MINNESOTA

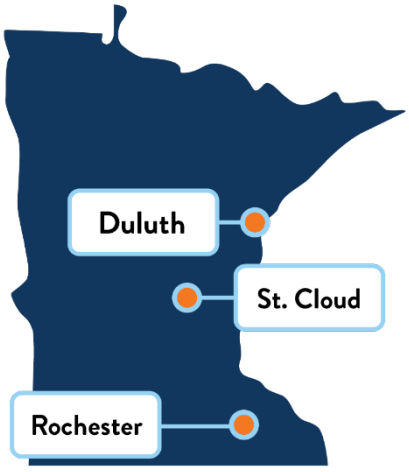
Life and Breath: Greater Minnesota Cities

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 (using methods from peer-reviewed literature[1]) in three of Greater Minnesota's largest cities: Duluth, Rochester, and St. Cloud. We focus on these cities because their population size is large enough to produce statistically stable estimates. 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 relatively good air quality in Duluth, Rochester, and St. Cloud, we find health impacts from fine particles and ozone pollution.**
- **Within these cities, communities with higher percentages of low-income residents; Black, Indigenous, or People of Color (BIPOC) residents; uninsured residents; or residents living with a disability have the highest estimated air pollution-related death and disease rates.**
- **Chronic health conditions heighten susceptibility to the negative effects of air pollution in the body.**
- **We estimate that air pollution played a role in close to 9% — or about 200 — of all deaths in 2015 in these three Greater Minnesota cities.** For comparison, in Minnesota the third leading cause of death in 2015 was accidents (6% of all deaths) after cancer and heart disease (22% and 18%, respectively).[2]

Greater Minnesota air pollution contributes to early deaths

In an earlier Life and Breath report, MDH and MPCA evaluated air pollution and health data for 2013 and estimated air pollution contributed to more than 2,000 premature deaths in the state. For the current analyses with city data, **Table 1** shows even low to moderate levels of fine particle ($PM_{2.5}$) pollution in 2015 contributed to around 200 early deaths in Duluth, Rochester, and St. Cloud. Additionally, the table highlights the estimated percentage of all deaths related to air pollution, the rate of air pollution-related early deaths (per 100,000 residents), and the potential number of avoided impacts from better air quality.

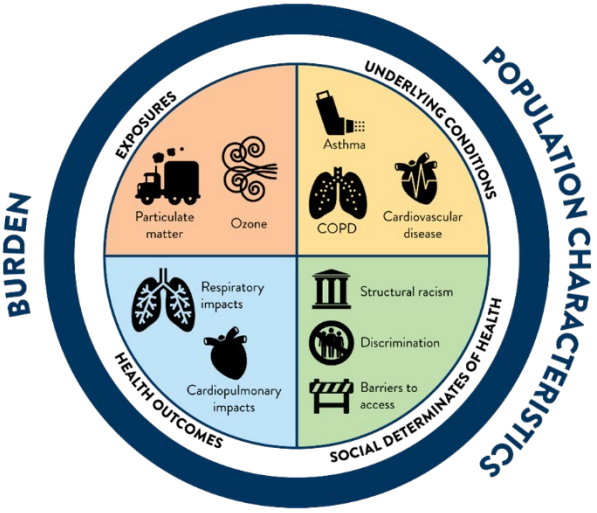
Table 1: Estimated 2015 deaths attributable to $PM_{2.5}$ pollution in Duluth, Rochester, and St. Cloud

Geographic Area	Deaths*	Percent of all deaths*	Attributable rate**	Deaths preventable with air quality improvements***
Three cities Combined	**203**	**8.5%**	**92.0**	**21**
Duluth	**62**	**7.8%**	**105.5**	**6**
Rochester	**74**	**9.5%**	**88.3**	**8**
St. Cloud	**67**	**8.2%**	**85.7**	**7**

*All cause deaths for individuals aged 25 and older attributable to $PM_{2.5}$
**Per 100,000 people
***Reduction of 10% of $PM_{2.5}$ in air

Health inequities of air pollution

While air quality has generally improved over the past few decades in Minnesota, gaps in the health impacts of air pollution based on race and other marginalizing factors persist in the state. In these three cities, disparities are not predominantly the result of differences in air pollution, but more likely a result from the already existing burden of lung and heart conditions. Populations in areas with higher disease and death rates generally have aging residents and ***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 burdens of air pollution.



