

Children's Exposure to Criteria Air Pollution Due to Drop-off Programs at School

MITL Research Brief

2016

**Research Funding Provided by the Ministry of the
Environment's Best In Science Research Grant Project**



Children's Exposure to Criteria Air Pollution Due to Drop-off Programs at School

Matthew Adams

Pavlos Kanaroglou

McMaster Institute for Transportation and Logistics

McMaster University

Hamilton, Ontario

September, 2016

mitl.mcmaster.ca

Research Description

Drop-off programs at schools are becoming more common with school boards because of the potential reduction in vehicle and student collisions compared to a disorganized school drop-off. Across North America, the number of students who are driven to school in a personal vehicle has been rising for the past five decades, with no foreseeable change in this behaviour.

A drop-off program, where parents must line-up their cars and idle, is one that is very organized; however our research has identified that this potential increased safety measure is creating potentially hazardous air quality conditions.

Air pollution health effect studies' methods and technologies are continually evolving. We have demonstrated a further refinement of air pollution exposure science that incorporates the activity patterns of people into the process of measuring exposure. Our research sets the foundation for a technique to calculate personal exposure without personal monitoring units.



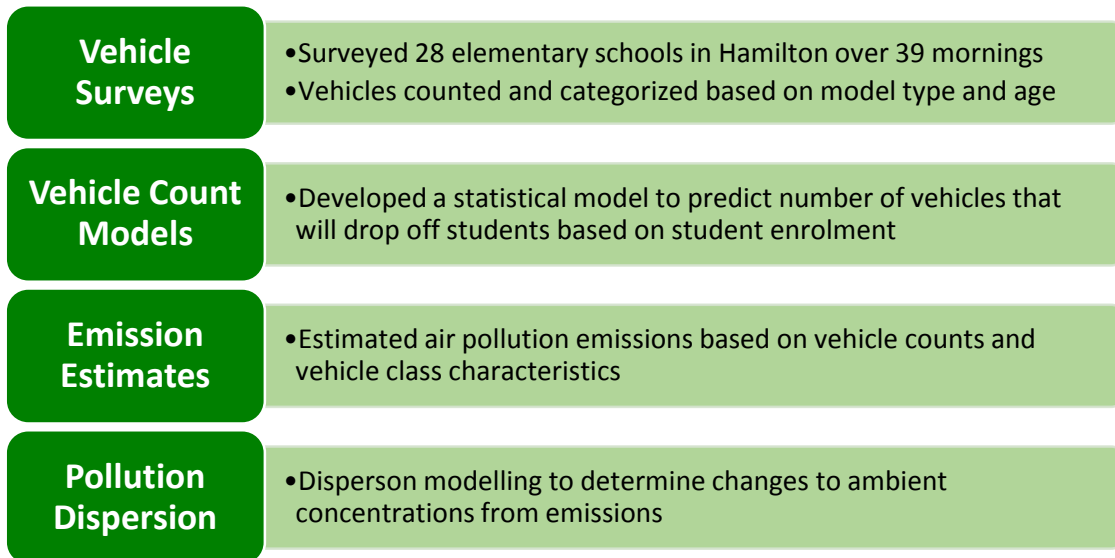
Hypothesis

It is hypothesized that organized school drop-off programs have the unintended consequence of increasing the ambient air pollution concentrations.

Project Objectives

1. Identify the factors of the home to school trip that can increase or decrease children’s air pollution exposure (e.g. ambient concentrations, route choice, mode choice, and exposure time)
2. Understand the air pollution emissions that are generated from organized drop-off programs as a result of the idling vehicles.
3. Determine the effect drop-off programs have on the ambient air pollution conditions at schools in Hamilton, Ontario.

Research Procedure



Research Outcomes

Vehicle Counts

- Vehicle survey counts varied between 23 and 116 vehicles at schools with student enrolment ranging from 160 to 765 students
- Vehicle count prediction models applied to all schools in Hamilton, suggest an average of 50 vehicles per school dropping off students

Vehicle Emissions

(particulate matter 2.5 μg or smaller)

Hamilton's average particulate concentration is $7.48 \mu\text{g}/\text{m}^3$. Drop-off programs would be responsible for notable air pollution increases around schools, especially in winter, when vehicle emissions are highest.

- At the drop-off location, ambient air pollution concentrations of $\text{PM}_{2.5}$ would increase on average by $3.45 \mu\text{g}/\text{m}^3$
- These programs would have a minor effect on school yard playgrounds with $\text{PM}_{2.5}$ increases of $0.39 \mu\text{g}/\text{m}^3$
- The air pollution concentrations near the school entrances, or the door closest to the program location would increase by $1.36 \mu\text{g}/\text{m}^3$
- Under certain meteorological conditions, the drop-off programs generated local concentrations that are $1.77 \mu\text{g}/\text{m}^3$ higher than the baseline conditions

Policy Outcomes

Our research findings indicate that the emissions from these programs have the potential to increase the ambient concentrations for the drop-off attendant by $1.77 \mu\text{g}/\text{m}^3$, which regardless of the background levels, are unhealthy concentrations. Our policy recommendations for school boards who are thinking of implementing a similar drop-off program are:

- A.** Implement the drop-off program a safe distance away from the school. For example, beyond 500m, the concentrations at the school should return close to the background concentrations.
- B.** The location where vehicles line up should be situated a significant distance away from the drop-off attendant. If vehicles must wait in a line, ensure they wait away from the attendant and pull up one at a time as the prior vehicle leaves the space. This will reduce exposure at the drop-off points.
- C.** Encourage active modes of transportation to offset the need for personal vehicles dropping off students at schools.



Future Work

Our study is the first to examine the air pollution effects from these programs. Additional research should attempt to confirm our results in different geographic locations, particularly in smaller cities with less than 100,000 residents, and in a major metropolis such as Toronto.

Secondly, similar programs have been introduced for afternoon pick-up from school. Parents often idle their vehicles while they wait for their children to be let out of school and arrive in the pick-up location. This may require multiple cycles of the vehicle through the pick-up area until the student arrives. The effect of these programs on ambient concentrations should be explored.

Further Reading

Journal Articles Published

Adams, M.D., Kanaroglou, P.S. (2016) Mapping real-time air pollution health risk for environmental management: Combining mobile and stationary air pollution monitoring with neural network models. *Journal of Environmental Management* 168:133-141. doi: 10.1016/j.jenvman.2015.12.012.

Adams, M.D., Yiannakoulis, N., Kanaroglou, P.S. (2016) Air pollution exposure: An activity pattern approach for active transportation. *Atmospheric Environment* 140:52-59. doi: 10.1016/j.atmosenv.2016.05.055

Journal Articles to be Submitted

Adams, M.D. Impacts of organized school drop-off programs on ambient air pollution conditions at elementary schools.