



Original Research Paper

Assessing The Impact of Environmental Factors on Animals and Their Role in Causing Chronic Respiratory Diseases Including Asthma and Bronchitis

Guli Shaykhova^{1*}, Ibrohim Sapaev², Eshquvvat Bekmirzayev³,

Najmitdinov Akhadkhon Khamitdkhanovich⁴, Koshkar Hakimov⁵, Diyora Pulatova⁶

^{1*}Professor, Department of Nutrition Hygiene, Child and Adolescent Hygiene, Tashkent State Medical University, Tashkent, Uzbekistan. Email: guli.shayxova@tma.uz, ORCID: <https://orcid.org/0000-0003-2297-5450>

²Head, Physics and Chemistry, Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, National Research University, Tashkent, Uzbekistan; School of Engineering, Central Asian University, Tashkent, Uzbekistan. Email: sapaevibrokhim@gmail.com, ORCID: <https://orcid.org/0000-0003-2365-1554>

³Department of Basic Medical Sciences, Faculty of Medicine, Termez University of Economics and Service, Termez, Uzbekistan. Email: eshquvvat_bekmirzayev@tues.uz, ORCID: <https://orcid.org/0009-0007-3718-2847>

⁴Turan International University, Namangan, Uzbekistan. Email: a.najmitdinov@turan-edu.kz, ORCID: <https://orcid.org/0009-0005-9740-1971>

⁵Department of Geographical Sciences, Jizzakh State Pedagogical University, Jizzakh, Uzbekistan. Email: hakimov_54@mail.ru, ORCID: <https://orcid.org/0000-0001-8985-8457>

⁶Central Asian University, Medical School Year 6, Tashkent, Uzbekistan. Email: diyora_pulatova@list.ru, ORCID: <https://orcid.org/0009-0003-3388-4762>

Key Words
Abstract

Chronic respiratory diseases, Air pollution, Environmental risk factors, Animal health, Pollutant transmission, Public health interventions, Animal-human health link.

Chronic respiratory diseases (CRD) such as asthma and bronchitis are significant problems of public health with great morbidity and mortality globally. Environmental factors, including air pollution, indoor air quality, and occupational exposures, have been recognized as major factors in the development and aggravation of these diseases. The objective of this study is to evaluate the effects of environmental factors on the epidemiology of CRDs and to determine the impact of various pollutants and exposures on the prevalence, severity, and progression of the disease. An epidemiological literature search, environmental surveillance data, and case studies show that exposure to particulate matter (PM), nitrogen dioxide (NO₂), and tobacco smoke is closely associated with the occurrence of CRD and the aggravation of symptoms. This study also highlights how environmental factors affecting animals contribute to the transmission of pollutants, which in turn exacerbate respiratory conditions in humans. The role of animals as intermediaries in the environmental health chain further emphasizes the need for controlling environmental risks to both animal and human health. The results emphasize the need for measures to control environmental risk factors through public health interventions. Some of the policy recommendations here include tighter air quality standards, improved indoor air quality, and stronger occupational safety measures. The paper also addresses the role of education for the general public and future research on low-level environmental exposures and their long-term impacts. These environmental determinants are critical for reducing the burden of CRDs and improving respiratory health outcomes.

* Corresponding Author's email: guli.shayxova@tma.uz

Received: 3 May 2025; Reviewed: 10 June 2025; Revised: 4 August 2025; Accepted: 25 August 2025

(DOI): [10.70102/AEJ.2025.17.2.23](https://doi.org/10.70102/AEJ.2025.17.2.23)

Introduction

Chronic respiratory diseases (CRDs) are a set of lung conditions that have a significant impact on populations worldwide (Chen et al., 2023). These conditions are typified by persistent inflammation and obstruction of the airways that makes it hard to breathe. The most frequent CRDs are asthma, chronic obstructive pulmonary disease (COPD), chronic bronchitis, and emphysema (Chatkin et al., 2022). Asthma is a chronic airway disorder that manifests through the inflammatory process and leads to such symptoms as wheezing, shortness, and cough, and is typically caused by allergens or environmental irritants. Instead, bronchitis is characterized by inflammation of the bronchial tubes and is accompanied by a persistent cough, mucus production, and recurrent respiratory infections (Bhatia & Iyer, 2025). Both diseases may vary in severity, affect quality of life, and cause morbidity and mortality worldwide.

