frontiers | Frontiers in Climate

TYPE Systematic Review
PUBLISHED 01 October 2025
DOI 10.3389/fclim.2025.1555383

OPEN ACCESS

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RECEIVED 04 January 2025
ACCEPTED 10 September 2025
PUBLISHED 01 October 2025

CITATION
Andualem Z, Alemu AT, Geddif A, Kassie GG, Mitiku KW, Belay MA, Simegn MB, Chanie SD, Tilahun WM, Menber Y, Wasihun Y and Gebreegziabher ZA (2025) Impacts of climate change on chronic respiratory health in Ethiopia: a systematic review and meta-analysis.
Front. Clim. 7:1555383.
doi: 10.3389/fclim.2025.1555383

Impacts of climate change on chronic respiratory health in Ethiopia: a systematic review and meta-analysis

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Introduction: Climate change presents profound public health challenges, particularly in low-income countries like Ethiopia. Chronic respiratory diseases and chronic respiratory symptoms, are exacerbated by environmental factors such as air pollution, extreme temperatures, and occupational exposure. Despite its vulnerability, Ethiopia lacks comprehensive data on impacts of climate change on chronic respiratory health, limiting effective policy and intervention strategies. Therefore, the aims of this study to assess the impact of climate change on chronic respiratory health in Ethiopia.

Methods: A systematic review and meta-analysis were conducted using Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. Studies published between 2015 and 2024 were retrieved from PubMed, Embase, Google Scholar, and institutional repositories. Eligible studies focused on chronic respiratory diseases and chronic respiratory symptoms in Ethiopia and employed observational designs. Data extraction followed Joanna Briggs Institute protocols, and risk of bias was assessed using Hoy et al.'s checklist. Statistical analyses were performed in STATA 14, including pooled prevalence estimation using a random-effects model, subgroup analyses by region and study design, and publication bias assessment using Egger's test and funnel plots.

Results: A total of 21 studies with 10,785 participants were included, the pooled prevalence of chronic respiratory health was 39% (95% CI: 31–48%). The most common symptoms were cough, phlegm, wheezing, and shortness of breath. Air pollution, particularly particulate matter (PM2.5 and PM10), temperature, and altitude were reported as a significant contributor. Subgroup analysis revealed

the highest prevalence in Oromia (61, 95% CI: 58–64%) and the lowest in the Southern Nations, Nationalities and People Region (23, 95% CI: 13–33%). Study design influenced prevalence estimates, with cross-sectional studies reporting higher rates (46%) than case–control studies (14%). Significant heterogeneity (I^2 = 99%, $p < 0.001$) was observed across studies.

Conclusion: The findings highlight a substantial burden of chronic respiratory health in Ethiopia, resulting from climatic, environmental, and occupational exposures. Decreasing biomass fuel use, enhancing air quality, and incorporating climate adaptation measures into public health policy are key interventions.

KEYWORDS

climate change, chronic respiratory diseases, Ethiopia, systematic review, meta-analysis

Introduction

Climate change is one of the most critical global issues, significantly affecting public health (Simane et al., 2016). The World Health Organization (WHO) considers climate change a health determinant that worsens existing vulnerabilities and introduces new health risks (Rawat et al., 2024; Watts et al., 2018). Chronic respiratory diseases (CRDs) like COPD, asthma, and allergies are key health outcomes linked to climate change, driven by poor air quality, increased allergens, temperature changes, precipitation patterns, and extreme weather events. CRDs, particularly asthma and COPD, account for about 7% of global deaths (Xu et al., 2025; Momtazmanesh et al., 2023; Lee and Yoon, 2024). Environmental factors such as air pollution, occupational exposures, and climate change-induced factors exacerbate these conditions (Momtazmanesh et al., 2023; Lee and Yoon, 2024).

Climate change adversely affects respiratory health through multiple mechanisms (D'Amato et al., 2014). Rising temperatures enhance ground-level ozone formation, causing oxidative stress and lung inflammation. Particulate matter (PM2.5 and PM10) from natural and human activities aggravates airway inflammation and existing respiratory conditions (Abdul-Nabi et al., 2025). Heatwaves, wildfires, and increased allergen production, such as pollen, contribute to acute and chronic respiratory issues (Anenberg et al., 2012; Scheerens et al., 2022). Air pollution remains the leading global environmental risk for respiratory diseases. Urbanization and industrialization have heightened emissions of pollutants like nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and black carbon (Andersen et al., 2023). Heatwaves increase respiratory-related hospitalizations, particularly in vulnerable groups. Additionally, longer growing seasons and elevated CO_2 levels make allergens like mold and pollen more potent and widespread, exacerbating respiratory problems (Smith and Pillarisetti, 2017).

