education programs can enhance patients' disease knowledge, which can contribute to strengthening daily nursing practice for improving patients' health status (Urstad et al, 2018). Child-oriented education can meet the needs of children and families, and is easier to be accepted and understood by children (Chen, 2023). By virtue of the characteristics of children and the methods of clinical disease control of asthma, we believe that implementing a child-oriented asthma education program can improve the effect of disease management in children with asthma. At present, studies on the application of child-oriented asthma education program in the disease management of children with asthma remain scarce. Our findings from this study carry theoretical and practical significance, providing reference and guidance for clinical disease management in children with asthma.

## Methods

### Research Subjects

In this retrospective study, 60 patients who had undergone routine nursing mode at Beijing Shijitan Hospital affiliated to Capital Medical University from May 2022 to May 2023 were enrolled for the reference group; after excluding 3 patients, this study finally included 57 patients. Separately, 55 patients who had attended the child-oriented asthma education program on the basis of the routine nursing care at the same hospital from May 2023 to May 2024 were enrolled for the observation group; after excluding 2 patients, this study eventually included 53 patients. Informed consent was obtained from all patients and guardians included,

and this study was conducted in accordance with the relevant requirements of the Declaration of Helsinki (World Medical Association, 2013).

Individuals with the following conditions were included for this study: (1) In fulfilment of the clinical diagnostic criteria for asthma (Radivojević and Radivojević, 1994); (2) 3 years old < age < 14 years old; and (3) with complete clinical data.

Individuals with the following conditions were excluded from this study: (1) acute or chronic lung disease; (2) with malignant tumors; (3) autoimmune diseases; (4) severe respiratory failure; (5) on immunosuppressive therapy or corticosteroid therapy within 4 weeks before the study; (6) mental disorders; and (7) hearing impairment.

### Grouping

The subjects in the reference group adopted the routine nursing care mode, which entails the following:

(1) *Conventional treatment.* Routine drug treatment, bronchodilators, anti-inflammatory drugs and aerosol inhalation therapy were used to control the progression of the disease. Oxygen therapy was performed according to the patient's condition to maintain normal oxygen saturation. The basic vital signs of the children were closely monitored.

(2) *Environmental control.* Reducing allergen exposure is key to disease control. Nursing staff should disinfect the ward regularly to keep the ward clean and reduce levels of airborne allergens.

(3) *Health education.* Relevant nursing educations such as cognitive education, medication guidance and psychological counseling were provided by nurses with expertise in these areas.

On the basis of nursing care administered to the subjects in the reference group, the patients in the observation group were additionally subjected to child-oriented asthma education program, which entails the following procedures:

(1) *Preparatory works by specialist nurses.* (i) A child-friendly propaganda for the asthma education program was created, and an education group was established. The group members included head nurse of pediatric respiratory department, asthma specialist nurses and psychological specialist nurses. The head nurse was responsible for the formulation and supervision of the plan; the psychological specialist nurse was responsible for the assessment of the mental health of the children; and the primary nurse was responsible for the implementation of the plan. (ii) Before the implementation of the nursing plan, all nursing team members were educated on the concept of the child-friendly education plan and knowledge related to pediatric asthma. The evaluation process consisted of two components: a theoretical assessment and a practical skills test. Theoretical assessment: Nursing team members were required to attend a series of lectures and workshops covering topics such as the pathophysiology of pediatric asthma, common triggers, treatment protocols, psychological considerations for pediatric patients, and principles of child-friendly communication. Upon completion of the training, team members took a written test, which included multiple-choice questions and case-based scenarios designed to as-

sess their understanding of the material. Practical skills test: Nurses were required to demonstrate proficiency in using child-friendly communication techniques, properly administering inhaler devices, and explaining asthma management strategies in a manner appropriate for children and their parents. Only nursing team members who met the minimum standards in both the theoretical assessment and the practical skills test were permitted to participate in the child-oriented asthma education program for pediatric patients. Those who did not meet the standards underwent additional training and retesting until they achieved the required qualifications. (iii) A weekly workshop was held to guide the nursing members in tackling the nursing problems arising in the care of the children.

