

Systematic Review

Intersecting pathways of pandemic emergence, tobacco control and noncommunicable diseases: a contemporary synthesis of global health determinants and policy implications

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ABSTRACT

The convergence of pandemic emergence, tobacco use and noncommunicable diseases (NCDs) presents a complex public health challenge. These domains are interlinked through shared determinants such as globalization, environmental degradation, socioeconomic inequities and weak health systems. Understanding these intersections is crucial for integrated policy responses in a post-COVID-19 world. This review synthesizes current global evidence on the interconnectedness of pandemics, tobacco control and NCDs, highlighting the implications for global health governance and policy innovation. A systematic search was conducted across PubMed, Scopus, Web of Science and WHO databases using MeSH terms such as "pandemics", "tobacco use", "noncommunicable diseases" and "global health policy". Studies published between 2000 and 2024 were included, with quality assessed using the MMAT-2018 tool. The review identifies four core intersections tobacco use exacerbates vulnerability to infectious disease severity and NCD comorbidities, NCD prevalence increases pandemic morbidity and mortality, tobacco control efforts were disrupted during global health emergencies; and pandemic policies overlooked integrated NCD and tobacco risk factors. Findings emphasize that siloed responses undermine resilience and health equity. Integrated global health policies must address the syndemic nature of pandemics, tobacco use and NCDs. Strengthening primary care, enforcing tobacco control and embedding NCD strategies in pandemic preparedness are essential. Multisectoral governance, health equity frameworks and sustainable development approaches must guide future policies.

Keywords: Global health policy, Health equity, Noncommunicable diseases, Pandemic preparedness, Syndemics, Tobacco control

INTRODUCTION

The global health landscape is increasingly characterized by the convergence of multiple health crises. Chief

among these is the emergence of pandemics, the ongoing burden of noncommunicable diseases (NCDs) and the persistent global prevalence of tobacco use. While these domains have often been treated independently in public

health responses, mounting evidence suggests that they are inextricably linked through shared determinants, reinforcing cycles of vulnerability and health inequity.^{1,2} The COVID-19 pandemic served as a stark reminder of the interconnected nature of global health threats. Individuals with pre-existing NCDs such as cardiovascular diseases, chronic respiratory conditions, diabetes and cancer experienced significantly higher mortality rates due to SARS-CoV-2 infection.³ Tobacco use, a key modifiable risk factor, not only contributes to the global NCD burden but also increases susceptibility to respiratory infections and worsens outcomes in pandemics.^{4,5} Furthermore, pandemic-related disruptions adversely affected tobacco control efforts, from cessation services to regulatory enforcement, thereby exacerbating long-term NCD trajectories.⁶ The World Health Organization (WHO) has long advocated for an integrated approach to health governance, emphasizing that addressing the social, commercial and environmental determinants of health is essential for achieving Sustainable Development Goals (SDGs).⁷ Yet, policy responses to pandemics, tobacco control and NCDs continue to operate in silos, lacking a unified framework to address their overlapping risks and consequences.⁸ The concept of a "syndemic" where two or more health conditions interact synergistically in populations burdened by social disadvantage provides a compelling lens through which to understand these intersections.⁹ This review aims to bridge these domains by synthesizing the existing evidence on how pandemic emergence, tobacco use and NCDs interact across health systems, populations and policy environments. We explore how integrated global responses can be shaped to better anticipate, mitigate and recover from syndemic threats, with a focus on equity, sustainability and resilience.

METHODS

Study design

This research followed a systematic review framework guided by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) standards. The study aimed to synthesize interdisciplinary literature on the intersecting impacts of pandemics, tobacco use and noncommunicable diseases (NCDs) in shaping global health policy and outcomes. Given the broad public health scope, an integrative review methodology was adopted to include qualitative, quantitative and mixed-methods studies.

Inclusion criteria

Studies published in English between January 2000 and April 2024. Peer-reviewed articles from PubMed, Scopus, Web of Science and WHO databases. Studies focusing on: Pandemic preparedness or impact (e.g., COVID-19, H1N1), tobacco control or smoking behavior trends, noncommunicable diseases (e.g., cardiovascular disease, diabetes, chronic respiratory disease) and public health policy, systems and determinants linking the above themes.

