Etiology and Risk Factors of Lung Diseases Among Non-Smokers: A Systematic Review

Cherono Joyous Apidia[1], Clifford Mocha[2], Chelangat Jeva[3], Lydia Jepchirchir[4], Kevin Mwangi Macharia[5]

[1,2,3] Department of Clinical Medicine, Kenya Medical Training College, Kenya.
[4] Department of Nursing, Kenya Medical Training College, Kenya.
[5] Department of Health and Sanitation, Muranga, Kenya.

ABSTRACT

Lung diseases are a major cause of morbidity and mortality worldwide. Although tobacco smoking is the leading risk factor, a large proportion of lung diseases occur among non-smokers. In rural and low resource settings, exposure to biomass fuel, environmental pollutants, occupational dust and recurrent infections may significantly contribute to respiratory disease burden. The objective is to systematically review and synthesize evidence on the etiology and risk factors of lung diseases among non-smokers. A systematic review and meta-analysis was conducted and the literature database was conducted in 4 search PubMed, Google Scholar, Cochrane Library and WHO reports for studies published in English between 2000 and 2026. Studies involving non-smokers with lung diseases were included. The results indicate that a total of 520 studies were identified, 28 studies met the inclusion criteria, with 15 included in meta-analysis. Major lung diseases identified included asthma, chronic obstructive pulmonary disease (COPD), lung cancer, bronchiectasis and post tuberculosis lung disease. Biomass smoke exposure was the strongest risk factor, followed by outdoor air pollution, occupational dust and chemical exposure, passive smoking and recurrent respiratory infections. The conclusion is that lung diseases among non-smokers are strongly associated with environmental and occupational exposures. Prevention strategies should focus on reducing biomass exposure, improving ventilation and strengthening infection control.

KEYWORDS

Lung disease among non-smokers, COPD in non-smokers, Indoor air pollution and respiratory disease, Biomass smoke exposure and Passive smoking and lung disease

I. INTRODUCTION

Chronic lung diseases are among the leading causes of morbidity and mortality worldwide and remain a major public health challenge (World Health Organization, 2024). These diseases include: chronic obstructive pulmonary disease (COPD), chronic bronchitis, asthma, interstitial lung diseases, pulmonary fibrosis and lung cancer and contribute significantly to disability, poor quality of life and premature deaths globally (GBD Chronic Respiratory Collaborators, 2020). Although tobacco smoking is the principal cause of chronic respiratory diseases, increasing evidence shows that many cases occur among non-smokers (Salvi & Barnes, 2009; Gunasekera, et al., 2025). Globally, approximately 25-45% of COPD cases and up to 30-40% of lung cancer cases occur among individuals who have never smoked (Yang, 2011; Samet & Rudin, 2009).

Environmental and occupational exposures are major contributors to lung diseases among non-smokers (McAllister, et al., 2025; Chen, Huang, & Li, 2026). Indoor air pollution from biomass fuel combustion is a leading risk factor, particularly among women and children in rural settings where firewood, charcoal and crop residues are commonly used for cooking in poorly ventilated homes (Pandey & Dixit, 2024; World Health Organization, 2024). Chronic exposure to biomass smoke contributes to airway inflammation and airflow obstruction, increasing the risk of COPD, chronic bronchitis and asthma (Alvarado., 2022). Outdoor air pollution from industrial emissions, vehicle exhaust and fossil fuel combustion also contributes to chronic respiratory diseases among never smokers (GBD Chronic Respiratory Collaborators, 2020). Exposure to particulate matter, especially PM2.5, has been associated with chronic bronchitis, asthma exacerbations, pulmonary fibrosis and lung cancer (Albano, et al., 2023; Yan, Jang, & Xie, 2025).

Occupational exposure to silica dust, asbestos, pesticides and industrial chemicals further increases the risk of chronic respiratory diseases among workers in mining, construction, agriculture and manufacturing sectors (Blanc, et al., 2019). Long term exposure has been linked to chronic bronchitis, occupational asthma, COPD, pulmonary fibrosis and lung cancer among individuals with no history of smoking (McAllister, et al., 2025). In addition, exposure to passive tobacco smoke increases the risk of asthma, COPD and lung cancer among non-smokers (Samet & Rudin, 2009). Previous respiratory infections such as pulmonary tuberculosis, poorly controlled asthma and recurrent pneumonia may also result in irreversible lung damage including fibrosis and bronchiectasis (Yang, 2011). Sociodemographic factors including poverty, rural residence, overcrowding, poor housing and limited access to healthcare further increase susceptibility to chronic respiratory diseases among non-smokers (World Health Organization, 2024).

