Postprint: Control Rate and Influencing Factors of Bronchial Asthma in School-age Children

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Abstract

Background: Bronchial asthma is a common chronic respiratory disease in children, with its global incidence continuing to rise. Due to its unique geographical location and climatic conditions, Lanzhou has a relatively high incidence of childhood asthma. The level of asthma control is closely associated with the quality of life and prognosis of affected children; however, studies on asthma control status and influencing factors among school-age children in Lanzhou remain limited.

Objective: To evaluate the control rate of bronchial asthma among school-age children in Lanzhou and to explore the factors influencing asthma control levels.

Methods: School-age children diagnosed with bronchial asthma and their caregivers at the Department of Pediatrics, Gansu Provincial Maternal and Child Health Hospital (Gansu Provincial Central Hospital) from 2021 to 2023 were enrolled for a questionnaire survey. Based on Childhood Asthma Control Test (C-ACT) scores, the children were divided into two groups: a controlled group (215 cases, C-ACT score $ $23) and an uncontrolled group (199 cases, C-ACT score <23). Clinical data from both groups were collected and compared. Univariate and multivariate Logistic regression analyses were employed to investigate the influencing factors of asthma control levels in school-age children.

Results: A total of 414 children with bronchial asthma were included in this study, comprising 244 males (58.9%) and 170 females (41.1%), with a mean age of (7.64$±$1.94) years. The control rate of bronchial asthma among school-age children in Lanzhou was 51.9% (215/414). Multivariate Logistic regression analysis revealed that keeping cats or dogs at home (OR=3.075, 95%CI=1.453~6.508, P=0.003), comorbid allergic rhinitis (OR=1.947, 95%CI=1.127~3.364, P=0.017), autumn season (OR=3.891, 95%CI=2.008~7.519, P<0.001), and winter season (OR=2.227, 95%CI=1.140~4.367, P=0.019) were detrimental to asthma control in school-age children, whereas proficient inhalation technique

(OR=0.191, 95%CI=0.117~0.312, P<0.001) and good medication adherence to inhaled corticosteroids (ICS) (OR=0.202, 95%CI=0.123~0.332, P<0.001) were beneficial for asthma control.

Conclusion: The control rate of bronchial asthma among school-age children in Lanzhou is suboptimal and requires further improvement. Keeping cats or dogs at home, comorbid allergic rhinitis, autumn and winter seasons, unproficient inhalation technique, and poor ICS medication adherence are risk factors for poor asthma control in school-age children.

Full Text

Study on the Control Rate and Influencing Factors of Bronchial Asthma in School-aged Children

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Abstract

Background: Bronchial asthma is a common chronic respiratory disease in children, with a rising global incidence. Due to its unique geographical location and climatic conditions, Lanzhou has a relatively high prevalence of childhood asthma. The level of asthma control is closely related to children' s quality of life and prognosis, yet research on asthma control status and influencing factors among school-age children in Lanzhou remains limited.

Objective: To evaluate the control rate of bronchial asthma in school-age children in Lanzhou and explore the influencing factors of asthma control levels.

Methods: A questionnaire survey was conducted among school-age children diagnosed with bronchial asthma and their families at the Department of Pediatrics, Gansu Provincial Maternal and Child-care Hospital (Gansu Provincial Central Hospital) from 2021 to 2023. Based on the Childhood Asthma Control Test (C-ACT) scores, children were divided into two groups: a controlled group (215 cases, C-ACT score $\geq$ 23) and an uncontrolled group (199 cases, C-ACT score $<$ 23). Clinical data of the two groups were collected and compared, and univariate and multivariate Logistic regression analyses were used to explore influencing factors of asthma control levels in school-age children.

