Supplemental Material

Within-City Spatial Variations in Ambient Ultrafine Particle Concentrations and Incident Brain Tumours in Adults

Scott Weichenthal,\*1,2 Toyib Olaniyan,3 Tanya Christidis,3 Eric Lavigne,2 Marianne Hatzopoulou,4 Keith Van Ryswyk,2 Michael Tjepkema,3 Rick Burnett6

1 Department of Epidemiology, Biostatistics, and Occupational Health, McGill University, Montreal, Canada

2 Air Health Science Division, Health Canada, Ottawa, Canada

3 Statistics Canada, Ottawa, Canada

4 University of Toronto, Department of Civil Engineering, Toronto, Ontario, Canada

5 Population Studies Division, Health Canada, Ottawa, Canada

\*Corresponding Author

Dr. Scott Weichenthal
Department of Epidemiology, Biostatistics, and Occupational Health McGill University 1020 avenue des Pins Ouest, Montreal, QC, Canada, H3A 1A2 Email: scott.weichenthal@mcgill.ca Tel: (514) 398-1584

**eFigure 1.** Conceptual directed acyclical graph (DAG) for outdoor UFP concentrations and brain tumour incidence. Parameters in grey are unmeasured variables, parameters in red are potential confounding factors, and parameters in blue were included as strata variables in the Cox models.



eTable 1. UFP exposures (particles/cm3) for the CCHS and CanCHEC cohorts at time of entry

|  |  |  |  |
| --- | --- | --- | --- |
| Covariates  | CanCHEC | CCHS | Median Difference(CanCHEC-CCHS)  |
| n  | UFP  | n  | UFP  |
| Mean | SD | Mean | SD |
| All | 1938100 | 26,697 | 8030 | 1800 | 27,045 | 8266 | -201 |
| Sex |   |   |   |  |  |  |  |
| Male | 1017300 | 26,722 | 8015 | 600 | 27,104 | 8341 | -202 |
| Female | 920900 | 26,668 | 8048 | 1200 | 27,020 | 8235 | -228 |
| Age group (years) |   |   |   |  |  |  |  |
| 25 to 29 | 225300 | 26,639 | 7958 | 100 | 26,844 | 8071 | -639 |
| 30 to 39 | 492900 | 26,607 | 8010 | 300 | 27,379 | 9615 | -269 |
| 40 to 49 | 433800 | 26,532 | 7958 | 100 | 26,928 | 7787 | -111 |
| 50 to 59 | 312100 | 26,606 | 8003 | 90 | 26,695 | 7786 | -114 |
| 60 to 69 | 244100 | 26,971 | 8150 | 300 | 26,694 | 7134 | -50 |
| 70 to 79 | 171100 | 27,182 | 8227 | 500 | 27,327 | 8641 | 265 |
| 80 to 89 | 58700 | 27,207 | 8025 | 300 | 26,895 | 7869 | 408 |
| Visible minority status |   |   |   |  |  |  |  |
| White or Aboriginal | 1449000 | 26,483 | 7819 | 1400 | 26,889 | 8172 | -322 |
| Visible minority | 489100 | 27,313 | 8577 | 400 | 27,556 | 8555 | 201 |
| Immigrant status |   |   |   |  |  |  |  |
| Non-immigrant | 1073100 | 25,923 | 7466 | 1000 | 26,112 | 7920 | 28 |
| immigrant | 865100 | 27,580 | 8544 | 800 | 28,194 | 8538 | -491 |
| Marital status |   |   |   |  |  |  |  |
| Single | 388500 | 26,372 | 7621 | 300 | 27,021 | 9776 | 9 |
| Common-law | 173300 | 25,307 | 6708 | 100 | 25,320 | 5010 | -372 |
| Married | 1071900 | 26,989 | 8318 | 900 | 27,482 | 8476 | -208 |
| Separated | 57700 | 27,190 | 8404 | 100 | 29,775 | 11003 | -959 |
| Divorced | 128100 | 26,376 | 7729 | 100 | 25,984 | 6332 | -361 |
| Widowed | 118600 | 27,056 | 8116 | 500 | 26,487 | 7349 | 194 |
| Educational attainment |   |  |   |  |  |  |  |
| Not completed high school | 491300 | 27,150 | 8195 | 600 | 26,520 | 7844 | 275 |
| High school with/without trades certificate | 584900 | 26,818 | 8298 | 300 | 28,130 | 9428 | -799 |
| Post-secondary non-university | 356200 | 26,615 | 8134 | 400 | 27,378 | 8436 | -1042 |
| University degree | 505700 | 26,177 | 7433 | 500 | 26,764 | 7804 | -281 |
| Income adequacy quintile |   |  |   |  |  |  |  |
| 1st quintile - lowest | 437100 | 26,913 | 8039 | 600 | 27,236 | 8197 | -387 |
| 2nd quintile  | 401900 | 27,009 | 8237 | 400 | 27,449 | 8476 | 79 |
| 3rd quintile | 373900 | 26,812 | 8229 | 200 | 27,067 | 8439 | -209 |
| 4th quintile | 352800 | 26,638 | 8128 | 200 | 26,586 | 7258 | -785 |
| 5th quintile - highest | 372500 | 26,078 | 7458 | 200 | 26,421 | 9141 | 277 |