Africa faces disproportionate impacts from climate change due to its dependence on climate-sensitive sectors, limited adaptive capacity, and existing health challenges (Wright et al., 2024). Rising temperatures, recurrent droughts, and extreme weather worsen health disparities and disrupt livelihoods (Simane et al., 2016; Teku and Eshetu, 2024). Sub-Saharan Africa is particularly vulnerable as climate change exacerbates infectious diseases, malnutrition, and non-communicable diseases like chronic respiratory diseases (Abdrabo et al., 2014). Household air pollution, driven by widespread biomass fuel use for cooking and heating, affects about 80% of African households. Women and children face the greatest exposure, leading to higher rates of respiratory diseases. Additionally, rapid urbanization has increased outdoor air pollution in African cities, where emissions regulations are often insufficient (Jestin-Guyon et al., 2023).

Data on chronic respiratory diseases (CRDs) in Africa are scarce but indicate a rising burden. COPD is increasing due to tobacco use and biomass smoke, while asthma affects millions, with prevalence reaching 20% in some urban areas. Dust storms in arid regions are linked to higher respiratory hospitalizations (Georgakopoulou et al., 2024). Efforts to mitigate climate-related health risks include National Adaptation Plans (NAPs) and regional strategies like the African Union's Agenda 2063 (Commission and Cooke, 2022). However, progress is hindered by financial and institutional challenges. Key public health measures, such as promoting clean cooking technologies and strengthening health systems, remain underfunded (Abdrabo et al., 2014).

Ethiopia is particularly vulnerable to climate change, facing rising temperatures, erratic rainfall, and recurrent droughts. These shifts significantly affect health, especially in rural, agriculture-dependent communities, where geographic and socioeconomic factors compound vulnerabilities (Alemu and Mengistu, 2019; Fekad and Bekalu, 2020). Indoor air pollution is a significant health concern in Ethiopia, where over 90% of households rely on solid fuels for cooking, exposing women and children to high levels of particulate matter and respiratory diseases. Urban air pollution is also rising, with vehicle emissions and industrial activities causing PM2.5 levels in Addis Ababa to exceed WHO guidelines (Mulgeta et al., 2024; Tarekegn and Gulilat, 2018). CRDs like COPD and asthma are often underdiagnosed and underreported, especially in rural areas reliant on biomass fuels. Seasonal factors, including dust storms and pollen blooms, further worsen respiratory conditions (Mebrahtom et al., 2024).

Ethiopia's healthcare system faces major challenges, including limited diagnostic facilities, healthcare worker shortages, and poor access to treatment. Poverty and low awareness further impede the prevention and management of chronic respiratory diseases (Aschalew et al., 2022). Comprehensive data on CRD prevalence and determinants are lacking, and studies on the impacts of climate change on respiratory health are scarce (Smith and Pillarisetti, 2017). This

Abbreviations: COPD, Chronic Obstructive Pulmonary Disease; CRDs, Chronic respiratory diseases; CRS, Chronic Respiratory Symptoms; NAPs, National Adaptation Plans; PM, Particulate Matter; PRISMA, Preferred Reporting Items for Systematic reviews and Meta-Analyses; SNNP, Southern Nation Nationality People.

systematic review and meta-analysis synthesize findings from multiple studies to provide robust evidence. By consolidating data, this study aims to assess the impacts of climate change on chronic respiratory health in Ethiopia.

Methods

Search strategy and information sources

The PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) statement was used as a guide for this review. The search terms and keywords were identified based on the purpose of this study (Table 1). PubMed, Embase, Google scholar, and University repository databases were used. Peer-reviewed full-text articles in English language, published between 2015 and 2024 were included in the study.

Eligibility criteria

Studies were selected for inclusion in this systematic review and meta-analysis based on the eligibility criteria summarized in the table.

Study selection procedures

Studies identified by our search strategy were retrieved and managed using Endnote X8 software to remove duplicate studies. Two independent authors [ZA, GGK] screened the title and abstract. The disagreement was handled based on established article selection criteria. Two independent authors [ZA, GGK] conducted the full text review.

TABLE 1 Thematic areas and search terms used for the search process.

Thematic areas	Search terms (MeSH terms and free text)
Outcome (Chronic Respiratory Health)	("Chronic Respiratory Diseases"[MeSH] OR "Asthma"[MeSH] OR "Chronic Respiratory Symptoms"[MeSH] OR "chronic respiratory health" OR "chronic respiratory disease*" OR "CRD*" OR "COPD" OR "asthma" OR "chronic bronchitis" OR "chronic respiratory symptom*")
Exposure (Climatic Related Factors)	("Climate Change"[MeSH] OR "Air Pollution"[MeSH] OR "Temperature"[MeSH] OR "Humidity"[MeSH] OR "Extreme Weather"[MeSH] OR "climate change" OR "global warming" OR "air pollution" OR "air quality" OR "temperature*" OR "particulate matter*" OR "extreme weather event*" OR "humidity*")
Geographic focus	("Ethiopia"[Mesh] OR "Ethiopia")
Search strategy: (1) AND (2) AND (3)	

