

School absences correlate to impaired air quality

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School books in a classroom. Credit: University of Utah

In Salt Lake City schools, absences rise when the air quality worsens, and it's not just in times of high pollution or 'red' air quality days—even days following lower levels of pollutions saw increased absences.

Research is still ongoing, and the evidence isn't yet conclusive enough to draw a cause-and-effect relationship between air quality and children's

absences from school but the correlation, according to Daniel Mendoza, a research assistant professor in the Department of Atmospheric Sciences and visiting assistant professor in the Department of City & Metropolitan Planning, merits further exploration. Mendoza and his colleagues published their results in *Environmental Research Letters*.

Air pollution is harmful for not only the health, but also the education and well-being of children in our community," says study co-author Cheryl Pirozzi, assistant professor in the Division of Respiratory, Critical Care, and Occupational Pulmonary Medicine. "Even at relatively low levels that many people would not think to be harmful air pollution is associated with increased school absences."

"Any pollution is bad," Mendoza says. "And these lower levels of pollution, which are still harmful to our health, have been understudied."

The correlation

Mendoza, who also holds appointments as adjunct assistant professor in the Pulmonary Division at the School of Medicine and as senior scientist at the NEXUS Institute, and his interdisciplinary colleagues looked at absence data from 36 schools in the Salt Lake City School District and compared them with ozone and air particulate matter levels in those neighborhoods from 2015 to 2018.

This kind of neighborhood-level air quality modeling requires a network of research-quality air sensors, and such a network has been building in the Salt Lake Valley over the last several years, operated by the U and by the state Division of Air Quality. That network includes mobile sensors on light rail trains as well as stationary research and regulatory grade sensors.

"These are critical because now we can see small nuances, small

differences across neighborhoods," Mendoza says. "Now we can see how one school, for example, had slightly higher or slightly lower values of ozone and particulate matter. And now, instead of looking at the difference between green and yellow days, we can actually see small amounts of variability because of the density of our networks."

To understand the findings, it's important to first review how air quality conditions are reported. Particulate matter is most often reported as PM_{2.5}, or the amount of particulate matter with a diameter less than 2.5 microns. These particles can reach the deepest parts of our lungs and may actually pass into our bloodstream. The unit of measurement is micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). Ozone is a molecule made from three oxygen atoms and is highly reactive, damaging the respiratory and circulatory systems. It's reported in parts per billion (ppb).

Although the study looked at elementary, middle and high schools, the authors write that elementary students may be most vulnerable to health effects from air pollution.

"Children are particularly susceptible to the health effects of air pollution," Pirozzi says, "and it is possible that health effects, such as respiratory tract infections or asthma exacerbations, may lead to them missing more school, which can have long-term consequences for them."

Across the school district, they found, school absences increased by 1.04 per $\mu\text{g}/\text{m}^3$ of particulate matter and by 1.01 per ppb of ozone, even at levels of air pollution that aren't considered harmful. The worst increase in absences happened the day after high pollution exposure—possibly because reactions to high pollution might reduce exposure and prevent further absences. But on days after low, yet still elevated, pollution, absences continued to rise on the third, fourth and fifth days of exposure—suggesting a cumulative exposure effect, Mendoza says.

"So what that really leads us to think is that even low levels of poor air quality can, in a cumulative manner lead to negative health outcomes—in this case increased school absences. Even on green air quality days, when the pollution was just slightly elevated, if we had several of those days, then kids would still be absent."

Additionally, the researchers write that there may be a disparity between eastside and westside schools. Schools on the west side, with a higher proportion of residents from minority groups, already have a higher rate of absences than the comparatively more affluent east side and are slightly more affected by the same level of pollution. The disparity isn't yet statistically significant, and Mendoza hopes that an interdisciplinary team can further study these socioeconomic factors.

Mendoza acknowledges that there may be more factors at play that could account for some of the absences. Poor air quality days in the winter tend to be colder days, for example, and some children might stay home to stay out of the cold.

"So we're not saying that this is all due to poor air quality," he says. "We do know that there are more social and demographic variables at play here, but we already know the best way to estimate the [pollution](#) is in your zip code is by quantifying the percent of minority residents."

The costs

Absences come at a cost to schools, families and the larger economy. As part of the study, the researchers tried to estimate those costs.

First, the cost to schools. Using average per-pupil spending, the authors found that the state spends \$41.30 per student per day—funding that doesn't benefit a student who's absent.

Next, the cost to families. Often a child staying home from school means a parent staying home from work. At an average hourly wage of \$23.74, an absence can cost an hourly worker close to \$200 a day. For families who receive free or reduced lunch, the cost of food then reverts to the family on days home.

And there are costs to the larger economy as well. Factoring in lost wages, lost taxes and lost productivity due to absences, reducing [air pollution](#) by 50 percent could save Utah's economy around \$426,000 per year just from reducing absences in the Salt Lake School District. This result, the authors say, shows how reducing [school](#) absenteeism can and should be considered a benefit of improving [air quality](#) in the Salt Lake Valley.

"This is definitely not negligible," Mendoza says. "This is a real definite number, very close to half a million dollars in terms of income that does not need to be lost."

Find the full study here.

More information: Daniel L Mendoza et al, Impact of low-level fine particulate matter and ozone exposure on absences in K-12 students and economic consequences, *Environmental Research Letters* (2020). [DOI: 10.1088/1748-9326/abbf7a](https://doi.org/10.1088/1748-9326/abbf7a)

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