(2) *Ward decoration with child-friendly concepts.* (i) First, interesting stickers featuring cartoons, such as Peppa Pig, Pig Man, Pleasant Goat and Big Big Wolf, were affixed on the walls inside the children's wards. (ii) Secondly, multi-color light sources were installed on the walls or ceilings. The main light source was of warm colors, and the auxiliary light source of cold colors was installed to reduce the fear of children in the ward. (iii) Finally, the ward was supplied with appropriate amount of dolls, building blocks, toy cars and other items that could enhance the child-friendliness of the interior environment.

(3) *Nursing implementation.* (i) Firstly, a relationship of trust was built: When the children were admitted to the hospital, the attending nurses would get to know their patients' interests and hobbies through conversation with them and their parents, and encourage the children to call the attending nursing staff by the name of their favorite cartoon characters, such as "Pleasant Goat Brother" and so on. The children were encouraged to speak out about their concerns in the process of disease treatment and to understand their psychological status. (ii) Health education videoclips tailored to the child-age patients were played. There are in total five videoclips, each with a length of about 10 minutes, covering contents such as knowledge about asthma, types and administration methods of common drugs for asthma, adverse drug reactions, precautions, importance of ensuring adequate exercise and nutrition for asthma disease management. The videos were played in the ward every morning and afternoon. (iii) This nursing mode emphasizes interactive education involving fun games. The nursing staff and the children carried out role exchange games, and the children were allowed to simulate the treatment of a doll based on what they have learnt from the videoclips. At the same time, the parents were guided to express their feelings to the children, and comforting phrases like "It is not scary at all; you will recover soon." were used to alleviate the children's fear and increase their sense of control over the disease treatment.

(4) *Content of feedback education.* After each child-oriented asthma education program, the children were asked a few questions about what they have learned from the education program. A small red-flower reward would be given for every correct (and comprehensive) answer. The videoclips would be played again if the responses were incorrect or insufficient.

### Observation Indicators

(1) *Asthma control status.* The Childhood Asthma Control Test (C-ACT) was used to evaluate the asthma control status of the children at admission and on the day of discharge (Liu et al, 2007). The test consists of seven questions, of which the first four were answered by the child and the last three by the parent or caregiver. The questions focus on the frequency of asthma symptoms, number of nighttime awakenings, and limitations in daytime activity during the previous 4 weeks. Scores on the test range from 0 to 27, with higher scores indicating better asthma control.

(2) *Quality of life.* The Pediatric Asthma Quality of Life Questionnaire (PAQLQ) was used to evaluate the quality of life of children at admission and on the day of discharge (Juniper et al, 1996). The questionnaire contains 23 questions grouped into 3 domains: activity limitation, symptoms, and emotional functioning, with questions in each domain designed to assess the extent to which asthma affects children's daily life. The questionnaire scores range from 23 to 161, with a higher score indicating better quality of life.

(3) *Pulmonary function indexes.* The percentage of predicted forced vital capacity (FVC%; normal range:  $\geq 80\%$ ), peak expiratory flow (PEF; normal range: boys:  $5.29 \times \text{Height (cm)} - 427.1$  (L/min), girls:  $4.94 \times \text{Height (cm)} - 399.8$  (L/min)) (Lu et al, 2018), forced vital capacity in one second/forced vital capacity (FEV1/FVC; normal range:  $\geq 70\%$ ).

(4) *The disappearance time of clinical symptoms.* The disappearance time of dyspnea, chest tightness, cough and wheezing were compared between the two groups.

### Statistical Analysis

The SPSS statistical software (version 25.0; International Business Machines Corporation, Armonk, NY, USA) was used to process the data in this study. Expressed as count and percentage, the categorical variables were analyzed by Pearson's chi-square test. The Kolmogorov-Smirnov test was adopted to test the normal distribution of continuous variables. Non-normally distributed continuous data are expressed as median (P<sub>25</sub>, P<sub>75</sub>). The Mann-Whitney *U* test was used to compare the non-normal continuous data between groups. A difference with  $p < 0.05$  was regarded as statistically significant.

