

The Relationship Between Peak Expiratory Flow Values and The Quality of Life among Asthma Patients

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Abstract:

Asthma is a common respiratory disease that significantly impacts patients' quality of life. Despite advances in asthma management, challenges remain in controlling symptoms and maintaining patients' quality of life. Peak Expiratory Flow (PEF) is an important parameter for monitoring lung function and managing asthma effectively. This study explores the relationship between Peak Expiratory Flow (PEF) values and the quality of life of asthma patients at the Pulmonary Polyclinic of Bhayangkara Lumajang Hospital. The study design used was observational analytics with a cross-sectional approach. The study population consisted of asthma patients undergoing regular check-ups at the pulmonary clinic, with a sample size of 60 patients selected through accidental sampling. Data were collected using a peak flow meter to measure PEF values and the Standardized Asthma Quality of Life Questionnaire (AQLQ-S) to assess patients' quality of life. Data analysis was conducted using the Spearman rank correlation test. The results showed that 37 respondents (61.7%) experienced airway narrowing, while 23 respondents (38.3%) had more severe airway narrowing. Regarding quality of life, 34 respondents (56.7%) fell into the moderate quality of life category, while 26 respondents (43.3%) were in the poor quality of life category. Spearman rank correlation analysis revealed a significant relationship between PEF values and the quality of life of asthma patients, with a p -value = 0.000. This indicates that higher PEF values are associated with better quality of life among asthma patients. The study concludes that PEF is an important indicator for assessing the quality of life of asthma patients, and regular PEF monitoring can help improve their quality of life. This research provides a foundation for developing more effective asthma management strategies.

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INTRODUCTION

Asthma is a respiratory disease with a high prevalence rate in Indonesia and remains a significant health issue in nearly all countries worldwide (Le Souëf et al., 2024; Van Beveren et al., 2023). Asthma is a chronic respiratory system condition characterized by symptoms such as wheezing, coughing, and chest tightness caused by airway obstruction (Lisznay et al., 2024; Kurnianto et al., 2022). Uncontrolled asthma symptoms can adversely affect patients' quality of life, not only by increasing healthcare costs but also by hindering daily activities, reducing productivity, altering job functions, and potentially contributing to mortality (Jansen et al., 2021; Larsson et al., 2020; Menzies-Gow et al., 2022).

Asthma affects over 12 million Indonesians or approximately 4.5% of the total population. Data from the East Java Basic Health Research shows that East Java ranked 13th among Indonesian provinces in asthma prevalence, with a rate of 5.1% in 2013, decreasing to 2.57% in 2018. However, 58.7% of asthma patients experienced relapse within the last 12 months (Primarani & Megastsari, 2022). In Lumajang City, asthma prevalence reached 3.88%. A preliminary study conducted in March 2024 at the pulmonary clinic of Bhayangkara Lumajang Hospital revealed a significant increase in asthma patient visits over the past three months. In December 2023, there were 60 patient visits, which rose to 69 in January 2024 and 84 in February 2024. Additionally, 7 out of 10 patients (70%) had a Peak Expiratory Flow (PEF) percentage of 60–80%, while three patients (30%) had a PEF percentage of 81–100%. Using the Standardized Asthma Quality of Life Questionnaire (AQLQ-S), it was found that 6 out of 10 patients (60%) had a moderate quality of life with scores ranging from 3 to 5, 3 patients (30%) had a good quality of life with scores ranging from 6 to 7, and 1 patient (10%) had a poor quality of life with scores ranging from 1 to 2.

Asthma involves three simultaneous processes: airway inflammation, bronchoconstriction, and excessive mucus secretion. Acute asthma attacks often begin with persistent coughing and difficulty inhaling or exhaling, causing discomfort and pain (Amantéa, 2024; Chacko et al., 2020; Shulhan-Kilroy et al., 2022). Asthma symptoms such as wheezing, shortness of breath, chest tightness, and coughing vary in frequency, duration, and intensity. In emergencies, patients diagnosed with bronchial asthma may experience airway, breathing, and circulation issues. Asthma attacks can lead to respiratory rates dropping to over 30 breaths per minute, a critical condition requiring immediate intervention to prevent fatal outcomes (Sun et al., 2024; Mazurek et al., 2023).