Outcome measurement

The objectives of this study explore the impacts of climate change on chronic respiratory health. Chronic Respiratory Health refers to the condition of the respiratory system over an extended period, assessed in terms of the presence or absence of chronic respiratory diseases (CRDs) and/or chronic respiratory symptoms (CRS). CRDs: Long-term conditions affecting the airways and other structures of the lungs, including but not limited to: Chronic Obstructive Pulmonary Disease (COPD), Asthma, Bronchiectasis, Interstitial lung disease diagnosed based on clinical, radiographic, or spirometric criteria, or by a healthcare professional. Where, CRS: Persistent symptoms lasting at least 3 months in a year for at least two consecutive years, such as: Chronic cough, chronic sputum production, wheezing, and shortness of breath dyspnea; (GBD Chronic Respiratory Disease Collaborators, 2020).

Data extraction and quality assessment

Data from included articles were extracted using a standardized data extraction format, adapted from the Joanna Briggs Institute (JBI), by two authors [GGK & ZA]. The data extraction format included primary author, study design, sample size, response rate, prevalence of chronic respiratory health, publication year, chronic respiratory health symptoms, and region(s) of the country where the study was conducted. Two authors (ZA & GGK) independently assessed the risk of bias for each original study by using a quality assessment checklist for prevalence studies adapted from Hoy et al.

Data processing and analysis

Pertinent data from every primary study were extracted using Microsoft Excel format. Data were then exported to STATA Version 14 statistical software for analysis. Heterogeneity of the studies was assessed by computing *p*-values of I^2 statics and publication bias was checked objectively via Egger's regression test. In the current meta-analysis, the pooled proportion was estimated by using the back-transform of the weighted mean of the transformed proportions, using arcsine variance weights for the fixed-effects model and DerSimonian-Laird weights for the random-effects model. Point prevalence, as well as 95% confidence intervals, was presented in the forest plot format.

Result

Characteristics of included studies

Initially, 492 articles reporting the prevalence of chronic respiratory health issues were identified from various databases. After removing duplicates, 296 studies remained. Of these, 228 were excluded based on their titles, and 41 were excluded after reviewing their abstracts. Ultimately, 27 studies were selected for full-text review, with 21 articles included in the synthesis and meta-analysis (Figure 1).

