

# HOW ROADWAY POLLUTANTS AFFECT HEALTH

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High levels of particulate matter (PM) around roadways are major risk factors to developing lungs. A recent study involving children of 10 to 18 years of age found that pollutants from roadways caused harm to children's respiratory systems.<sup>1</sup> In this age group, the lungs are developing rapidly and lung damage has life-long consequences. We hypothesized that PM and benzene levels would be high close to major intersections in Anchorage. To test this, we measured benzene levels on crosswalks adjacent to three major intersections and 0.5  $\mu\text{m}$  and 5.0  $\mu\text{m}$  diameter PM levels 0.6 m, 9.6 m, and 18.6 m from each of four major intersections. Benzene was present in air samples from all three crosswalks at concentrations between 1.54–1.57 parts per billion. The mean PM levels were still high enough to be capable of inducing asthma 18.6 m from the intersection. This suggests that proximity to roadways is harmful to respiratory health.

## INTRODUCTION

Particulate matter (PM) is made up of extremely small particles, ranging from 1 to 10  $\mu\text{m}$  in diameter, and liquid droplets.<sup>2</sup> PM smaller than 2.5  $\mu\text{m}$  in diameter, PM 1 to PM 2.5, are referred to as fine particles. They may be caused by haze, smoke, and fossil fuel burning. These fine particles are able to penetrate the nose, the tracheal and bronchial regions and cause respiratory problems and they can also enter the bloodstream and cause irregular heartbeats, non-fatal cardiac arrest, and premature death. Particulate matter larger than 2.5  $\mu\text{m}$ , PM 2.5 to PM 10, are termed inhalable coarse particles and usually come from car emissions, dust, or dirt. Their presence leads to an excessive amount of mucus in the airway which makes it harder to breathe. They can cause problems such as asthma and chronic bronchitis. Particles such as nitrates, sulfates, organic chemicals, metals, soil, and dust particles are all commonly seen in PM 2.5 to PM 10.<sup>3</sup>

Benzene is an aromatic hydrocarbon that is produced by the burning of natural products such as coal and petroleum and is found in gasoline and other fuels. Benzene is carcinogenic and also affects the bone marrow and blood production.<sup>4</sup> High and/or constant exposure to benzene can be fatal.<sup>4</sup>

Our aim was to test the air quality near busy road intersections in Anchorage, Alaska. To do this we measured the level of PM near the intersection and tested whether it decreased with distance from the intersection. We also tested for the presence of benzene in the air near the intersections.

## METHODS

To measure PM we used an Aero-cet 531 (Met One). We measured the concentration from 4 different intersections during after-work traffic (1 minute reading at 18:00 hours). At each intersection we made measurements 0.6 m, 9.6 m and 18.6 m from the intersection. 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 (3M<sup>TM</sup>). These contained a single charcoal sorbent wafer that trapped organic vapors in the air. We attached a benzene patch to a cross walk associated with each of three different intersections. Each cross walk was 0.6 m from all the intersections. We collected the benzene patches after 24 hours and measured the amount of benzene in the patch in parts per million, ppm, using a gas chromatography (Agilent 6890).

## RESULTS

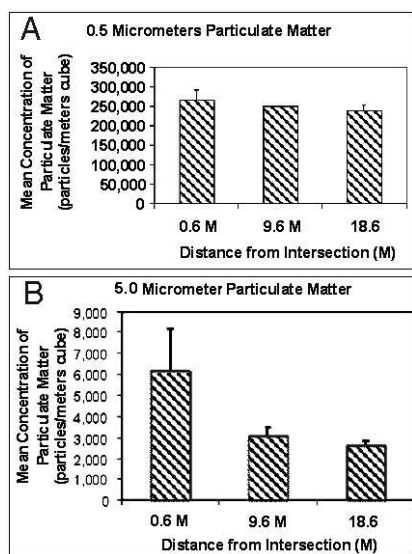
Concentration of PM at three distances from the intersection is shown in Table 1. The mean concentration of PM was highest closest to the roadway but was not significantly lower 9.6 m or 18.6 m from the roadway ( $P > 0.05$ , figure 1) Benzene was present at each of the three intersection (1.54–1.58 parts per billion, figure 2).

## DISCUSSION

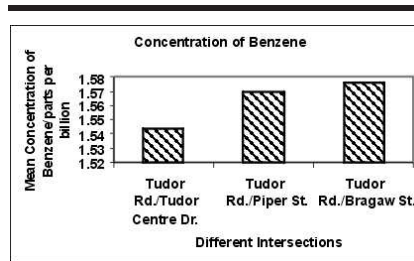
The mean levels of fine PM near the intersections were high enough to be harmful to human health.<sup>5</sup> The test

**Table 1. Concentration of particulate matter from .6, 9.6, and 18.6 M from intersection**

Size Particles	Distance from Intersection		
	0.6 M	9.6 M	18.6 M
0.5 µm	266608±24583	250250±117	237583±17483
5.0 µm	6142±2059	3067±400	2583±283



**Fig 1A &B. Effect of distance from the roadway on the level of particulate matter. Note: Bars represent means, error bars represent standard errors, and sample size is 4**



**Fig 2. Concentration of benzene in the air adjacent to Anchorage intersection. Note: Bars represent means, error bars represent standard errors, and sample size is 4**

showed that the concentration of PM 0.5 µm did not differ significantly at 0.6, 9.6, or 18.6 m from the intersection, suggesting that the air is as dangerous 18 m from a major road as it is in the intersection itself. The level of PM 5.0 µm decreased significantly as we moved back from the roadway. The results suggest that the air has less PM 5.0 µm 18.6 m from a major road than occurs close to an intersection. It would, therefore, be in

the residents' interest to either minimize their exposure to such air or to promote steps that would reduce benzene and PM production. The limitations of this project were the few samples taken for only one minute intervals.

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