Original Article

A Prospective Observational Study on the Severity of Cotton Dust-Related Allergic Asthma and its Management at Textile City - Tiruppur

Rithika. K*[1], Ranjith. M[1], Sailakshmi. P[1], Parthasarathi. S[1], Dr.M.Sivashanmugam[2] , Thirumalai.R[3]
[1] Student, The Erode College of Pharmacy, Erode-638 112, India.
[2]Professor, Department of Respiratory Medicine, Government Medical College Hospital, Tiruppur – 641601, India.
[3]Student, SS Institute of Pharmacy, Sankari, Salem – 637301, India.
***Corresponding author's E-mail:** rithikapharmd@gmail.com

Received: 04-05-2025; **Revised:** 28-07-2025; **Accepted:** 09-08-2025; **Published online:** 20-08-2025.

ABSTRACT

Background: As the "Knitwear Capital of India," Tiruppur is home to a booming textile sector that supports the country's exports and creates jobs for thousands of people. The high number of cotton processing operations that are a necessary part of the production process raises concerns about the prevalence of allergic asthma in Tiruppur's textile sector. Cotton dust is a common workplace irritant and allergen, making workers more susceptible to respiratory illnesses. Although this occupational danger is well known, little is known about the exact scope of the issue and how it affects employees' health. By conducting a prospective observational analysis aimed at assessing the severity of allergic asthma caused by cotton dust in Tiruppur, this study aims to close this information gap.

Methods: There are one hundred patients in our sample. The proposed study at the Tiruppur Government Medical College would proceed according to the relevant community norms. We watched and gathered information from patients who were employed by textile industries in Tiruppur over the course of six months. These patients had been diagnosed with allergic asthma, which was linked to exposure to cotton dust. Demographic data, medical histories, prior inhaler usage, the degree of symptoms a patient was experiencing as measured by the mMRC dyspnoea scale, and the severity of the patient's condition as determined by the GINA scale were all collected. The degree of asthmatic symptoms was evaluated based on established standards. This involved keeping track of the frequency of symptoms, daily activity limits, and nightly awakenings. After a month of therapy, we used to check in with the patients to assess their severity and to assess the management techniques that had been employed.

Results: Our study's preliminary results show that allergic asthma affects a sizable number of textile workers in Tiruppur. The spectrum of asthma symptoms was mild to severe, with a significant percentage of individuals falling into the moderate to severe category. The most popular management strategy, with variable degrees of efficacy, was inhaler treatment. Notably, the workers' lack of knowledge and instruction about the dangers of cotton dust exposure was apparent, highlighting the necessity of safety precautions and health education.

Conclusion: This study emphasizes how urgently the textile sector in Tiruppur has to address the problem of allergic asthma caused by cotton dust. Protecting the health and well-being of the impacted workforce will require better management practices and more efforts in health education. A more in-depth understanding will be possible by a comprehensive examination of the entire dataset, which will allow for focused measures to lessen the effects of this serious occupational health issue.

Keywords: Cotton dust, Allergic asthma, Textile industry, Occupational health, Prospective observational study.

INTRODUCTION

Allergy-induced asthma caused by dust mites is still a major occupational health risk, especially in textile and agricultural industries where dust mite exposure is common. In order to shed light on the complex nature of allergic asthma and its effects on both affected individuals and the general public's health, this thorough review aims to investigate the frequency and severity of the illness that is brought on by exposure to cotton dust.[1]

The incidence of allergic asthma caused by cotton dust varies between industries and geographical areas, depending on variables such as worker genetic predisposition, efficient preventative measures, and exposure level. According to epidemiological research, workers who are routinely exposed to cotton dust have a greater frequency of allergic asthma than the overall population. Furthermore, the frequency of new instances keeps bringing attention to the continuous risk that this workplace hazard poses.[2]

For successful diagnosis and intervention, it is important to comprehend the severity range of allergic asthma generated by cotton dust in addition to its prevalence. Some people may have moderate symptoms that are readily controlled, while others may suffer severe exacerbations that impair lung function, lower quality of life, or even result in life-threatening consequences. Numerous factors, such as the length and intensity of the exposure, the individual's vulnerability to allergens, and the existence of concomitant respiratory diseases, might affect how severe allergic asthma is.[3,4]

Moreover, it is impossible to ignore the financial cost of allergic asthma brought on by cotton dust. In addition to the direct expenses of hospitalization, diagnosis, and treatment, there are indirect costs associated with disability, lost productivity, and absenteeism. In addition to a clinical focus on patient care, larger initiatives in workplace safety,

regulatory enforcement, and public health advocacy are needed to address the prevalence and severity of this disorder.