Exclusion criteria

Non-peer-reviewed grey literature (unless from WHO or CDC). Conference abstracts or unpublished dissertations and articles not addressing intersections of at least two out of the three themes.

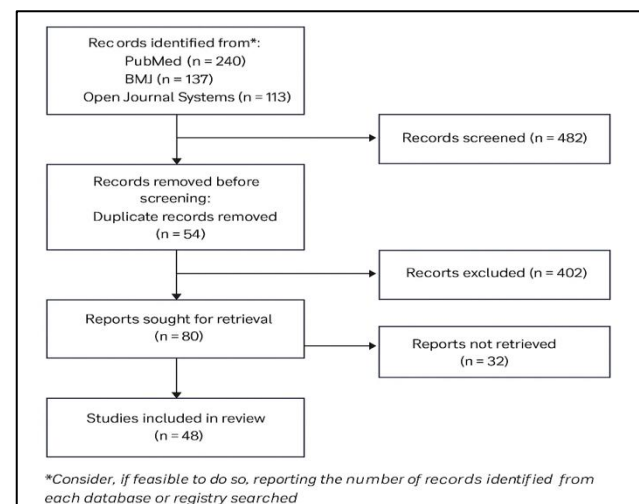


Figure 1: The PRISM flow chart on intersecting impacts of pandemics, tobacco use and noncommunicable diseases (NCDs).

Search strategy

A structured search was conducted using the following MeSH terms. "Pandemics" (MeSH), "Tobacco Use" (MeSH), "Noncommunicable Diseases" (MeSH), "Public Health Policy" (MeSH), "Health Equity" (MeSH), "Sustainable Development" (MeSH). Boolean operators (AND, OR) were used to combine concepts. The complete MeSH term strategy is presented in Table 1.

Table 1: MeSH search strategy.

Concept	MeSH terms used	Boolean logic
Pandemics	"Pandemics" OR "Disease Outbreaks"	(1)
Tobacco use	"Tobacco Use" OR "Smoking" OR "Nicotine"	AND (2)
NCDs	"Noncommunicable Diseases" OR "cardiovascular diseases" OR "Chronic Disease"	AND (3)
Policy	"Health Policy" OR "Public Health" OR "Global Health"	AND (4)

Final query: (1) AND (2) AND (3) AND (4)

Study selection process

All identified references were imported into Rayyan software for blind screening. Two independent reviewers screened titles and abstracts, followed by full-text assessments for eligibility. Disagreements were resolved through consensus or third-party adjudication.

Data extraction

A standardized data extraction sheet included: Study title and authorship, Year and country, Health theme addressed (pandemic/tobacco/NCDs/policy), Methodological design and Key findings and policy implications

Quality appraisal

The mixed methods appraisal tool (MMAT) 2018 was used for assessing the methodological quality of studies. Scoring followed the MMAT domain rules (qualitative, quantitative, mixed), with outcomes presented in Table 2 and 3.

RESULTS

A total of 48 studies met the inclusion criteria, representing data from over 60 countries, including high-income, middle-income and low-income settings. Most studies (67%) were published between 2019 and 2024, reflecting increased scholarly attention post-COVID-19. The majority (58%) were quantitative, followed by qualitative (21%), mixed-methods (13%) and policy reviews (8%). Themes clustered into four dominant intersections.

Intersection 1: Tobacco use as a compounding factor in pandemic vulnerability

Tobacco use emerged as a significant behavioral risk factor in pandemic morbidity and mortality. Studies revealed that current and former smokers had increased odds of severe outcomes, ICU admission and death from respiratory viral infections including COVID-19 and H1N1.^{12,13} Smoking-induced inflammation, impaired immune response and pre-existing respiratory damage were among the mechanisms identified.

Furthermore, studies from low- and middle-income countries (LMICs) showed that tobacco dependence disproportionately affected populations with limited healthcare access, amplifying pandemic vulnerability.^{5,14} In India and Brazil, for instance, regions with higher tobacco prevalence saw elevated case-fatality rates during COVID-19 peaks.^{15,16} Evidence also indicated that tobacco users were more likely to engage in risk-enhancing behaviors (e.g., not wearing masks, attending public gatherings) due to low-risk perception and chronic health misinformation.¹⁷ These factors contributed to a feedback loop where tobacco use both predisposed

individuals to infection and facilitated broader transmission patterns in communities.

