SURVEILLANCE BRIEF

Wisconsin Environmental Public Health Tracking Program

# Outdoor Air Pollution in Wisconsin: Fine Particulate Matter

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**SUMMARY** — Fine particulate matter ($PM_{2.5}$) is an air pollutant that causes heart and lung disease and can lead to premature death, especially in infants, people over 65 years of age, and people with cardiovascular or respiratory disease. In Wisconsin, people of color tend to face higher rates of exposure to $PM_{2.5}$ as compared to people who are white. There is no safe level of exposure to $PM_{2.5}$. Although Wisconsin's $PM_{2.5}$ rates have decreased over the last 20 years, it is still important to take steps to reduce exposure. Recommendations to reduce harm caused by $PM_{2.5}$ include policy development and taking individual precautions to reduce personal exposure.

## BACKGROUND

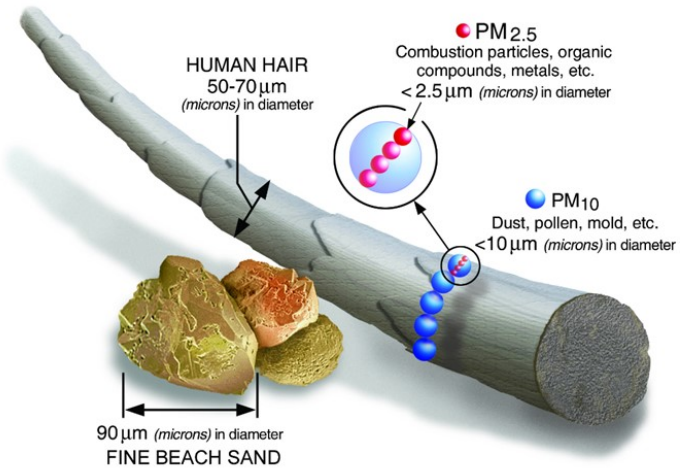
Air pollution is a worldwide environmental health threat that is associated with 7 million premature deaths annually.[1] A variety of health conditions are associated with air pollution, including heart disease, heart attacks, stroke, and lung cancer, as well as acute and chronic respiratory diseases such as asthma. Research has shown that lower levels of air pollution are linked with better short- and long-term cardiovascular and respiratory health.[2]

Particulate matter (PM) is one harmful component of outdoor air pollution. PM is composed of a mixture of solid particles and liquid droplets of organic and inorganic substances such as ammonia, black carbon, mineral dust, nitrates, sodium chloride, sulfate, and water. There are two key types of particulate matter: $PM_{10}$ and $PM_{2.5}$. Inhalable coarse particles ($PM_{10}$) result from wind-blown dust (for example, dust from unpaved roadways and dust-creating industries).[3] Fine particles ($PM_{2.5}$) are most commonly created by chemical reactions of other air pollutants from sources such as power plants, automobiles, and industries. Forest fires and wood stoves also create $PM_{2.5}$ pollution.

The hazardous effects of particulate matter impact more people than any other pollutant.[2] $PM_{2.5}$ is particularly dangerous because these particles are so small that after they are inhaled, they can travel through the lung barrier and enter the bloodstream, leading to additional health-damaging

effects. See Figure 1 for size comparisons between fine beach sand, human hair, $PM_{10}$, and $PM_{2.5}$. Long-term exposure to particulate matter has been linked to a higher risk of developing heart and lung disease, lung cancer, diabetes, Parkinson's disease, Alzheimer's disease, and other dementias.[4] Long- and short-term exposure also increase the risk of premature death in infants, people over 65 years, and people with heart or lung disease.[4] In Wisconsin, it is estimated that in the year 2012, 16.5% of deaths of individuals over 14 years of age were attributable to $PM_{2.5}$ pollution—the 9th highest state rate in the United States.[5]

FIGURE 1. Particulate matter size comparison[3]




$PM_{2.5}$ has been linked to health impacts even at very low concentrations, and no safe level of exposure has been determined.[2] The safest approach to protect public health is to achieve the lowest concentrations of $PM_{2.5}$ possible. The Environmental Protection Agency (EPA) sets primary and secondary standards for particulate matter in the United States.[6] Primary standards are created to protect public health, including the health of individuals who are at increased risk from air pollution, such as children, older individuals, as well as those with asthma and/or heart disease. Secondary standards are created to protect public welfare and the environment. The current EPA primary standard for $PM_{2.5}$ is 12 µg/m³ (annual mean, averaged over three years). The current EPA secondary standard for $PM_{2.5}$ is 15 µg/m³ (annual mean, averaged over three years).