The intricate interaction of immunological dysregulation, environmental exposures, and genetic predispositions results in allergic asthma. Cotton dust can include a wide range of allergens, including fungus, endotoxins, and plant debris, which can cause a heightened immune response in those who are prone to allergic responses. This reaction frequently takes the form of wheezing, coughing, tightness in the chest, and dyspnea, which are the classic asthmatic symptoms.[5,6,7]

Even though the connection between exposure to cotton dust and allergic asthma is well-established, there is still a significant knowledge gap on the varying severity of this problem in afflicted individuals. Some people may only have moderate, sporadic symptoms, but others may have incapacitating exacerbations that need immediate medical attention. It is crucial to identify the underlying causes of this severity spectrum to customize efficient therapy plans and enhance patient outcomes.

Furthermore, a comprehensive strategy including both preventative actions and therapeutic interventions is required for the successful management of allergic asthma triggered by cotton dust. A comprehensive management strategy is necessary to reduce symptoms, improve lung function, and improve the overall quality of life for those who are affected. This includes everything from engineering controls to minimize dust exposure in the workplace to pharmacological treatments that target airway inflammation and bronchoconstriction [8,9,10]

Located in the southern Indian state of Tamil Nadu, Tiruppur is one of the world's leading centers for textile manufacture, making a substantial economic contribution to the nation. But among its industrial might is a serious occupational health risk: the frequency and intensity of allergic asthma brought on by cotton dust among workers.

Many factors, such as the sheer volume of cotton processing operations, the presence of obsolete or insufficient ventilation systems in workplaces, and the socioeconomic situations of the workers, all have an impact on the incidence of cotton dust-induced allergic asthma in Tiruppur. Anecdotal data and infrequent reports, in spite of the paucity of thorough research, indicate a noteworthy incidence of allergic respiratory diseases among textile workers, underscoring the critical need for rigorous inquiry.[11]

Through a prospective investigation of the severity of allergic asthma associated with cotton dust and the exploration of potential management strategies, this study aims to make a significant contribution to the current corpus of knowledge in respiratory medicine and occupational health. We hope to open the door to safer and better working conditions for employees who are susceptible to the dangers of cotton dust exposure by meticulous scientific investigation and cooperation between researchers, medical specialists, and industry stakeholders.[12,13]

AIM

To study the severity of cotton dust-related allergic asthma and its management at textile city-Tiruppur.

OBJECTIVES

- To study the prevalence of cotton dust-related allergic asthma in the textile city.
- To assess the therapeutic drug management.
- To assess the severity of conditions of the patients using the mMRC dyspnea scale and the GINA assessment scale.

METHODOLOGY

Ethical Approval: The study was initiated after the clearance of the institutional ethics committee

Study Site: This study was conducted at the Department of Respiratory Medicine in Government Medical College and Hospital, Tiruppur.

Study Duration: The study was conducted for 6 months.

Sample Size: 100 patients were included in the study

Study Design and Setting: This was a prospective and observational study, carried out in the Department of Respiratory Medicine, Government Medical College Hospital, Tiruppur.

Study Criteria

Inclusion criteria:

a) Patients in age groups such as adults and geriatrics.

b) Patients with asthmatic conditions (both outpatient and inpatient).

c) Patients of all genders.

Exclusion criteria:

a) Pregnant and lactating women.

b) Patients with psychiatric illness.

c) Pediatric patients.

Study Procedure and Data Collection

Patients with established cotton allergy asthma will be evaluated, and a history of their prior use of inhalers and health gains while off the job will be obtained. The patients' names, age, sex, occupation, history of using inhalers, and mMRC scores were among the demographic information gathered. The patients' severe conditions were evaluated following GINA recommendations. The guidelines were used to evaluate the patient's degree of symptom control. The case performance would be used to gather all of the questionnaire responses required for the study. Utilizing statistical analysis software, the collected data will be examined.

Statistical Analysis

After entering the data into a Microsoft Excel spreadsheet, basic statistical procedures were used to perform statistical analysis and provide frequencies and percentages. The data was all examined using the GraphPad Prism tool. A one-way ANOVA was employed to examine the variations between the two groups.

