

# Is ultrafine particle exposure associated with Attention Deficit-Hyperactivity Disorder in children?



Nicholas Newman, D.O., Kim Dietrich, Ph.D., Grace LeMasters, Ph.D.  
University of Cincinnati College of Medicine, Department of Environmental Health



## Introduction

Attention Deficit-Hyperactivity Disorder (ADHD) affects approximately 3.8 million children between 4 and 15-years-old in the United States. There has been an increase in the prevalence of ADHD over the past decade. There is a genetic predisposition to ADHD, but the rate of increase in prevalence dictates an environmental exposure. There is evidence of an association between exposure to traffic exhaust and suboptimal neurocognitive outcomes in children. Animal and human studies demonstrate that ultrafine particles found in 92% of diesel exhaust can translocate to the brain and cause localized neuroinflammation. There is also an association between allergic or atopic disease and the symptoms of ADHD. The purpose of this study is to explore the potential interaction between exposure to traffic-related air pollution (TRAP), thought to be dominated by diesel exhaust particles, in children at risk for atopic disease and ADHD.

## Methods

- 7-year-old children were drawn from the Cincinnati Childhood Allergy and Air Pollution Study (CCAAPS), a longitudinal birth cohort.
- Estimates of TRAP exposure were derived from 27 air-monitoring stations over a five-year period using land-use regression modeling.
- The Behavioral Assessment System for Children, 2<sup>nd</sup> Edition, Parent Rating Scale was administered at the 7-year study clinic visit.

## Demographics

Mean age ± SD	6.9 ± 0.1 years
Percentage male	59.6%
Percentage non-black	81%

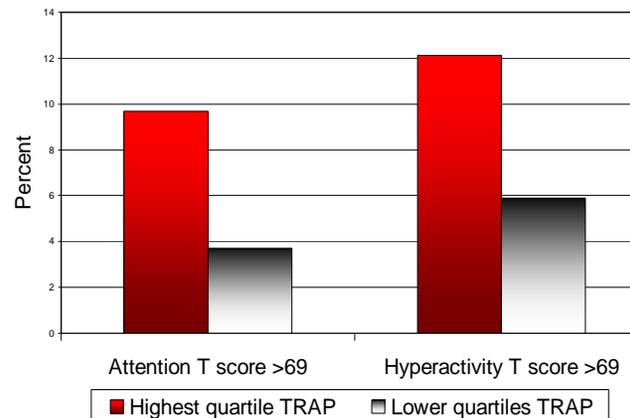
## References

1. Calderon-Garciduenas L, Mora-Tiscareno A, Ontiveros E, Gomez-Garza G, Barragan-Mejia G, Broadway J, et al. Air pollution, cognitive deficits and brain abnormalities: A pilot study with children and dogs. *Brain Cogn*. 2008 Jun 10.
2. Suglia SF, Gryparis A, Wright RO, Schwartz J, Wright RJ. Association of black carbon with cognition among children in a prospective birth cohort study. *Am J Epidemiol*. 2008 Feb 1;167(3):280-6.
3. Ryan PH, Lemasters GK, Levin L, Burkle J, Biswas P, Hu S, et al. A land-use regression model for estimating microenvironmental diesel exposure given multiple addresses from birth through childhood. *Sci Total Environ*. 2008 Oct 1;404(1):139-47.
4. LeMasters GK, Wilson K, Levin L, Biagini J, Ryan P, Lockey JE, et al. High prevalence of aeroallergen sensitization among infants of atopic parents. *J Pediatr*. 2006 Oct;149(4):505-11.

## Results

- The rate of completion of the Behavioral Assessment System for Children 2nd Edition, Parent Rating Scale (BASC-2 PRS) questionnaire was > 95%.
- Thus far, there are 140 completed BASC-2 PRS questionnaires available for preliminary analysis.
- The BASC-2 PRS T scores for Attention Problems were in the clinical range (>69) in 4.6% (n=7). Hyperactivity T scores were >69 in 7.2% (n=11).
- The prevalence of T scores >69 on the Attention Subscale for children exposed to high levels of TRAP was 9.1% whereas the prevalence of elevated T scores for the lower exposure group was 3.4%.
- The prevalence of T scores >69 on the Hyperactivity Subscale for children exposed to high levels of TRAP was 12.1% whereas the prevalence of elevated T scores for the lower exposure group was 5.9%.

## ADHD Symptoms by TRAP Exposure



## Conclusions

These data are preliminary but suggest that traffic exhaust exposure may be associated with more than a doubling effect on ADHD symptoms. Data collection will be completed January 2010.

### PM<sub>2.5</sub> Air Sampling Harvard-type impactor Collector



## Funding

NIHES ES10957 ES11170

