

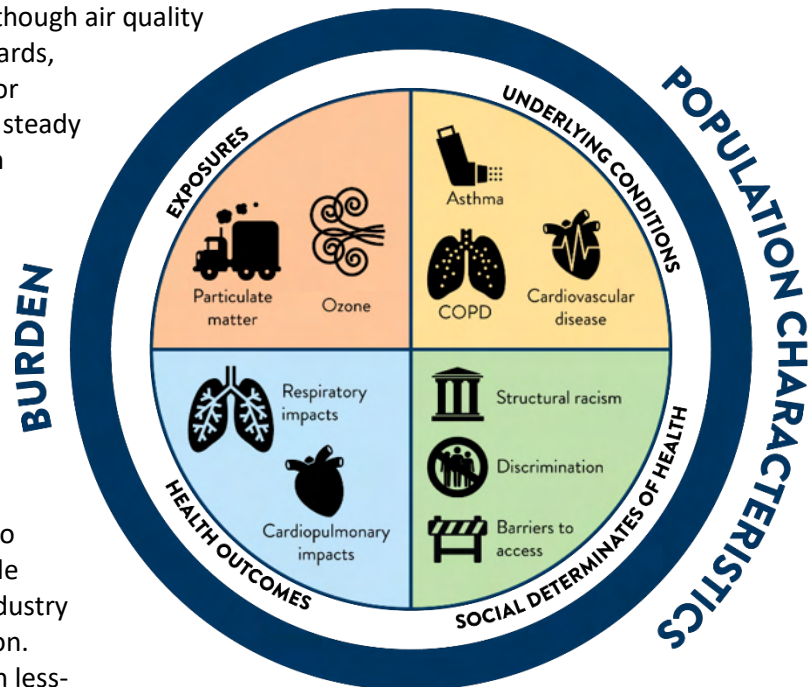
Life and Breath: Twin Cities Metro Area

Air pollution leads to heart and lung conditions and premature deaths, with the largest impacts in marginalized communities.

Air pollution is a public health issue

Breathing polluted air creates or worsens numerous health conditions and can lead to early death. Although air quality in Minnesota meets current federal standards, environmental conditions are changing. For example, Minnesotans are experiencing a steady increase in seasonal smoke exposure from wildfires, triggering air quality alerts and heightening concerns about the health impacts of smoke and other air pollutants.

While all Minnesotans are susceptible to the health impacts of air pollution, these impacts are not equal. Due to structural inequities (i.e., institutional systems including city planning, infrastructure, and policies that have led to disparities in local source pollution), people living near high-traffic roads and heavy industry often have added exposures to air pollution. Communities that live, work, and gather in less-polluted areas often fare better. This unequal air pollution burden, together with higher underlying rates of lung, heart, and other health conditions, can lead to disparate health outcomes.



The **Minnesota Department of Health (MDH)** and the **Minnesota Pollution Control Agency (MPCA)** work together on the intersection of air and health. In this brief, we have estimated annual health impacts of air pollution by ZIP code across the seven-county Minneapolis-St. Paul (Twin Cities) metro area. The findings highlight population-level health impacts of air pollution as well as differences across demographic groups. From the analysis, we describe the impact on communities while adding to the body of evidence that some populations bear a heavier burden of air pollution and the associated health-related outcomes. Taking these findings forward to action requires conversations with communities most impacted by health inequities and environmental injustice to identify actionable interventions to improve and protect health.

