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EMPOVERING ASTHMA PATIENTS THROUGH PHARMACIST LED EDUCATION: EFFECTS ON ADHERENCE AND QUALITY OF LIFE

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Abstract:
Background: *Asthma is a chronic inflammatory disease of the reversible airway obstruction increased sensitivity to triggers recurring symptoms such as shortness of breath, wheezing, chest tightness, cough.*
Methodology: *A prospective study was conducted on eligible asthma patients and randomized into test and control. The MARS and AQLQ was administered. Test group patients received education at every follow-up while control group received at the end of the study.*
Results: *726 patients analysed, Medication adherence and quality of life showed notable differences between the groups it is baseline both the control group and test group demonstrated poor adherence with medication adherence rating scale (MARS) scores around 30%. Over the follow-up period, The test group exhibited a significantly improvement in adherence, reaching 90% by the final assessment ($p<0.001$), while the control group showed no meaningful change. Similarly quality of life assessed using asthma quality of life scores was initially low (30%) in both groups. By the end of the study the test group experienced a marked improvement to 90% whereas the control group remained unchanged. These findings indicate the intervention significantly enhanced both medication adherence and quality of life in the test group compared to the control group.*
Conclusion: *Pharmacist led education has shown a positive impact on asthma control and medication adherence behaviour among test group patients.*
Keywords: *Asthma, pharmacist – mediated education, therapeutic adherence, exacerbation prevention*

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INTRODUCTION:

Asthma is a chronic inflammatory disorder of the airways characterized by variable and recurring symptoms, reversible airflow obstruction, and bronchial hyperresponsiveness. It is one of the most common respiratory diseases worldwide, affecting approximately 1–29% of the global population, with significant variations across regions and age groups. Clinically, asthma presents with symptoms such as wheezing, shortness of breath, chest tightness, and coughing, particularly at night or early morning, which result from limitation of expiratory airflow.(1)

Epidemiology:

Asthma represents a major global health burden. According to the World Health Organization, approximately 262 million people are affected by asthma worldwide, and nearly 455,000 deaths have been attributed to the disease. The prevalence of asthma increased notably during the late 20th century; for instance, between 1989 and 1992, reported cases rose from 34.7 to 49.4 per 1,000 individuals, indicating a significant rise in incidence and diagnosis.

In 1989, the Global Initiative for Asthma was established to improve asthma awareness, prevention, and management strategies globally. This initiative has played a key role in standardizing treatment guidelines and reducing disease burden.(2,3,4).

Etiology (Causes):

Asthma is a multifactorial disease resulting from a complex interaction between genetic predisposition and environmental exposures. It is often associated with polygenic inheritance and involves immunological mechanisms, particularly the role of immunoglobulin E (Ige) in hypersensitivity reactions. Common triggers and risk factors include: Air pollutants and environmental toxins, Exposure to allergens such as dust mites, pollen, and molds, Occupational chemicals and irritants, Respiratory infections and many more. These factors contribute to airway inflammation and hyperresponsiveness, ultimately leading to airflow obstruction.(4,6)

Asthma primarily affects the lungs, particularly the bronchial airways. The disease is characterized by two phases of inflammatory response:

Early Phase Reaction – Triggered by allergen exposure leading to mast cell activation and release of mediators such as histamine, causing bronchoconstriction

Late Phase Reaction – Involves recruitment of inflammatory cells (e.g., eosinophils, T-lymphocytes), resulting in sustained airway inflammation, edema, and mucus hypersecretion. These changes lead to airway narrowing, increased resistance, and impaired airflow, especially during expiration.(4)

Asthma can be classified into several types based on triggers and clinical presentation: Allergic (Extrinsic) Asthma, Cough-Variant Asthma, Exercise-Induced Asthma Occupational Asthma, Asthma-COPD Overlap Syndrome (ACOS).(5)

The diagnosis of asthma involves clinical evaluation and objective testing of lung function: Pulmonary Function Tests (PFTs), Spirometry, Peak Expiratory Flow (PEF) Measurement, Bronchodilator Reversibility Testing,