RESULTS

Distribution According to Patient Characteristics

Patient characteristics		No.of patients	Percentage
Age	20-40	20	20%
	41-60	56	56%
	61-80	24	24%
Gender	Male	54	54%
	Female	46	46%
Smoking	Yes	54	54%
	No	46	46%
Previous use of inhalers	Yes	90	90%
	No	10	10%

Distribution According to Symptoms

Symptoms	Baseline		After a month	
	No. Of patients	Percentage	No. Of patients	Percentage
Wheezing	3	3%	3	3%
Cough+Wheezing	7	7%	8	8%
Shortness of Breath + Wheezing	1	1%	7	7%
Cough+ Shortness of Breath +Wheezing	88	88%	80	80%
Cough +Shortness of Breath +Wheezing +COLD	1	1%	1	1%
Cough+Shortness of Breath	0	0%	1	1%

Distribution According to mMRCGrade

mMRC GRADE	Baseline		After a month	
	No. Of patients	Percentage	No. Of patients	Percentage
Grade 0	0	0%	0	0%
Grade 1	4	4%	11	11%
Grade 2	40	40%	45	45%
Grade 3	48	48%	35	35%
Grade 4	8	8%	9	9%

T Test analysis of mMRC GRADE before and after treatment

Before Treatment		After Treatment		T-TEST VALUE	P- VALUE
MEAN	STD DEV	MEAN	STD DEV		
2.60	0.70	2.41	0.08	2.5416	0.0001

DISCUSSION

In the current study involving 100 asthma patients, 37% were found to be in the mild stage, 47% in the moderate stage, and 16% in the severe stage. Asthma was more prevalent among individuals aged 40 to 60 years (56%), followed by those aged 61 to 80 years (24%) and 20 to 40 years (20%). This distribution closely resembled the findings of Paula J. Busse et al., who reported a higher prevalence in the 45–60 age group. Furthermore, the study revealed that men (54%) were more affected than women (46%). Among the 100 patients, 54% were smokers, a finding consistent with the study by Mary C. et al., which also identified a greater incidence of asthma among smokers than non-

smokers. Coughing, shortness of breath, and wheezing were the three most common symptoms, observed in 88% of patients, aligning with the findings of Safia Beshir et al., who also reported a high prevalence of wheeze, coughing, and dyspnoea. Symptom evaluation after one month indicated a slight reduction in their severity. Of the 100 patients, 90% were already using inhalers, whereas the remaining 10% were not, as presented in Table 12 and Figure 10. Obesity and rhinosinusitis (20%) were identified as the most common comorbid conditions, findings that were consistent with those of Paola Rogliani et al., who also reported a high frequency of these conditions. The GINA assessment revealed that 42% of patients had a score of 3, 36% had a score of 2, and 17% had a score of 1 at baseline. After a one-month follow-up, 39% had a score of 3, another 39% had a score of 2, and 17% maintained a score of 1. In terms of severity, moderate asthma remained the most prevalent both initially (47%) and after a month (45%), followed by mild (37% initially and again after a month) and severe cases (16% initially, 18% after a month). Based on mMRC dyspnoea grading, 48% of patients were found to have Grade III dyspnoea, which decreased to Grade II (45%) after one month of follow-up. The most frequently prescribed medications, as noted in Table 22 and Figure 20, included Methyl Xanthines, Short-acting beta agonists, Corticosteroids, Antihistamines, and Antibiotics. Salbutamol (100%) was the predominant short-acting beta agonist prescribed. Among Methyl Xanthines, Deriphylline was prescribed to 90% of patients. The most commonly used corticosteroid was Hydrocortisone (31%), followed by Dexamethasone (25%), Budesonide (5%), and Prednisolone (3%). Ceftriaxone (33%) emerged as the most frequently prescribed antibiotic, followed by Azithromycin (10%), Doxycycline (5%), and Amoxicillin (2%). Among antihistamines, Chlorpheniramine maleate was most commonly administered (74%), followed by Cetirizine (10%). Non-asthmatic medications included Ranitidine (52%), Paracetamol (13%), Omeprazole (13%), BCT (8%), MVT (2%), and Calcium supplements (1%).

LIMITATION

• Patients who were discharged sooner than expected or who fled during treatment are ineligible for inclusion in the study.

• It is impossible to gather comprehensive information regarding past medication use

• Difficulty in offering patient counseling.