Asthma significantly impacts the quality of life, as symptoms like breathlessness, coughing, and wheezing cause discomfort and restrict routine daily activities, ultimately reducing patients' quality of life (Lee et al., 2025; Ma et al., 2024). Asthma management focuses on symptom reduction through effective control. Asthma control can be assessed using parameters such as the Asthma Control Test (ACT), which evaluates limitations in daily activities, nighttime symptoms, use of relief medications, and perceived asthma control (Alyas et al., 2025; Akca et al., 2024). PEF measurements using a Peak Expiratory Flow Meter (PEF meter) provide a simple method to assess airflow limitation. Forced Expiratory Volume in One Second (FEV1) and Forced Vital Capacity (FVC) are measured using forced expiration maneuvers. The highest value from two to three repeatable and acceptable attempts is recorded. Airway obstruction is confirmed when FEV1 or FVC ratios fall below 75% or 80% of predicted values (Alicandro et al., 2024; Alzate et al., 2024).

A study (Kharaba et al., 2022) involving 74 participants found that symptoms such as shortness of breath, anxiety, sleep disturbances, prior chest discomfort, and depression contribute to a decline in quality of life. Conversely, higher education levels are associated with improved quality of life. Similarly, (Ali et al., 2020) reported that among 134 bronchial asthma patients, 96 (71.4%) had a low quality of life. Factors such as age (≥ 40 years), obesity, female gender, family history of asthma, presence of pets at home, and moderate asthma severity were significantly associated with poor quality of life.

METHOD

This research employed an observational analytic type with a cross-sectional design, focusing on measuring independent and dependent variables simultaneously at one point. The study was conducted at the Pulmonary Clinic of Bhayangkara Hospital, Lumajang, targeting asthma patients with an average monthly visit rate of 60. The accidental sampling technique was applied to select 57 respondents who met the inclusion criteria (e.g., patients aged 18–60 with controlled asthma) and

exclusion criteria (e.g., acute asthma attacks or other complications). Peak expiratory flow (PEF) was measured using a peak flow meter, while the AQLQ(S) questionnaire assessed quality of life. The study was conducted from July 15 to August 15, 2024, encompassing administrative preparations, respondent identification, PEF measurements, and questionnaire distribution. Data were processed using IBM SPSS software to analyze the correlation between PEF and patients' quality of life. Interpretation was performed to evaluate the relationship between these variables statistically. This research has met ethical requirements and obtained approval from the Faculty of Health Sciences Ethics Committee, Hafshawaty Zainul Hasan University, 2024.

RESULT

Table 1. Characteristics of Respondents (n=60)

Characteristics	Frequency	Percentage (%)
Age		
18 – 23 year	8	13.3
24 – 29 year	10	16.7
30 – 35 year	9	15.0
36 – 41 year	4	6.7
42 – 47 year	7	11.7
48 – 53 year	7	11.7
54 – 60 year	15	25.0
Gender		
Male	13	21.7
Female	47	78.3
Education		
No Schooling	4	6.7
Elementary School	11	18.3
Junior High School	9	15
Senior High School	20	33.3
Higher Education	16	26.7
Occupation		
Not Working	19	31.7
Student	6	10.0
Entrepreneur	6	10.0
Private Sector Employee	12	20.0
Civil Servant (PNS)	17	28.3
Family History of Asthma		
Yes	44	73.3
No	16	26.7

The respondents' demographic characteristics show that most are aged 54-60 years (25.0%), with a higher proportion of females (78.3%) compared to males (21.7%). Regarding education, the largest group has completed Senior High School (33.3%), followed by Higher Education (26.7%). Occupation-wise, 31.7% are not working, 28.3% are Civil Servants, and 20.0% are Private Sector Employees. Additionally, 73.3% of respondents have a family history of asthma. These findings clearly describe the respondents' age, gender, education, occupation, and family medical history.