In Kenya, chronic respiratory diseases are an emerging but under-recognized public health concern, particularly among never smokers exposed to environmental and occupational risk factors. Many households rely on biomass fuels such as firewood and charcoal for cooking, contributing to indoor air pollution, especially in rural and informal urban settlements (Ministry of Health, 2023). Rapid urbanization in cities such as Nairobi, Mombasa and Kisumu has also increased exposure to environmental air pollution from vehicle emissions and industrial activities (World Bank, 2022). Occupational exposure in construction, agriculture and small scale industries, together with the high burden of tuberculosis, further contributes to chronic respiratory impairment among non-smokers (National TB Program Kenya, 2023). Despite the growing burden of respiratory diseases among non-smokers, these conditions remain underdiagnosed and under-recognized in many healthcare systems (Salvi & Barnes, 2009). Most prevention programs continue to focus mainly on smoking cessation, with limited attention to environmental, occupational, infectious and sociodemographic determinants (World Health Organization, 2024). Although several studies have investigated risk factors associated with respiratory diseases among never smokers, the evidence remains inconsistent across populations and regions (Gunasekera, et al., 2025; Zhang Y, 2023). Therefore, this systematic review and meta-analysis aimed to synthesize available evidence on the etiology and risk factors associated with lung diseases among non-smokers (Page, et al., 2021).

II. MATERIALS AND METHODOLOGY

This study employed a Preferred Reporting Items for Systematic Reviews and meta-Analysis PRISMA 2020 (Page, et al., 2021) to synthesize global evidence on the etiology and risk factors of lung diseases in non-smokers. The chapter outlines the research question, search strategy, selection criteria and data extraction procedures used in identifying and synthesizing relevant studies. The review focused on environmental, occupational, medical and sociodemographic risk factors associated with lung diseases among non-smokers.

A. Research question

To address the core objectives of this study, the following research question was formulated: "What are the etiological factors and risk factors associated with lung diseases among non-smokers globally?"

B. Search strategy and selection criteria

A comprehensive literature search was conducted to identify relevant studies on lung diseases among non-smokers using PRISMA 2020 guidelines as illustrated in Figure 1 (Page, et al., 2021). Electronic databases searched included PubMed, Google Scholar, the Cochrane Library and reports published by the World Health Organization. The search focused on studies published in English that investigated the causes and risk factors of lung diseases among non-smokers. Reference lists of selected articles were also reviewed to identify additional studies relevant to the review topic.

Studies were included in the review if they involved non-smokers, adults aged 18 years and above, studies reporting causes, prevalence or risk factors associated with lung diseases and studies published in English language. Studies were excluded if they involved active smokers, Paediatric only studies, studies without clear outcomes related to lung diseases and duplicate studies and studies with incomplete data. The search was performed using a combination of keywords and Boolean operators to maximize retrieval of relevant studies. Boolean operators such as "AND" and "OR" were used to combine search terms and improve retrieval of relevant studies as illustrated in Table 1.

Table 1: Search term combinations used in identifying relevant studies.

Concept Area	**Keywords**	**Boolean Operators / Search Strings**
Population	"Non-smokers" OR "Never smokers"	("non-smokers" OR "never smokers")
Disease Condition	"Lung diseases" OR "COPD" OR "Asthma" OR "Chronic respiratory diseases"	AND ("lung diseases" OR "COPD" OR "asthma" OR "chronic respiratory diseases")
Environmental Exposure	"Biomass smoke" OR "Indoor air pollution" OR "Air pollution" OR "Passive smoking"	AND ("biomass smoke" OR "indoor air pollution" OR "air pollution" OR "passive smoking")

Occupational Exposure	"Occupational dust" OR "Silica" OR "Asbestos" OR "Chemical fumes"	AND ("occupational dust" OR "silica" OR "asbestos" OR "chemical fumes")
/Outcomes	"Risk factors" OR "Etiology" OR "Respiratory outcomes"	AND ("risk factors" OR "etiology" OR "respiratory outcomes")
Study Design Filters	"Systematic review" OR "Cohort study" OR "Case-control study" OR "Cross-sectional study"	AND ("systematic review" OR "cohort study" OR "case-control" OR "cross-sectional")

C. Data extraction procedure

Data extraction was conducted systematically using a standardized data extraction form developed by the researcher. Relevant information was extracted from each included study and summarized according to the objectives of the review. The following variables were extracted: authors and year of publication, study setting, study design, sample size, type of lung disease investigated, identified risk factors, measures of association used and conclusions. The extracted data were reviewed for accuracy and completeness before they were synthesized qualitatively and quantitatively, with meta-analysis conducted where sufficient homogeneity existed among studies.