## WISCONSIN $PM_{2.5}$ DATA

The Wisconsin Department of Health Services' Environmental Public Health Tracking Program provides data on $PM_{2.5}$ levels in Wisconsin within the program's data portal . These data are available to the public and are regularly updated. The portal provides historical data from counties with air monitors and modeled data from counties without monitors. The modeled data come from the EPA's Downscaler (DS) model, which uses the Community Multi-scale Air Quality (CMAQ) modeling system to provide $PM_{2.5}$ concentration estimates for areas without monitors. To learn more about this, see our Air Quality Data Details. Figure 2 displays data from the portal, which shows a trend of decreasing $PM_{2.5}$ annual average concentration in Wisconsin from 2002 to 2018.

$PM_{2.5}$ concentrations in Wisconsin have decreased by over 35% since the early 2000's.[8] From 2006–2008, several Wisconsin counties were not in compliance with federal $PM_{2.5}$ standards, as shown in Figure 3. Currently, all Wisconsin counties are in compliance with federal $PM_{2.5}$ standards. This improvement is the result of a variety of federal and state laws and control programs which have significantly reduced pollutant emissions. One law that has significantly reduced Wisconsin's $PM_{2.5}$ rates is the Clean Air Act. The Clean Air Act is a federal law which led to the creation of a variety of state and federal environmental protection programs to improve air quality in the United States. From 2002 to 2017, many air-polluting emissions have decreased substantially. This includes reductions in air pollutants which create $PM_{2.5}$,[9] such as an 89% reduction in sulfur dioxide ($SO_2$), a 63% reduction in emissions of nitrogen oxides (NOx), as well as a 58% reduction in volatile organic compounds (VOCs).[8]

FIGURE 2. $PM_{2.5}$ (µg/m³): Annual Average Concentration (Monitor + Modeled Data), 2002, 2010, and 2018[7]

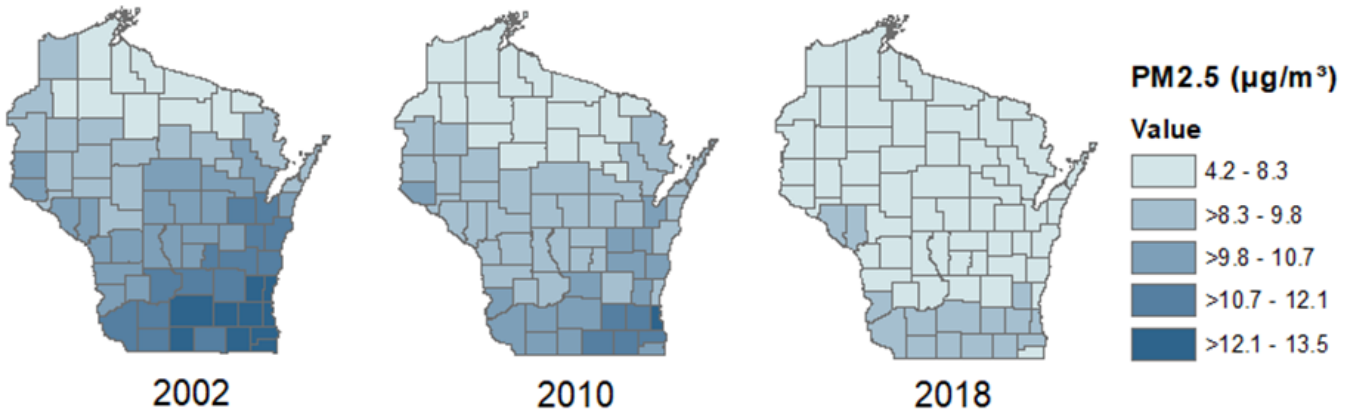
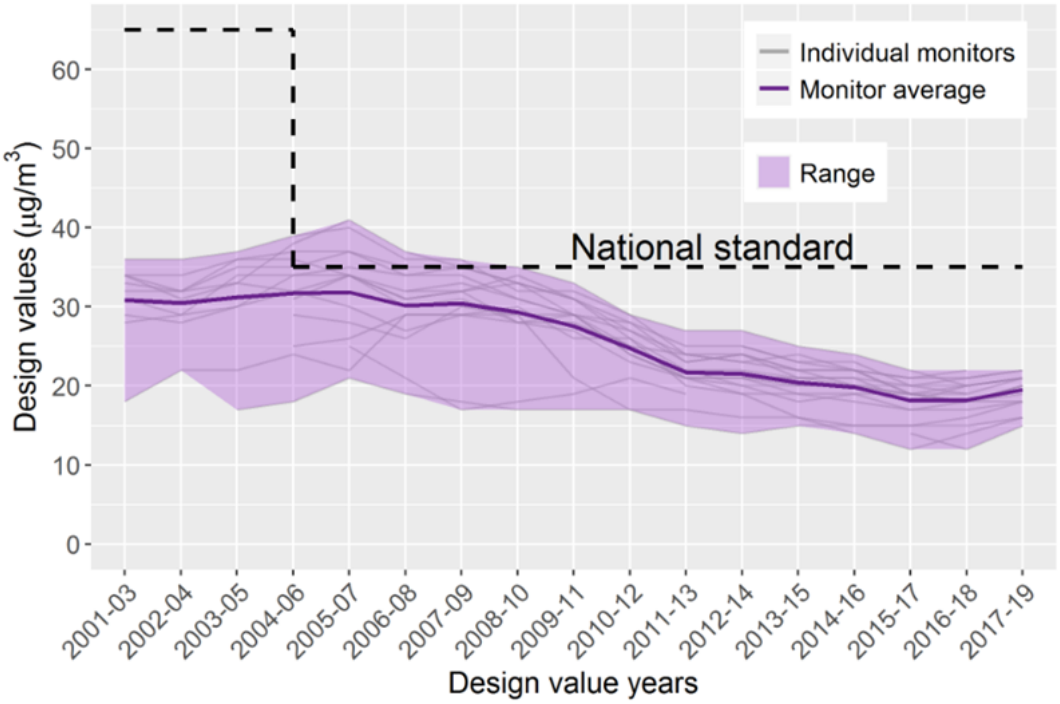