Table 2. Peak Expiratory Flow (PEF) and Quality of Life Measurements of Asthma Patients

Category	Frequency (f)	Percentage (%)
Peak Expiratory Flow (PEF)		
Normal Function	0	0
Mild Airway Narrowing	37	61.7
Severe Airway Narrowing	23	38.3
Quality of Life		
Good	0	0
Moderate	34	56.7
Poor	26	43.3

The majority of respondents in this study experienced mild airway narrowing, as indicated by 61.7% of participants in the "Mild Airway Narrowing" category. Regarding quality of life, most respondents (56.7%) reported a moderate quality of life, while 43.3% reported a poor quality of life. This suggests that while many patients with mild airway narrowing manage to maintain a moderate quality of life, there is still a significant portion who experience a poorer quality of life due to asthma symptoms.

Table 3. Cross-tabulation of Peak Expiratory Flow (PEF) and Quality of Life

Cross-tabulation		Quality of Life						Total	
		Good		Moderate		Poor			
		f	%	f	%	f	%	f	%
Peak	Normal Function	0	0	0	0	0	0	0	0
Expiratory	Mild Airway Narrowing	0	0	34	56.7	3	5	37	61.7
Flow (PEF)	Severe Airway Narrowing	0	0	0	0	23	38.3	23	38.3
	Total	0	0	34	56.7	26	43.3	60	100

The cross-tabulation results indicate no participants had Normal Function Peak Expiratory Flow (PEF). Among those with Mild Airway Narrowing (61.7% of the total sample), the majority (56.7%) reported a Moderate quality of life, while a small proportion (5%) reported a Poor quality of life. In contrast, all individuals with Severe Airway Narrowing (38.3% of the total sample) reported a Poor quality of life. These findings highlight a significant relationship between the severity of airway narrowing and a decline in quality of life.

Table 4. Spearman Correlation Analysis Results

Variable	Sample Size (N)	Spearman Rank Correlation		Significance Value
		Peak Expiratory Flow (PEF)	Quality of Life	
Peak Expiratory Flow (PEF)	60	1	0.902	0.000
Quality of Life		0.902	1	

There is a robust positive correlation between Peak Expiratory Flow (PEF) and Quality of Life ($r = 0.902$, $p < 0.001$). This indicates that increased PEF is significantly associated with improving quality of life.

DISCUSSION

Peak Expiratory Flow Values at the Pulmonary Clinic of Bhayangkara Hospital Lumajang

Table 2 shows that the number of respondents experiencing the early stages of airway narrowing was 37 (61.7%), while those with significant airway narrowing totaled 23 (38.3%). Airway narrowing is a key characteristic of asthma, resulting from chronic inflammation, bronchial hyperresponsiveness, and bronchoconstriction. According to (Jansen et al., 2021), this narrowing can trigger a cascade of symptoms such as shortness of breath, coughing, and wheezing, which, if untreated, may progress to more severe conditions. This highlights the importance of early detection and proper management to prevent the progression of severe asthma.

In emergency cases diagnosed as Bronchial Asthma, problems may arise in Airway, Breathing, and Circulation. Asthma attacks can lead to a respiratory rate exceeding 30 breaths per minute, indicating a critical condition requiring immediate intervention, as it can threaten the patient's life (Gowda et al., 2024). This data underscores the importance of early intervention during the initial phase of airway narrowing. Proper management at this stage can prevent the transition to more severe phases, where the airway is significantly narrowed, and asthma symptoms become more challenging to control. Patients need to be educated about recognizing early signs of airway narrowing and the necessity of prompt treatment. This is crucial to avoid severe asthma exacerbations, which can negatively impact the patient's quality of life and increase the need for intensive medical intervention. Additionally, the findings highlight the need for regular monitoring of asthma patients, including using tools like Peak Flow Meters to ensure symptoms are well-controlled and to prevent further deterioration.