III. RESULTS

A total of 520 studies were identified, with 28 studies included in the systematic review and 15 studies included in the final meta-analysis. Recent evidence consistently demonstrates that lung diseases among non-smokers are strongly associated with environmental, occupational and infectious exposures. Biomass smoke exposure was identified as the leading risk factor, particularly in rural and resource limited settings where solid fuels are commonly used for cooking and heating. Meta-analysis findings showed that exposure to biomass smoke increased the risk of COPD among non-smokers by approximately two to three times (pooled OR = 2.44).

Environmental air pollution, passive smoking and occupational exposure to dust, silica, asbestos, pesticides and chemical fumes were also significantly associated with chronic respiratory diseases among non-smokers, with pooled odds ratios ranging between 1.4-1.9. Previous respiratory infections especially pulmonary tuberculosis and recurrent pneumonia, were linked to chronic airflow limitation, fibrosis and bronchiectasis.

Findings indicated that asthma is the most common chronic lung disease among non-smokers, with an adult prevalence of about 4-8% globally. Non-smoking related COPD is increasingly recognized and accounts for approximately 25-45% of COPD cases in some populations. Studies show that non-smokers may represent more than the above COPD cases, with similar exacerbation rates compared to smokers.

The findings further indicated that adults aged above 40 years were the most affected population group, with females disproportionately affected in rural communities due to

prolonged exposure to indoor biomass smoke. As a whole, the information presented here shows that lung disease among non-smokers is an important issue in public health on a worldwide basis, especially in developing nations where exposure is very common.

significant and growing public health concern worldwide, particularly in low and middle income countries. The findings indicate that non-smokers are substantially affected by chronic respiratory diseases, including asthma, COPD, bronchiectasis, lung cancer and post tuberculosis lung disease. Across the reviewed studies, environmental, occupational, infectious and sociodemographic

IV. DISCUSSION

This systematic review provides evidence that lung diseases among non-smokers are serious and increasing public health problem globally, especially in low and middle income countries. The results suggest that there is significant impact of chronic respiratory diseases (CRD) such as asthma, COPD, bronchiectasis, lung cancer and post tuberculosis lung disease on non-smokers. In all of the studies reviewed, environmental, occupational, infectious and sociodemographic factors were found to be the most important factors influencing lung disease burden. The risk factors most frequently and strongly associated were exposure to biomass smoke, outdoor air pollution, dust and chemical exposures at work and passive smoking and repeated respiratory infections. The findings align with previous studies, which have shown that there is a significant proportion of chronic respiratory diseases that affect people who have not smoked tobacco (Salvi & Barnes, 2009; World Health Organization, 2024).

The review emphasizes the importance of environmental exposures, especially biomass fuel combustion in the household, for the onset of lung diseases in never smokers. In many rural and resource limited areas, firewood, charcoal and agricultural residues are used as a primary source of energy for cooking and heating. Burning of these fuels in poorly ventilated areas creates high levels of particulate matter and toxic vapour that cause chronic inflammation of the airways, oxidative stress and progressive loss of lung function. Thus, people who are exposed to biomass smoke are more likely to get COPD, chronic bronchitis and asthma. In a similar manner, respiratory morbidity and mortality has been linked to outdoor air pollution caused by industrial emissions, motor vehicle exhaust and fossil fuel combustion even in the absence of smoking. These results support the ever increasing awareness of air pollution as a significant cause of chronic respiratory illnesses around the world.

Other characteristics associated with occupational exposures were also found to be significant risk factors among non-smokers for lung diseases. The workers in mining, construction, agriculture and manufacturing industries are exposed to harmful agents like silica dust, asbestos fibres, pesticides, chemical fumes and this exposure is often without adequate protection. Chronic Bronchitis, Occupational Asthma, Pulmonary fibrosis and Lung cancer are associated with long-term exposure to these substances. Consistency of these findings in different studies highlights the importance of having more strong occupational

health policies, better workplace safety practices and more frequent respiratory health assessment of workers at high risk.

