**Supplementary Material**

Residential greenspace in childhood reduces risk of pediatric inflammatory bowel disease: a population-based cohort study

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## Supplementary Material 1. Air pollutants exposure assessment

Exposures to nitrogen dioxide (NO2), particulate matter with diameter < 2.5 μm (PM2.5), and ozone (O3)were assigned based on the centroid of the 6-digit postal area for each member in the study population using surfaces created using the following methods.

Assessment of NO2 exposures were based on a national land-use regression (LUR) model which used data from the National Air Pollution Surveillance (NAPS) monitoring network combined with satellite derived NO2 estimates from 2005-2011, total distance of road lengths within 10 kilometres, area of industrial land use within 2 kilometres and mean summer rainfall.[1,2] To improve the model by capturing local variations in traffic, kernel density functions were used to describe the density of the roadways. This model explained 73% of the variation of NAPS measurements for NO2 in 2006.

To estimate PM2.5 exposures, satellite-derived estimates were combined with ground-level monitor data.[3] Total column aerosol optical depth measurements were generated at a 1 kilometre by 1 kilometre spatial resolution across North America from satellite retrievals and simulation. Next, a chemical transport model was used to relate these measurements to near-surface PM2.5. Ground-based observations were then added to these geophysical estimates using geographically weighted regression. This provided an R2 of 0.70 with cross-validated ground-based measurements over North America.

To calculate exposures to O3, an average of daily 8-hour maximum concentrations during the warm seasons (May 1st to October 31st) was used to generate a surface at a 21 kilometre resolution using an optimal interpolation technique that was specially adapted for air pollutants.[4]

A spatiotemporal interpolation technique was then applied to the three pollutants above using monitors from the NAPS network to get exposure estimates on a weekly scale. First a scaling factor was derived for each NAPS ground monitor by taking the weekly mean concentration at that monitor and dividing it by the long-term modelled surface estimate at the monitor location. Inverse distance weighting was then used to assign the scaling factors to all postal codes with 25 kilometres of a NAPS monitor. To get final concentrations, these surfaces were multiplied back to the long-term estimates for each week.

Finally, weekly estimates from birth to end of follow-up were averaged to get a single childhood average exposure to each of the selected pollutants.

References:

1 Lamsal LN, Martin R V., van Donkelaar A, *et al.* Ground-level nitrogen dioxide concentrations inferred from the satellite-borne Ozone Monitoring Instrument. *J Geophys Res Atmos* 2008;**113**:1–15. doi:10.1029/2007JD009235

2 Hystad P, Setton E, Cervantes A, *et al.* Creating national air pollution models for population exposure assessment in Canada. *Environ Health Perspect* 2011;**119**:1123–9. doi:10.1289/ehp.1002976

3 Van Donkelaar A, Martin R V., Li C, *et al.* Regional Estimates of Chemical Composition of Fine Particulate Matter Using a Combined Geoscience-Statistical Method with Information from Satellites, Models, and Monitors. *Environ Sci Technol* 2019;**53**:2595–611. doi:10.1021/acs.est.8b06392

4 Robichaud A, Ménard R. Multi-year objective analyses of warm season ground-level ozone and PM2.5 over North America using real-time observations and Canadian operational air quality models. *Atmos Chem Phys* 2014;**14**:1769–800. doi:10.5194/acp-14-1769-2014

**Supplementary Table 1. Distribution of prenatal and childhood NDVI values in the study population.**

|  |  |  |
| --- | --- | --- |
| **Quantile** | **Prenatal NDVI** | **Childhood NDVI** |
| 0 | 0.084 | 0.106 |
| 5 | 0.534 | 0.601 |
| 10 | 0.574 | 0.632 |
| 15 | 0.600 | 0.651 |
| 20 | 0.620 | 0.665 |
| 25 | 0.636 | 0.677 |
| 30 | 0.650 | 0.687 |
| 35 | 0.662 | 0.696 |
| 40 | 0.673 | 0.704 |
| 45 | 0.683 | 0.712 |
| 50 | 0.693 | 0.719 |
| 55 | 0.702 | 0.726 |
| 60 | 0.711 | 0.733 |
| 65 | 0.719 | 0.740 |
| 70 | 0.728 | 0.747 |
| 75 | 0.737 | 0.754 |
| 80 | 0.747 | 0.761 |
| 85 | 0.757 | 0.770 |
| 90 | 0.769 | 0.779 |
| 95 | 0.787 | 0.794 |
| 100 | 1.000 | 1.000 |

**Supplementary Table 2. Effect measure modification analysis for the association between childhood exposure to residential greenspace and pediatric-onset Crohn’s disease**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Effect modifier |  | Number of cases | Measure of association | P value for product interaction term |
| Rurality | Rural area | 147 | 0.79 (0.61-1.02) | 0.84 |
|  | Urban area | 1758 | 0.82 (0.76-0.87) |  |
| Maternal IBD | Yes | 60 | 0.80 (0.57-1.13) | 0.93 |
|  | No | 1845 | 0.81 (0.76-0.87) |  |
| NO2 | High | 918 | 0.89 (0.81-0.97) | 0.05 |
|  | Low | 608 | 0.79 (0.69-0.89) |  |
| PM2.5 | High | 952 | 0.83 (0.76-0.91) | 0.49 |
|  | Low | 670 | 0.81 (0.73-0.90) |  |
| O3 | High | 710 | 0.83 (0.74-0.92) | 0.86 |
|  | Low | 995 | 0.81 (0.74-0.88) |  |

All models adjusted for sex, rural/urban residence at birth, maternal IBD status, neighborhood income quintile, and two-level random effects

**Supplementary Table 3. Effect measure modification analysis for the association between childhood exposure to residential greenspace and pediatric-onset ulcerative colitis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Effect modifier |  | Number of cases | Measure of association | P value for product interaction term |
| Rurality | Rural area | 99 | 1.00 (0.71-1.42) | 0.05 |
|  | Urban area | 1146 | 0.71 (0.66-0.77) |  |
| Maternal IBD | Yes | 35 | 1.00 (0.62-1.61) | 0.18 |
|  | No | 1210 | 0.72 (0.67-0.77) |  |
| NO2 | High | 638 | 0.71 (0.64-0.79) | 0.05 |
|  | Low | 351 | 0.87 (0.73-1.03) |  |
| PM2.5 | High | 614 | 0.74 (0.66-0.82) | 0.65 |
|  | Low | 414 | 0.71 (0.63-0.81) |  |
| O3 | High | 434 | 0.73 (0.64-0.83) | 0.54 |
|  | Low | 649 | 0.75 (0.67-0.83) |  |

All models adjusted for sex, rural/urban residence at birth, maternal IBD status, neighborhood income quintile, and two-level random effects