It is essential to the health and prevention strategies for chronic respiratory diseases to understand the environmental factors that contribute to their onset and aggravation (Fishe et al., 2022). The environmental factors that significantly contribute to the development and progression of asthma and bronchitis include air pollution, climate change, occupational hazards, indoor air quality, and tobacco smoke exposure (Loffredo et al., 2025). In particular, PM, NO₂ and ozone (O₃) were proven to aggravate symptoms in susceptible people. Additionally, urbanization and industrialization have also promoted exposure to these pollutants, and it is essential to evaluate their contribution to the

epidemiology of CRDs (Ibragimov et al., 2024). Learning these factors will help us design interventions to reduce the burden of disease by minimizing exposure.

The environment is a strong determinant of chronic respiratory diseases (CRDs) in asthma and bronchitis, contributing to their occurrence and severity (Ko & Kyung, 2022). These conditions have been ascribed to air pollution and have been particularly severe in urban areas where there is high pollution such as particulate matter (PM), nitrogen oxide (NO₂) and ozone (O₃) (Clark et al., 2009). Indoor air quality is also an essential element, and tobacco smoke, mold, and household chemicals can worsen respiratory symptoms (Arvinth, 2025). Moreover, occupational exposures to harmful materials such as dust, fumes, and chemicals in other industries like construction, mining, and agriculture are also known to cause risks of developing asthma and chronic obstructive pulmonary disease (COPD), especially to those workers who are frequently exposed to these irritants (Jesi et al., 2025).

This interconnection between environmental exposure, animal health, and human respiratory diseases highlights the importance of addressing environmental factors that affect both populations. The influence of animals in spreading pollutants and exacerbating respiratory conditions in humans requires a holistic approach in tackling CRDs, which includes monitoring animal health and their exposure to environmental pollutants (Williams & Roman, 2016). Understanding the role of animals as carriers of environmental toxins will be essential

in the development of comprehensive public health interventions (May et al., 2012).

The significant contributions made in this research are as follows:

- The research demonstrates how air pollution, climatic factors, and work hazards contribute to the epidemiology of chronic respiratory disorders.
- The study provides insight into the effects of geographical and socio-economic aspects on the predisposition and severity of asthma and bronchitis.
- The paper presents evidence-based recommendations for environmental policy and healthcare interventions to reduce the burden of chronic respiratory diseases, based on the findings.

The paper will be organized as follows: Section II presents a methodology for assessing these influences. The results are presented in Section III and include the correlation between environmental factors and CRD prevalence. Section IV presents the results and the implications of this research for people's health policy. Section V provides recommendations for future research and intervention. Finally, Section VI will draw conclusions by summarizing the key findings and the necessity to take the environmental factors into account when preventing CRD.

Epidemiology of Chronic Respiratory Diseases

Prevalence Rates

CRDs, including asthma and bronchitis, are common, and their prevalence varies by region

and population (Boutros et al., 2024). About 235 million individuals in the world, especially children, are exposed to asthma, especially in urbanized areas where there is more air pollution. Chronic bronchitis is more common among older adults, especially in areas where smoking is more prevalent or the air quality is poor. These diseases are on the increase and are more prevalent in the low and middle-income countries where environmental risk factors such as pollution and access to healthcare are more prevalent (Marchetti et al., 2023). Lifestyle changes, urbanization, and the rising rates of allergies are also posing an asthma burden. Moreover, the reasons behind rising cases of chronic bronchitis and other chronic obstructive pulmonary diseases (COPD) are the aging population of the world, since these diseases are more prevalent in the elderly (Ioannou et al., 2025).

Risk Factors

Genetic and environmental risk factors influence the development and exacerbation of CRD. The genetic predisposition is crucial in the predisposition of asthma and the environmental influences such as air pollution in the outdoors, tobacco smokes, and allergens are critical to the pathogenesis and exacerbation of these diseases (Yang et al., 2022). Occupational exposure to irritants such as dust, fumes, and chemicals is also a significant risk factor, especially for employees in industries such as construction, agriculture, and manufacturing. In addition to well-known environmental risk factors like air pollution and tobacco smoke, emerging pathogens from intensive livestock systems could also influence respiratory health outcomes,

especially in communities with close proximity to such farming operations (Punam, 2024). Besides, lifestyle factors, such as poor diet, obesity, and physical inactivity, have also been found to contribute to the risk of CRDs. Also, comorbid cardiovascular disease can make the

respiratory diseases worse (Thomson, 2022). Climate change is another risk factor of respiratory wellbeing that enhances the severity of extreme weather and the concentration of allergens.