It was discovered that infectious diseases also were important contributors to the pathogenesis of CRD in never smokers. Long term structural and functional lung changes were associated with previous respiratory infections, mainly pulmonary tuberculosis and recurrent pneumonia. Post infectious complications, including bronchiectasis, pulmonary fibrosis and chronic airflow limitation are still very common, particularly in areas where tuberculosis is prevalent. The results are important in sub Saharan Africa where infectious diseases still exist alongside non communicable respiratory diseases, thus adding to the burden of chronic lung disease.

Passive smoking and the sociodemographic factors were also found to be significant factors for the respiratory morbidity. Passive smokers are at increased risk of developing asthma, COPD and lung cancer. Women and children are especially vulnerable from extended exposure to household settings. In addition, poverty, overcrowding, insufficient housing and limited access to health care services make people more vulnerable to respiratory diseases, as they are more likely to be exposed to environmental and occupational hazards and less likely to have access to routine health check-ups, early diagnosis and treatment services.

The results of this review are in line with the international literature, revealing that non-smokers represent a large proportion of people with chronic respiratory disease. Both surrounding air pollution and exposure to biomass smoke in the home are major causes of respiratory morbidity in the world (World Health Organization, 2024). In previous studies, it has been reported that around 30-40% of lung cancer cases and 25-45% of COPD cases are attributable to non-tobacco related risk factors, indicating that there is a significant amount of disease burden due to these non-tobaccos related factors.

However, the consistent results obtained with these studies are accompanied by some difficulties in the prevention and management of lung diseases in non-smokers. An important limitation is lack of recognition of non-smoking-related respiratory diseases in clinical practice, with more attention being given to smoking exposure. Furthermore, there was some heterogeneity within the evidence base due to differences in study designs, exposure assessment methods and diagnostic criteria of the included studies. The restrictions highlight the necessity for standardised methods, better exposure assessment methods and better quality longitudinal studies to enhance future research in this area.

These problems can be solved through integrated public health measures to reduce environmental and occupational risk factors. Ensuring access to clean energy technologies, encouraging the use of better indoor air pollution control devices in households and improving occupational safety standards are key actions to be taken to decrease respiratory burden for non-smokers. In addition, comprehensive environmental and occupational exposure histories should be used routinely in clinical evaluation to aid in early detection and management of those with higher risk.

The evidence from this review indicates a need for a multispectral approach in dealing with non-smokers' lung disease. Good inter-sectoral coordination is key to minimizing harmful exposures and ensuring positive respiratory health outcomes, between health,

environmental and labour, energy and policy sectors. In addition, there is a need to increase the awareness and health education of the public about non tobacco related causes of lung disease, which will also be an important aspect of prevention and early intervention. When taken together, they could make a significant contribution to the rising morbidity and mortality from chronic respiratory conditions among non-smokers globally.

V. CONCLUSION

Environmental pollution, indoor air pollution, occupational exposure and previous respiratory illnesses are some of the factors responsible for the increasing public health burden of lung diseases in non-smokers. However, although non-smokers are the focus of issues of great importance in terms of health, it is important to note that smoking remains a major risk factor for lung disease. Special measures must be taken to minimise exposure and enhance respiratory health outcomes.

RECOMMENDATIONS

In order to significantly decrease the burden of lung diseases that are associated with environmental and occupational risk factors among non-smokers, strict public health policies should be adopted. Improving ventilation systems and promoting the use of clean household fuels should be a priority, especially in low resource areas and rural locations where biomass fuels are used. Further, measures for the prevention of occupational hazards such as the wearing of mandatory protective clothing and the provision of regular respiratory health screening should be strengthened in dusty, pesticide, asbestos and chemical fume exposed workers.

The healthcare system should also improve early diagnosis, treatment and monitoring of any respiratory infection like TB and recurrent pneumonia, to prevent long term lung damage to never smokers. In addition, there is need to raise the awareness of the community about non-smoking related causes of chronic lung diseases and encourage preventive respiratory health programmes. Finally, larger scale epidemiology studies and meta-analyses are encouraged to further our understanding of emerging risk factors and aid in evidence based respiratory health interventions around the world.

AUTHOR CONTRIBUTIONS

This paper was designed and written by the authors, based on their own ideas and work.

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CONFLICT OF INTEREST

The authors have no conflict of interest regarding the publication of this paper.

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