Quality of Life of Asthma Patients at the Pulmonary Clinic of Bhayangkara Hospital Lumajang

The research findings in Table 2 indicate that 34 respondents (56.7%) had a moderate quality of life, while 26 respondents (43.3%) experienced a poor quality of life. The quality of life of asthma patients is significantly influenced by various factors, including the severity of symptoms and the ability to manage the condition effectively. Research by (Ali et al., 2020) revealed that 71.4% of 134 bronchial asthma patients reported a low quality of life, with contributing factors such as advanced age, obesity, female gender, a family history of asthma, and the presence of pets at home significantly affecting their well-being.

The researcher observed that patients with a moderate quality of life experienced manageable symptoms, such as shortness of breath, coughing, and wheezing, without significantly disrupting their daily lives. Based on the Asthma Quality of Life Questionnaire (AQLQ-S), these patients could engage in light to moderate physical activities, albeit with occasional difficulties. Their emotional state was generally stable, although there was some concern about sudden asthma attacks. Environmental factors such as weather and allergens continued to affect their condition, but the patients were able to adapt. While the quality of life in this group was relatively good, optimal symptom management and education about asthma triggers remain essential.

Conversely, patients with a poor quality of life experienced significant impacts from asthma on their daily lives. According to the AQLQ-S, these patients frequently suffered from severe and recurring symptoms, such as shortness of breath and coughing, which could occur even at rest. Physical limitations were pronounced, rendering them unable to perform even simple daily activities. Emotional well-being was also affected, with anxiety and fear of asthma attacks negatively impacting psychological health. Environmental factors were critical in worsening their condition, leading patients to avoid certain situations to prevent triggers. This highlights the need for intensive medical intervention and a comprehensive approach to asthma management to improve their well-being.

Asthma sufferers' decline in quality of life stems from symptoms such as difficulty breathing, coughing, and wheezing, which cause discomfort and limitations in carrying out normal daily activities (Patel et al., 2023). Uncontrolled asthma symptoms not only increase healthcare costs but also hinder daily productivity, lead to changes in functional roles, and may even contribute to mortality (Jansen et al., 2021; Larsson et al., 2020; Menzies-Gow et al., 2022).

The research findings highlight the necessity of further interventions to improve the quality of life for asthma patients. A holistic approach that addresses physical, psychological, and social aspects is crucial. With better asthma management strategies, it is hoped that patients' quality of life can be enhanced, enabling them to live every day and productive lives despite their condition.

The Relationship Between Peak Expiratory Flow Values and Quality of Life in Asthma Patients at the Pulmonary Clinic of Bhayangkara Hospital, Lumajang

The research results in Table 3 show that out of 60 respondents, 34 (56.7%) experienced mild airway narrowing and had a moderate quality of life. In comparison, 23 respondents (38.3%) experienced more severe airway narrowing with a poor quality of life. This data indicates that while most patients with airway narrowing can maintain a moderate quality of life, those with more significant narrowing generally experience a greater decline in quality of life.

Data analysis using the Spearman rank correlation test presented in Table 4 shows a coefficient value of 0.902, indicating a robust relationship between peak expiratory flow (PEF) values and the quality of life of asthma patients. The positive correlation coefficient demonstrates that the relationship between these two variables is direct; in other words, as PEF values increase, the quality of life of asthma patients also tends to improve. Table 4 also reports a significance value of 0.000, less than 0.05, confirming a significant relationship between PEF values and quality of life.