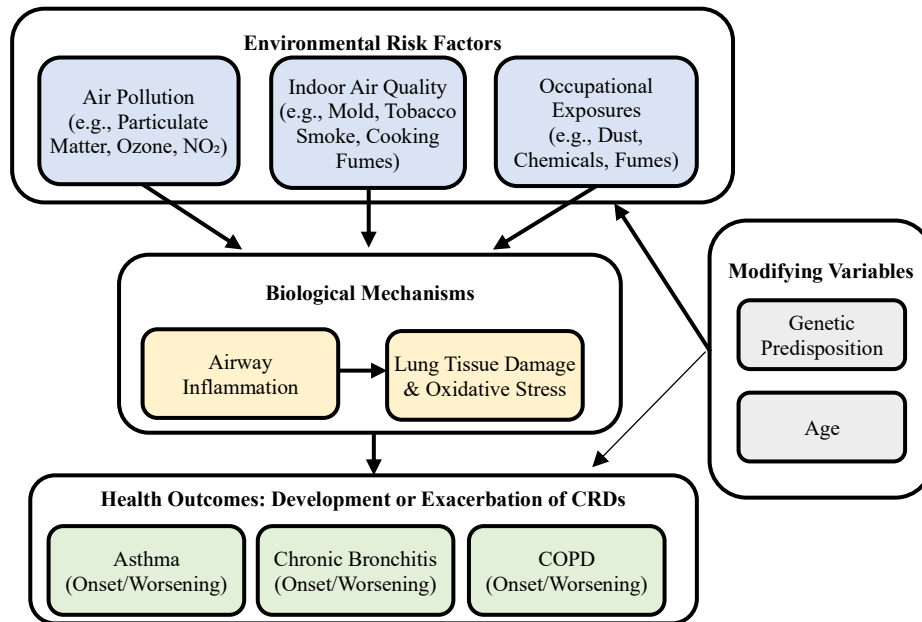


Figure 1: The effects of environmental Risk Factors on chronic respiratory diseases

Figure 1 shows how environmental risk factors, biological processes, and health outcomes relate with each other, and it specifically focuses on chronic respiratory diseases (CRDs). It brings out the key ecological risks of air pollution, indoor air quality (mold, tobacco smoke, and cooking fumes) and occupational exposures to dust and chemicals. These are some of the factors involved in biological processes, such as airway inflammation and lung tissue damage, that are not oxidative in nature. Some of the variables that alter these processes are genetic predisposition and age. In the end, this may lead to the development or worsening of conditions such as asthma, chronic bronchitis, and chronic

obstructive pulmonary disease (COPD) (Wypych-Ślusarska et al., 2022).

Impact on Public Health

CRDs are major contributors to morbidity, health care costs, and productivity. The diseases are significant causes of disability and early mortality, especially in vulnerable groups such as children, the elderly, and low-income groups (Lee et al., 2025). The cost of treatment of asthma and chronic bronchitis incurred in hospitalizations and consequent long-term treatments imposes a significant economic burden on health care systems (Wang et al., 2021). Besides this, CRDs result in significant workday losses, which is an impact on the workforce and the overall economy productivity.

The health effects on the population are severe in areas with limited access to adequate health care and preventive services. For example, rural areas might not receive adequate attention to asthma management, leading to a deterioration in their health status. Also, the burden of health systems caused by the rising rate of these diseases demands a pressing policy intervention to enhance early diagnosis, treatment, and management, especially in resource-constrained environments (Dondi et al., 2023).

Methods for Assessing Environmental Factors

Epidemiological Studies

Epidemiological research is essential for determining the relationship between environmental factors and chronic respiratory diseases (CRDs). These studies aim at establishing trends, causes, and impacts of illnesses within populations. Cohort studies follow individuals over an extended period to assess the occurrence of asthma or chronic bronchitis associated with specific environmental exposures, such as air pollution or tobacco smoke. Case-control studies compare persons with CRDs and those without, analyzing prior exposure to environmental risk factors. Cross-sectional studies evaluate the prevalence of respiratory diseases and environmental exposures at a single point in time, providing a snapshot of their relationship. The research is required to identify the primary environmental risk factors and to establish the impact these factors have on the development and progression of CRDs across various populations.

