

The Hazard of Tobacco Smoke Pollution in Cars: New Evidence from an Air Quality Monitoring Study

Taryn Sendzik ¹, Geoffrey T. Fong ^{2, 3, 4}, Mark Travers ⁵, and Andrew Hyland ⁵

¹ Department of Health Studies and Gerontology; ² Department of Psychology, University of Waterloo; ³ Centre for Behavioural Research and Program Evaluation, National Cancer Institute of Canada / Canadian Cancer Society, Waterloo, Ontario, Canada; ⁴ Ontario Tobacco Research Unit; ⁵ Department of Cancer Prevention, Roswell Park Cancer Institute, Buffalo, New York

Background

- TSP is complex mixture of carcinogenic environmental pollutants released by the burning and exhalation of tobacco products
- PM_{2.5} is a particle component of TSP that is easily inhaled into the lungs because of its size (2.5 microns)
- Exposure in cars may be 23 times greater than in a home ^a
- Children have little or no control over their exposure, and may be at increased risk
- Few successful laws, despite Article 8 of FCTC calling on protection laws ^b
- PM_{2.5} monitoring has been used to support and promote smoke-free policies ^{c,d,e}

Objectives

- To further quantify the levels of TSP exposure in cars;
- To provide the evidence base for possible laws to reduce TSP in cars by measuring levels of TSP under varying conditions in order to determine the efficacy of methods of reducing TSP.

Method

- PM_{2.5} monitored using a TSI DustTrak aerosol monitor (St. Paul, MN)
- 4 smokers (2 females, 2 males) owning cars in which they smoked completed 5 different *in vivo* air sampling conditions
- 10 min. measures of PM_{2.5} collected before each session



- Equipment placed on the back of the passenger seat to collect samples at the level of child's in a car
- PM_{2.5} measured for at least 30 min. after participant first enters the car
- During each session only 1 cigarette was smoked under differing conditions:

Summary of Conditions

	Engine on	30 min. drive	Window position	A/C On	Cig. position
Condition 1	No	No	All closed	No	In car
Condition 2	Yes	Yes	All closed	No	In car
Condition 3	Yes	Yes	All open	No	In car
Condition 4	Yes	Yes	Driver's open 7"	No	In car when inhaled*
Condition 5	Yes	Yes	All closed	Yes	In car

* Participants completed this condition by holding their cigarette outside the half-open window when not inhaling the cigarette

Results

- A 0.32 revised calibration factor was applied to all downloaded data
- Results from the present study were combined with a previous study using the same equipment and protocol to provide a clearer picture about TSP exposure
- Data from one car completing session 4 in the previous study was excluded from analysis due to machine failure

Summary of Average, and Peak PM_{2.5} Levels by Condition

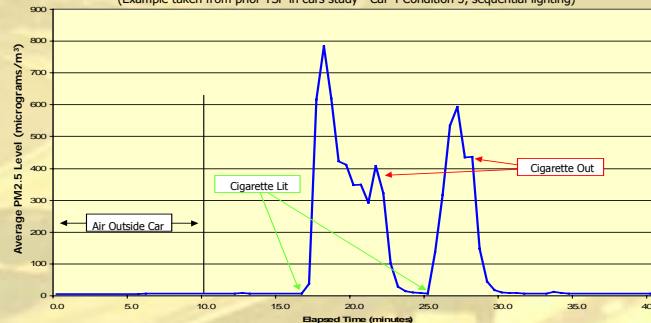
	Ave. Baseline		Ave. Cig. Time (min.)	Ave. PM _{2.5} Exposure			Average Peak
	Before	After		Prior to lit cig.	During Cig.	20 minutes	
Condition 1	14.7	17.4	8.3	16.0	4722.8	5213.1	8214.9
Condition 2	15.7	35.4	10.4	20.5	2240.8	1556.5	3847.5
Condition 3	13.8	15.6	6.2	16.4	47.8	24.8	214.5
Condition 4	12.8	15.4	6.6	41.0*	181.4*	79.0*	375.4
Condition 5	16.3	13.4	9.1	22.2	770.0	395.1	1213.4