Top takeaways

- **Despite overall annual improvements in air quality, we find noteworthy local health impacts from fine particles and ozone pollution.** Between 2008 and 2015, fine particles (PM_{2.5}) pollution improved by 30% and ozone pollution improved by nearly 10% in the metro. We know that even low levels of air pollution can adversely affect health and more for people who already have lung and heart conditions.
- **Disproportionate impacts across Twin Cities communities persist.** There is an observable trend where the highest estimated rates of air pollution-related death and disease are found in neighborhoods with the largest percentage of Black, Indigenous and People of Color (BIPOC), low-income and uninsured residents, and people who live with a disability. For example, zip codes with the largest percentage of BIPOC residents had more than *five times* the rate of asthma emergency room visits related to air pollution compared to areas with more white residents.
- **Chronic health conditions heighten susceptibility to negative effects of air pollution in the body.** Across the Twin Cities, hospitalizations related to chronic conditions, such as asthma, vary widely and are highest in communities with a large percentage of BIPOC residents, people living in poverty, uninsured individuals, and those with a disability. Reducing air pollution is part of the overall strategy to address structural inequities in health care, housing, and other social factors that influence health.
- **In 2015, we estimated that air pollution played a role in 10% of all deaths — about 1,600 — in the Twin Cities metro area.** For comparison, Alzheimer’s disease caused a similar number of deaths in 2015 — about 1,700 — and was the sixth leading cause of death in Minnesota.
- **Nearly 500 hospitalizations and emergency room (ER) visits for heart and lung problems were related to PM_{2.5} and ozone pollution in 2015.** We know that PM_{2.5} and ozone are two of many air pollutants that impact health, therefore these estimates for hospitalizations and ER visits are likely an underestimate of the real burden.

Twin Cities air pollution continues to contribute to early deaths

In the first [Twin Cities Life and Breath report](#), MDH and MPCA evaluated air pollution and health data for 2008 and found that moderate levels of air pollution contributed to over 2,000 early deaths annually in the seven-county metro area. While the overall trend is improving, specific location and population data reveal that negative impacts persist. As **Table 1** shows, Twin Cities air quality improved between 2008 and 2015, and the number of early deaths and the proportion of all deaths connected to air pollution decreased.

Table 1: Estimated deaths attributable to air pollution in the seven-county Twin Cities metro area.

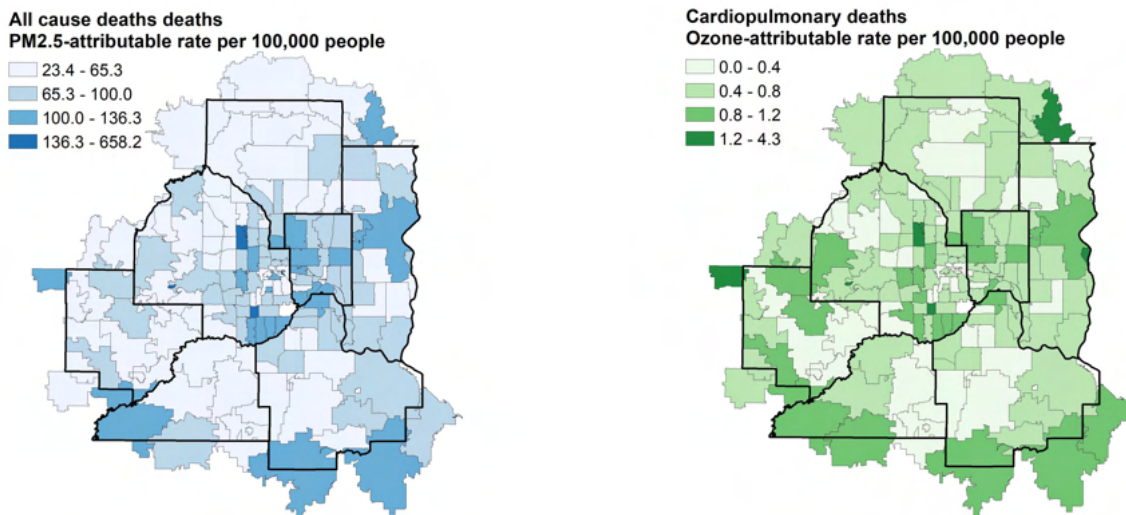
Health outcome	Pollutant	Year	Deaths*	Percent of deaths*	Attributable rate**	Deaths preventable with air quality improvements***
All cause deaths (25 and older)	PM _{2.5}	2008	2,152	12.6%	110.5	247
		2015	1,588	8.6%	74.9	185
Cardiopulmonary deaths (all ages)	Ozone	2008	23	1.1%	0.8	7
		2015	19	0.8%	0.6	7