Environmental Monitoring

Environmental monitoring is the planned collection of information on pollutants and other environmental factors that may affect respiratory health. This tends to be achieved by monitoring the quality of air, temperature, humidity and other environmental conditions which might affect respiratory diseases. Instrumentation of air pollution and remote sensing technologies are devices used to monitor the levels of particulate matter (PM), nitrogen oxide (NO₂), ozone (O₃) and other unfriendly pollutants. The levels of indoor air quality are also estimated by checking the levels of allergens, tobacco smoke, and volatile organic compounds (VOCs) in homes, workplaces, and other indoor conditions. This data will provide the necessary information on the level of exposure and help the researcher to analyze the connection between the elements of the environment and the outcomes of CRD and trace the dynamics of the degree of pollution in the long run.

Statistical Analysis

Statistical analysis is a major component of the analysis of the resilience of environmental variables and chronic respiratory illnesses. Researchers use different statistical tools to manipulate statistical data acquired due to epidemiological research and ecological surveillance. The regression models are typically applied to evaluate the relationship between exposure to environmental factors and the incidence or severity of CRDs, and such a study controls possible confounders like age, gender, and socioeconomic status. Often, Geographic Information Systems (GIS) are used to map the

spatial distribution of environmental exposures and the prevalence of diseases, providing information on the regional distribution patterns. Further, multivariate analysis is employed to learn the joint impact of more than two environmental factors on respiratory health. The techniques of statistical analysis are used to achieve causality, measure risk, and predict future trends in CRD rates in response to changes in environmental conditions.

Case Studies and Research Findings

Study on the Relationship Between Air Pollution and Asthma

It has been widely pointed out by various studies that there is a strong correlation between air pollution and the onset or severe exacerbation of asthma. Indicatively, when research was

carried out in cities that had a high concentration of particulate matter (PM 2.5) and nitrogen dioxide (NO₂), children in the regions of high pollution had more asthma attacks and worsening conditions. A longitudinal study with children followed over a number of years demonstrated that long-term air pollution exposure was not only a contributor to asthma in previously healthy children but also the degree of symptoms in children with pre-existing asthma. The researchers highlighted that air pollution, especially that of traffic, worsens airway inflammation and can lead to lung functionality changes in the long run. These results serve as an indication of the necessity of more rigid requirements on the level of air quality to reduce the effects of pollution on respiratory health.

Table 1: Comparison of Environmental Risk Factors and Respiratory Health Outcomes

| Study | Environmental Risk Factors | Population |
|------------------------|--|--|
| Loffredo et al., 2025 | Tobacco smoke, heated tobacco products (HTPs), and air pollution | Children and adults (passively and actively exposed) |
| Ibragimov et al., 2024 | Working with dust (organic, inorganic), chemicals (acids, aldehydes, etc.) | Adults with COPD (retrospective study) |
| Chen et al., 2023 | Traffic-related air pollution (NO, NO ₂ , PM10, CO, SO ₂) | Children (aged 3–4) |

Table 1 presents a comparison of three studies that identified the effects of environmental exposures on respiratory health. It identifies significant risk factors, which are tobacco smoke, occupational dust, and traffic-related pollution, targeting such populations as children and adults with COPD. The table is a summary of the role of these exposures in the development and progression of respiratory diseases such as asthma and COPD.

Figure 2 is used to show the prevalence of asthma (blue bars) and chronic bronchitis (red bars) by age groups. The prevalence of asthma is found to be higher in 0-4 years, whereas the prevalence of chronic bronchitis is steadily increasing in accordance with the age of the population with the highest trends in the 65-year bracket. This means younger people have increased asthma and the older adults have chronic bronchitis.