We categorized each of 19 ZIP codes (collectively constituting the three cities of Duluth, Rochester, and St. Cloud) according to poverty level, percentage of BIPOC residents, percentage of uninsured residents, and percentage of residents reporting any disability. As in the previous Life and Breath report for all of Minnesota, we considered residents to be living in poverty if their household income was below 200% of the federal poverty level. (In 2015, 200% of the federal poverty level for a family of four was $48,500.) We assigned a community to a high poverty rank if the percentage of its residents living in poverty was higher than the population-weighted average for its city. We used the same method to rank communities as low or high for the each of the categories: poverty, BIPOC, uninsurance, and disability.

Figure 1 and Figure 2 show how the non-fatal but serious health impacts of air pollution vary across Greater Minnesota cities' zip codes depending on poverty, BIPOC, uninsurance, and disability levels. This analysis shows rates of hospitalizations and emergency department visits attributable to $PM_{2.5}$ and to ozone exhibit similar patterns for each of these demographic indicators. Areas with higher poverty, higher BIPOC populations, higher levels of uninsurance or higher disability rankings each show increasing attributable rates for every estimated health impact.

Figure 1: Demographic indicators of Greater Minnesota cities zip codes 2015: Non-fatal impacts from $PM_{2.5}$ by poverty, BIPOC residents, uninsurance status, and any disability.

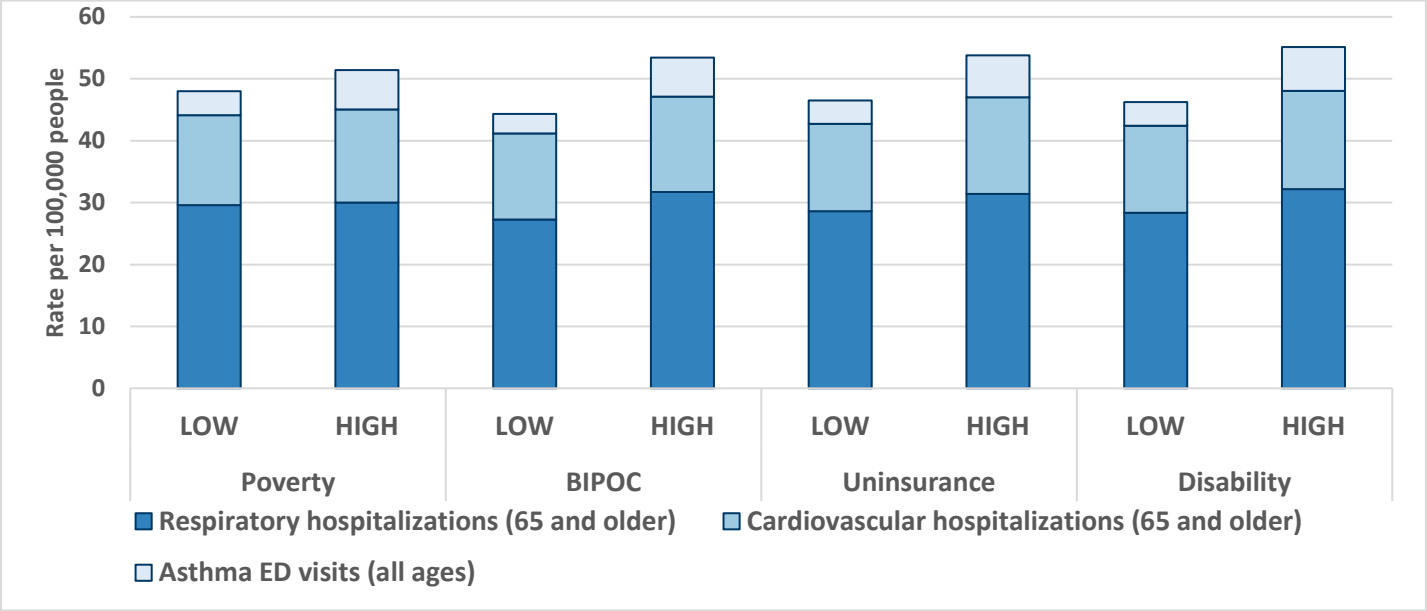
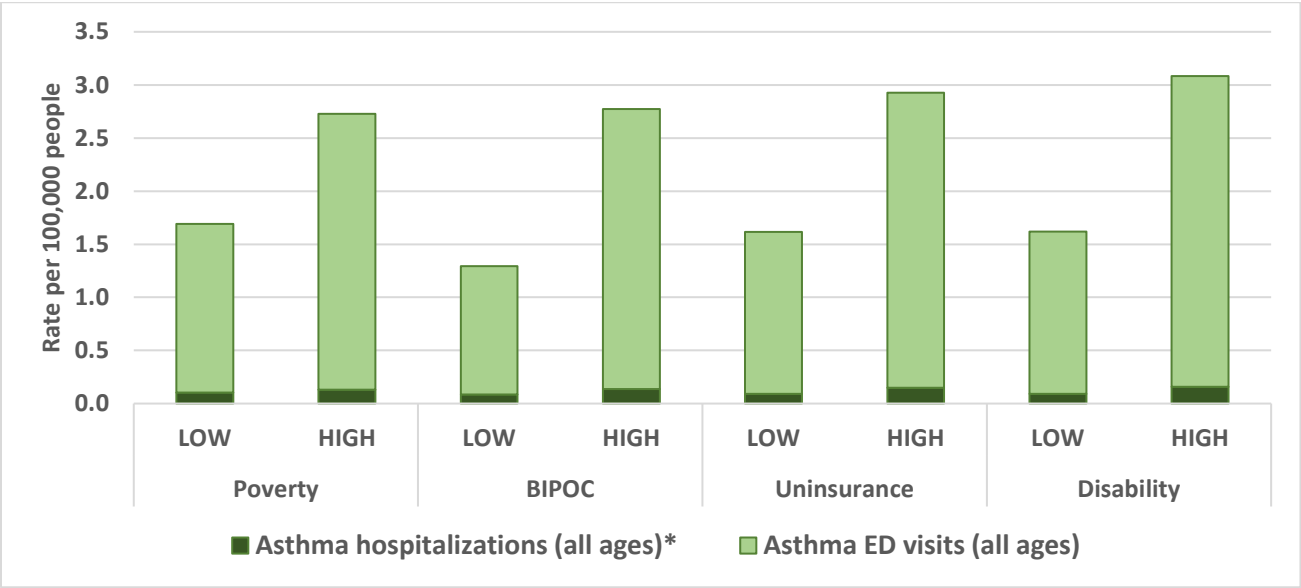


