How Roadway Pollutants Affect Health

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High levels of particulate matter around roadways are major risk factors to developing lung conditions and diseases, especially among small children whose lungs are in early developmental stages. A recent study shows chronic exposure to air pollution has been associated with adverse effects on children's lung growth. Lung damage during early childhood has life-long consequences.

Our aim was to test the levels of particulate matter and benzene near major intersections in Anchorage. Benzene is an aromatic hydrocarbon, which is produced by the burning of natural products, such as coal and petroleum, found in gasoline and other fuels. Benzene may also place youth at risk, but a recent study could not determine the health effects of continuous exposure to low dose benzene. To test this, I measured benzene levels 0.6 m, 9.6 m, and 18.6 m from crosswalks adjacent to two major intersections.

Particulate matters are inhalable particles that come from car emission, dust and dirt. Along with benzene levels, I checked 0.5 and 5.0 μm diameter particulate matter levels in the same locations. We expected benzene and particulate matter levels to be higher near the intersections compared to levels found away from the intersections. If this proved true, it would suggest that proximity to roadways could be harmful to respiratory health.

Introduction

Extremely small particles, less than 10 μm in diameter, and liquid droplets are known as particulate matter.[1] Particulate matter smaller than 2.5 μm in diameter are known as fine particles. Haze, smoke, fuel and fossil burning may place particulate matter in the air we breathe. These fine particles are able to penetrate the nose, the tracheal and bronchial regions and cause respiratory problems; they can also enter the bloodstream and cause irregular heartbeats, non-fatal cardiac arrest, and premature death.[2] Particulate matter larger than 2.5 μm, (2.5 to 10 μm) are termed inhalable coarse particles and usually come from car emission, dust, and dirt. Their presence leads to an excessive amount of mucus in the airway, which makes it harder to breath. They can cause problems such as asthma and chronic bronchitis. Particles, such as nitrates, sulfates, organic chemicals, metals, soil, and dust particles, can be found in inhalable coarse particles.[3]

Benzene is an aromatic hydrocarbon, which is produced by the burning of natural products such as coal and petroleum and is found in gasoline and other fuels. Benzene is carcinogenic which can affect the bone marrow and blood production.[4] High and/or constant exposure to benzene can be fatal.[4]

Our aim was to test the air quality near busy road intersections in Anchorage, Alaska. To do this we measured the level of particulate matter and the presence of benzene near the intersection and level of particulate matter and benzene taken from specified distances from the intersection.

Methods and materials

To measure particulate matter we used an Aerocet 531 (Met One). We measured the concentration from 3 different intersections over a five-day period: 1) Lake Otis Pkway/Tudor Rd.; 2) Providence Dr. /Prov. East LP; and 3) Tudor Rd./Elmore. These intersections were chosen because of the heavy traffic that travels thru each daily. We did our measurements on weekdays, when traffic would be highest in the late afternoon (at 5-minute intervals). At each intersection, we made measurements 0.6 m, 9.6 m and 18.6 m from the intersection. Because of rain, some day's particulate matter could not be measured. We tested for a significant effect of distance on particulate matter levels using a repeated measures Analysis of Variance, ANOVA.

To measure benzene levels, we used benzene patches (3 M^{TM}). These contained a single charcoal sorbent wafer that trapped organic vapors in the air. We attached these benzene patches to cross walks 0.6 m from the intersections, a tree that was 9.6 m from the intersection and another tree that was 18.6 m from the intersection. We collected the benzene patches after 24 hours of exposure and delivered them to the ASET lab were they measured the amount of benzene in the patch in parts per billion, using a gas chromatography (Agilent 6890).

Results

The levels of particulate matter were highest 0.6 m from the intersection and then the particles steadily declined, suggesting a decrease in mean particles

with the further the distance from the intersection. Likewise, we found a high level of benzene 0.6 m from the intersection, with decreased levels the further the distance from the intersection. In one test site (Lake Otis Pkway/ Tudor Road), we found the levels of benzene increased the further the distance from the intersection. We explained this phenomenon by the fact the site was near an old gas station at the site, which likely still had a gas tank located underneath the ground.

Discussion

The mean levels of fine particulate matter and benzene levels near the intersections were high enough to be harmful to human health, if exposure occurs during a long period time. It would be in the residents' interest either to minimize their exposure to such air or to promote steps that would reduce benzene and particulate matter production. Limitations for this research were that the rainy weather in Anchorage at the time of our research made it more difficult to get accurate readings. Also, the rain affected our ability to collect accurate benzene readings.

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