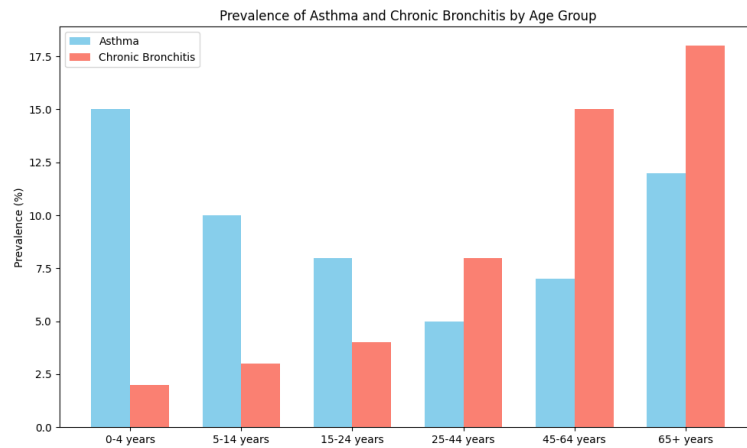


Figure 2: Prevalence of Asthma and Chronic Bronchitis by Age Group

Effect of Exposures on Chronic Obstructive Pulmonary Disease at the Workplace

It has been an established fact that there is an increased risk of occupational exposures leading to the development of chronic obstructive pulmonary disease (COPD) that encompasses chronic bronchitis and emphysema. A research study conducted on the Employees in the construction and mining industries showed that the long-term exposure to dust and chemical fume had high chances of acquiring COPD. The exposed silica dust workers showed signs of

initial lung damage and a high prevalence of persistent cough and wheezing. A different study on agricultural workers also established that pesticide exposure was linked with development of respiratory symptoms and high incidences of COPD. These findings show that the correct implementation of occupational health standards such as the use of appropriate protective equipment and ventilation systems in working environments should be implemented to reduce the amount of any adverse exposures that lead to the development of long-term respiratory diseases.

Table 2: Environmental Exposures and Their Effects on Chronic Respiratory Diseases

| Environmental Exposure | Effect on Asthma | Effect on Bronchitis | Effect on COPD |
|------------------------|----------------------------------|----------------------|--------------------------|
| Air Pollution (PM2.5) | Increased incidence and severity | Worsening symptoms | Accelerates progression |
| Indoor Tobacco Smoke | Exacerbation of symptoms | Chronic inflammation | Contributes to the onset |
| Mold | Trigger for attacks | Aggravates symptoms | N/A |

Table 2 is a summary of the effects of main environmental exposures on chronic respiratory diseases (CRDs) such as asthma, chronic bronchitis, and chronic obstructive pulmonary disease (COPD). Air pollution in the form of particulate matter (PM 2.5) has been proven to contribute to the occurrence and severity of asthma, exacerbation of bronchitis symptoms,

and COPD progression. Tobacco smoke inside buildings worsens the symptoms of asthma patients, causes chronic inflammation of bronchitis, and causes the development of COPD. The causal influence of mold on COPD is still not apparent, but the virus is known to cause asthma exacerbation and exacerbate bronchitis symptoms. These environmental

factors are essential in understanding in order to come up with effective prevention and intervention strategies to contain the burden of CRDs.

Effect of Indoor Air Quality on Respiratory Health

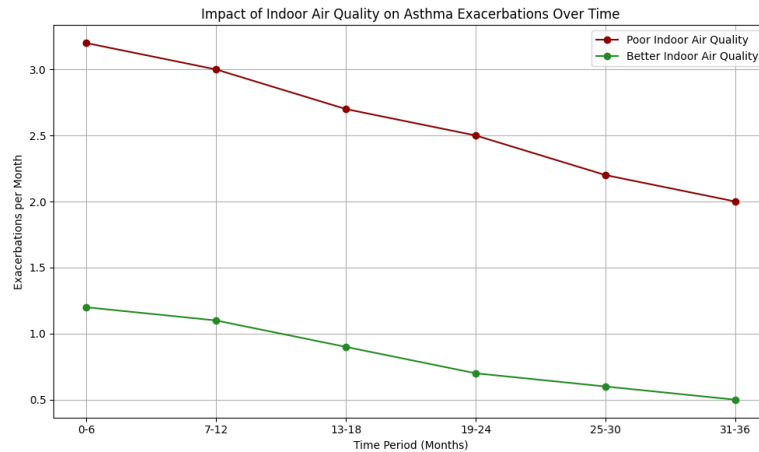


Figure 3: Impact of Indoor Air Quality on Asthma Exacerbations Over Time

Figure 3 illustrates how indoor air quality affects asthma exacerbation in 36 months. Two trends are displayed, one of them is the Poor Indoor Air Quality (illustrated in red), and the other is the Better Indoor Air Quality (illustrated in green). The statistics show that both air quality conditions reduce the incidence of asthma exacerbation as time goes by. Nevertheless, the drop is steeper in those who have an improved indoor air quality, and exacerbation is always lower at all periods of time relative to those who are affected by poor indoor air quality.