Results: This study included a total of 414 children with bronchial asthma, including 244 males (58.9%) and 170 females (41.1%), with a mean age of (7.64$±$1.94) years. The asthma control rate among school-age children in Lanzhou was 51.9% (215/414). Multivariate Logistic regression analysis revealed that keeping cats or dogs at home (OR=3.075, 95%CI=1.453-6.508, P=0.003), comorbid allergic rhinitis (OR=1.947, 95%CI=1.127-3.364, P=0.017), autumn (OR=3.891, 95%CI=2.008-7.519, P<0.001) and winter (OR=2.227, 95%CI=1.140-4.367, P=0.019) were associated with poor asthma control, while proficiency in inhalation techniques (OR=0.191, 95%CI=0.117-0.312, P<0.001) and good compliance with inhaled corticosteroids (ICS) medication (OR=0.202, 95%CI=0.123-0.332, P<0.001) were associated with better asthma control.

Conclusion: The control rate of bronchial asthma in school-age children in Lanzhou is not high and needs further improvement. Keeping cats or dogs at home, comorbid allergic rhinitis, autumn and winter seasons, lack of proficiency in inhalation techniques, and poor ICS medication compliance are risk factors for poor asthma control in school-age children.

Keywords: Asthma; Bronchial asthma; School-age children; Control rate; Influencing factor; Lanzhou

1. Introduction

Bronchial asthma is a common chronic respiratory disease in children. The 2019 Global Burden of Disease Study showed that asthma carries the heaviest disease burden among non-infectious respiratory diseases [1]. The control level of childhood asthma in China is not optimistic [2]. As childhood is a critical period of growth, poorly controlled asthma not only affects children' s daily life, learning, and social activities, but also adversely impacts their physical and mental health. China is a vast country with diverse economic development, geographical regions, cultural awareness, and lifestyles, leading to regional variations in childhood asthma control rates and risk factors. This study aims to investigate the control rate and influencing factors of poor asthma control among school-age children in Lanzhou, providing scientific evidence for the management of childhood bronchial asthma in this region.

2. Methods

2.1 Study Subjects

School-age children diagnosed with bronchial asthma at the outpatient and inpatient departments of the Department of Pediatrics, Gansu Provincial Maternal and Child-care Hospital (Gansu Provincial Central Hospital) from 2021 to 2023 were selected as study subjects. This study was approved by the Ethics Com-

mittee of Gansu Provincial Maternal and Child-care Hospital (Approval No.: (2023)GSFY 伦申 [57]). Guardians of all participating children signed informed consent forms.

2.1.1 Inclusion Criteria

(1) Children who had resided in Lanzhou, Gansu Province since birth, of any gender, aged 6-11 years; (2) Diagnosed with bronchial asthma according to the diagnostic criteria in the 2016 edition of the "Guidelines for the Diagnosis and Prevention of Bronchial Asthma in Children" [3]; (3) Children who received regular anti-asthma treatment for 3 months before assessment of asthma control level; (4) Children not in the acute exacerbation phase of bronchial asthma.

2.1.2 Exclusion Criteria

(1) Children with diseases that may cause wheezing, such as congenital tracheal stenosis, pertussis, tracheal foreign body, or persistent bronchiolitis; (2) Children with severe systemic diseases such as immunodeficiency, hepatic or renal insufficiency, cardiovascular disease, or tuberculosis; (3) Children with a history of psychiatric disorders or consciousness impairment that prevented cooperation, or whose guardians had communication difficulties; (4) Children and guardians who were unable to complete the questionnaire due to limited cognitive ability or other reasons.

2.2 Data Collection

2.2.1 Assessment and Grouping of Asthma Control Level The Childhood Asthma Control Test (C-ACT) was used to evaluate asthma control levels in children. For children aged 6-11 years, a C-ACT score ≥ 23 indicated complete control, 20-22 indicated partial control, and ≤ 19 indicated uncontrolled asthma. In this study, children with C-ACT scores ≥ 23 were defined as the controlled group, and those with scores < 23 as the uncontrolled group.

2.2.2 Data Collection Procedures Data on children's general demographic characteristics, first- and second-degree relatives' allergy history, birth and feeding history, triggering factors, and treatment compliance were collected. Overweight and obesity were defined using BMI cut-off values for corresponding gender and age groups [4]. Seasons were defined using meteorological classification: March-May as spring, June-August as summer, September-November as autumn, and December-February as winter. Compliance with inhaled corticosteroids (ICS) was assessed by classifying children who regularly used ICS as the good compliance group, and those who used ICS irregularly or only when symptomatic as the poor compliance group.