• Seasonal variations in asthma symptoms and exposure to cotton dust may have an impact on the study's conclusions.

• Participants may have trouble accurately recalling past exposure and symptoms, which might cause recall bias.

• Results from one city with a textile industry might not be generalizable to other areas with diverse environmental and occupational factors.

• The reliability of self-reported symptoms and exposure information, which may not always be accurate, is dependent on the quality of the data.

CONCLUSION

Our prospective observational study in the textile city of Tiruppur has shed light on the significant burden of cotton dust-related allergic asthma within the local population. We found that a substantial number of textile workers in Tiruppur suffer from allergic asthma, with varying degrees of severity. The management of this condition involves a multi-faceted approach, including improved workplace safety measures, respiratory protective equipment, and access to appropriate medical care. Our study underscores the importance of implementing and enforcing stringent occupational health and safety regulations in the textile industry. This not only has implications for the well-being of the workers but also for the overall economic and social health of the region. The study of prescribing patterns is a major component of medical audit that monitors and evaluates prescribers as well as recommends necessary modifications to achieve rational medical care. Good symptom control and reducing the risk of exacerbations are two of the main objectives of asthma care. Pharmacists, who are also healthcare professionals, have a responsibility to educate patients about their conditions through effective counseling, the distribution of pamphlets, and the implementation of smoking cessation programs.

Source of Support: The author(s) received no financial support for the research, authorship, and/or publication of this article

Conflict of Interest: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

1. Akbari O, Faul JL, Hoyte EG, Berry GJ, Wahlström J, Kronenberg M, et al. CD4+ invariant T-cell–receptor+ natural killer T cells in bronchial asthma. N Engl J Med. 2006;354(11):1117–29.

2. Abraham TG, Huggins C, Diaz-Fuentes G, Roglieri J. Combining pharmacy expertise with asthma educator certification: assessing the impact on inner-city asthma patients. J Asthma. 2019;56(8):891–6. . 3. Ha TTT, Hanh BM, Van Son N, Giang HT, Hai NT, Thuc VM, et al. The Cotton Dust-Related Allergic Asthma: Prevalence and Associated Factors among Textile Workers in Nam Dinh Province, Vietnam. Int J Environ Res Public Health. 2021 Sep 17;18(18):9813.

4. Eder W, Ege MJ, von Mutius E. The asthma epidemic. N Engl J Med. 2006;355:2226–35.

5. Castillo JR, Peters SP, Busse WW. Asthma exacerbations: Pathogenesis, prevention, and treatment. J Allergy Clin Immunol Pract. 2017;5(4):918–27. .

6. Kwah JH, Peters AT. Asthma in adults: Principles of treatment. Allergy Asthma Proc. 2019;40(6):396–402. .

7. Schatz M, Rosenwasser L. The allergic asthma phenotype. J Allergy Clin Immunol Pract. 2014;2(6):645–8.

8. Masoli M, Fabian D, Holt S, Beasley R, Global Initiative for Asthma (GINA) Program. The global burden of asthma: executive summary of the GINA Dissemination Committee Report. Allergy. 2004;59(5):469–78

9. Chipps BE, Murphy KR, Oppenheimer J. 2020 NAEPP guidelines update and GINA 2021—asthma care differences, overlap, and challenges. J Allergy Clin Immunol Pract. 2022;10(1):S19–30.

10. Levy ML, Bacharier LB, Bateman E, Boulet L-P, Brightling C, Buhl R, et al. Key recommendations for primary care from the 2022 Global Initiative for Asthma (GINA) update. NPJ Prim Care Respir Med. 2023;33(1).

11. Cloutier MM. Asthma management programs for primary care providers: Increasing adherence to asthma guidelines. Curr Opin Allergy Clin Immunol. 2016;16(2):142–7.

12. Akbari O, Faul JL, Hoyte EG, Berry GJ, Wahlström J, Kronenberg M, et al. CD4+ invariant T-cell–receptor+ natural killer T cells in bronchial asthma. N Engl J Med. 2006;354(11):1117–29.

13. Masoli M, Fabian D, Holt S, Beasley R, Global Initiative for Asthma (GINA) Program. The global burden of asthma: executive summary of the GINA Dissemination Committee Report. Allergy. 2004;59(5):469–78.

14. Miller RL, Grayson MH, Strothman K. Advances in asthma: New understandings of asthma's natural history, risk factors, underlying mechanisms, and clinical management. J Allergy Clin Immunol. 2021;148(6):1430–41.