The impact of the indoor air quality on respiratory health is immense, as it affects individuals in poorly ventilated rooms or those who have a particular exposure to indoor pollutants. In a case study, urban children who resided in homes that had a great concentration of second-hand smoke, mold, and volatile organic compounds (VOC) were shown to be at high risk of developing asthma, or children with

existing asthma had their symptoms aggravated. In particular, the presence of mold under humid conditions was associated with the threat of respiratory infection and an attack of asthma. This was yet another research that focused on the households fueling wood-burning stoves, and the indoor smoke was identified to be linked with acute and chronic respiratory issues. These findings underline the importance of improving the quality of indoor air by improving ventilation, reducing the cigarette smoke exposure, and eliminating mould in the home environment to prevent respiratory diseases in at-risk populations, including children and the elderly.

Implications for Public Health

Policy Recommendations

To cope with such environmental factors that cause the occurrence of chronic respiratory diseases (CRDs), robust policies in the field of social health are necessary to decrease the

exposure of people to dangerous pollutants. To restrict air quality pollution, especially the presence of particulate matter (PM 2.5) and nitrogen dioxide (NO₂), which have been proven to aggravate asthma and bronchitis, governments need to educate and enforce stricter air quality standards. Also, the air pollution generated by burning fossil fuels can be minimized through policies that encourage the use of clean energy sources, such as solar and wind energy. On the workplace level, regulations, which ensure that

work laborers are not exposed to occupational hazards such as dusts, chemicals, and fumes in industries such as construction, agriculture, and manufacturing, are necessary. The public health campaigns must also promote a smoke-free atmosphere, especially in homes and workplaces, to minimize the dangers of respiratory disorders brought about by exposure to smoke. A combination of such policy interventions with other global policies on reducing pollution can significantly decrease the CRD's burden.

Table 3: Policy Recommendations and Public Health Interventions

| Environmental Risk Factor | Policy Recommendation | Public Health Intervention |
|----------------------------------|--|-----------------------------------|
| Air Pollution | Stricter air quality standards | Pollution control programs |
| Tobacco Smoke | Smoking bans in public places | Anti-smoking campaigns |
| Occupational Exposures | Improve safety regulations in workplaces | Regular health screenings |
| Indoor Air Quality | Implement ventilation standards in homes | Public education on air quality |

Table 3 identifies some of the main policy proposals and possible public health interventions to the existing environmental risk factors that lead to chronic respiratory diseases (CRDs), including asthma, bronchitis, and COPD. To fight air pollution, the air quality standards should be tightened, and pollution control programs need to be put in place. Smoking cessation campaigns and the prohibition of smoking in social places in response to tobacco smoke are necessary to minimize exposure. In the workplace, risks related to dangerous substances can be addressed by enhancing the safety standards in the workplace and carrying out frequent health checks as a form of preventive measures. Finally, the management of indoor air quality by setting ventilation standards in residential buildings and educating the population concerning air quality will contribute to minimizing the threats to human health by reducing their risks, especially

in urban and risky areas. The interventions are essential in the process of decreasing the burden of CRDs and enhancing the health of the population.

Strategies for Prevention and Intervention

The prevention and intervention strategies would be necessary in providing solutions to the effects of environmental factors on respiratory health. The campaigns on public health should aim at informing the people about the dangers posed by air pollution, tobacco smoke, and indoor air quality. The study can also encourage people to use air purifiers to enhance the quality of indoor air, especially in areas with high pollution rates. Urban planning policies like the development of green regions, the minimization of vehicle pollutants, and the enhancement of transportation of people can be used at the community level to reduce exposure to environmental pollutants. Behavioral

interventions, including advising people to quit smoking and engage in exercise to enhance lung functioning, are also necessary. With regard to individuals having the underlying respiratory disorders, it is possible to avoid them by detecting them in the early stages of development, observing the individual periodically, and by a particular treatment course, thereby delaying the development of CRDs and reducing the intensity of the symptoms.

Future Research Directions

Future studies ought to seek to better comprehend the long-term outcomes of low-level environmental exposures that people may be exposed to in urban environments or workers in agriculture. Research that examines how a series of ecological changes, including pollution, climate change, and work-related dangers, together impact the respiratory conditions is essential in designing more specific approaches to community health. The other developing field of research is climate change, where the changing weather patterns can raise the incidence of respiratory exacerbations with high temperatures and air pollution. It is also necessary to conduct further studies on the subject worldwide to detect variations in the prevalence of CRD in various socio-economic groups and geographic areas, particularly in low- and middle-income countries. The insights gained as a result of these patterns will be used to develop more equitable health policies that will support vulnerable groups. Last but not least, studies about new treatment interventions against CRDs, including interventions that address environmental stimuli,

can present new opportunities to enhance patient outcomes.