All investigators were pediatric respiratory or asthma specialists who received unified training. Questionnaires were completed through face-to-face or tele-

phone interviews (for patients without regular follow-up). When respondents could not understand questionnaire items, investigators provided explanations to ensure correct and reliable responses, thereby improving data quality.

2.3 Statistical Analysis

Statistical analysis was performed using SPSS 24.00 software. Categorical data were expressed as cases (%) and compared between groups using the ^{2} test. Potential influencing factors were first analyzed using univariate analysis, and factors with statistical significance were then included in multivariate Logistic regression analysis to explore influencing factors of asthma control levels in school-age children. P<0.05 was considered statistically significant.

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3. Results

3.1 General Characteristics and Control Rate

This study ultimately included 414 children with bronchial asthma, including 244 males (58.9%) and 170 females (41.1%), with a mean age of (7.64$±$1.94) years. Among the 414 children, 215 (51.9%) had completely controlled asthma, 153 (37.0%) had partially controlled asthma, and 46 (11.1%) had uncontrolled asthma. Based on C-ACT scores, children were divided into two groups: a controlled group with 215 cases (51.9%) and an uncontrolled group with 199 cases (48.1%).

There were no statistically significant differences between the two groups in terms of gender, ethnicity, BMI, first-degree relative allergic diseases, second-degree relative allergic diseases, premature birth, or recent home renovation (P>0.05). However, significant differences were observed in breastfeeding, keeping cats or dogs at home, comorbid allergic rhinitis, proficiency in inhalation techniques, season, and good ICS medication compliance (P<0.05, see Table 1).

3.2 Multivariate Logistic Analysis

Using asthma control level as the dependent variable and statistically significant indicators from univariate analysis as independent variables, multivariate Logistic regression analysis was performed (variable assignments are shown in Table 2). The results showed that keeping cats or dogs at home, comorbid allergic rhinitis, proficiency in inhalation techniques, autumn and winter seasons, and good ICS medication compliance were influencing factors of asthma control levels in school-age children (P<0.05). Specifically, keeping cats or dogs at home (OR=3.075, 95%CI=1.453-6.508, P=0.003), comorbid allergic rhinitis (OR=1.947, 95%CI=1.127-3.364, P=0.017), autumn (OR=3.891, 95%CI=2.008-7.519, P<0.001), and winter (OR=2.227, 95%CI=1.140-4.367, P=0.019) were associated with poor asthma control, while proficiency in inhalation techniques

(OR=0.191, 95%CI=0.117-0.312, P<0.001) and good ICS medication compliance (OR=0.202, 95%CI=0.123-0.332, P<0.001) were associated with better asthma control (see Table 3).

4. Discussion

With changes in the environment, lifestyle, and economic development, the prevalence of childhood asthma has gradually increased. In 2019, the prevalence of asthma among children aged 0-9 years worldwide was 4.21%, and 4.10% among those aged 10-14 years [1]. XIANG et al. [5] conducted a large-scale population survey on asthma control levels in Chinese children, revealing that 20% of children with asthma were uncontrolled and 52.1% had experienced acute asthma exacerbations in the past three months. Additionally, FAN et al. [6] reported that the asthma control rate among children aged 6-11 years in Xuzhou was 56.3%. YU et al. [7] found that the good control rate of asthma among children aged 4-11 years in Wuxi was 68.98%. LI et al. [8] reported that the good control rate of childhood asthma in Qingdao was 66.09%. LEI et al. [9] found that the asthma control rate in Qinghai Province was only 9.78%. These studies indicate significant regional variations in childhood asthma control levels. The results of this study showed that the asthma control rate among school-age children in Lanzhou was 51.9%. Compared with economically developed regions in China, asthma control levels in western regions (such as Lanzhou and Qinghai) lag behind and require substantial improvement. With the further implementation of the "China Childhood Asthma Action Plan" [10] and increased public awareness of asthma, the asthma control level among children in Lanzhou is expected to gradually improve.