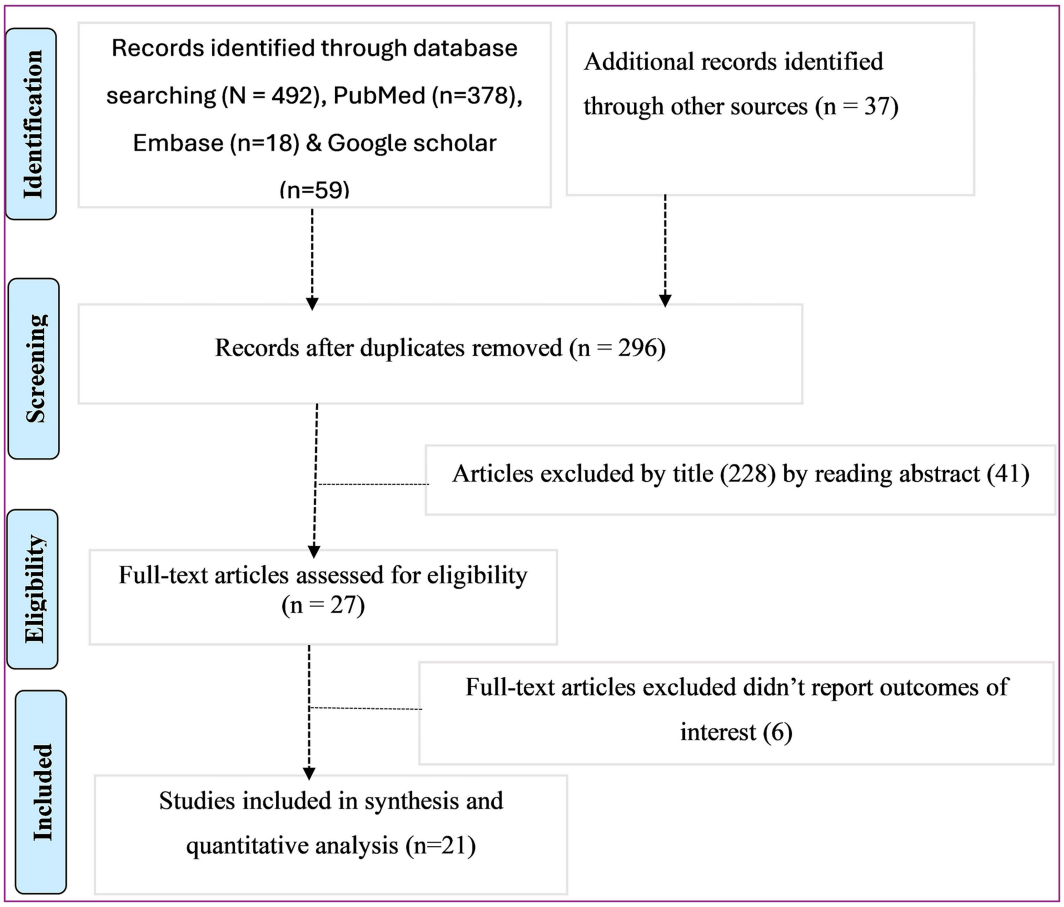

FIGURE 1
Flow chart for study selection.

Description of included studies

As shown in (Table 2; Supplementary Table 1), a total of 21 studies published between 2015 and 2024 were included in the analysis. Of these, 9 utilized a cross-sectional (Woldeamanuel et al., 2019; Awoke et al., 2021; Wubet, 2018; Agedew et al., 2021; Hailu Tesfaye et al., 2023; Manaye et al., 2022; Mekasha et al., 2018; Gizaw et al., 2016; Alemseged et al., 2020), 1 case control (Asfaw et al., 2017) and one longitudinal study design (Debela et al., 2023), while 10 employed a comparative cross-sectional study design (Beyene, 2016; Bogale, 2021; Abay, 2019; Negash et al., 2023; Jabur et al., 2022; Abateneh et al., 2024; Badima et al., 2024; Lagiso et al., 2020; Woldeamanuel et al., 2020; Feleke et al., 2023). Additionally, 11 of the studies were conducted at the industry level in Addis Ababa. The current meta-analysis included 10,785 participants to estimate the pooled prevalence of chronic respiratory health at different study design. More than half of the studies reported a 100% response rate. However, no studies were reported in the regions of Benishangul Gumuz, Tigray, Gambella, Dire Dawa, Harari, Afar, and Somalia Region.

Chronic respiratory disease and symptoms

Nineteen studies were reported cough, phlegm and wheezing are most common chronic respiratory symptoms and have highest prevalence, respectively. However, one study reported wheezing were reported highest prevalence among study participants and one study reported prevalence of chronic obstructive pulmonary disease.

Climate change and chronic respiratory health

Air pollution

Air pollutants can exacerbate symptoms in individuals with chronic respiratory conditions. Particulate matter (PM2.5 and PM10) and other pollutants are affected by weather conditions and can contribute to the worsening of chronic respiratory health. Seventeen studies (80.95%) reported that dust exposure was a major contributing factor to chronic respiratory symptoms. Additionally, at the industry level six studies identified PM2.5 as a contributing factor to chronic respiratory health. At the household level, three studies reported that the type of household energy source was a contributing factor to chronic respiratory health.

Temperature and altitude

High temperatures can increase ground-level ozone and other pollutants, exacerbating respiratory conditions, while low temperatures can lead to airway constriction and an increased risk of respiratory infections. One study reported that both higher and lower

TABLE 2 Inclusion and exclusion criteria of the study.

Criterion type	Category	Criteria details
Inclusion Criteria	Study setting	Studies must have been conducted entirely within the country of Ethiopia.
	Publication status	Both published & unpublished studies were considered to mitigate publication bias.
	Language of publication	Studies must be written in English to ensure accurate interpretation.
	Study design	Study designs were included: Cross-sectional studies Comparative cross-sectional studies Case–control studies Longitudinal studies (e.g., cohort, follow-up)
	Publication date	Articles published between January 1, 2015, and December 22, 2024, were included to capture the most recent and relevant evidence.
Exclusion Criteria	Accessibility	Studies were excluded if, after two attempts to contact the corresponding author via email with a reasonable waiting period, the full text could not be obtained for review and data extraction.

temperatures contribute to chronic respiratory health. One study reported that high altitude living environment has impact on chronic respiratory health

Prevalence of chronic respiratory health in Ethiopia

The estimated pooled proportion of chronic respiratory health in Ethiopia was 39% (at 95% CI: 31, 48) (Figure 2). Moderate heterogeneity was observed among the included studies, as shown in the Figure 2 there is the presence of non-overlapping confidence interval in the forest plot with true variability across studies beyond chance estimated at 99.00% (I^2 = 99.00% at $p < 0.001$).