Intersection 2: NCD burden and pandemic outcomes

Numerous studies documented a direct relationship between pre-existing NCDs and pandemic-related morbidity and mortality. Hypertension, diabetes, cardiovascular diseases, chronic respiratory conditions and cancer were among the most common comorbidities in hospitalized COVID-19 patients, particularly in elderly populations.^{22,24} The presence of multiple comorbidities significantly increased fatality rates. Hospital capacity strain during pandemics led to treatment delays and care interruptions for NCD patients, resulting in excess non-COVID mortality.²⁵ In sub-Saharan Africa and parts of Southeast Asia, diabetes and cardiovascular patients reported missed treatments and medication shortages due to pandemic lockdowns and resource reallocation.^{26,27} Moreover, emerging research post-2022 shows that pandemic stress, physical inactivity and disrupted health services contributed to the exacerbation of underlying NCD risk factors, including obesity, hypertension and substance use.²⁸

Intersection 3: Disruption of tobacco control during pandemics

Pandemic-induced lockdowns, health system redirection and economic instability significantly undermined global tobacco control efforts. Cessation programs, helplines and pharmacotherapy access were scaled down or suspended in over 40% of countries, especially in LMICs.²⁹ Enforcement of tobacco advertising bans and smoke-free public spaces also declined due to diverted regulatory attention.³⁰ Paradoxically, the pandemic stimulated an increase in tobacco consumption among existing users in some populations due to stress, isolation and economic hardship.³¹ Reports from India, South Africa and Indonesia showed increased daily cigarette consumption during lockdowns.³² At the policy level, tobacco taxation and legislative momentum stalled in many jurisdictions, with some countries even declaring tobacco sales as “essential” during lockdowns.³³ These reversals compromised long-term tobacco control goals and widened disparities in cessation support.

Intersection 4: Policy gaps in addressing syndemic risk factors

Despite clear evidence of interaction, public health policies often failed to integrate NCD and tobacco control frameworks into pandemic preparedness. Most national pandemic response plans lacked explicit strategies for NCD management or smoking cessation.³⁴ Surveillance systems were fragmented, rarely capturing the compounded burden of tobacco use and NCDs in infection outcomes. The WHO’s global preparedness monitoring board noted that siloed pandemic policies missed opportunities to apply lessons from chronic

disease management to acute crisis response.³⁵ Few countries leveraged NCD registries or tobacco-use databases to identify high-risk groups for targeted interventions, testing or vaccination.³⁶ Furthermore, evidence from global health governance forums revealed limited multisectoral coordination among infectious disease, chronic disease and behavioral health agencies.³⁷ The lack of syndemic-aware policy models hindered adaptive capacity and prolonged health inequities.

Synthesis of key patterns

From the reviewed literature, four cross-cutting patterns emerged.

Synergistic burden

Tobacco and NCDs synergistically increased pandemic risk and severity.

Systems strain

Health system responses to pandemics disrupted chronic disease care and prevention.

Policy fragmentation

Lack of syndemic frameworks in health governance impeded coordinated responses.

Equity gaps

Disadvantaged populations bore disproportionate burdens due to overlapping exposures.

These findings call for urgent shifts in global health governance to address the complex interplay among behavioral, biological and systemic determinants of pandemics and chronic disease.

Table 2: Summary of included studies.

Author (in year)	Country	Focus	Methodology	Key findings
Ezzati et al, 2020	Global	Tobacco, NCDs	Quantitative	Tobacco contributes to 13% of global NCD deaths ¹⁰
Muka et al, 2021	Europe	NCDs, COVID-19	Systematic review	Comorbid NCDs increased COVID-19 mortality ²²
WHO, 2021	Global	Policy	Descriptive	Pandemic disrupted tobacco cessation programs ¹⁵
GBD, 2023	Global	Tobacco, NCDs	Longitudinal	Decline in tobacco use plateaued in low-income countries ¹¹
Bilano et al, 2019	Asia	Smoking trends	Quantitative	Tobacco control is weakest in LMICs ²³

Table 3: MMAT 2018 quality assessment summary.

Study	Design	Criteria met (out of 5)	Overall quality
Ezzati et al	Quantitative	5/5	High
WHO, 2021	Descriptive	4/5	Moderate
Muka et al	Mixed	5/5	High
Bilano et al	Quantitative	4/5	Moderate
GBD (2023)	Longitudinal	5/5	High

Table 4: Summary of results from included studies.