FIGURE 3. Trends in 24-hour $PM_{2.5}$ Design Values in Wisconsin, 2001–2019[8]

*Note: The dark purple line shows the mean design value (a statistic that describes air quality status compared to national standards), the light gray lines show trends for each monitor, and the purple shaded area shows the range of values observed. The dotted line represents the national standard, which decreased in 2006.*

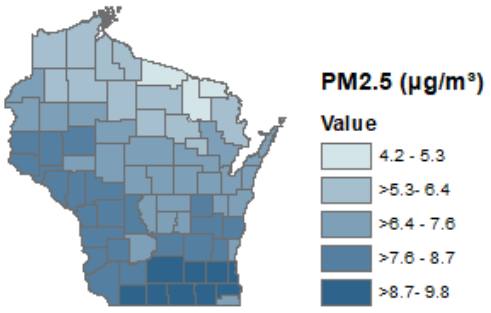


## DISPROPORTIONATE $PM_{2.5}$ EXPOSURE FOR PEOPLE OF COLOR IN WISCONSIN

Throughout the United States, people of color are exposed to disproportionately high levels of $PM_{2.5}$.[10] This trend is consistent across states, urban and rural areas, and income levels. In the United States, people of color have 25% higher rates of exposure to $PM_{2.5}$, on average, compared with people who are white.[10] In Wisconsin, people of color have 34% higher rates of exposure to $PM_{2.5}$, on average, compared with people who are white.[10]

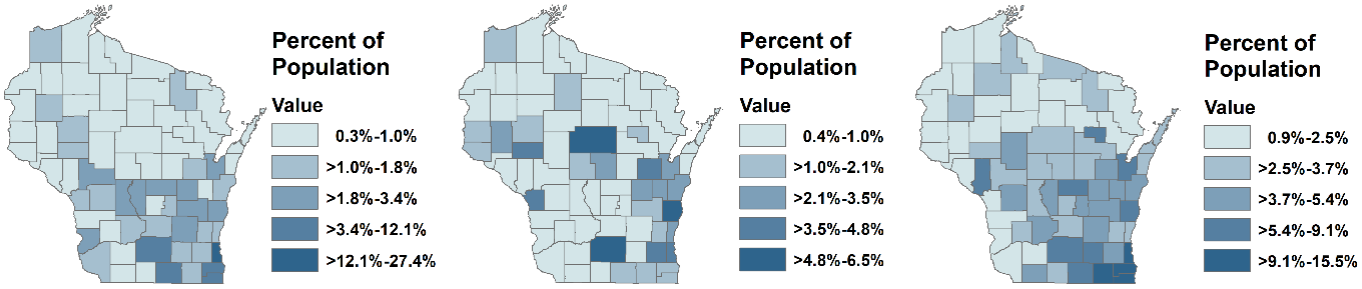
DHS' Environmental Public Health Tracking portal shows overlap between the counties with the highest yearly average $PM_{2.5}$ concentration and the counties with the highest percentage of people who are Black/African American (including those of Hispanic ethnicity), people who are Asian/Pacific Islander (including those of Hispanic ethnicity), and Hispanic individuals. In fact, the eight counties with the highest annual average concentration of $PM_{2.5}$ include four of the five counties with the highest percentage of Black/African American residents (Milwaukee, Racine, Dane, and Rock counties), two of the five counties with the highest percentage of Asian/Pacific Islander residents (Dane and Milwaukee counties), and four of the five counties with the highest percentage of Hispanic residents (Milwaukee, Racine, Walworth, and Rock counties). See Figures 4 and 5 for visualizations of these data.