* Average of 7 car monitoring sessions due to machine failure in one car

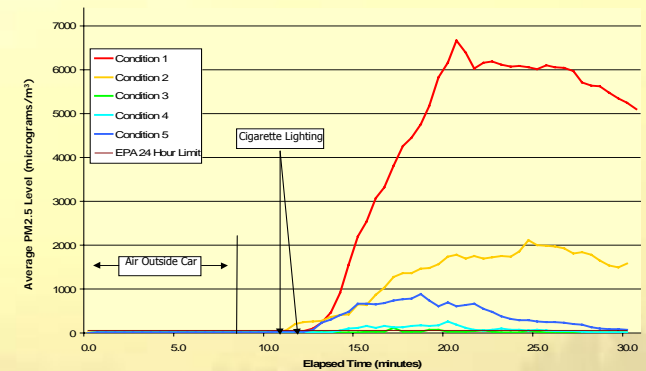
- Exposure levels measured inside the cars in all conditions quickly exceeded background levels putting occupants at an increased health risk in terms of 24-hour and annual exposure
- Extremely high levels of PM_{2.5}, >15,000 µg/m³, were recorded in car 7 under the least airflow condition, equivalent to over 9 times the U.S. Environmental Protection Agency's 24-hour average rating of "hazardous" for PM_{2.5}
- In the greatest airflow condition, the average PM_{2.5} peaks exceeded 214.5 µg/m³

Sensitivity of Equipment

(Example taken from prior TSP in cars study - Car 4 Condition 5, sequential lighting)



Summary of Average, and Peak PM_{2.5} Levels by Condition



Discussion

- Observed levels of PM_{2.5} in all conditions quickly exceeded background levels and Conditions 1, 2, and 5 reached levels identified by US EPA as being Very Hazardous.
- Peak exposure in cars can reach levels of PM_{2.5}—much higher than in smoky bars prior to the implementation of a smoking ban ^{d,e}
- Ventilation does have an impact on exposure, however, not enough to completely eliminate exposure
- Strong need for further research on air exchange, acute health effect, and policies to protect individuals from second-hand smoke in cars.
- Need for research on public support of car policies
- Public should be informed of the potentially significant health hazard of exposure in cars, particularly to children
- Private and public health policies are needed to protect individuals from TSP exposure in cars

References:

- Ontario Medical Association. Exposure to second-hand smoke: Are we protecting our kids? A Position paper by the Ontario Medical Association. Ontario Medical Review; 2004; 71 (9):36-52. Available from: <http://www.oma.org/ghesht/tobaccomain.htm>
- The World Health Organization. WHO Framework Convention on Tobacco Control. World Health Organization: Geneva, Switzerland 2003.
- Repace, J. Respirable particles and carcinogens in the air of Delaware hospitality venues before and after a smoking ban. Journal of Occupational and Environmental Medicine. 2004; 46(9): 887-905.
- Hyland, A., Travers, M., & Repace, J. Seven city air monitoring (7CAM), March-April 2004. Report for the Campaign for Tobacco-Free Kids and the Flight Attendant Medical Research Institute, 2004.
- Travers MJ, Cummings KM, Hyland A, Repace JL, Pechacek TF, Caraballo R, et al. Indoor Air Quality in Hospitality Venues Before and After the Implementation of a Clean Indoor Air Law-Western New York, 2003. Morbidity and Mortality Weekly Report. 2004; 53(44):1038-1041.
- Guideline for Reporting of Daily Air Quality - Air Quality Index(AQI) United States Office of Air Quality EPA-454/R-99-010 Environmental Protection Planning and Standards July 1999 Agency Research Triangle Park, NC 27711