Subgroup analysis

A subgroup analysis by region and study design was conducted to compare the effect of chronic respiratory health across different regions of the country. The highest proportion was observed in Oromia [0.56, CI: (0.46, 0.66)], while the lowest effect was observed in SNNP [0.23, CI: (0.13, 33)]. By study design, the proportion was

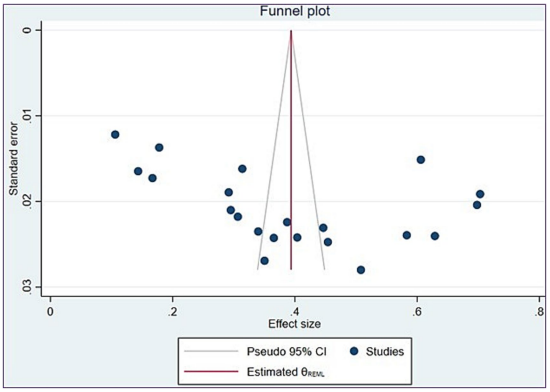

FIGURE 2
Forest plot showing the pooled proportion of chronic respiratory health in Ethiopia. Black boxes and lines represent the effect size (ES) and 95% confidence intervals (CIs) for each study. The overall ES, indicated by a blue diamond, includes a width corresponding to the 95% CI. The height of boxes and the diamond reflects the precision of the ES estimate.

[0.32, CI: (0.26, 0.38)] for comparative cross-sectional studies and [0.46, CI: (0.30, 0.63)] for cross-sectional studies (Table 3).

Sensitivity analysis

We looked at how each study affected the combined prevalence using a sensitivity analysis. The results showed that no single study significantly changed the overall estimate in the meta-analysis (Figure 3).

Publication bias

All 21 included studies were assessed for publication bias using a funnel plot and Egger's test. The funnel plot (Figure 4) showed an asymmetric distribution, indicating a small study effect. Additionally, Egger's test results confirmed evidence of publication bias (p value = 0.018; Table 4).

Trim and fill analysis

Publication bias was indicated by a significant Egger's test and asymmetry in the funnel plot. To correct for this bias, we employed the trim-and-fill method. The adjusted meta-analysis estimate derived from this procedure revealed a prevalence of chronic respiratory health of 0.394 (95% CI: 0.318 to 0.470), as presented in Figure 5. The trim-and-fill adjustment indicates that the true pooled prevalence of chronic respiratory health may be approximately 0.4 percentage points higher than the original estimate. However, the original finding of 39% (95% CI: 31 to 48%) can be considered robust, as the adjusted value of 39.4% falls well within the original confidence interval. This suggests that while publication bias may be present, its effect on the overall point estimate is minimal.

The pooled estimate may be biased due to the underrepresentation of specific regions and study designs in the available literature. For

TABLE 3 Characteristics and quality status of the studies included in systematic review and meta-analysis chronic respiratory health in Ethiopia, 2024.

Authors	Year of publication	Study Design	Region	Sample size	Proportion	Response rate	Quality status
Abateneh et al. (Alemseged et al., 2020)	2024	CCS	Amhara	472	0.3873	97.03%	Low Risk
Abay et al. (Manaye et al., 2022)	2019	CCS	AA	394	0.3655	100%	Low Risk
Agedew et al. (Mulgeta et al., 2024)	2021	CS	SNNP	638	0.1060	96.40%	Low Risk
Alemseged et al. (Woldeamanuel et al., 2019)	2020	CS	AA	424	0.5830	97.87%	Low Risk
Asfaw et al. (Awoke et al., 2021)	2018	CC	AA	453	0.1435	100%	Low Risk
Awoke et al. (Alemu and Mengistu, 2019)	2021	CS	AA	506	0.6980	98%	Low Risk
Badima et al. (Asfaw et al., 2017)	2024	CCS	AA	466	0.1670	96.99%	Low Risk
Beyene et al. (Agedew et al., 2021)	2016	CCS	AA	411	0.4038	100%	Low Risk
Bogale et al. (Hailu Tesfaye et al., 2023)	2021	CCS	AA	471	0.2951	95.40%	Low Risk
Debela et al. (Wubet, 2018)	2023	LS	Oromia	1,043	0.6060	100%	Low Risk
Feleke et al. (Bogale, 2021)	2022	CCS	AA	314	0.3503	98.73%	Low Risk
Gizaw et al. (GBD Chronic Respiratory Disease Collaborators, 2020)	2016	CS	Amhara	404	0.6290	100%	Low Risk
Jabur et al. (Gizaw et al., 2016)	2019	CCS	AA	464	0.4464	99.13%	Low Risk
Lagiso et al. (Debela et al., 2023)	2020	CCS	SNNP	406	0.3399	100%	Low Risk
Manaye et al. (Mebrahtom et al., 2024)	2022	CS	Amhara	405	0.4540	96.70%	Low Risk
Mekasha et al. (Aschalew et al., 2022)	2018	CS	AA	319	0.5080	97%	Low Risk
Negash et al. (Mekasha et al., 2018)	2020	CCS	AA	448	0.3066	91.74%	Low Risk
Tesfaye et al. (Tarekegn and Gulilat, 2018)	2023	CS	Amhara	822	0.3140	97.40%	Low Risk
Tsehaye et al. (Fekad and Bekalu, 2020)	2018	CS	AA	570	0.7030	99.30%	Low Risk
Woldeamanuel et al. (Beyene, 2016)	2020	CCS	SNNP	576	0.2917	100%	Low Risk
Woldeamanuel et al. (Commission and Cooke, 2022)	2019	CS	SNNP	779	0.1780	94.22%	Low Risk