15. Lommatzsch M, Virchow JC. Severe Asthma. Dtsch Arztebl Int. 2014;111(50).

16. Miller RL, Grayson MH, Strothman K. Advances in asthma: New understandings of asthma's natural history, risk factors, underlying mechanisms, and clinical management. J Allergy Clin Immunol. 2021;148(6):1430–41

17. Toren K, Balder B, Brisman J, Lindholm N, Lowhagen O, Palmqvist M, Tunsater A. The risk of asthma with occupational exposures: a case control study from a Swedish city. European Respiratory Journal. 1999 Mar 1;13(3):496-501

18. da Costa JT, Ferreira JA, Castro E, Vaz M, Barros H, Marques JA, Pinto AS. Asma ocupacional na industrials têxtil: avaliação pela hiperreactividade brônquica e registo do DEMI. Revista Portuguesa de Pneumologia. 2002 Mar 1;8(2):115-29.

19. Lantto J, Suojalehto H, Karvala K, Remes J, Soini S, Suuronen K, Lindström I. Clinical characteristics of irritant-induced occupational asthma. The Journal of Allergy and Clinical Immunology: In Practice. 2022 Jun 1;10(6):1554-61.

20. Dao A, Bernstein DI. Occupational exposure and asthma. Annals of Allergy, Asthma & Immunology. 2018 May 1;120(5):468-75.

21. Maoua M, Gaddour A, Rouis H, Kacem I, Guedri S. Occupational Rhinitis and Asthma in the Textile Sector of the Central Region of Tunisia. Int J Respir Pulm Med. 2018; 5:088. 22. Chaari N, Amri C, Khalfallah T, Alaya A, Abdallah B, Harzallah L, Henchi MA, Bchir N, Kamel A, Akrout M. Rhinitis and asthma related to cotton dust exposure in apprentices in the clothing industry. Revue des Maladies Respiratoires. 2009 Jan 1;26(1):29-36.

23. Woldeyohannes M, Bergevin Y, Mgeni AY, Theriault G. Respiratory problems among cotton textile mill workers in Ethiopia. Br J Ind Med. 1991 Feb;48(2):110–5.

24. Ali NA, Nafees AA, Fatmi Z, Azam SI. Dose-response of Cotton Dust Exposure with Lung Function among Textile Workers: MultiTex Study in Karachi, Pakistan. Int J Occup Environ Med. 2018 Jul;9(3):120–8.

25. Hinson AV, Lokossou VK, Schlünssen V, Agodokpessi G, Sigsgaard T, Fayomi B. Cotton Dust Exposure and Respiratory Disorders among Textile Workers at a Textile Company in the Southern Part of Benin. Int J Environ Res Public Health. 2016 Sep 8;13(9):895.

26. Aminian O, Mozafari SA, Haghighi KS, Chavoshi F, Saraie M, Izadi N. Study of respiratory symptoms and pulmonary function in cotton textile workers. J Basic Appl Sci Res. 2013;3(4):33-6.

27. Ali NA, Nafees AA, Fatmi Z, Azam SI. Dose-response of Cotton Dust Exposure with Lung Function among Textile Workers: MultiTex Study in Karachi, Pakistan. Int J Occup Environ Med. 2018 Jul;9(3):120–8.

28. Dangi BM, Bhise AR. Cotton dust exposure: Analysis of pulmonary function and respiratory symptoms. Lung India. 2017;34(2):144–9.

29. Paudyal P, Semple S, Gairhe S, Steiner MFC, Niven R, Ayres JG. Respiratory symptoms and cross-shift lung function concerning cotton dust and endotoxin exposure in textile workers in Nepal: a cross-sectional study. Occup Environ Med. 2015 Dec;72(12):870–6.

30. Kennedy SM, Christiani DC, Eisen EA, Wegman DH, Greaves IA, Olenchock SA, et al. Cotton dust and endotoxin exposure-response relationships in cotton textile workers. Am Rev Respir Dis. 1987 Jan;135(1):194–200.

31. Muittari A, Veneskoski T. Natural and synthetic fibers as causes of asthma and rhinitis. Ann Allergy. 1978 Jul 1;41(1):48–50.

32. Beshir S, Mahdy-Abdallah H, Saad-Hussein A. Ventilatory functions in cotton textile workers and the role of some inflammatory cytokines. Toxicol Ind Health. 2013 Mar;29(2):114–20.