This study identified keeping cats or dogs at home, comorbid allergic rhinitis, proficiency in inhalation techniques, autumn and winter seasons, and good ICS medication compliance as influencing factors of asthma control levels in school-age children (P<0.05). Among these, keeping cats or dogs at home, comorbid allergic rhinitis, and autumn and winter seasons were associated with poor asthma control, while proficiency in inhalation techniques and good ICS medication compliance were associated with better control. With improving living standards and increased emotional attachment to pets, the number of cat and dog owners in China continues to grow. Studies have shown that cat and dog dander are common allergens in children that can trigger asthma attacks [11-12]. The allergenic proteins carried by pet hair, dander, and saliva have strong environmental adhesiveness. These substances not only spread easily indoors through air circulation but also stubbornly attach to fabric fibers and hidden spaces. Even with regular cleaning and air purification, complete removal in a short time is difficult, leading to long-term retention of allergens. This persistent presence of allergenic materials significantly increases sensitization probability and interferes with effective asthma control. This study found a significant association between keeping cats or dogs and poor asthma control

in children, suggesting that families with asthmatic children should carefully evaluate the potential risks of pet ownership.

Allergic rhinitis and bronchial asthma are inflammatory allergic diseases within the same anatomical system. The presence of allergic rhinitis affects asthma control levels because nasal symptoms can lead to poor sleep quality at night, increased airway inflammation, and worsening asthma symptoms. Inflammation in the upper airway may increase lower airway reactivity. Additionally, symptoms of allergic rhinitis cause mouth breathing, which increases airway dryness and irritation. This study found that children with comorbid allergic rhinitis were more likely to have poorly controlled bronchial asthma, consistent with previous research [13-14]. Therefore, for children with both allergic rhinitis and bronchial asthma, objective assessment of rhinitis control and comprehensive management of both conditions are needed to improve asthma control rates.

Proficiency in inhalation techniques is crucial for asthma control in children and helps improve disease prognosis. Incorrect use of inhaler devices is common among pediatric patients and increases the proportion of poorly controlled asthma. Proper use of inhaler devices facilitates better asthma control, while incorrect inhalation technique directly affects drug deposition in the trachea and lungs. This study identified proficiency in asthma inhalation techniques as an influencing factor for asthma control levels in children, consistent with previous findings [6]. Healthcare professionals should first strengthen inhalation technique training to improve their professional guidance capabilities on device usage. Second, one-on-one instruction should be provided to children and their parents to ensure accurate and standardized inhalation techniques. Finally, a regular follow-up mechanism should be established to dynamically monitor inhaler device usage, identify errors promptly, and provide corrections, thereby improving asthma control levels.

ICS is an effective treatment for asthma that can control symptoms, improve lung function, reduce airway inflammation and hyperresponsiveness, and decrease asthma exacerbations [15-16]. This study demonstrated that good ICS medication compliance can improve asthma control levels in children, consistent with previous research [6-9,13,17]. Studies have shown that childhood asthma control levels are closely related to ICS medication compliance, and good compliance ensures standardized and smooth implementation of treatment, thereby improving asthma control [18]. Therefore, it is necessary to improve parents' understanding of bronchial asthma and ICS therapy through regular educational seminars that systematically explain asthma pathophysiology and the mechanism of ICS action, emphasizing the importance of standardized treatment. Additionally, a personalized consultation mechanism should be established where specialized healthcare professionals address specific concerns from parents to improve treatment compliance.

