Top Tips: Road Traffic's Effect on Respiratory Illness and Leukemia

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As the weather has gotten warmer and our windows have been opened and as the traffic increases in developing Lancaster County, the following two articles have a common thread: there are traffic related medical conditions other than motor vehicle accidents. The first article discusses traffic-related air pollution and acute respiratory health among elementary school children with asthma. The second study researches the fact that road traffic can be associated with acute leukemia in children.

PERSONAL EXPOSURES TO TRAFFIC-RELATED AIR POLLUTION AND ACUTE RESPIRATORY HEALTH AMONG BRONX SCHOOL CHILDREN WITH ASTHMA[1]

Previous studies have reported the relationship between adverse respiratory health outcomes and exposure to traffic pollution in populations, but this study measured that relationship at the personal level of exposure. (Diesel particulate matter (DPM), sometimes called diesel exhaust particles (DEP), is the *particulate* component of diesel exhaust, which includes diesel soot, and aerosols such as ash particulates, metallic abrasion particles, sulfates, and silicates.) Prior measurements of particulate mass (PM) as an index of exposure to traffic have relied on measurements by central-site monitors. The present study confirmed the data by measuring individual components of the PM directly in affected individuals.

Bronx County in New York has among the highest incidence of asthma emergency department visits and hospital discharges both in New York City and throughout New York State. Although levels of other pollutants have shown a significant decline in New York City in the last decade, EC levels have not shown the same decline. (Although various carbon types exist, EC is the superior marker of DEP because EC constitutes a large fraction of the particulate mass and its only significant source is the diesel engine. The presence of elemental carbon (EC) in the lung has also been directly associated with adverse health effects.[2]) By collecting personal monitoring data from this group of children with asthma in South Bronx, the study was able to directly compare the health effects from exposure to all particulate matter ≤ 2.5 μm in aerodynamic diameter (PM2.5) versus the effects of the diesel "soot" EC-related fraction of PM2.5.

Daily 24-hr personal samples of $PM_{2.5}$, including the EC fraction, were collected from 40 fifth-grade children with asthma at four South Bronx schools during one month. The studied children were either doctor-diagnosed with asthma or had experienced asthma attacks while at school, for which the child visited the school's nurse. Personal exposures were collected using a rolling backpack with air pollution monitoring equipment attached to the upper handle as close as possible to the breathing zone. The subjects took the backpack along with them 24 hr/day during the sampling period. Spirometry and symptom scores were recorded several times daily during weekdays.

The investigators found elevated same-day relative risks of wheeze, shortness of breath, and total symptoms with an increase in personal EC, but not with personal $PM_{2.5}$ mass. They also found an increased risk of cough, wheeze, and total symptoms with increased one-day lag and two-day average personal and school-site EC. There were no significant associations with school-site PM2.5 mass or sulfur. They also investigated the role of ozone, nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) as possible potential confounders. Although the ozone and sulfur dioxide were also associated with some asthma morbidity metrics, the findings did not confound EC in co-pollutant models.

CONCLUSIONS

Diesel exhaust is a major source of atmospheric soot and fine particles, which is a fraction of air pollution implicated in heart and lung disease. This article was a significant addition to the literature concerning this topic in that they found the strongest associations between EC levels and respiratory symptoms with the more accurate personal measure of "actual" exposure.

Using these personal measurements they more definitively confirmed that the carbonation fraction of the PM, rather than the total $PM_{2.5}$, showed stronger associations with adverse respiratory health. Therefore, exposure/health effects studies that rely on exposure measures of PM from central-site monitors may be underestimating the relationship between respiratory health and individual components of the PM.

ROAD TRAFFIC AND CHILDHOOD LEUKEMIA: THE ESCALE STUDY[3]

Leukemia is the most common cancer of childhood. In France, where this study was done, there are about 470 new cases each year. Except for Down syndrome, high doses of ionizing radiation, a few rare genetic disorders, and certain chemotherapies, all of which explain a few cases, the etiology of childhood leukemia remains largely unknown.[4] This national registry-based case-control study was used to assess the effect of exposure to road traffic exhaust fumes on the risk of childhood leukemia. In adults, occupational exposure to high doses of benzene is an established cause of acute leukemia. Benzene was assigned to group 1 of the agents carcinogenic to humans by the International Agency for Research on Cancer in 1982. Gasoline exhaust fumes and diesel fumes were classified as probably (group 2A) and possibly (group 2B) carcinogenic to humans.

This ESCALE study was a national French study conducted in 2003 and 2004 in mainland France (where 11 million children are under the age of 15 years) to investigate the role of infectious, environmental, and genetic factors in four childhood neoplastic diseases (acute leukemia, lymphoma, neuroblastoma, and brain tumor). This article focuses on acute leukemia. Case and control ascertainment was meticulously conducted. For exposure assessment they used a geographic information system to generate Lambert II coordinates of the residents at the time of the diagnosis or interview and automatically matched the address with the Navteq vector map of the road network. National estimates of NO_2 concentrations were used as indicators of background air pollution. They then constructed composite exposure indicators by crossing the three variables: proximity to heavy-traffic roads, density of heavy-traffic roads, and traffic NO2 concentration.

The results included a total of 763 cases, consisting of 645 cases of acute lymphocytic leukemia (ALL) and 118 cases of acute non-lymphocytic leukemia. ALL distribution showed the expected male predominance (56.3%) and incidence peak at 2–6 years of age. The rural/urban status, closely related to population density, was a strong determinant of traffic NO_2 concentrations, which ranged from 10.1 in the rural areas to 20.4 μg/m3 in Paris.

Acute leukemia (AL) was associated with the indicators of proximity and density of heavy-traffic roads. The variable that combined proximity to roads with heavy traffic, road density, and traffic NO_2 was significantly associated with AL, with an OR of 2.6 (95% CI, 1.2-5.3) for the most-exposed category versus the unexposed category.

The results were unchanged after adjustments for potential confounders such as degree of urbanization, type of housing, and other factors related to AL such as birth order, early common infections in childhood (at least one infection per quarter before 1 year of age), paternal smoking before conception, and maternal pesticide use during pregnancy. Exclusion from the analysis of the 11 cases with Down syndrome and the 35 cases and 42 controls having lived in a residence adjoining a gas station did not change the results.

The indicators used to assess and quantify heavy-traffic road exposure or air pollution vary markedly from one study to another, which makes comparisons between various studies concerning this topic difficult. A Taiwanese study based on monitoring stations evidenced an association between AL and the highest background NO_2 concentrations.[5] The association of AL was even stronger in the Taiwanese study; however it covered more urbanized areas. An Italian study found an association between the highest estimates of benzene concentration and the risk of leukemia with an OR of 3.9, that significantly increased with estimated benzene concentration.[6] A United Stated ecological study used model-based benzene and 1,3-butadiene concentrations as indicators of traffic.[7] The study showed an increased risk of AL in the census tracts with the highest benzene concentrations with a relative risk of 1.4 and similar associations with the highest 1,3-butadiene levels.

CONCLUSION

This study supports the hypothesis that living close to heavy-traffic roads may increase the risk of childhood leukemia. The exposure was assessed on an objective basis, using the geographic information system, with comparable quality for all the included children, at least within a given stratum of rural/urban status.

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