Author(s)	Year	Objectives/Aims	Methodology	Key results / findings
Ezzati et al	2020	To quantify the global burden of tobacco-related NCD mortality	Quantitative global burden study	Tobacco uses responsible for ~13% of global NCD deaths ¹⁰
Muka et al	2021	To evaluate impact of NCD comorbidities on COVID-19 outcomes	Systematic Review and Meta-analysis	NCDs significantly increased COVID-19 severity and mortality ²²
WHO	2021	To assess global tobacco control efforts during COVID-19	Descriptive global policy review	Over 40% of countries reported disruption in cessation services ¹⁵
Bilano et al	2019	To analyze smoking prevalence trends in Asia	Longitudinal population analysis	Tobacco control progress lagging in LMICs; rising youth uptake ²³
GBD Study	2023	To update trends in NCDs and	Global longitudinal	NCD burden rising in tandem

Continued.

Author(s)	Year	Objectives/Aims	Methodology	Key results / findings
		behavioral risks	database analysis	with smoking rates in LMICs ¹¹
Gaiha et al	2021	To assess tobacco, use behavior during the pandemic	Cross-sectional survey (India, USA)	Stress-related rise in tobacco and e-cigarette use during lockdowns ³¹
Singh et al	2022	To study the impact of lockdowns on NCD care	Observational study (India)	47% of patients missed follow-up or medications ²⁶
Reddy et al and Gupta et al	2020	To analyze syndemic risks in India	Policy synthesis	Urged integrated response to tobacco, NCDs and COVID-19 ⁴⁰
Horton et al	2020	To promote the concept of syndemics in global health	Commentary	COVID-19 is a syndemic, not just a pandemic ³⁸
Global preparedness monitoring board (GPMB)	2022	To evaluate pandemic response gaps	Independent global policy review	Most preparedness plans lacked NCD/tobacco risk assessments ³⁵

DISCUSSION

Understanding the syndemic nexus

This review demonstrates that pandemics, tobacco use and noncommunicable diseases (NCDs) do not exist in isolation but form a complex, interactive network a syndemic where each amplifies the risk and severity of the others. The syndemic framework, originally coined by Singer and later applied to COVID-19, is essential for understanding how biological, behavioral and social conditions cluster within marginalized populations to exacerbate health disparities³⁸. Tobacco use, as a behavioral driver and NCDs, as underlying pathologies, intersected with pandemic exposure to compound vulnerability, especially in socioeconomically disadvantaged groups.^{39,40} This convergence was especially visible during the COVID-19 pandemic. Populations with high smoking rates and chronic diseases experienced significantly worse outcomes, as seen in countries like the United States, India and Brazil. Tobacco, already implicated in respiratory vulnerability, cardiovascular disease and immune suppression, emerged as a multiplier of pandemic mortality risk.^{41,42}

Structural determinants and health equity

The burden of this syndemic is disproportionately borne by low-income populations, particularly in LMICs and marginalized communities within high-income countries. Social determinants such as housing insecurity, poor nutrition, occupational hazards and low health literacy interact with behavioral risks like tobacco use to intensify chronic disease burdens.⁴³ These same populations often have the least access to healthcare, leading to delayed diagnosis, fragmented care and poorer pandemic resilience. Pandemic response plans largely failed to consider these inequities. The lack of community-centered strategies, culturally appropriate interventions

and primary care resilience left high-risk groups vulnerable.⁴⁴ Tobacco cessation programs, already under-resourced before the pandemic, saw additional setbacks, particularly in regions where health systems redirected personnel and funding toward COVID-19.⁴⁵

Policy blind spots and governance fragmentation

One of the most striking findings from this review is the failure of national and global health policies to address the co-occurrence of pandemics, tobacco and NCDs. Most countries' pandemic preparedness plans were disease-specific, neglecting chronic comorbidities despite decades of warnings from global health literature⁴⁶. Tobacco control, often handled by separate regulatory bodies, was sidelined during emergency responses. The WHO framework convention on tobacco control (FCTC) and the Global Action Plan for NCDs both emphasize the need for integration with infectious disease control. However, implementation remains fragmented. Lessons from the HIV/AIDS pandemic where syndemic-informed models improved outcomes were not widely applied to COVID-19 or influenza pandemic preparedness.⁴⁷