A straightforward method to measure PEF is by using a Peak Expiratory Flow Meter (PEF meter), which involves measuring forced expiratory volume in the first Second (FEV1) and forced vital capacity (FVC) using standard forced expiration procedures. Clear instructions and patient cooperation are crucial for accurate measurements, as this examination heavily relies on the patient's effort. The research findings indicate that of the 60 respondents involved, 34 respondents (56.7%) with asthma experienced airway narrowing but had a moderate quality of life. Several interrelated factors can explain this phenomenon. First, despite airway narrowing, the severity of asthma symptoms in these respondents may have been relatively well-controlled. This factor can be influenced by appropriate therapy, adherence to medication, and patients' understanding of asthma management. Respondents with good knowledge of their condition are more likely to avoid triggers and apply effective preventive strategies, reducing symptoms' frequency and intensity.

Second, psychological and emotional aspects also play a significant role in the quality of life of asthma patients. Respondents with good social support, whether from family or community, may feel more capable of coping with challenges. This support can enhance their sense of control and optimism, so their quality of life remains unaffected despite experiencing airway narrowing. Third, variations in individual perceptions of asthma symptoms and their impact on daily life may also explain these findings. Some respondents may have higher tolerance levels for the symptoms they experience and can adapt to existing limitations, allowing them to feel capable of carrying out daily activities without significant disruption.

Thus, the study results demonstrate that airway narrowing in asthma patients does not always correlate with poor quality of life. On the contrary, good management, social support, and a positive perception of the condition can contribute to maintaining a moderate quality of life despite physiological impairments. Further research is needed to explore these factors in greater depth and to identify effective intervention strategies for improving the quality of life of asthma patients.

CONCLUSION

The study shows that before health promotion, the students at Roudlotul Falah Islamic Boarding School exhibited poor health behaviors, such as smoking and improper handwashing. After the intervention, improvements were observed, with many students adopting healthier habits, like better eating and cleanliness practices. Although some still showed poor health behaviors, the promotion significantly impacted their health behaviors, enhancing knowledge, attitudes, and actions. The conclusion is that health promotion effectively improves students' health behaviors, prevents unhealthy practices, and promotes better hygiene and health habits. It is recommended that health promotion programs continue to be strengthened for sustained improvements.

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The study concludes a strong and significant relationship between Peak Expiratory Flow (PEF) values and the quality of life of asthma patients, as indicated by a correlation coefficient of 0.902. Patients with higher PEF values generally exhibit better quality of life, demonstrating that effective management of asthma symptoms, including early detection and proper treatment, plays a pivotal role in maintaining well-being. Psychological and social factors, such as emotional stability, social support, and positive perceptions of the condition, also contribute significantly to the quality of life. Despite airway narrowing, many patients can achieve a moderate quality of life through adherence to therapy, symptom control, and avoiding triggers. These findings highlight the importance of holistic asthma management strategies that integrate physical, psychological, and social interventions to improve patient outcomes and prevent further deterioration of their quality of life.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this study.

REFERENCES

- Akca Sumengen, A., Ozcevik Subasi, D., Semerci, R., & Cakir, G. N. (2024). Effect of game-based asthma management interventions on pediatric asthma control, knowledge, attitudes, hospitalizations, and emergency visits: A systematic review and meta-analysis. *Journal of Pediatric Nursing*. <https://doi.org/10.1016/j.pedn.2024.12.009>