Conclusion

The results of the given research underline the necessity to consider environmental factors in the prevention and control of chronic respiratory disease (CRD). Genetics and lifestyle choices are also factors that lead to these conditions; however, environmental exposures are also significant risk factors that are modifiable. Through the control of such contributing factors, e.g., air pollution, poor indoor air quality, and workplace risks, we will be able to significantly decrease the burden of CRDs. The strategies of improving the state of air and enhancing healthy indoor environments, as well as the tighter enforcement of regulations that will restrict the harmful exposures so that more effective results can be achieved in improving the respiratory health of the population at the individual level, should also be considered as ways of promoting better health of the population.

Policymakers, public health organizations, and healthcare providers must take immediate action to minimize the effects of environmental risk factors on CRDs. Given the critical role of animals in transmitting environmental pollutants to humans, it is also essential that policies address the health of animals as part of the broader environmental health strategy. The mitigation of these risks would be possible through stricter ecological laws, campaigns of public awareness, and educating people. Promoting such behaviors as giving up smoking, improving indoor ventilation, and responding to indoor pollutants are essential strategies. Additionally,

recognizing the contribution of animals to the transmission of environmental toxins can enhance public health approaches and reduce CRDs in both human and animal populations. Future research should focus on the enduring consequences of environmental exposures and investigate novel approaches for disease prevention and management. We can lower the number of people with CRD and improve public health by dealing with these problems.

References

- [1] Arvinth, N. "Effect of Pranayama on respiratory efficiency and stress levels in adolescent athletes." *Journal of Yoga, Sports, and Health Sciences* (2025): 1-8.
- [2] Bhatia, M., and R. Ramesh Iyer. "Immunological Responses to Viral Infections." *Medxplore: Frontiers in Medical Science* (2025): 52-70.
- [3] Boutros, Perla, Nour Kassem, Valentin Boudo, Ali Sié, Stephen Munga, Martina A. Maggioni, Marcin Golec et al. "Understanding the risk factors, burden, and interventions for chronic respiratory diseases in low-and middle-income countries: a scoping review." *Public Health Reviews* 45 (2024): 1607339. <https://doi.org/10.3389/phrs.2024.1607339>
- [4] Chatkin, Jose, Liana Correa, and Ubiratan Santos. "External environmental pollution as a risk factor for asthma." *Clinical reviews in allergy & immunology* 62, no. 1 (2022): 72-89.
- [5] Chen, Yao, Cong Peng, Hua Zhang, Yu Cai, Rui Yuan, Pingping Song, Chunling Zhang, and Yongjian Yan. "Exposure to occupational risk factors is associated with the severity and progression of chronic obstructive pulmonary disease." *Medicine* 102, no. 6 (2023): e32908. <https://doi.org/10.1097/MD.00000000000032908>
- [6] Clark, Nina Annika, Paul A. Demers, Catherine J. Karr, Mieke Koehoorn, Cornel Lencar, Lillian Tamburic, and Michael Brauer. "Effect of early life exposure to air pollution on development of childhood asthma." *Environmental health perspectives* 118, no. 2 (2009): 284. <https://doi.org/10.1289/ehp.0900916>
- [7] Dondi, Arianna, Claudio Carbone, Elisa Manieri, Daniele Zama, Chiara Del Bono, Ludovica Betti, Carlotta Biagi, and Marcello Lanari. "Outdoor air pollution and childhood respiratory disease: the role of oxidative stress." *International journal of molecular sciences* 24, no. 5 (2023): 4345. <https://doi.org/10.3390/ijms24054345>
- [8] Fische, Jennifer, Yi Zheng, Tianchen Lyu, Jiang Bian, and Hui Hu. "Environmental effects on acute exacerbations of respiratory diseases: A real-world big data study." *Science of The Total Environment* 806 (2022): 150352. <https://doi.org/10.1016/j.scitotenv.2021.150352>
- [9] Ibragimov, S., R. Mavlyanova, N. Burieva, S. Abdusatorov, A. Mengliboev, B. Nazirov, I. Norbotaev, and K. Zokirov. "Investigating the Effects of Aquatic Pollutants on Human Health."