Bronchial Provocation (Challenge) Tests, these assess airway hyperresponsiveness using: Inhaled pharmacological agents, Allergens, Exercise or hyperventilation, Blood investigations (e.g., eosinophil count, Ige levels), Imaging such as chest CT scan.(6)

Asthma management involves both reliever (short-term) and controller (long-term) medications: Short-Acting $Beta_2$-Agonists (SABA), e.g., Albuterol, Levalbuterol, Long-Acting $Beta_2$-Agonists (LABA) combined with Inhaled Corticosteroids (ICS), Leukotriene Receptor Antagonists, Immunomodulators (Biologic therapies).(7)

The primary goal of treatment is to achieve symptom control, prevent exacerbations, and improve quality of life.

METHOD AND MATERIALS:

Design and Ethics

This prospective study was conducted in the inpatients and outpatient departments of hospital in Telangana, India over 7 months. Asthma patient (disease duration <3 years) meeting inclusion criteria were enrolled using block randomization.

Patients with psychiatric illness, pregnancy, or severe illness were excluded.

Participants

Asthma patients were enrolled from the inpatient and outpatient departments. A structured data collection form recorded patient demographics details, education, social habits, socioeconomic status, past medical/medication history, family history, allergies, marital status, smoking, and alcohol status.

Assessments

Medication adherence was assessed using the 10-item Medication Adherence Rating Scale (MARS), with scores ranging from 0 to 10 (higher scores indicating better adherence). Asthma Quality of Life (AQL) was used to assess asthma risk. Spirometry measurements (FEV1 and FVC) were conducted at baseline and final follow-up.

Intervention

The test group received pharmacist-mediated structured education on disease, medications, diet, and lifestyle at baseline and follow-ups, along with a patient information leaflet. The control group received education only at the final follow-up.

Data Collection

Data were collected using the structured form at baseline and follow-up, alongside MARS, AQL, and spirometry assessments.

Statistical Analysis

Statistical analysis was performed using by SPSS. The Wilcoxon signed-rank test assessed variations in MARS, AQL scores, FEV1, FVC, and complications from baseline to final follow-up. A p-value <0.05 was considered statistically significant.

RESULTS:

A total of 726 patients from the pulmonology department of MAMS Hospital were included in the study, with their details presented in the table below

Table: 1. DEMOGRAPHIC DETAILS OF THE ASTHMA PATIENTS

PARAMETER	CONTROL (n=363)	TEST (n=363)
Gender	N(%)	N(%)
• Male	200(55.09)	196(53.99)
• Female	163(44.9)	167(46)
Age		
• 10-20	58(15.97)	43(11.8)
• 21-30	115(31.68)	126(34.71)
• 31-40	68(18.7)	97(26.72)
• 41-50	26(7.16)	17(4.68)
• 51-60	83(22.8)	62(17.07)
• 61-70	13(3.58)	18(4.95)
Educational Qualification		
• Uneducated	108(29.75)	93(25.61)
• Primary school	58(15.97)	116((31.95)
• Secondary school	13(3.58)	28(7.71)
• Intermediate	109(30.02)	44(12.12)
• Graduate	75(20.66)	82(22.58)
Occupational Status		

• Farmer	67(18.45)	81(22.31)
• Daily wage worker	83(22.86)	91(25.06)
• Housewife	33(9.09)	39(10.7
• Business	19(5.23)	26(7.16)
• IT employee	87(23.96)	52(14.32)
• Teacher	3(0.08)	9(2.47)
• Engineer	32(8.81)	29(7.98)
• Others	39(10.7)	36(9.91)
Annual Income		
• <50,000	39(10.74)	76(20.93)
• 50,001-1,00,00	198((54.54)	182(50.13)
• 1,00,001-1,50.000	36(9.91)	43(11.84)
• 1,50,001-3,00,000	23(6.33)	18(4.95)
• 3,00,001-5,00,000	43((11.84)	236.33)
• >5,00,000	24(6.61)	21(5.78)
Marital Status		
• Married	228(62.8)	258(71.07)
• Unmarried	112(30.85)	116(31.95)
• Divorce	23(6.33)	11(3.03)
Alcoholic Status		
• Non-alcoholic	89(24.51)	110(30.3)
• Social drinker	128(35.26)	82(22.58)
• Alcoholic	96(26.44)	99(27.27)
• Past alcoholic	50((13.77)	7219.83)
Smoking Status		
• Non- Smoker	168(51.23)	193(53.16)
• Smoker	99(27.27)	112(30.85)
• Past smoker	78(21.48)	58(15.97)