There is also limited intersectoral governance. Health, finance, agriculture and education ministries often operate in silos, with minimal coordination. For example, during COVID-19, economic relief programs sometimes overlooked how tobacco farming and marketing contributed to long-term NCD and pandemic vulnerabilities.⁴⁸

Missed opportunities during the COVID-19 pandemic

The COVID-19 pandemic presented a critical window for health system transformation. Yet, most countries failed to integrate NCD and tobacco interventions into their pandemic strategies. Very few jurisdictions maintained or expanded smoking cessation services and few used NCD

data to target high-risk populations for vaccination or early intervention.⁴⁹ Meanwhile, the pandemic also created new risk behaviors. Increased isolation, unemployment and stress contributed to rising tobacco and alcohol use in several countries.⁵⁰ Digital cessation tools, though promising, had limited reach in rural or underserved areas. The opportunity to build resilient, integrated health systems was largely missed due to political inertia, resource constraints and a failure to adopt systems thinking.

Toward integrated global health systems

Moving forward, a paradigm shift is essential. Pandemic preparedness must no longer be viewed in isolation but rather as part of a larger public health system that includes NCD prevention and health promotion. The syndemic framework provides a roadmap for this integration. Key strategies should include.

Syndemic-informed health surveillance that captures data on tobacco use, NCDs and infectious disease exposure in a unified platform. Resilient primary care systems equipped to deliver both acute care and chronic disease management during emergencies. Sustainable financing models that ensure tobacco taxes and global health funds support integrated prevention infrastructure. Cross-sectoral governance involving health, environment, labor and finance sectors to align pandemic and chronic disease strategies. Equity-driven frameworks that prioritize resource allocation and targeted outreach for the most vulnerable populations.

Countries that successfully integrated HIV and tuberculosis programs into routine health systems can serve as models for pandemic-NCD integration. For example, Rwanda and Thailand have demonstrated that comprehensive primary care, community health workers and digital surveillance can be scaled to manage both acute and chronic conditions.⁵¹

Implications for the SDGs and global health agenda

The convergence of pandemics, tobacco use and NCDs threatens progress toward several Sustainable Development Goals (SDGs), including SDG 3 (Good Health and Well-being), SDG 10 (Reduced Inequalities) and SDG 13 (Climate Action). Tobacco control intersects with environmental sustainability, economic productivity and gender equity.⁵² Similarly, pandemic resilience depends not just on emergency response but on robust, equitable systems for managing chronic disease.

The post-COVID recovery period offers a unique opportunity to realign global health priorities. Policymakers must invest in integrated frameworks that recognize health as a dynamic, cross-cutting issue shaped by interdependent biological, behavioral and structural factors. The window for action is limited, but with global commitment, a healthier, more resilient future is possible.

This review is subject to several limitations. First, only studies published in English were included, potentially introducing language bias. Second, while extensive, the literature search may have missed relevant grey literature or country-specific policies not indexed in the selected databases. Third, the heterogeneity in methodologies and populations among the included studies limited meta-analysis and generalization. Finally, rapidly evolving evidence post-COVID-19 means some findings may be superseded by newer data not captured in this review.

Despite these limitations, the study provides a valuable synthesis of interdisciplinary evidence and highlights critical gaps and opportunities for integrated policy action.

CONCLUSION

This review underscores the critical intersection of pandemic emergence, tobacco use and noncommunicable diseases (NCDs), which together constitute a global syndemic with profound implications for health systems and policy. The evidence clearly demonstrates that tobacco use and pre-existing NCDs magnify pandemic vulnerability and in turn, pandemics disrupt both tobacco control efforts and chronic disease care. Despite this, global and national policies remain largely compartmentalized, failing to reflect the integrated nature of these threats.

The COVID-19 pandemic exposed these systemic weaknesses, revealing the consequences of policy fragmentation, under-resourced prevention systems and inequitable health structures. A truly resilient health system must recognize and respond to these interconnected pathways. The way forward lies in syndemic-aware strategies that integrate pandemic preparedness with NCD prevention and robust tobacco control. By aligning global health governance, resource allocation and local interventions with this integrative vision, nations can better anticipate future crises, improve health outcomes and reduce inequities. Syndemic thinking is no longer optional it is essential for a healthier, fairer and more sustainable future.

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