- International Journal of Aquatic Research and Environmental Studies* 4, no. S1 (2024): 107–12. <https://doi.org/10.70102/IJARES/V4S1/18>
- [10] Ioannou, Andreas, Elena Papadopoulos, and MohammadReza Qaderi. "The Impact of Air Pollution on Chronic Respiratory Diseases." *International journal of medical and applied health science* 1, no. 1 (2025): 14-20. <https://doi.org/10.22034/ijmahs.v1i1.165>
- [11] Jesi, Nishat Shabnam, Sumaiya Chaudhuri Sharmy, Aishwarya Sarker Hridi, Md Shamim Reza, and Farhana Ferdous. "Chronic Lung Disease in Focus: Epidemiological Perspectives on Lifestyle, Environmental, and Clinical Risk Factors." *Asia Pacific Journal of Surgical Advances* 2, no. 3 (2025): 130-138. <https://doi.org/10.70818/apjsa.v02i03.053>
- [12] Ko, Ui Won, and Sun Young Kyung. "Adverse effects of air pollution on pulmonary diseases." *Tuberculosis and Respiratory Diseases* 85, no. 4 (2022): 313. <https://doi.org/10.4046/trd.2022.0116>
- [13] Lee, Ji Young, Seulbi Lee, Dirga Kumar Lamichhane, Sabina Shrestha, Eunji Kim, Jongmin Oh, Whanhee Lee et al. "Combined effects of traffic-related air pollution, climate factors, and greenness on respiratory disease risk in infants." *Scientific Reports* 15, no. 1 (2025): 31250.
- [14] Loffredo, Lorenzo, Enrico Maggio, Simona Bartimoccia, Arianna Magna, Chiara Maria Totè, Chiara Bagnato, Bianca Laura Cinicola et al. "Tobacco Smoke Exposure and Oxidative Stress: The Role of Circulating Lipopolysaccharides in Heated and Conventional Products." *Antioxidants* 14, no. 11 (2025): 1316. <https://doi.org/10.3390/antiox14111316>
- [15] Marchetti, Pierpaolo, Jessica Miotti, Francesca Locatelli, Leonardo Antonicelli, Sandra Baldacci, Salvatore Battaglia, Roberto Bono et al. "Long-term residential exposure to air pollution and risk of chronic respiratory diseases in Italy: The BIGEPI study." *Science of the Total Environment* 884 (2023): 163802. <https://doi.org/10.1016/j.scitotenv.2023.163802>
- [16] May, Sara, Debra J. Romberger, and Jill A. Poole. "Respiratory health effects of large animal farming environments." *Journal of toxicology and environmental health, part B* 15, no. 8 (2012): 524-541. <https://doi.org/10.1080/10937404.2012.744288>
- [17] Punam, Sumit Ramswami. "Metagenomic Surveillance of Emerging Pathogens in Intensive Dairy and Poultry Systems." *National Journal of Animal Health and Sustainable Livestock* 2, no. 1 (2024): 63-70.
- [18] Thomson, Neil C. "The role of smoking in asthma and chronic obstructive pulmonary disease overlap." *Immunology and Allergy Clinics* 42, no. 3 (2022): 615-630.
- [19] Wang, Gang, Jenny Hallberg, Petra Um Bergström, Christer Janson, Göran

- Pershagen, Olena Gruzieva, Marianne Van Hage et al. "Assessment of chronic bronchitis and risk factors in young adults: results from BAMSE." *European Respiratory Journal* 57, no. 3 (2021). <https://doi.org/10.1183/13993003.02120-2020>
- [20] Williams, Kurt, and Jesse Roman. "Studying human respiratory disease in animals—role of induced and naturally occurring models." *The Journal of pathology* 238, no. 2 (2016): 220-232. <https://doi.org/10.1002/path.4658>
- [21] Wypych-Ślusarska, Agata, Martina Grot, Maria Kujawińska, Maciej Nigowski, Karolina Krupa-Kotara, Klaudia Oleksiuk, Joanna Głogowska-Ligus, and Mateusz Grajek. "Respiratory symptoms, allergies, and environmental exposures in children with and without asthma." *International Journal of Environmental Research and Public Health* 19, no. 18 (2022): 11180. <https://doi.org/10.3390/ijerph191811180>
- [22] Yang, Ian A., Christine R. Jenkins, and Sundeep S. Salvi. "Chronic obstructive pulmonary disease in never-smokers: risk factors, pathogenesis, and implications for prevention and treatment." *The Lancet Respiratory Medicine* 10, no. 5 (2022): 497-511. [https://doi.org/10.1016/S2213-2600\(21\)00506-3](https://doi.org/10.1016/S2213-2600(21)00506-3)