The sample size was determined using Cochran's formula for an unlimited population, with a required sample size of 385.The present study enrolled a total of 785 patients. During the study, 59 patients (7.51%) were lost to follow-up, resulting in a final sample of 726 patients.

Out of the 726 patients, 363 were randomized into the test group and 363 into the control group. The majority of patients in both groups were male, with 296 patients in the control group and 52.34 ± 13.78 years. In both the control and test groups, the majority of patients belonged to the 21 - 30 years age category.

Based on educational qualification, most patients in the control group had an intermediate level of education, whereas in the test group the majority had completed primary school.

In the present study, most patients in the control group were employed in the IT profession, while the majority in the test group were daily wage laborers.

The annual income of most patients in both the control and test groups ranged between INR 50,001 and 1,00,000.

Most patients in both the control and test groups were married, accounting for 228 (62.8%) and 258(71.07%) respectively.

Regarding alcohol consumption, the majority of patients in the control group were social drinkers (128;35.26%), whereas in the test group most were non-alcoholics (110;30.3%).

The majority of patients in both the control and test groups were non-smokers, accounting for 168(51.23%) and 193(53.16%) respectively.

MEDIAN FEV1 SCORES AMONG CONTROL AND TEST GROUP

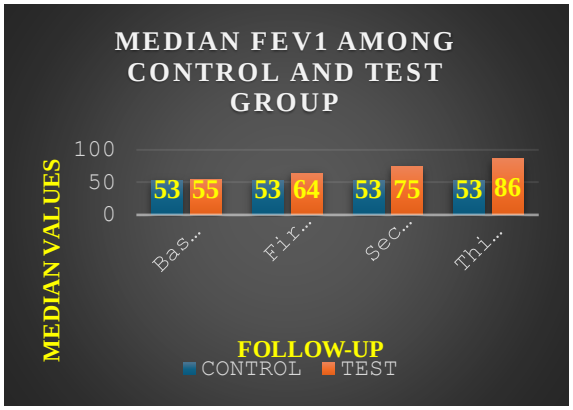

Fig:1. Median FEV1 scores among control and test group

From baseline to the last follow-up, FEV1 scores were assessed for all enrolled patients. By the end of the follow-up, the test group's FEV1 scores had significantly improved from 55-86($p<0.001$), while the control group's FEV1 values had not increased during the study($p>0.91$).

MEDIAN FVC SCORES AMONG CONTROL AND TEST GROUP

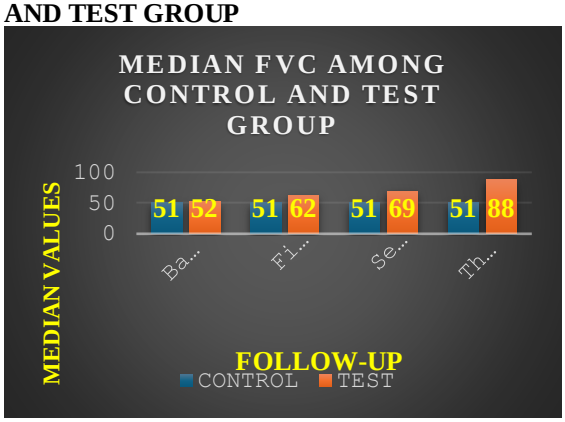

Fig:2. Median FVC scores among control and test group

From baseline to the last follow-up, FVC scores were assessed for all enrolled patients. By the end of the follow-up, test group patients FVC scores had significantly increased from 51-88($p<0.001$), while the control group's FVC values had not increased during the research($p>0.41$).