Figure 2: Demographic indicators of Greater Minnesota cities zip codes 2015: Non-fatal impacts from ozone by poverty, BIPOC residents, uninsurance status, and any disability.



*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.

Across Minnesota, hospitalizations related to chronic conditions, such as asthma, vary widely and are highest in communities already overburdened with underlying health conditions. Reducing air pollution is part of the overall strategy to address structural inequities in health care, housing, and other social factors that influence health.

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.[3] [4] Although the data analyzed in this brief predate the COVID-19 pandemic and recent spike in wildfire events, there is evidence that long-standing areas of local air quality inequities have continued throughout Minnesota.

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 at-risk populations in order to target funding and resources. Health equity is core to MDH's mission, and the agency strives to identify and protect communities experiencing high rates of chronic health conditions and those who are disproportionately impacted by environmental pollution.

Learn more about environmental justice and health equity and how MPCA and MDH incorporate these initiatives into everyday work.

One of MPCA's key strategic goals is to improve air quality in Minnesota population centers, including Greater Minnesota cities. Recently the MPCA enacted the Clean Cars Minnesota rule, which reduces emissions of 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 forced proximity of residents 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, affordable housing, and education. We intend this report to promote dialogue among environmental and health policymakers, advocates, and organizations, and to combine the findings with practical experience to address health disparities, advance health equity, and improve population health at the local level in Minnesota. Below are additional resources for communities along with links to 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*** *is the 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.*
- ***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 outcome. 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 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 model[5], 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]

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[1] See, for example, Fann N, Lamson AD, Anenberg SC, Wesson K, Risley D, Hubbell BJ. Estimating the National Public Health Burden Associated with Exposure to Ambient $PM_{2.5}$ and Ozone. Risk Analysis. 2012 32(1). Available at https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1539-6924.2011.01630.x.

[2] Mortality (deaths) - Minnesota Dept. of Health (state.mn.us)

[3] 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.

[4] 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 Downscalermodel: 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