- Ali, R., Ahmed, N., Salman, M., Daudpota, S., Masroor, M., & Nasir, M. (2020). Assessment Of Quality Of Life In Bronchial Asthma Patients. *Cureus*. <https://doi.org/10.7759/Cureus.10845>
- Alicandro, G., Nazzari, E., Zazzeron, L., Rosazza, C., Mariani, A., Rizza, C., Bellante, F., Blasi, F., & Daccò, V. (2024). P169 Lung clearance index as an alternative respiratory outcome in elexacaftor/tezacaftor/ivacaftor treated patients without clinically important improvement in forced expiratory volume in one second. *Journal of Cystic Fibrosis*, 23, S107. [https://doi.org/10.1016/S1569-1993\(24\)00431-4](https://doi.org/10.1016/S1569-1993(24)00431-4)
- Alyas, S., Hussain, R., Ababneh, B. F., Ong, S. C., & Babar, Z. (2025). Knowledge, perceptions, facilitators, and barriers towards asthma self-management among patients: A systematic review of the literature. *Exploratory Research in Clinical and Social Pharmacy*, 17, 100558. <https://doi.org/10.1016/j.rcsop.2024.100558>
- Alzate, M., Adrián López-Castillo, C., Bernal-Villada, L., Buelvas, W., de Oro, K., Camilo Rivera, J., Pinilla, S., Garcia, P., Rivero, P., Almanza, M., & Gonzalez, L. (2024). AutoAsmaAlert: Technological tool to prevent Salbutamol Overuse in a Colombian Healthcare Provider "Letter to the Editor". *Health and Technology Journal (HTechJ)*, 2(3), 202–204. <https://doi.org/10.53713/htechj.v2i3.192>
- Amantéa, S. L. (2024). Inhaled MgSO₄ in acute asthma: Are we on the right course? *Jornal de Pediatria*, 100(6), 674-675. <https://doi.org/10.1016/j.jped.2024.08.001>
- Chacko, J., King, C., Harkness, D., Messahel, S., Grice, J., Roe, J., Mullen, N., Sinha, I. P., & Hawcutt, D. B. (2020). Pediatric acute asthma scoring systems: A systematic review and survey of UK practice. *JACEP Open*, 1(5), 1000-1008. <https://doi.org/10.1002/emp2.12083>
- Gowda, G., Athani, S. B., & Maragowdanahalli Gurupadaswamy, S. (2024). Prevalence of bronchial asthma among urban school children in Bengaluru city. *Clinical Epidemiology and Global Health*, 31, 101895. <https://doi.org/10.1016/j.cegh.2024.101895>
- Jansen, E. M., Van De Hei, S. J., Dierick, B. J. H., Kerstjens, H. A. M., Kocks, J. W. H., & Van Boven, J. F. M. (2021). Global Burden Of Medication Non-Adherence In Chronic Obstructive Pulmonary Disease (COPD) And Asthma: A Narrative Review Of The Clinical And Economic Case For Smart Inhalers. *Journal Of Thoracic Disease*, 13(6), 3846–3864. <https://doi.org/10.21037/Jtd-20-2360>
- Kharaba, Z., Feghali, E., El Hussein, F., Sacre, H., Abou Selwan, C., Saadeh, S., Hallit, S., Jirjees, F., Alobaidi, H., Salameh, P., & Malaeb, D. (2022). An Assessment Of Quality Of Life In Patients With Asthma Through Physical, Emotional, Social, And Occupational Aspects. A Cross-Sectional Study. *Frontiers In Public Health*, 10, 883784. <https://doi.org/10.3389/Fpubh.2022.883784>
- Kurnianto, S., Astuti, A., Endro Sulistyono, R., & Cahyo Putri, M. (2022). Changes in Respiratory Function in Asthma Patients using Respiratory Inspiration Muscle Exercise: Literature Review. *Nursing and Health Sciences Journal (NHSJ)*, 2(2), 179-182. <https://doi.org/10.53713/nhs.v2i2.126>
- Larsson, K., Kankaanranta, H., Janson, C., Lehtimäki, L., Ställberg, B., Løkke, A., Høines, K., Roslind, K., & Ulrik, C. S. (2020). Bringing Asthma Care Into The Twenty-First Century. *Npj Primary Care Respiratory Medicine*, 30(1), 25. <https://doi.org/10.1038/S41533-020-0182-2>
- Le Souëf, P. N., Adachi, Y., Anastasiou, E., Ansotegui, I. J., Badellino, H. A., Banzon, T., Beltrán, C. P., D'Amato, G., El-Sayed, Z. A., Gómez, R. M., Hossny, E., Kalayci, Ö., Morais-Almeida, M., Nieto-Garcia, A., Peden, D. B., Phipatanakul, W., Wang, J., Wan, I., Wong, G., . . . Papadopoulos, N. G. (2024). Global change, climate change, and asthma in children: Direct and indirect effects - A WAO Pediatric Asthma Committee Report. *World Allergy Organization Journal*, 17(11), 100988. <https://doi.org/10.1016/j.waojou.2024.100988>
- Lee, H. Y., Lee, Y., Lee, S., Sim, D. W., Kang, N., Lee, B., Kim, J., Kang, S., Kim, S., Oh, J. H., Sohn, K., Park, H., Kim, S. R., Kim, M., Park, H., Park, S., Kwon, J., Park, H., Kim, S., . . . Song, W. (2025). Relationships between Chronic Cough and Asthma Control and Quality-of-Life in Patients with Severe Asthma: A 6-Month Longitudinal Analysis. *The Journal of Allergy and Clinical Immunology: In Practice*. <https://doi.org/10.1016/j.jaip.2025.01.006>