33. The prevalence of byssinosis among cotton workers in the north of Benin A V Hinson et al. Int J Occup Environ Med. 2014 Oct.

34. Nafees AA, Fatmi Z. Available Interventions for Prevention of Cotton Dust- Associated Lung Diseases Among Textile Workers. J Coll Physicians Surg Pak. 2016 Aug;26(8):685–91.

35. Daba Wami S, Chercos DH, Dessie A, Gizaw Z, Getachew A, Hambisa T, et al. Cotton dust exposure and self-reported respiratory symptoms among textile factory workers in Northwest Ethiopia: a comparative cross-sectional study. Journal of Occupational Medicine and Toxicology. 2018 Apr 3;13(1):13.

36. Baur X, Bakehe P, Vellguth H. Bronchial asthma and COPD due to irritants in the workplace - an evidence-based approach. J Occup Med Toxicol. 2012 Sep 26;7(1):19.

37. Schachter EN, Kapp MC, Beck GJ, Maunder LR, Witek TJ. Smoking and cotton dust effects in cotton textile workers. Chest. 1989 May;95(5):997–1003.

38. Butcher BT, O'Neil CE, Jones RN. The Respiratory Effects of Cotton Dust. Clinics in Chest Medicine. 1983 Jan 1;4(1):63–70

39. Tageldin M, Gomaa A, Hegazy E. Respiratory symptoms and pulmonary function among cotton textile workers at Misr Company for Spinning and Weaving EL-Mahalla, Egypt. Egyptian Journal of Chest Diseases and Tuberculosis. 2017 Apr 1;66.

40. Rohani A, Nouri A, Kordjazi S. Allergies caused by textiles and their control 18. In 2022. p. 551–79.

41. Tounsadi H, Metarfi Y, Taleb M, Karima ER, Rais Z. Impact of chemical substances used in textile industry on the employees' health: Epidemiological study. Ecotoxicology and Environmental Safety. 2020 Jul 1;197:110594.

42. Christiani DC, Ye T ting, Wegman DH, Eisen EA, Dai H lian, Lu P lian. Pulmonary Function Among Cotton Textile Workers: A Study of Variability in Symptom Reporting, Across-Shift Drop in FEV1, and Longitudinal Change. Chest. 1994 Jun 1;105(6):1713–21.

43. Sadia A, Ali Y, Tahir HN, Shaukat N, Irfan M, Nafees AA. Effect Of Cotton Dust Exposure On Respiratory Health Outcomes Among Textile Workers. J Ayub Med Coll Abbottabad. 2023;35(1):104–9.

44. Jacobs RR, Boehlecke B, van Hage-Hamsten M, Rylander R. Bronchial reactivity, atopy, and airway response to cotton dust. Am Rev Respir Dis. 1993 Jul;148(1):19–24.

45. Zhang Y, Ye B, Zheng H, Zhang W, Han L, Yuan P, et al. Association Between Organic Dust Exposure and Adult Asthma: A Systematic Review and Meta Analysis of Case-Control Studies. Allergy Asthma Immunol Res. 2019 Nov;11(6):818–29.

46. Berger Z, Rom WN, Reibman J, Kim M, Zhang S, Luo L, et al. Prevalence of workplace exacerbation of asthma symptoms in an urban working population of asthmatics. J Occup Environ Med. 2006 Aug;48(8):833–9.

47. Islam T. Health Concerns of Textile Workers and the Associated Community. Inquiry. 2022;59:469580221088626

48. Zuskin E, Mustajbegovic J, Schachter EN, Doko-Jelinic J. Respiratory function of textile workers employed in dyeing cotton and wool fibers. Am J Ind Med. 1997 Mar;31(3):344–52.

49. Salmani Nodoushan M, Mehrparvar AH, Loukzadeh Z, Rahimian M, Ghove Nodoushan MA, Jafari Nodoushan R. Evaluation of the respiratory system in textile-dyeing workers. Med J Islam Repub Iran. 2014;28:88.

50. Rogliani P, Sforza M, Calzetta L. The impact of comorbidities on severe asthma. Curr Opin Pulm Med. 2020 Jan;26(1):47–55.

51. Busse PJ, McDonald VM, Wisnivesky JP, Gibson PG. Asthma Across the Ages: Adults. J Allergy Clin Immunol Pract. 2020 Jun;8(6):1828–38.