MEDIAN PEF SCORES AMONG CONTROL AND TEST GROUP

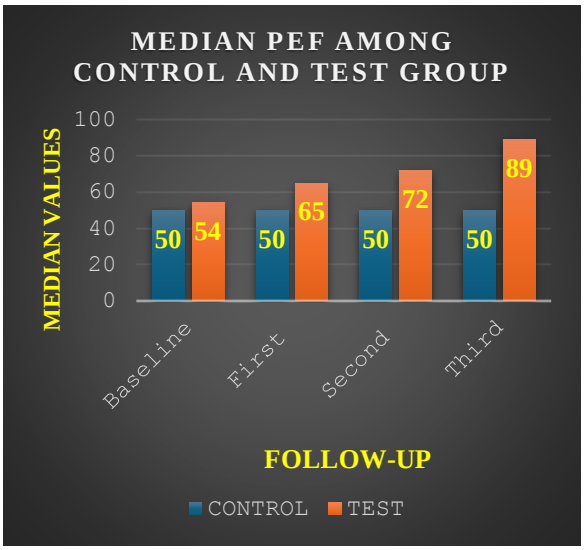

Fig:3. Median PEF scores among control and test group

From baseline to the last follow-up, PEF scores were calculated for all enrolled patients. By the end of the follow-up, the test group patient's PEF scores had significantly increased from 51-88($p<0.001$), while the control group's PEF values did not increase during the research($p>0.29$).

Mean and Median scores of the MARS questionnaire among control and test groups

Descriptive statistics was applied to obtain mean and median values of the MARS (Medication Adherence Rating Scale) for every follow-up are represented in table

Table: 2. Mean and Median scores of the MARS questionnaire among control and test groups

Medication adherence scores	**Control 0** Mean±SD Median [IQR]	**Control 1** Mean±SD Median [IQR]	**Control 2** Mean±SD Median [IQR]	**Control 3** Mean±SD Median [IQR]	**Test 0** Mean±SD Median [IQR]	**Test 1** Mean±SD Median [IQR]	**Test 2** Mean±SD Median [IQR]	**Test 3** Mean±SD Median [IQR]
MARS	2.63±0.615 3 (2-3)	3.02±0.692 3 (3-30)	3.20±0.831 3 (3-3)	3.66±4.0 3 (3-4)	3.02±1.038 3 (2-4)	4.71±1.288 5 (4-6)	6.72±0.714 7 (6-7)	8.60±0.676 9 (8-9)

The medication adherence behavior of patients in both groups was evaluated at baseline, first, second, and final follow-up using the Medication Adherence Rating Scale, as the table illustrates. Patients in the test group showed a considerable improvement in their medication behavior when compared to those in the control group.

From baseline to the last follow-up, MARS scores were estimated for every patient who was enrolled. Both groups had poor adherence at the beginning (Baseline), with MARS scores of (30%) for the control group and 3(30%) for the test group. By the last check-in, the test group's medication adherence knowledge had significantly improved to 9 (90%), but the control group's knowledge had not changed.

Comparison of MARS scores between the follow-ups among the control and test groups:

Patients in both groups were evaluated for medication adherence behavior at baseline, first, second, and final follow-up using the Medication Adherence Rating Scale. Patients in the test group showed significantly better medication behavior ($p<0.001$) than patients in the control group ($p>0.005$).

Mean and Median scores of the Asthma Quality of Life among control and test groups:

The Asthma Quality of Life was used to evaluate the patient's quality at baseline, first, second, and final follow-up in both groups, as the table demonstrates. Patients in the test group showed a showed a marked increase in quality of life when compared to those in the control group.