## Results

### General Information

There were no significant differences in age, body mass index (BMI), duration, respiratory rate, pulse, incidence of rhinitis and adenoid hypertrophy, education background of mother, education background of father, and length of hospital stay between the two groups ( $p > 0.05$ ; Table 1).

### Asthma Control Status and Quality of Life in Children

Before management, there were no differences in C-ACT and PAQLQ scores between the two groups ( $p > 0.05$ ). After management, the C-ACT and PAQLQ

**Table 1. Comparison of general information between the reference and observation groups.**

Projects	Reference group ( <i>n</i> = 57)	Observation group ( <i>n</i> = 53)	$\chi^2/Z$	<i>p</i>
Age (years)	7.00 (7.00, 9.00)	8.00 (7.00, 10.00)	1.439	0.150
BMI (kg/m <sup>2</sup> )	18.20 (17.15, 19.05)	17.90 (16.60, 18.95)	-0.994	0.320
Duration (months)	16.00 (12.50, 20.50)	16.00 (12.00, 22.00)	0.432	0.666
Respiratory rate (breaths/min)	27.00 (25.50, 29.00)	27.00 (26.00, 28.50)	-0.599	0.549
Pulse (beats/min)	108.00 (104.00, 112.00)	108.00 (104.00, 112.00)	-0.102	0.919
Incidence of rhinitis			0.000	0.997
Yes	43 (75.44)	40 (75.47)		
No	14 (24.56)	13 (24.53)		
Incidence of adenoid hypertrophy			0.025	0.875
Yes	18 (31.58)	16 (30.19)		
No	39 (68.42)	37 (69.81)		
Education background of mother			0.031	0.859
Below undergraduate level	27 (47.37)	26 (49.06)		
Bachelor degree or above	30 (52.63)	27 (50.94)		
Education background of father			0.121	0.728
Below undergraduate level	25 (43.86)	25 (47.17)		
Bachelor degree or above	32 (56.14)	28 (52.83)		
Length of hospital stay (days)	8.00 (7.00, 9.00)	7.00 (6.00, 9.00)	-0.799	0.424

BMI, body mass index.

scores of the two groups increased, with the scores of the observation group significantly higher than those of the reference group ( $p < 0.001$ ; Table 2).

**Table 2. Asthma control status and quality of life in the reference and observation groups.**

Indicators	Timepoint	Reference group ( <i>n</i> = 57)	Observation group ( <i>n</i> = 53)	<i>Z</i>	<i>p</i>
C-ACT	Before management	13.00 (12.00, 15.00)	13.00 (12.00, 15.00)	-0.759	0.448
	After management	19.00 (18.00, 21.00)*	22.00 (21.00, 23.00)*	6.242	<0.001
PAQLQ	Before management	77.00 (72.50, 80.00)	78.00 (73.00, 81.50)	0.864	0.388
	After management	101.00 (95.00, 105.00)*	113.00 (105.50, 119.00)*	6.778	<0.001

\*  $p < 0.001$ , indicating statistical difference before and after treatment in the same group.

C-ACT, the Childhood Asthma Control Test; PAQLQ, the Pediatric Asthma Quality of Life Questionnaire.

### Pulmonary Function Indexes

There were no differences in FVC%, PEF, and FEV1/FVC between the two groups before management ( $p > 0.05$ ). After management, FVC%, PEF and FEV1/FVC levels of the two groups increased, but these parameters were significantly higher in the observation group than in the reference group ( $p < 0.001$ ; Table 3).