AA, Addis Ababa; CC, Case control; CS, Cross sectional; CCS, Comparative Cross Sectional; and LS, Longitudinal Study.

instance, the low prevalence (23%) reported in the SNNP region, the relative scarcity of case–control (14%), and longitudinal studies (61%) could introduce bias if their true effects are systematically underreported in the literature.

Discussion

The meta-analysis found a pooled prevalence of chronic respiratory health was 39% at (95% CI: 31–48%), highlighting a major public

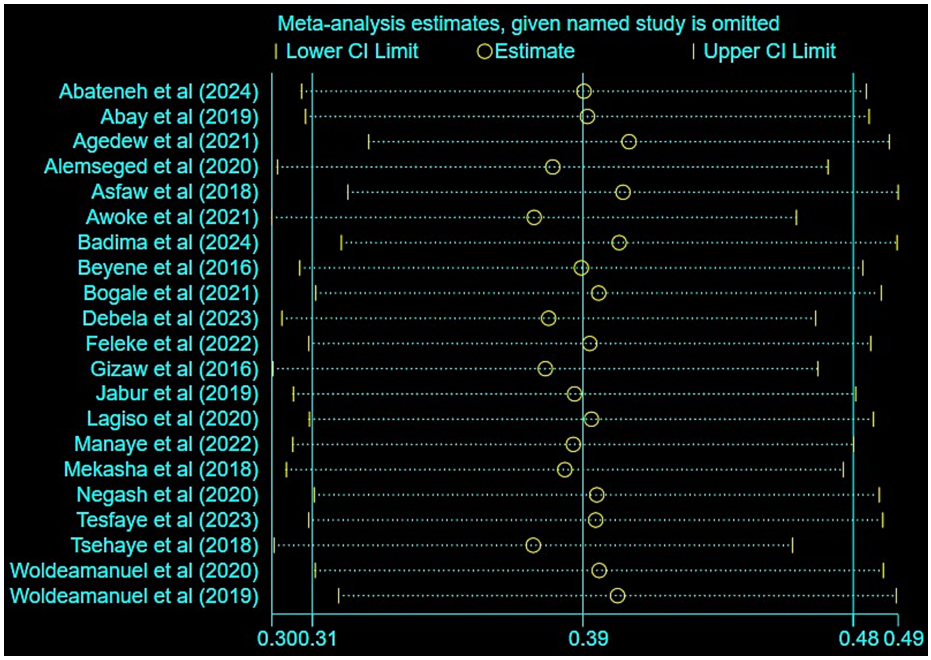

FIGURE 3
Sensitivity analysis to examine the effect of a single study on the pooled result.

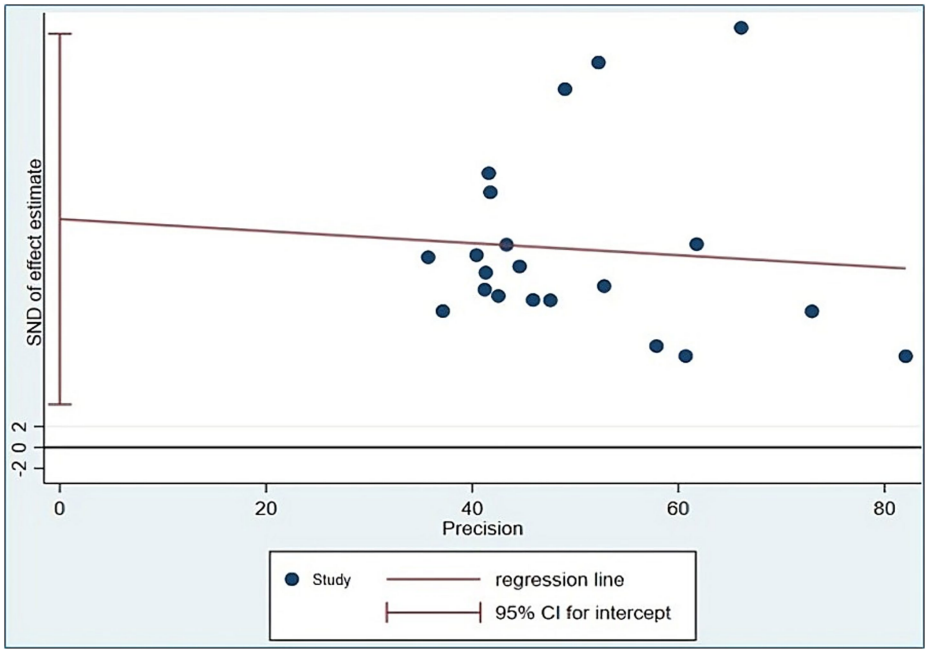

FIGURE 4
Funnel plots of egger test.