From baseline to the final follow-up, AQL scores were assessed for every patient who was enrolled. With AQL values of 224(30%) for the control group and 224(30%) for the test group, both groups experienced poor quality of life at the beginning (Baseline). By the last follow-up, the test group's quality of life had significantly improved (224, or 90%), but the control group's quality of life had not changed.

Patients in both groups had their quality of life evaluated at baseline, first, second, and final follow-ups using the Medication Adherence Rating Scale. Patients in the test group showed significantly better medication behavior ($p<0.001$) than patients in the control group ($p>0.05$).

DISCUSSION:

Patient education in asthma plays a major role in reducing hospitalization and adverse effects. Globally, asthma is a long-term disease for any age group, we need better medications and education of patient are needed in order to reduce the prevalence of asthma. Reasons for poor medication adherence include: Lack of communication/ knowledge between a physician and patient, patient decision to find an alternative to current treatment, listening to peers' opinion on medication. (1)

In order to improve patient medication adherence, we carried out prospective observational research. We shared knowledge of asthma, causes, side effects of medications and triggers of asthma, healthy diet and exercise to be followed. The main aim of study is to estimate the impact of patient education in asthma. We had a positive impact by providing education on asthma through prospective research in a tertiary care hospital. In order to assess patient, the medication adherence we used Asthma quality of life questionnaire and Medication adherence report scale (MARS) forms. (2).

Subjects are divided into 2 groups knows as Test and Control; control group subjects didn't receive any means of education on the other hand test group received patient education. At baseline responders/ subjects showed poor level of control in asthma. After continuous education by various approaches subjects made a significant change in the asthma control. Visible outcomes including reduction of symptoms like wheezing and shortness of breath and improvement/ changes in FEV1 values are seen.

Post education of patients, the test group subjects had scored high in knowledge when compared to control group subjects in all 4 domains of asthma quality of life questionnaire, this helped in improving knowledge in ay areas like to identify triggers, symptom identification, level of severity etc., various triggers of asthma like allergens, smoke, previous history was also assessed and properly educated.

726 subjects are analyzed, at baseline both groups were with poor adherence in both scales at 30%, over a period of time the test group improved to 90%, final assessment P (< 0.001), control group had not depicted any significant change.

This result of study clearly depicts the importance of asthma education should be added along with pharmacological treatment, this type of approach will not only enhance the knowledge on asthma but also enable subjects for better control of the disease which contributes to reduce the frequency of visits, hospitalization and complications. This study enhances the role of clinical pharmacist in improving asthma control through various approaches.

CONCLUSION:

Pharmacist-Led educational interventions constitute a critical and evidence-driven technique in boosting therapeutic outcomes among patients with asthma, notably by addressing multifactorial barriers associated with poor medication adherence and inefficient self-management. Asthma, being a chronic inflammatory illness, demands not only pharmaceutical treatment but also sustained patient engagement, knowledge, and behavioural adaptation-domains in which pharmacists play a highly important role. In the present study, the implementation of structured, patient-centred counselling combined with systematic follow-up significantly improved patients' cognitive and practical understanding of asthma pathophysiology, appropriate inhaler technique, and the long-term significance of adherence to maintenance therapy.

Quantitative study using the Medication Adherence Reporting Scale (MARS) indicated a statistically and clinically significant improvement in adherence levels among patients receiving pharmacist-led interventions. This research emphasises the importance of targeted instructional interventions in fostering lasting behavioural change, which is often problematic in chronic disease treatment. Furthermore, improvements observed in the Asthma Quality of Life (AQL) scores show not just better symptom control but also a broader increase in patients' physical, emotional and social well-being. The reduction in exacerbation frequency and better functional capacity further show the translation influence of enhanced adherence on clinical outcomes.

These results underscore the crucial involvement of pharmacists within a multidisciplinary healthcare system, especially in chronic respiratory illnesses, where long-term disease treatment is strongly dependent on patient behaviour and awareness. Pharmacists, by tailored instruction, constant therapeutic monitoring, and reinforcement of good practices, efficiently bridge the gap between prescription therapy and real-world patient utilisation. Their accessibility and frequent patient interactions position them perfectly to identify and rectify adherence-related difficulties in a timely manner.