*Attributable to PM_{2.5} and ozone **per 100,000 people ***reduction of 10% for PM_{2.5} and ozone

Disparities persist despite overall improvements

While on average there have been improvements for the health impacts of air pollution across Twin Cities communities, disparities persist. The maps in **Figure 1** show the estimated death rates connected to air pollution. The highest death rates are concentrated in zip codes in the core of the metro area and around the periphery. The estimated PM_{2.5} and ozone attributable deaths follow similar patterns as the underlying death rates. Populations in zip codes with higher underlying death rates generally have older residents or are overburdened by structural inequities, such as systemic racism, housing insecurity, discrimination in health care, and other social and economic stressors, sometimes called **social determinants of health**. These factors all contribute to unequal health burden.

Figure 1: PM_{2.5} attributable (left) all-cause death rates (ages 25 and older) and ozone-attributable (right) cardiopulmonary death rates (all ages) in the Twin Cities metro area for 2015 by ZIP code.



Health inequities of air pollution

The MPCA defines environmental justice (EJ) areas of concern as communities where more than 40% of the population is living below 185% of the federal poverty line (approximately \$48,000 gross annual income for a family of four) and/or over 50% of the residents are BIPOC.¹ This analysis shows that populations in these areas also bear a disproportionate burden of health inequities related to air pollution:

- Air pollution-attributable heart and lung hospitalizations and ER visits are highest in EJ-defined zip codes in the metro.
- Areas with more uninsured residents (around 10% and higher, nearly double the state average of 5.2%) and with more residents who report a disability (around 12% and higher, compared to the metro area average of around 9%) also experience more air-related health impacts.



<https://www.pca.state.mn.us/about-mpca/mpca-and-environmental-justice>



<https://data.web.health.state.mn.us/web/mndata/equity>

For this report, we looked at four community characteristics that can indicate inequity and barriers to sustaining health and well-being: the percent of residents living under the poverty line, percent of BIPOC residents, percent uninsured, and percent with a disability. These are shown for metro area zip codes in **Figure 2**. **Figure 3** and **Figure 4** (below) summarize PM_{2.5} and ozone attributable hospitalization rates across these social determinants of health, respectively. The charts show areas with higher poverty, higher BIPOC populations, higher levels of un-insurance, or more individuals living with a disability have a substantially higher rate of negative health impacts, approximately three to four times greater for all outcomes.

Figure 2: The maps show zip code area population for percent in poverty and BIPOC (left), and disability ranking with high (10% or more) un-insurance rates (right).

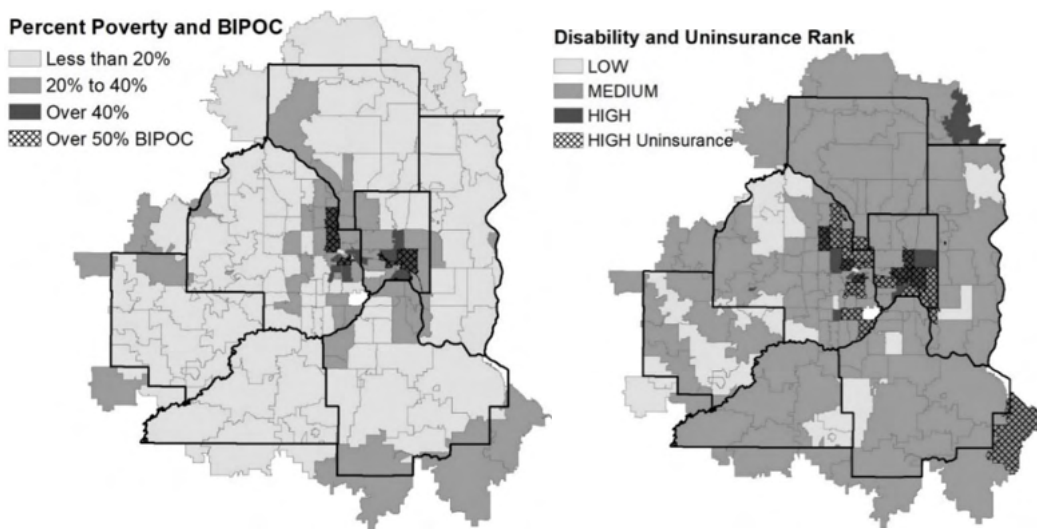


Figure 3: Demographic indicators of Twin Cities zip codes 2015: non-fatal impacts from PM_{2.5} by poverty, BIPOC residents, un-insurance status, and any disability.