health issue. Commonly reported chronic respiratory symptoms included chronic cough, phlegm, wheezing, and shortness of breath, consistent with global trends linking CRDs to prolonged exposure to environmental pollutants and climatic factors (Viegi et al., 2020; Oluwole et al., 2017; Doherty et al., 2017). High heterogeneity among studies ($I^2 = 99.0\%$, $p < 0.001$) reflects differences in exposure levels, healthcare access, and regional disparities within Ethiopia.

Seventeen studies identified air pollutants, including particulate matter (PM2.5 and PM10), as significant contributors to respiratory health deterioration. At the household level, biomass fuel usage was

TABLE 4 Subgroup analysis by region and study design.

Subgroup analysis		No of studies	Prevalence (95% CI)	*p*-value	I^2
By region	Amhara	4	0.45(0.31, 0.58)	<0.001	97.50%
	Addis Ababa	11	0.41(0.30, 0.53)	<0.001	99.00%
	SNNP	4	0.23(0.13, 0.33)	<0.001	97.40%
	Oromia	2	0.56(0.46, 0.66)	<0.001	89.50%
By Study design	Comparative cross sectional	10	0.33(0.28, 0.39)	<0.001	93.50%
	Cross sectional	9	0.46(0.30, 0.63)	<0.001	99.50%
	Case control	1	0.14(0.11, 0.18)	<0.001	0.00%
	Longitudinal	1	0.61(0.58, 0.64)	<0.001	0.00%
Overall		21	0.39(0.31, 0.48)	<0.001	99.00%

SNNP, Southern Nation Nationality People.

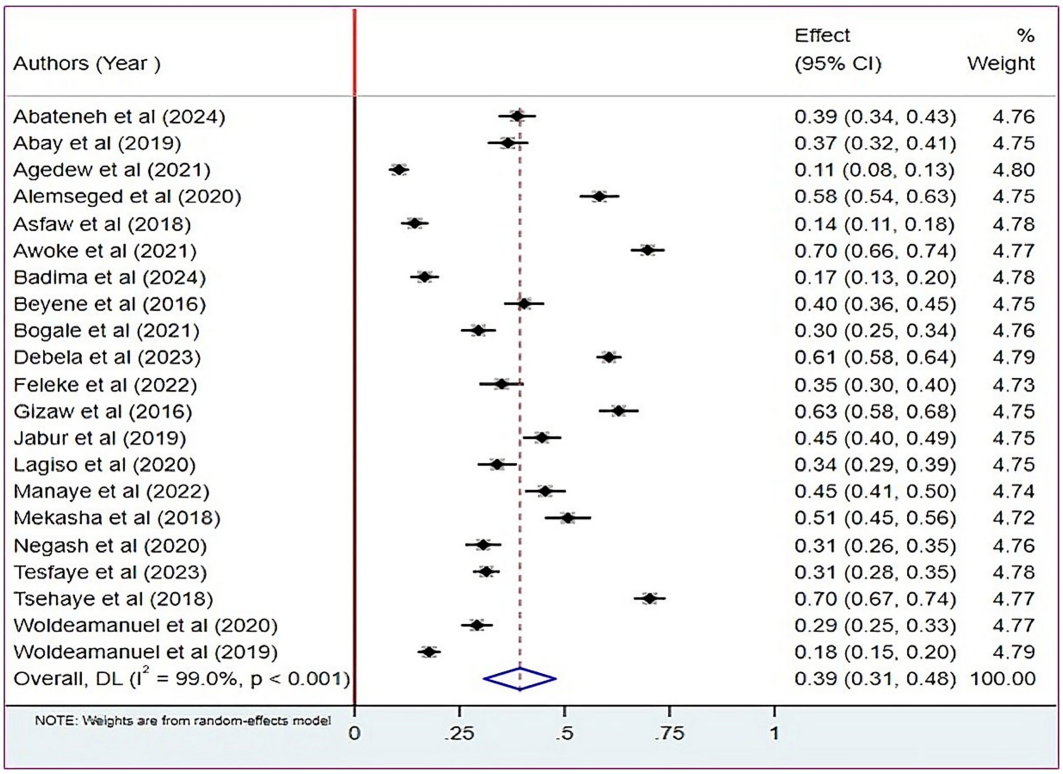

FIGURE 5
Funnel plot of 21 studies after trim-and-fill analysis.

