Assessing the Impact on Human Health of Net Zero Pathways

A Summary of Ongoing Research and Methodologies

This article by **Aishwarya Ramachandran** and **Kasvi Sansanwal** explores the health co-benefits of net zero strategies, emphasizing India's opportunity to gain significant advantages.

Achieving net zero emissions is vital for limiting global warming to 1.5°C, as outlined in the 2015 Paris Agreement. For India, with its lower-than-average per capita emissions but high climate vulnerability, the commitment to achieve net zero by 2070, as announced at COP26, is especially significant.

Emissions mitigation policies improve human health by addressing environmental and behavioural risks, such as reducing air pollution through clean energy, adopting sustainable diets, and promoting active travel and public transport. Health co-benefits, like lower rates of obesity and lung cancer, underscore the localized, immediate advantages of climate action, boosting public and political support for mitigation efforts. These benefits are increasingly vital, as the 2024 Lancet Countdown on Health and Climate Change highlights that delays in the Paris Agreement implementation have exacerbated threats to global health and survival.

Methodology

A scoping review following PRISMA-Scr guidelines was conducted to define research questions, identify relevant studies, and synthesize findings. Peer-reviewed articles and gray literature from Web of Science, SCOPUS, and PubMed, along with Google Scholar, were reviewed between September and October 2024. The search, limited to English-language publications, covered all available dates and utilized four

keyword sets (Table 1) adapted from a similar review on the global health co-benefits literature by Moutet et al., (2024).

Table 1: Keyword sets for bibliographic databases[1]

Set 1	Set 2	Set 3
India*	Net Zero	Health*
	Net-Zero	Mortality
	Decarboni*	Death*
	Transition scenario	
	Carbon neutrality	
	Paris Agreement	
	Climate change act*	
	Climate change action*	
	Climate change target*	
	Below 2°C	
	Below 1.5°C	

After applying inclusion criteria, 31 sources were selected (Figure 1).

[1] The asterisk (*) indicates a wildcard, which includes variations of the word (e.g., plural)

Key variables included publication details, study design, and health impact assessments, which were iteratively charted. The analytical matrix focused on data collection, emissions and health prediction models, and health endpoints. Consistent with scoping review standards, risks of bias and study quality were not assessed. Results were reported using themes, percentages, frequency counts, and visualizations.

Results and Discussion

Focus on ambient air pollution

Ambient air pollution (AAP) was the most studied co-benefit pathway (n=28). India faces some of the worst AAP globally, with 14 of its cities ranked among the top 20 most polluted in terms of $PM_{2.5}$. In 2019, AAP was responsible for 1.67 million premature deaths in India—18 per cent of the nation's total mortality.

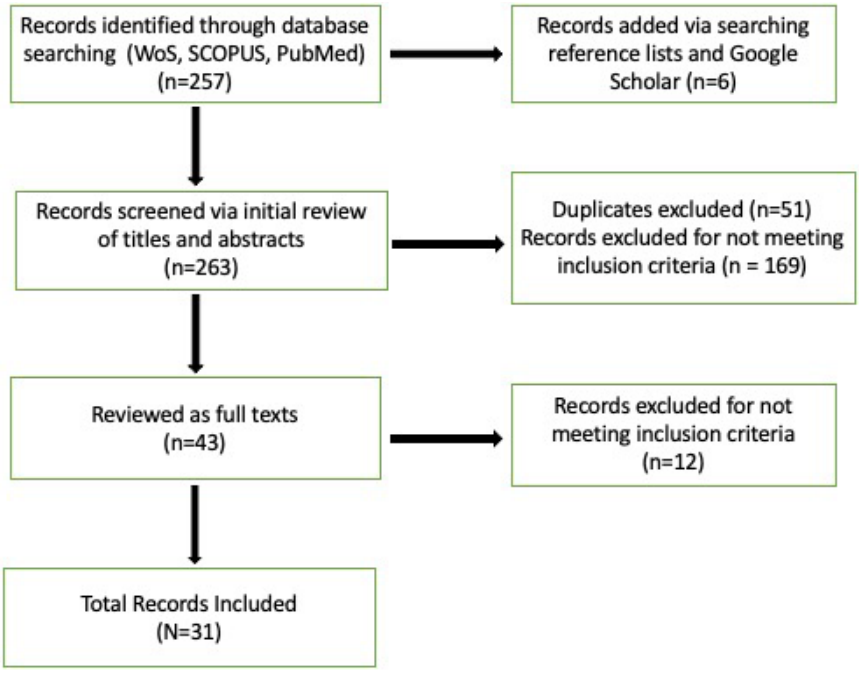

Figure 1: Source identification, screening, and exclusion

The northern and eastern parts of the country disproportionately face the burden of $PM_{2.5}$ mortality, owing to reduced air circulation caused by obstruction from the Tibetan Plateau. Delhi, for example, has experienced unprecedented levels of AAP, resulting in significant increases in respiratory illnesses, hospitalizations, and premature deaths.