- Lisznyai, E., Hutchings, H., Debiante, L., & Okereke, I. (2024). Central airway carcinoid tumor mimicking chronic asthma and necessitating pneumonectomy: A case report. *International Journal of Surgery Case Reports*, 122, 110167. <https://doi.org/10.1016/j.ijscr.2024.110167>
- Ma, Q., Lu, M., Yang, Q., Gong, F., Zhou, L., & Xu, D. (2024). Effects of aerobic exercise-based pulmonary rehabilitation on quality of life in pediatric asthma: A systematic review and meta-analysis. *Heart & Lung*, 69, 11-30. <https://doi.org/10.1016/j.hrtlng.2024.09.005>
- Mazurek, J., Syamlal, G., & Dodd, K. (2023). Prevalence Of Asthma Attacks And Emergency Department Visits Among Us Working Adults, 2020–2021. *Annals of Allergy, Asthma & Immunology*, 131(5), S55-S56. <https://doi.org/10.1016/j.anai.2023.08.165>
- Menzies-Gow, A., Jackson, D. J., Al-Ahmad, M., Bleecker, E. R., Cosio Piqueras, F. D. B. G., Brunton, S., Canonica, G. W., Chan, C. K. N., Haughney, J., Holmes, S., Kocks, J., & Winders, T. (2022). A Renewed Charter: Key Principles To Improve Patient Care In Severe Asthma. *Advances In Therapy*, 39(12), 5307–5326. <https://doi.org/10.1007/S12325-022-02340-W>
- Patel, V. H., Thannir, S., Dhanani, M., Augustine, I., Sandeep, S. L., Mehadi, A., Avanthika, C., & Jhaveri, S. (2023). Current Limitations and Recent Advances in the Management of Asthma. *Disease-A-Month*, 69(7), 101483. <https://doi.org/10.1016/j.disamonth.2022.101483>
- Primarani, S. P., & Megastsari, F. (2022). Environmental-Related Trigger For Asthma In East Java: An Advance Analysis Of The Risk Factor. *Jurnal Promkes*, 10(2), 130–137. <https://doi.org/10.20473/Jpk.V10.I2.2022.130-137>
- Shulhan-Kilroy, J., Elliott, S. A., Scott, S. D., & Hartling, L. (2022). Parents' self-reported experiences and information needs related to acute pediatric asthma exacerbations: A mixed studies systematic review. *PEC Innovation*, 1, 100006. <https://doi.org/10.1016/j.pecinn.2021.100006>
- Sun, C., Lee, K., Chan, Y., Ho, S., Liu, C., Wu, S., Sun, W., Ke, Y., & Liu, C. (2024). A bronchiole-on-a-chip and a stretching system for studying human disease model of asthma attack. *Sensors and Actuators B: Chemical*, 416, 136031. <https://doi.org/10.1016/j.snb.2024.136031>
- Van Beveren, G. J., Said, H., Van Houten, M. A., & Bogaert, D. (2023). The respiratory microbiome in childhood asthma. *Journal of Allergy and Clinical Immunology*, 152(6), 1352-1367. <https://doi.org/10.1016/j.jaci.2023.10.001>