This study found that climatic and environmental factors during autumn and winter in Lanzhou significantly affect childhood asthma control levels. In recent years, abundant grass vegetation around Lanzhou, combined with its unique to-

pography and climate, has resulted in high pollen concentrations nationwide during autumn. Pollen is a major allergen for childhood asthma in Lanzhou, and its high concentration directly exacerbates asthma symptoms [19]. In autumn, Lanzhou experiences frequent cold air activity and a high incidence of thunderstorms. This phenomenon is closely related to Lanzhou' s geographical location in the subtropical high-pressure zone, where climatic conditions easily form convective weather such as thunderstorms, particularly at night. Research indicates that in the high humidity environment after thunderstorms, pollen grains rupture and release large amounts of small, easily inhalable pollen particles. Meanwhile, strong winds from thunderstorms accelerate the spread of these small pollen particles, making them more likely to enter the lower respiratory tract through the nasal cavity and trigger "thunderstorm asthma" [20]. In winter, Lanzhou' s climate becomes cold and dry, and the incidence of respiratory infections increases significantly. Additionally, concentrations of air pollutants (sulfur dioxide, nitrogen dioxide) increase during winter [21]. These factors collectively contribute to decreased asthma control levels in children. Based on these environmental changes, special attention should be paid to the impact of climate and environmental factors on asthma during autumn and winter. Clinicians should develop personalized treatment plans for children with bronchial asthma according to seasonal characteristics to improve asthma control rates and reduce the adverse effects of seasonal changes on the disease.

4.1 Limitations

This study has several limitations. First, it was a single-center study; future research should involve multiple hospitals in Lanzhou to more comprehensively understand asthma control rates and influencing factors among children in the region. Second, as a retrospective study, parents and children may have been subject to recall bias when assessing asthma control levels, particularly for time-related indicators such as nocturnal symptoms and medication frequency. Finally, the assessment of pet exposure was based solely on current ownership status, without quantifying exposure dose parameters such as dander concentration or pet activity areas. With the development of artificial intelligence, future research could develop machine learning-based exposure risk early warning systems and build localized tools to achieve dynamic graded early warning of asthma attack risks in this region.

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5. Conclusion

In summary, the control rate of bronchial asthma among school-age children in Lanzhou is not high. The influencing factors include keeping cats or dogs at home, comorbid allergic rhinitis, proficiency in inhalation techniques, autumn and winter seasons, and ICS medication compliance. Addressing these factors, pediatricians in Lanzhou are recommended to develop individualized treatment

plans based on each child' s specific condition in clinical practice, aiming to comprehensively improve asthma control levels among school-age children. Through precise and personalized management strategies, the prognosis of children with bronchial asthma can be further improved, ultimately achieving effective asthma control.

References

[1] GBD 2019 Adolescent Mortality Collaborators. Global, regional, and national mortality among young people aged 10-24 years, 1950-2019: a systematic analysis for the Global Burden of Disease Study 2019[J]. Lancet, 2021, 398(10311): 1593-1618. DOI: 10.1016/S0140-6736(21)01546-4.

[2] XIANG L, ZHAO J, ZHENG Y J, et al. Uncontrolled asthma and its risk factors in Chinese children: a cross-sectional observational study[J]. J Asthma, 2016, 53(7): 699-706. DOI: 10.3109/02770903.2016.1144199.

[3] Respiratory Group, Chinese Pediatric Society, Chinese Medical Association, Editorial Board of Chinese Journal of Pediatrics. Guidelines for the Diagnosis and Prevention of Bronchial Asthma in Children (2016 Edition)[J]. Chinese Journal of Pediatrics, 2016, 54(3): 167-181. DOI: 10.3760/cma.j.issn.0578-1310.2016.03.003.

[4] National Health and Family Planning Commission of the People' s Republic of China. Screening for Overweight and Obesity Among School-age Children and Adolescents: WS/T 586—2018[S]. Beijing: Standards Press of China, 2018.

[5] XIANG L, ZHAO J, ZHENG Y J, et al. Uncontrolled asthma and its risk factors in Chinese children: a cross-sectional observational study[J]. J Asthma, 2016, 53(7): 699-706. DOI: 10.3109/02770903.2016.1144199.

[6] FAN Yuan, GONG Liang, SHI Xinhui, et al. Control rate and risk factors for poor control of bronchial asthma in children aged 6-11 years in Xuzhou[J]. Chinese Journal of Applied Clinical Pediatrics, 2024, 39(5): 360-363.