Numbers are rounded to the nearest 100 for confidentiality

**eTable 2.** Descriptive statistics for brain tumor cases (ICD-10-codes: C71.0 – C71.9) in Montreal and Toronto, Canada (2001-2016)

|  |  |
| --- | --- |
| Covariates | Brain tumor Cases aN (%) |
| All | 1400 (100) |
| Sex |  |
| Male | 600 (42.9) |
| Female | 800 (57.1) |
| Age at enrollment (years) |  |
| 25 to 29 | 50 (3.6) |
| 30 to 39 | 200 (14.3) |
| 40 to 49 | 300 (21.4) |
| 50 to 59 | 300 (21.4) |
| 60 to 69 | 300 (21.4) |
| 70 to 79 | 200 (14.3) |
| 80 to 89 | 50 (3.6) |
| Visible Minority Status |  |
| White or Aboriginal | 1200 (85.7) |
| Visible minority | 200 (14.3) |
| Immigrant status |  |
| Non-immigrant | 800 (57.1) |
| immigrant | 600 (42.9) |
| Marital status |  |
| Single | 200 (14.3) |
| Common-law | 100 (7.1) |
| Married | 900 (64.3) |
| Separated | 50 (3.6) |
| Divorced | 100 (7.1) |
| Widowed | 100 (7.1) |
| Educational attainment |  |
| Not completed high school | 400 (30.6) |
| High school with/without trades certificate | 400 (30.6) |
| Post-secondary non-university | 200 (13.8) |
| University degree | 300 (23.9) |
| Occupational level |  |
| Management | 100 (7.1) |
| Professional | 200 (14.3) |
| Skilled, technical & supervisory | 200 (14.3) |
| Semi-skilled | 300 (23.9) |
| Unskilled | 100 (7.1) |
| Not applicable | 500 (35.7) |
| Income adequacy quintile |  |
| 1st quintile - lowest | 300 (23.9) |
| 2nd quintile  | 300 (23.9) |
| 3rd quintile | 300 (23.9) |
| 4th quintile | 300 (23.9) |
| 5th quintile - highest | 300 (23.9) |

a Numbers were rounded to the nearest 100 for confidentiality as required by Statistics Canada and may not always add up to the total (100%).

**eTable 3.** Hazard ratios (95% confidence intervals) for PM2.5 concentrations (per 3 ug/m3) and incident brain tumours (n=1400) in Montreal and Toronto, Canada (2001-2016)

|  |  |
| --- | --- |
| Model | HR (95% CI) |
| Base Modela | 0.772 (0.547, 1.092) |
| *Base Model + SESb Variables (Individually)* |   |
| + Visible Minority Status | 0.754 (0.535, 1.063) |
| + Occupational Level | 0.776 (0.549, 1.097) |
| + Education | 0.770 (0.544, 1089) |
| + Marital Status | 0.790 (0.558. 1.118) |
| + Income Quintile | 0.782 (0.553, 1.106) |
| *Base Model + Co-Pollutants (Individually)* |   |
| + NO2 | 0.856 (0.573, 1.277) |
| + UFPs | 0.718 (0.399, 1.290) |
| Fully Adjusted Multi-Pollutant Models |   |
| All SES | 0.769 (0.544, 1.086) |
| All SES + NO2 | 0.803 (0.538, 1.199) |
| All SES + UFPs | 0.673 (0.374, 1.212) |
| All SES + UFPs + NO2 | 0.697 (0.388, 1.255) |
| All SES + UFPs+ NO2 + Indirect Adjustment for Smoking and BMI | 0.734 (0.403, 1.338) |

aBase model is stratified by 5-year age groups, sex, census cycle (1991, 1996, 2001, 2006), and immigrant status. b SES, socio-economic status variables (visible minority status, occupational level, education, marital status, and income quintile).

**eTable 4.** Hazard ratios (95% confidence intervals) for NO2 concentrations (per 10 ppb) and incident brain tumours (n=1400) in Montreal and Toronto, Canada (2001-2016)

|  |  |
| --- | --- |
| Model | HR (95% CI) |
| Base Modela | 0.943 (0.876, 1.045) |
| *Base Model + SESb Variables (Individually)* |   |
| + Visible Minority Status | 0.948 (0.881, 1.020) |
| + Occupational Level | 0.945 (0.878, 1.018) |
| + Education | 0.944 (0.877, 1.016) |
| + Marital Status | 0.951 (0.883, 1.024) |
| + Income Quintile | 0.948 (0.880, 1.020) |
| *Base Model + Co-Pollutants (Individually)* |   |
| + PM2.5 | 0.959 (0.880, 1.044) |
| + UFPs | 0.907 (0.812, 1.013) |
| Fully Adjusted Multi-Pollutant Models |   |
| All SES | 0.959 (0.890, 1.033) |
| All SES + PM2.5 | 0.982 (0.902, 1.070) |
| All SES + UFPs | 0.932 (0.833, 1.042) |
| All SES + UFPs + PM2.5 | 0.939 (0.839, 1.050) |
| All SES + PM2.5+ UFP+ Indirect Adjustment for Smoking and BMI | 0.988 (0.839, 1.165) |

aBase model is stratified by 5-year age groups, sex, census cycle (1991, 1996, 2001, 2006), and immigrant status. b SES, socio-economic status variables (visible minority status, occupational level, education, marital status, and income quintile).