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REFERENCES:

1) Jennifer Golden et.al. Asthma, May 3, 2004, National Library of Medicine, [2861365]

2) Prof. Alberto Papi MD et.al. Asthma, 24 March 2018, Science Direct, Pages 783–800, [Volume 39]

3) Jennifer E. Ferguson et.al. Acute Asthma: Prognosis and Treatment, February 2017, The Journal of Allergy and Clinical Immunology, Pages B438–447, [Volume 139]

4) Gauseem Gohal et.al. A Review on Asthma and Allergy: Current Understanding on Molecular Perspectives, 2019, [Volume 13 (13195775)], Published in MDPI

5) Yvette Brazier et.al. Types, Causes, Treatment, and Diagnosis of Asthma, Medical News Today, Jan 5, 2023

6) Hasanin Khachie et.al. Asthma: Pathophysiology, Causes and Diagnosis, 21 Nov 2014, The PJT

7) Padmaja Subbarao et.al. Asthma: Epidemiology, Etiology and Risk Factors, 27 Oct 2009, National Library of Medicine, [19752106]

8) Richard Beasley DM et.al. Prevalence and Etiology of Asthma, Feb 2000, Pages 466–472, [Volume 105], Science Direct

9) Alberto Papi et.al. Treatment strategies for asthma: reshaping the concept of asthma management, 15 Aug 2020, National Library of Medicine

10) Ashleigh Witt et.al. Overview of recent advancements in asthma management, Volume 52, Issue 9, Internal Medicine Journal, Wiley, 13 Sept 2022

11) Desiree Larenas-Linnemann MD et.al. New advances in asthma care: Improving management and outcomes, Volume 13, Issue 7, July 2025

12) William J. Calhoun et.al. The new era of add-on asthma treatments: where do we stand?, 21 May 2022, Volume 18

13) K.F. Rabe, Pharmacological treatment of asthma today, European Respiratory Journal, 2001

14) Xipeng Zhang et.al. Bitter taste receptors as therapeutic targets in asthma, Taylor & Francis, 1 Sept 2025

15) Livio MN et.al. Prevalence and risk factors of asthma in children, THE LANCET

16) Yiyan Miao et.al. Circulating inflammatory proteins and therapeutic targets in asthma, Taylor & Francis, 8 Sept 2025

17) Willie Leong et.al. Physical activity levels in individuals with asthma

18) Michelle C. Maciag et.al. Prevention of asthma, CHEST, 2020

19) Erika Von Mutius MD, Primary prevention of asthma, 2020

20) James E. Gern MD, Challenges and opportunities in asthma prevention, 2023

21) E.D. Bateman et.al. Global strategy for asthma management and prevention, European Respiratory Journal, 2007

22) Milos Jesenak MD et.al. Promoting prevention and targeting remission of asthma, CHEST Journal, 2025

23) Neil Skolnik et.al. Best practice advice for asthma exacerbation prevention and management, 2024

24) Anshika Garg et.al. Association of sleep quality with asthma control, ResearchGate

25) Adel H. Mansour et.al. Biologic therapy practices in severe asthma, ResearchGate, 2022

26) Emran Ozdemir et.al. Asthma, ResearchGate, 2016

27) Peng Han et.al. Prevention of fatal pediatric asthma in China, ResearchGate, 2025

28) Alberto Garcia de la Fuente et.al. Asthma, infections and immunodeficiency, ResearchGate, 2025

29) Viju Gopikidinolal et.al. Bronchial asthma in pregnant women, ResearchGate, 2025

30) Tari Haahtela et.al. EAACI guidelines on green space and asthma prevention, 2025

31) Basma M.E. Mohamed et.al. Impact of counseling techniques on children asthma control, 2023

32) Basma M.E. Mohamed et.al. Impact of patient education on adult asthma control, 2025