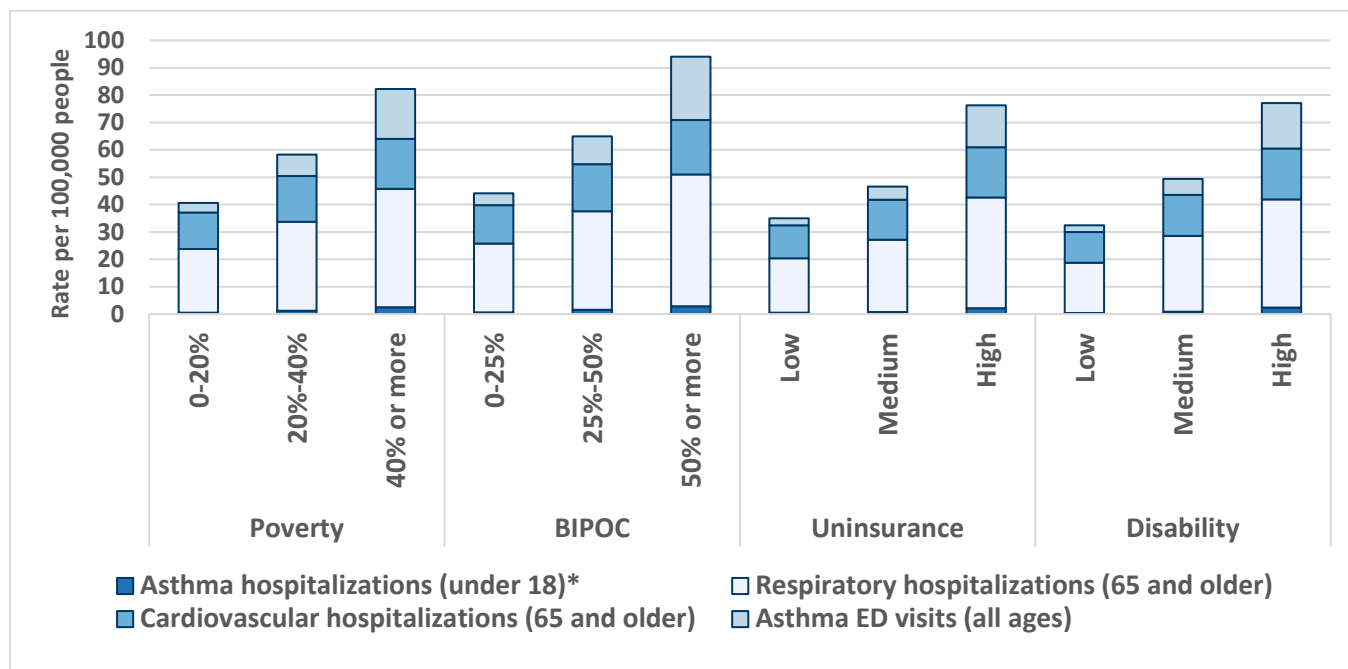
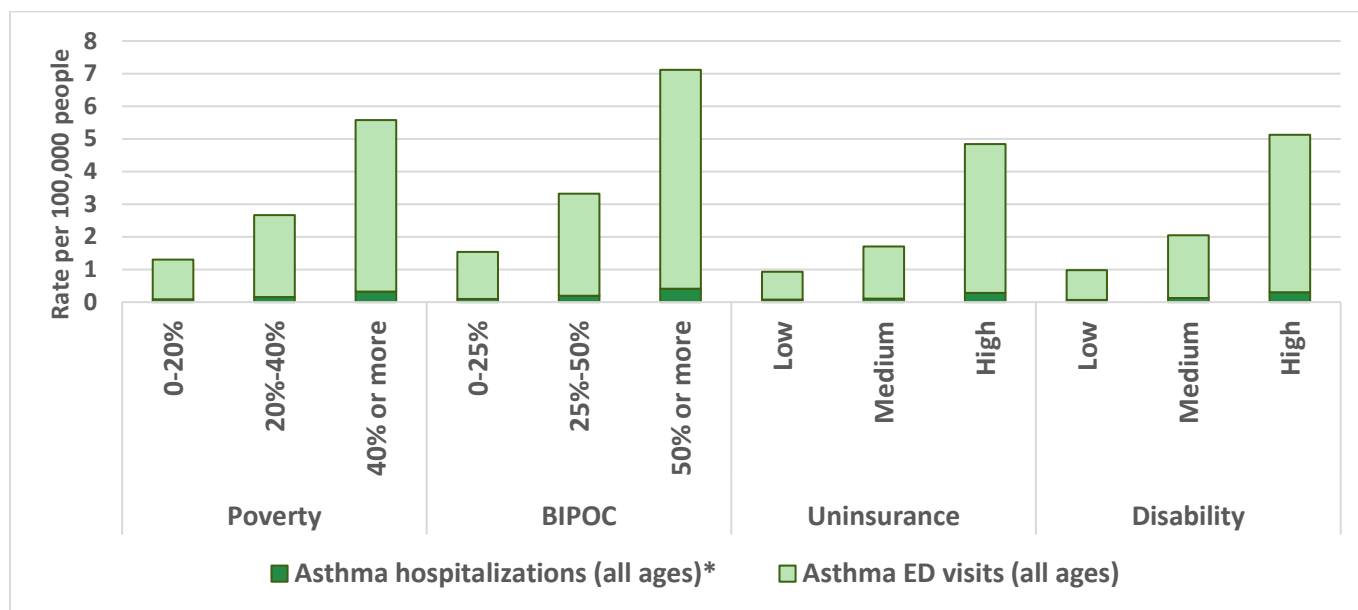