FIGURE 4. $PM_{2.5}$ (µg/m³): Annual Average Concentration (Monitor + Modeled Data), 2018[7]




PM2.5 Annual Average Concentration
(Monitor and Modeled Data)

FIGURE 5. Percent of Population by Demographic Group, 2018[7]




Black/African American Including Hispanic | Asian/Pacific Islander Including Hispanic | Hispanic All Races

## RECOMMENDATIONS

*For Individuals:*

Individuals can take the following steps to protect themselves from indoor particulate matter:

- Keep living quarters clean.[11]
- Don't smoke.[11]
- Vent fuel-fired combustion appliances (including furnaces, stoves, and heaters) to the outdoors.[12]
- Use an exhaust fan vented to the outdoors while cooking.[12]
- Ensure that woodstoves are properly sized, certified to meet EPA emission standards, and that doors to the woodstove close tightly.[12] Review the EPA's Burn Wise website for more information on burning wood safely.
- Ensure annual inspection, cleaning, and tune-up of central heating systems.[12]
- Change filters on air cleaners and central heating and cooling systems according to manufacturer's instructions.[12]

Use a reliable source such as AirNow.gov to track daily PM2.5 levels in your area. When outdoor particulate matter levels are extremely high, take additional steps to protect yourself and your family:

- Limit physical activity. Avoid activities that cause you to breathe faster or more deeply.[11]
- Stay indoors in an area with clean air.[11] If you live in an area with high levels of particulate matter, consider purchasing an air cleaner. Review the EPA's Guide to Air Cleaners in the Home to learn more about air cleaners. If you cannot afford an air cleaner, consider going somewhere that has air filtration (such as a friend's house) when air pollution levels are high.
- Take the following additional steps to reduce air pollution in your home when outdoor particulate matter levels are high:
    - Avoid burning anything, including wood, gas logs, candles, and incense.[11]
    - Avoid vacuuming unless your vacuum has a HEPA filter.[11]
    - Open windows and air out your home after outdoor air quality improves.[11]

*For Policymakers:*

Policy development is the best way to reduce particulate matter. Due to ongoing trends involving disproportionate $PM_{2.5}$ exposure among people of color in Wisconsin, it is critical that policymakers consider health equity in all policy decisions pertaining to $PM_{2.5}$. Policies that have been successful in reducing particulate matter include setting and enforcing standards for toxic air emissions,[13] as well as addressing the following:

- **Transportation:** Prioritize eco-friendly means of transportation, including rapid urban transit, rail travel, walking, and cycling. Shift towards low-emissions vehicles, low-emissions fuels (including fuels with reduced sulfur content), and cleaner heavy -duty diesel vehicles.[2]
- **Energy:** Ensure access to affordable clean energy solutions. Increase use of low-emissions fuels and renewable combustion-free power sources such as wind, solar, and hydropower.[2]
- **Industry:** Encourage clean technologies which reduce smokestack emissions. Improve management of agricultural and urban waste.[2]

## CONCLUSION

There is no safe level of exposure to $PM_{2.5}$. $PM_{2.5}$ penetrates the lung barrier and can enter the bloodstream. Long-term exposure increases the risk of developing heart and lung disease, lung cancer, diabetes, and dementia. Exposure (including short-term exposure) is also linked to premature death in infants, people over 65 years of age, and individuals with cardiovascular or respiratory disease. Following a nationwide trend of disproportionate $PM_{2.5}$ exposure, people of color in Wisconsin face disproportionately high rates of exposure to $PM_{2.5}$ compared with white individuals in Wisconsin. While Wisconsin's $PM_{2.5}$ levels have decreased in recent years, it is still important to take steps to reduce exposure since even low concentrations of $PM_{2.5}$ can cause harmful health effects.

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## ABOUT TRACKING

The Wisconsin Environmental Public Health Tracking Program is your source for environmental public health data on Wisconsin communities.

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## WISCONSIN ENVIRONMENTAL PUBLIC HEALTH TRACKING PROGRAM

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