[7] YU Yifang, SUI Lanxia, XUE Xin, et al. Asthma control level and its influencing factors in children with asthma in Wuxi area[J]. South China Journal of Preventive Medicine, 2023, 49(1): 48-53.

[8] LI Cui, JIN Rong, LIN Rongjun. Current status and influencing factors of bronchial asthma control in children in Qingdao area[J]. Journal of Jining Medical University, 2020, 43(6): 415-418.

[9] LEI Jiao, ZHANG Zuhao, LI Shuai, et al. Asthma control and treatment status of children with asthma in Qinghai Province[J]. Guangxi Medical Journal, 2022, 44(6): 635-639.

[10] SHEN Kunling. Control asthma, cherish life, implement the China Childhood Asthma Action Plan[J]. Chinese Journal of Applied Clinical Pediatrics,

2021, 36(6): 402-404.

[11] LUO S G, SUN Y X, HOU J, et al. Pet keeping in childhood and asthma and allergy among children in Tianjin area, China[J]. PLoS One, 2018, 13(5): e0197274. DOI: 10.1371/journal.pone.0197274.

[12] JI X Y, YAO Y, ZHENG P, et al. The relationship of domestic pet ownership with the risk of childhood asthma: a systematic review and meta-analysis[J]. Front Pediatr, 2022, 10: 953330. DOI: 10.3389/fped.2022.953330.

[13] XING Yan, LI Nan, ZHOU Wei, et al. Control level and influencing factors of asthma in children aged 4-11 years[J]. Journal of Peking University (Health Sciences), 2014, 46(6): 940-945. DOI: 10.3969/j.issn.1671-167X.2014.06.023.

[14] DE VITTORI V, PACILIO A, INDINNIMEO L, et al. When asthma and rhinitis coexist, could rhinitis reduce asthma control in children?[J]. Allergy Asthma Proc, 2019, 40(3): e8-13. DOI: 10.2500/aap.2019.40.4219.

[15] BAO Yixiao, LIN Qian, BAO Jun. Improving compliance with inhaled corticosteroid therapy to effectively control childhood asthma[J]. Chinese Journal of Practical Pediatrics, 2013, 28(11): 801-803.

[16] Asthma Group, Chinese Thoracic Society, Chinese Medical Association. Guidelines for the Prevention and Treatment of Bronchial Asthma (2020 Edition)[J]. Chinese Journal of Tuberculosis and Respiratory Diseases, 2020, 43(12): 1023-1048.

[17] TAN Li, ZHANG Quan, WU Chengqing, et al. Analysis of influencing factors and evaluation indicators of asthma control level in children[J]. Chinese Journal of Contemporary Pediatrics, 2016, 18(9): 812-816. DOI: 10.7499/j.issn.1008-8830.2016.09.005.

[18] HUANG Chuanjun, ZHAO Fangzheng, CHEN Fangfang, et al. Inhaled corticosteroids can effectively control airway inflammation in bronchial asthma[J]. Chinese Journal of Tuberculosis and Respiratory Diseases, 2018, 41(11): 859-862.

[19] NA Feiyang, WANG Jinping, GUO Li, et al. Results of skin prick test for allergens in 438 children with asthma in Lanzhou area[J]. Chinese Journal of Clinical Immunology and Allergy, 2021, 15(4): 384-389.

[20] XU Yingyang, LI Lisha, GUAN Kai. Thunderstorm asthma[J]. Chinese Journal of Clinical Immunology and Allergy, 2020, 14(1): 67-70.

[21] LI Longyan, WANG Jinyan, XIE Xiangshan, et al. Impact of winter air pollution on asthma in Lanzhou City[J]. Environmental Protection Science, 2022, 48(3): 94-98. DOI: 10.16803/j.cnki.issn.1004-6216.2022.03.015.

Author Contributions

NA Feiyang and WANG Yannan were responsible for study design, manuscript writing, submission, and revision; ZHANG Rongfang, ZHAO Qijun, LIANG Xuan, and WANG Yong were responsible for study implementation, data collection, and organization; NA Feiyang and WANG Yannan were responsible for quality control. This article has no conflicts of interest.

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