**Table 3. Pulmonary function indexes of the reference and observation groups.**

Indicators	Timepoint	Reference group ( <i>n</i> = 57)	Observation group ( <i>n</i> = 53)	Z	<i>p</i>
FVC% (%)	Before management	73.00 (69.00, 76.00)	73.00 (69.50, 75.00)	-0.439	0.661
	After management	78.00 (76.00, 80.00)*	81.00 (80.00, 84.00)*	5.945	<0.001
PEF (L/min)	Before management	237.00 (223.00, 249.50)	232.00 (217.50, 244.00)	-1.538	0.124
	After management	256.00 (242.00, 268.00)*	272.00 (260.50, 284.00)*	5.057	<0.001
FEV1/FVC (%)	Before management	75.00 (73.00, 78.00)	76.00 (74.50, 78.00)	1.783	0.075
	After management	79.00 (77.00, 80.00)*	82.00 (79.00, 84.00)*	5.524	<0.001

\*  $p < 0.001$ , indicating statistical difference before and after treatment in the same group.

FVC%, percentage of predicted forced vital capacity; PEF, peak expiratory flow; FEV1/FVC, forced vital capacity in one second/forced vital capacity.

### The Disappearance Time of Clinical Symptoms

The disappearance time of clinical symptoms such as dyspnea, chest tightness, cough and lung wheezing in the observation group was shorter than that in the reference group ( $p < 0.001$ ; Table 4).

**Table 4. The disappearance time of clinical symptoms in the reference and observation groups.**

Types	Reference group ( <i>n</i> = 57)	Observation group ( <i>n</i> = 53)	Z	<i>p</i>
Dyspnea	3.00 (2.00, 4.00)	1.00 (1.00, 2.00)	-8.141	<0.001
Chest distress	4.00 (3.00, 5.00)	2.00 (2.00, 3.00)	-7.267	<0.001
Cough	6.00 (5.00, 7.00)	4.00 (3.50, 5.00)	-7.858	<0.001
Lung wheezing	6.00 (5.00, 7.00)	5.00 (4.00, 5.50)	-6.570	<0.001

## Discussion

In the current study, we found that children in the observation group had better asthma control, higher quality of life, better performance in lung function indexes (FVC%, PEF, FEV1/FVC) and shorter time of symptom resolution. This suggests that the child-oriented asthma education program is effective for disease management in children with asthma. Thus, an in-depth analysis of the advantages of child-oriented asthma education program can provide reference and guidance for clinical disease management.

The child-oriented asthma education program can better control the condition of children, shorten the disappearance time of children's symptoms, and to a certain extent, prevent the deterioration of the disease from affecting the physical development and health of children. These favorable outcomes can be justified by the following: (1) First, the child-oriented asthma education program can significantly improve children's compliance with disease treatment, which is extremely crucial to ensure therapeutic outcomes because the young-age children have a strong aversion to hospital environment and dealing with medical staff, resulting in poor treat-

ment compliance, a contributing factor to less optimal treatment effect (Chan et al, 2022). In view of this phenomenon, in the process of implementing the child-friendly asthma education program, the nursing staff first established a relationship of trust with the children, such as forming an amicable vibe where the children can call the attending nurses “Pleasant Goat Brother” to effectively attract the children’s attention and improve their compliance with the medical staff. (2) Secondly, the child-oriented asthma education program can better alleviate children’s fear. During the treatment of asthma, children often feel afraid for being placed in an unfamiliar environment, which not only affects the treatment effect, but also increases the risk of asthma attack (Volpato et al, 2023). In line with the child-oriented asthma education program, the nursing staff decorated the child-oriented ward according to the contemporary preferences of their pediatric subjects. By creating a warm and interesting environment, such as setting up light sources of different colors and using cartoon characters to appeal the children, nursing staff can greatly allay the fear among children in the ward and during treatment, to ensure that children receive treatment in a relaxed and happy atmosphere. In addition, fun, interactive games were carried out, during which the children were guided with positive-language phrases and hints in order to enhance their enthusiasm toward and compliance with the treatment. (3) In addition, the child-oriented asthma education program can improve the children’s awareness of the disease. It has been validated that patients attempting to explain a disease through their personal experiences, knowledge and values, and perception is one of defining traits of treatment adherence (Yildirim and Baykal, 2020). Since the conventional health education videos could not attract the attention of children, it is critical to design such videos tailored to the pediatric population. Specifically, child-friendly medication health education videos featuring cartoon characters may capture the children’s attention. After playing the videos, the nursing staff can test children’s mastery of asthma-related knowledge by asking questions. Therefore, the child-oriented asthma education program enhances disease control and lung function-related indicators by improving treatment compliance, reducing fear, and enhancing disease awareness. This, to a large extent, accounts for the higher C-ACT and PAQLQ scores, shorter time of clinical symptom resolution, and better treatment effect in the children of the observation group. Sirimontakan et al (2022) showed that cartoon video instruction can improve the therapeutic effect of children with asthma. The results of Walker et al (2022) showed that the asthma education program could continuously improve asthma control and reduce asthma symptoms within 12 months of the intervention, supporting the results of this study.