Short- and long-term exposure to pollutants, including nitrogen oxides (NO_x), sulphur dioxide (SO_2), particulate matter (PM), ozone (O_3), and carbon monoxide (CO), contributes to a host of non-communicable diseases such as ischaemic heart disease, stroke, chronic obstructive pulmonary disease, lower respiratory infections, and lung cancer. Short- and long-term exposure to air pollutants additionally contributed to higher blood pressure and an increased risk of hypertension. In our corpus, the most studied pollutants include $PM_{2.5}$ (n=19), CO_2 and CO_2 equivalents (n=16), NO_x (n=11), O_3 (n=7), and CO (N=7).

Despite a steady reduction in indoor household air pollution, increasing ambient particulate matter and ambient ozone pollution were the primary causes of the majority of these deaths. Rapid urbanization has led to congested roads in Indian cities and the transport sector was responsible for 40 per cent of overall air pollution in 2023. Between 1990 and 2022, the Indian transport sector's emissions grew at an average annual rate of 1.7 per cent, with vehicular emissions and pollution levels in Indian urban centres exceeding WHO thresholds by up to 500 per cent. A 50 per cent reduction of land transportation emissions by 2040 would result in 250,000 premature deaths being avoided across the G20 countries, with high-emitter countries such as India and China standing to gain the greatest health benefits from any reduction in air pollution.

Large health co-benefits

Several studies point out that India would experience some of the greatest health co-benefits from climate mitigation efforts globally given its:

a. Much higher pre-existing levels of ambient and household air pollution. Most of the health co-benefits from decarbonization in India would occur domestically, emphasizing the local impact of emission reductions. Access to clean cookstoves has been found to have the greatest estimated median health co-benefits in India, with significant benefits to women's and children's health, particularly among disadvantaged groups, preventing low birthweight, stunting, and lower respiratory infections.
b. Presence of some of the worst hotspots globally, which are projected to significantly worsen under current conditions. A larger percentage of the population in India is exposed to ambient $PM_{2.5}$ concentrations far exceeding WHO guidelines compared to previous estimates. Following through on enforcing stringent

emissions targets would most benefit regions with lower socio-economic development, particularly along the Indo-Gangetic Plain, which currently experiences the worst health damages of air pollution.

c. Low levels of pollution control and enforcement currently, with a lack of clear coal emissions or air quality targets and nationally determined contributions failing to fully capture potential air quality benefits.
d. Comparatively lower costs of mitigation while accounting for a substantial portion of global co-benefits. Markandya *et al.* (2018) go so far as to suggest that the costs of reducing greenhouse gas emissions in India could be offset by health co-benefits alone, making aggressive climate policies economically viable.

Diet, physical activity, and active transport

Approximately 23% (n=7) of the corpus highlights health co-benefits from increased physical activity via active transport. Physical inactivity, a major risk factor for non-communicable diseases, contributes to about 5 million premature deaths annually worldwide. In India, rapid urbanization, rising car ownership, inadequate public transport, and poor infrastructure discourage walking and cycling. About 70 per cent of vehicles in India are two-wheelers, 25 per cent are cars, jeeps, taxis, and auto-rickshaws, and only 0.7 per cent are public transport vehicles. A lack of sidewalks, encroachment, poor maintenance, and a prioritization of the flow of car traffic through major urban areas discourages walking as a viable daily commute option, limiting the access of public transportation, walking, or cycling to a "captive population". Integrated spatial planning, by designing urban environments that encourage walking, cycling, and public transportation lowers traffic congestion and air pollution, leading to fewer respiratory diseases and promoting physical activity, which enhances cardiovascular health and overall fitness.

Diet represents the smallest percentage of the corpus (n=4) but is significant due to its outsized environmental and health impacts. The food system contributes 30 per cent of global GHG emissions, projected to double by 2050. International authorities acknowledge the immense carbon cost of meat production and consumption globally, as nations such as the US, UK, and China lead in emissions from their food systems. Demand-side consumer behaviour and population dietary changes are crucial to any substantial change in this sector, as replacing meat (particularly red meat) with plant-based foods like pulses not only drastically reduced GHG emissions but also land, water, energy use for food production. Whitmee *et al.* (2023) suggest that modelled estimates of the NDCs of greenhouse gas emission reductions in 9 countries showed that a sustainable pathways scenario resulted in an estimated annual reduction by 2040 of about 5.86 million diet-related premature deaths as compared to 1.18 million air pollution-related premature deaths and 1.15 million premature deaths due to physical inactivity though there is some overlap across these numbers. While some countries such as India, Indonesia, and Nigeria see little change in deaths avoided by switching to a plant-based diet, heavy meat-consuming nations like Germany, the USA, and China yielded larger co-benefits through dietary shifts, compared to air pollution reduction or active travel.

References

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Aishwarya Ramachandran, Consultant and Kasvi Sansanwal, Junior Research Associate, Ashoka Centre for a People-Centric Energy Transition, Ashoka University[2]