Figure 4: Demographic indicators of Twin Cities zip codes 2015: Non-fatal impacts from ozone by poverty, BIPOC residents, un-insurance status, and any disability.



* Note that asthma hospitalizations are more severe and therefore rarer than asthma emergency department (ED) visits, so we expect fewer incidents. It is still important to examine disparities of more severe health outcomes.

Health inequities for heart and lung conditions are compounded by stressors experienced within many communities, including emerging evidence connecting the number and severity of COVID infections (including deaths) and poor air quality.^{2 3} Although these data predate the COVID-19 pandemic and recent spike in wildfire events, there is evidence that long-standing areas of local air quality inequities continue in the Twin Cities.

Progress and the path forward

The goal of this analysis was to describe the impact on communities and add to the body of evidence around whether at-risk populations bear a heavier burden of air pollution and the associated health-related outcomes. MDH and MPCA have taken steps to address underlying inequities in air and health. MDH makes connections between the environment and health using [air quality and demographic data](#), and tracks health outcomes while identifying marginalized populations to target funding and resources. Health equity is core to the mission, and MDH strives to identify and protect communities experiencing high rates of chronic health conditions and/or those disproportionately impacted by environmental pollution.

One of MPCA's key strategic goals is to improve air quality in population centers. Recently the MPCA enacted the [Clean Cars Minnesota rule](#), which reduces emissions from greenhouse gases and pollutants that lead to PM_{2.5} formation from passenger vehicles. Another MPCA strategic goal is to address environmental justice in all programs while identifying communities most impacted by air pollution to focus programmatic work and increase engagement. [The Air We Breathe 2021 legislative report](#), a biannual report describing the state's air quality to inform and guide policies, highlights sources of air pollution and outlines the unequal exposures to pollution.