The child-oriented asthma education program has a beneficial effect on improving the quality of life of children with asthma. One study showed that the quality of life of children with asthma is affected by a variety of factors, including physical and psychological factors (Plaza-González et al, 2022). Another study also showed that variables such as self-efficacy, psychological resilience and asthma control can impact the quality of life of children with asthma (Zhang et al, 2023). Through the child-oriented asthma education program, complex disease and treatment knowledge is simplified and conveyed with vivid and interesting animation,

and in the form of games, etc., improving the children's understanding of the disease and cultivating their health responsibility and awareness, so that they play a more active role in treatment, enabling them to self-disease manage their condition in daily life. The program also improves the children's self-efficacy, clinical symptoms, and mental health to a certain extent. Therefore, the quality of life of children in the observation group was significantly higher than that in the reference group. Meng et al (2022) showed that child-oriented educational programs can improve the children's clinical symptoms, promote recovery, and improve treatment effect. The study by Akca Sumengen and Ocakci (2023) revealed that the incorporation of cartoon features in educational program can effectively improve disease control and quality of life of children with asthma, corroborating the potential of this approach in clinical settings.

However, our study has certain limitations. Firstly, this study was a retrospective study, and the data were extracted from the existing records, possibly introducing selection bias and hampering direct inferencing of causality. Secondly, due to the constraints of time, manpower and financial resources, the sample size of the current study was limited, which may lead to insufficient statistical power and limit the generalizability of our results; therefore, follow-up studies involving larger samples are warranted. Finally, the current study did not investigate the long-term application value of different management methods due to the relatively short follow-up time. Thus, extended follow-up time should be considered in further studies to fully evaluate the long-term clinical effect of child-oriented asthma education program.

## Conclusion

The child-oriented asthma education program can improve the asthma control, quality of life, lung function indexes of children, and shorten the time of symptom disappearance, providing a good asthma disease management method which is worthy of clinical promotion and application.

### Key Points

- The child-oriented asthma education program can improve asthma control and the Childhood Asthma Control Test (C-ACT) score of children with asthma.
- The child-oriented asthma education program can improve the quality of life of children with asthma.
- Child-oriented asthma education program can improve lung function in children with asthma.
- Child-oriented asthma education program can shorten the disappearance time of clinical symptoms in children with asthma.

## Availability of Data and Materials

The datasets used and/or analysed during the current study were available from the corresponding author on reasonable request.

## Author Contributions

YL and JX designed the study. All authors conducted the study. YL, ZM and QZ collected and analyzed the data. YL and QZ participated in drafting the manuscript, and all authors contributed to critical revision of the manuscript for important intellectual content. All authors gave final approval of the version to be published. All authors participated fully in the work, took public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or completeness of any part of the work were appropriately investigated and resolved.

## Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of Beijing Shijitan Hospital affiliated to Capital Medical University (institution review board number, 2019 Scientific Research Review No. (67)). This study was conducted in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from all patients and guardians included.

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## Conflict of Interest

The authors declare no conflict of interest.

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