frequently associated with respiratory symptoms, consistent with findings from studies conducted in sub-Saharan Africa (Smith and Pillarisetti, 2017; Azanaw and Melaku, 2023; Oluwatosin et al., 2022). Industrial activities, particularly in Addis Ababa, exacerbated exposure to harmful pollutants, with seven studies directly linking industrial particulate matter to chronic respiratory symptoms. Studies show that particulate matter (PM2.5 and PM10) exacerbates chronic respiratory symptoms by penetrating deep into the respiratory system, causing inflammation and oxidative stress in the airways. Prolonged exposure has been linked to increased prevalence of symptoms such as chronic cough, wheezing, and shortness of breath due to structural and functional changes in the lungs (Liu et al., 2017; Mebrahtu et al., 2023; Hansel et al., 2016).

Temperature extremes, both high and low, were linked to increased respiratory symptoms. This finding aligns with research from other low-income settings, where rising temperatures have been shown to increase ground-level ozone, exacerbating asthma and COPD symptoms (Scheerens et al., 2022; Hansel et al., 2016; Tran et al., 2023). Similarly, low temperatures are known to constrict airways and elevate the risk of infections, further burdening individuals with pre-existing conditions (Lee and Yoon, 2024; D'Amato et al., 2018).

High-altitude regions presented unique challenges for respiratory health, as evidenced in one included study. Living at high altitudes can exacerbate hypoxia, impacting individuals with chronic respiratory conditions. While limited, these findings call for further investigation into altitude's role in modulating respiratory health in Ethiopia.

The regional sub group analysis revealed marked disparities in chronic respiratory health prevalence. Oromia exhibited the highest prevalence (61%, CI: 58–64%), attributed to a combination of

industrial exposure and biomass fuel usage. In contrast, the SNNP region had the lowest prevalence (23%, CI: 13–33%), likely reflecting regional differences in study design, healthcare access, and environmental exposures. These disparities emphasize the need for region-specific interventions.

The variability by study design revealed that cross-sectional studies reported higher prevalence estimates (46%) compared to comparative cross-sectional (33%) and case–control designs (14%). This finding underscores the importance of considering study design when interpreting prevalence rates, as cross-sectional designs often capture acute exposure effects.

Generally, particulate matter (PM2.5 and PM10) damages the respiratory system by causing inflammation, oxidative stress, and fibrosis, which may progress to COPD, chronic bronchitis, or lung cancer if left untreated (Xing et al., 2016). Temperature extremes cause bronchoconstriction and mucus change, increasing asthma attacks and risk of respiratory failure (Tran et al., 2025; Han et al., 2023). High altitude induces hypoxic stress, which may lead to pulmonary hypertension, if not appropriately treated (Sydykov et al., 2021).

Implications for policy and practice

The high burden of chronic respiratory symptoms linked to climate change necessitates integrated policies addressing air quality, sustainable energy use, and climate adaptation strategies. Public awareness campaigns, coupled with enhanced healthcare access and targeted interventions in high-prevalence regions, are critical to mitigating the impact of climate change on respiratory health in Ethiopia.

Future research should prioritize underrepresented regions and employ longitudinal designs to capture long-term impacts of climate change on chronic respiratory health. Addressing the identified gaps will be vital for developing comprehensive strategies to combat the growing burden of CRDs in Ethiopia.

Conclusion

This systematic review and meta-analysis reveal a high burden of chronic respiratory diseases in Ethiopia, primarily attributed to climatic, environmental, and occupational factors, including air pollution, biomass fuel use, and temperature extremes. Regional disparities, such as the highest prevalence in Oromia and the lowest in Southern Nations, Nationalities and People, underscore the need for targeted interventions. The findings emphasize the urgency of integrating climate adaptation strategies, promoting clean energy alternatives, and strengthening healthcare systems to mitigate chronic respiratory diseases risks. Addressing these challenges requires multisectoral collaboration to reduce exposure hazards and improve respiratory health outcomes in Ethiopia. Future research should prioritize longitudinal studies and underrepresented regions to inform evidence-based policies.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

ZA: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Supervision, Writing – original draft, Writing – review & editing. AA: Writing – original draft, Writing – review & editing. AG: Writing – original draft, Writing – review & editing. GK: Data curation, Methodology, Writing – original draft, Writing – review & editing, Validation. KM: Writing – original draft, Writing – review & editing. MB: Writing – original draft, Writing – review & editing. MS: Writing – original draft, Writing – review & editing. SC: Writing – original draft, Writing – review & editing. WT: Writing – original draft, Writing – review & editing. YM: Writing – original draft, Writing – review & editing. YW: Writing – original draft, Writing – review & editing. ZG: Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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