Many historical factors, such as proximity to highways and industry due to systemic racism, continue to influence local air quality. Other factors that shape health and amplify impacts from air pollution include access to quality health care and green spaces, and affordable housing, and education. The overarching goal of this report is to promote dialogue among policymakers and environmental and health advocates and organizations to use the findings and practical experience to address health disparities, advance health equity, and improve population health at the local level in Minnesota and the metro. Below are additional resources for communities along with links to a more specific data tables to complement this high-level summary.

Health and environmental justice data tools

- [CDC's Environmental Justice Dashboard](#)
- [CDC's Environmental Public Health Tracking](#)
- [CDC's Heat and Health Tracker](#)
- [CDC's Social Vulnerability Index](#)
- [MPCA's Understanding Environmental Justice in Minnesota interactive map](#)

Glossary

- **Attributable rate:** *Estimated rate of health impacts due to air pollution in a specific population. This is a good measure of a population's overall vulnerability to air pollution. A population-based rate helps to make clear comparisons between groups of differing sizes.*
- **Environmental justice:** *Advancing health equity and eliminating environmental health disparities through the fair treatment and meaningful involvement of all people in environmental health policies, research, and programs and ensuring equal access to a healthy environment. In other words, all people — regardless of race, income, or other factors — should be involved in determining laws and practices about the environment as it relates to our health.*
- **Health disparities:** *Differences in health outcomes and their determinants among segments of the population as defined by social, demographic, environmental, or geographic category.*

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- **Health inequities:** Systematic, unfair, and avoidable differences in health outcomes and their determinants between segments of the population, such as by socioeconomic status, demographics, or geography.
- **Social determinants of health:** Conditions in the places where people live, learn, work, and play that affect a wide range of health and quality-of-life risks and outcomes. Key social determinants include health care access and quality, education access and quality, social and community context, economic stability, and the built environment. Learn more from the CDC here: <https://www.cdc.gov/socialdeterminants/about.html>
- **Structural inequities** occur when the fabric of organizations, institutions, governments, or social networks contains an embedded bias which provides advantages for some members and marginalizes or produces disadvantages for other members.

Methods: In this data brief we use the Environmental Protection Agency’s BenMAP model to estimate the relationship between air pollution and certain lung and heart conditions, and early death.⁴ Specifically, the inputs for the model include annual average air pollution concentrations (2015) by zip code from EPA’s Downscaler model⁵, hospital and death records (Minnesota Hospital Discharge Dataset -MNHDD- and vital records, 2013-2017) from the Minnesota Department of Health, population data from the Census Bureau, and concentration response functions from large national peer-reviewed research.

The MNHDD contains patient claims data voluntarily submitted by members of the Minnesota Hospital Association (MHA), a trade association representing Minnesota hospitals. Minnesota Department of Health (MDH) purchases these data from MHA under a Memorandum of Understanding between MHA and MDH. For further detail on our methods, see the previous Life and Breath reports for the Twin Cities metro area ([published in 2015](#)) and for the entire state of Minnesota ([published in 2019](#)).⁶

¹ <https://mpca.maps.arcgis.com/apps/MapSeries/index.html?appid=f5bf57c8dac24404b7f8ef1717f57d00>

² Wu X, Nethery RC, Sabath MB, Braun D, Dominici F. Air pollution and COVID-19 mortality in the United States: Strengths and limitations of an ecological regression analysis. *Sci Adv.* 2020 Nov 4;6(45):eabd4049. doi: 10.1126/sciadv.abd4049. PMID: 33148655; PMCID: PMC7673673.

³ Fine particulate matter and COVID-19 mortality in the United States (harvard.edu)

⁴ EPA’s BenMAP model: <https://www.epa.gov/benmap>

⁵ EPA’s Downscaler model: <https://nepis.epa.gov/Exe/ZyPDF.cgi/P100X1QF.PDF?Dockey=P100X1QF.PDF>

⁶ Previous MPCA/MDH Life and Breath reports: <https://www.pca.state.mn.us/air/life-and-breath-report>