33) Basma M.E. Mohamed et.al. Effectiveness of advanced verbal counseling in asthma, 2025

34) Nabila Iaz et.al. Counseling strategies for better asthma control, 2023

35) Basma M.E. Mohamed et.al. Efficacy comparison in asthma counseling, 2024

36) Muhammad Asad Abbas et.al. Improvement in inhaler techniques after counseling, 2024

37) Gavva Rajavaria et.al. Role of clinical pharmacist in counseling asthma patients, 2020

38) Rashid Iqbal et.al. Impact of counseling on inhaler technique, Pakistan Journal

39) Abeera Khaashid et.al. Enhancing inhaler technique using AI tools, Pharmacia, 2025

40) Singh A, Sharma R. The significant role of diet and yoga in the management of bronchial asthma: a comprehensive review. J Complement Integr Med. 2023;20(2):145–158. doi:10.1515/jcim-2023-0012

41) Jiang Y, Rosner B, Willett WC, et.al. Plant-based diets, genetic predisposition, and the risk of adult-onset asthma: a prospective study. JAMA Netw Open. 2022;5(8):e2224567. doi:10.1001/jamanetworkopen.2022.24567

42) Patel DK, Sharma P. Role of Ayurvedic diet and herbs as dietary adjuncts in the management of bronchial asthma: an overview. J Ayurveda Integr Med. 2021;12(4):789–795. doi:10.1016/j.jaim.2020.11.003

43) Li X, Wang M, Hu FB, et.al. Long-term air pollution exposure, plant-based diet and asthma exacerbations in the Nurses' Health Study II. Environ Health Perspect. 2023;131(5):57001. doi:10.1289/EHP12345

44) Global Initiative for Asthma (GINA). Advancing asthma treatment beyond the clinic. Eur Respir J. 2023;61(3):2202345. doi:10.1183/13993003.02345-2022

45) Dhami S, Kakourou A, Asamoah F, et.al. Allergen immunotherapy for the prevention of allergic asthma: a systematic review and meta-analysis. Allergy. 2017;72(1):35–44. doi:10.1111/all.13013

46) Wong GWK, Ko FW, Hui DSC, et.al. Changing trends and challenges in the management of asthma in Asia. J Allergy Clin Immunol. 2021;148(5):1235–1245. doi:10.1016/j.jaci.2021.07.012

47) WJ, Kang MG, Chang YS, et.al. Risk factors of asthma in the Asian population: a systematic review and meta-analysis. J Physiol Anthropol. 2022;41(1):15. doi:10.1186/s40101-022-00278-9

48) GBD 2021 Asthma Collaborators. Patterns and trends in burden of asthma and its attributable risk factors from 1990 to 2021 among South Asian countries: a systematic analysis for the Global Burden of Disease Study 2021. J Asthma. 2024;62(6):789–805. doi:10.1080/02770903.2024.1234567

49) Lee JY, Khoo SM, Tan WC, et.al. Personalising care of adults with asthma from Asia: a modified e-Delphi consensus study to inform management tailored to attitude and control profiles. NPJ Prim Care Respir Med. 2022;32(1):25. doi:10.1038/s41533-022-00274-3

50) Barnes PJ, Drazen JM. Patient education: asthma treatment in adolescents and adults (beyond the basics). UpToDate. Waltham (MA): UpToDate Inc.; 2024. Available from: https://www.uptodate.com

51) Wen-Yi-Liu et.al. Effect of asthma education on health outcomes in children: a systematic review feb 23 ,107 (12):1100-1105.

52) Hannan Ei Abed et.al. Impact of therapeutic education on asthma control, medication adherence, knowledge and quality of life in Moccoron adult asthma patients, 26 July 2023, volume 16.

53)Tirhas, Gebredhin, Gebreilassie et.al. Effect of asthma education intervention on self-management knowledge and control level in Tigray Northern Ethiopia; A quasi experimental study 15 march 2025 volume 25 article number 120.