

SUPPLEMENTAL MATERIAL

A RISK-BASED MODEL TO ASSESS ENVIRONMENTAL JUSTICE AND CORONARY HEART DISEASE BURDEN FROM TRAFFIC-RELATED AIR POLLUTANTS

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Equation S1. Mathematical representation of the black carbon (BC) component of CHD mortality risk in Allegheny County census tracts.

$$\mathbf{BC\ risk}_i = ((([\mathbf{BC}]_i - [\mathbf{BC}]_{\text{midpoint}})/0.752) \times 0.06) \times \mathbf{CHD\ risk}_{\text{county}} + \mathbf{BC\ risk}_{\text{lowest}}$$

Where,

$\mathbf{BC\ risk}_i$ = Black carbon component of CHD risk in tract i

$[\mathbf{BC}]_i$ = Black carbon concentration in tract i

$[\mathbf{BC}]_{\text{midpoint}}$ = Black carbon concentration at the population midpoint tract

$\mathbf{CHD\ risk}_{\text{county}}$ = Overall county wide CHD death rate assigned to the population midpoint tract. For hospitalizations, this term is replaced with overall county CHD hospitalization rate.

0.752 and 0.06 are derived from the effect estimates of Gan et al. (6% in CHD death for every 0.752 $\mu\text{g}/\text{m}^3$ of BC). Corresponding values for NO_2 and CHD hospitalization can also be found in Gan et al. (Gan et al. 2011)

$\mathbf{BC\ risk}_i$ provides a unitless risk estimate for each census tract_i that can then be applied to the population of that tract to give a predicted value for the number of BC-dependent CHD deaths in that tract_i.

Predicted number of deaths are then summed across all census tracts in the county or segregated by EJ and non-EJ designated tracts.

Table S1. Descriptive statistics for the distribution of BC exposure estimates ($\mu\text{g}/\text{m}^3$) across census tracts in Allegheny County, PA.

	Total	Q1	Q2	Q3	Q4
Mean	1.046	0.863	0.963	1.071	1.289
Median	1.009	0.875	0.959	1.108	1.263
Range	0.748 - 1.604	0.748 - 0.915	0.918 - 1.009	1.009 - 1.142	1.146 - 1.604
IQR	0.224	-	-	-	-

Table S2. Descriptive statistics for the distribution of NO₂ exposure estimates (ppb) across census tracts in Allegheny County, PA.

	Total	Q1	Q2	Q3	Q4
Mean	4.965	2.922	4.357	5.514	7.069
Median	4.889	3.025	4.448	5.593	6.824
Range	1.605 - 0.471	1.605 - 3.726	3.737 - 4.888	4.890 - 6.117	6.131 - 10.471
IQR	2.377	-	-	-	-

Tables S3, S4: Comparison of EJ tracts in Allegheny County as defined by PA-DEP and independent validation using 2010 decennial census and 2006 – 2010 and 2009 – 2013 5-yr ACS as described in METHODS. See methodology for validation immediately following S3 and S4.

S3: Comparison of the number of census tracts meeting the EJ thresholds of poverty, race, or both.

Designation	> 30% non-white	> 20% in poverty	> 30% non-white > 20% in poverty	Total
PA-DEP	33	36	67	136
Using ACS poverty from 2010 + 2013	23	34	77	134

S4: Identity of tracts with discrepancies between EJ status as delineated by PA-DEP and independent validation.

Census Tract	PA-DEP designation	With 2010/2013 ACS Designation	Calculated % Poverty with 2010/2013 ACS (Error %)
709	Race only	Both Race and Poverty	23.1% (18.9%)
2107	Race only	Both Race and Poverty	25.1% (27.8%)
4868	Race only	Both Race and Poverty	22.9% (24.2%)
5616	Race only	Both Race and Poverty	32.9% (29.9%)
5617	Race only	Both Race and Poverty	43.0% (30.5%)
5619	Race only	Both Race and Poverty	25.3% (31.8%)
5620	Race only	Both Race and Poverty	38.4% (22.8%)
5623	Race only	Both Race and Poverty	27.5% (22.2%)
5625	Race only	Both Race and Poverty	33.7% (22.3%)
5626	Race only	Both Race and Poverty	22.2% (28.1%)
5627	Race only	Both Race and Poverty	35.3% (20.1%)
5632	Race only	Both Race and Poverty	31.1% (20.9%)
9818	Race only	Both Race and Poverty	87.0% (73.1%)
1017	Both Race and Poverty	Race only	16.9% (34.9%)
1405	Both Race and Poverty	Race only	15.8% (36.2%)
5614	Both Race and Poverty	Race only	19.7% (23.7%)
2406	Poverty only	Non-EJ	16.9% (29.6%)
4135	Poverty only	Non-EJ	12.1% (40.2%)
4324	Poverty only	Non-EJ	15.5% (25.8%)
4706	Poverty only	Non-EJ	17.8% (25.4%)
5120	Poverty only	Non-EJ	16.5% (34.1%)
4507	Non-EJ	Poverty only	20.8% (33.0%)
4689	Non-EJ	Poverty only	20.7% (22.1%)
4882	Non-EJ	Poverty only	20.7% (21.7%)

Methodology for validating EJ tract characterization. PA-DEP EJ designations were obtained as described in METHODS. Racial data for all Allegheny County census tracts was obtained from the 2010 Decennial Census. Percent non-white minority living in each tract was calculated as [(total population of tract_i / total non-white population in tract_i) X 100]. This calculated percentage was then compared to the PA-DEP criteria of > 30% and found to match completely with PA-DEP delineations in all EJ tracts. Numbers of people in poverty were estimated in Allegheny County census tracts from 2 separate versions of the 5-yr American Community Survey (ACS) (2006 – 2010 & 2009 – 2013). For each version of the ACS we calculated as follows:

$$\% \text{ people in poverty tract}_i = (\# \text{ in poverty tract}_i / \# \text{ total population tract}_i) \times 100$$

$$\text{SE \# total population in tract}_i = \text{MOE \# total population tract}_i / 1.645 \text{ (see ACS documentation in references)}$$

$$\text{CV for \# total population tract}_i = \text{SE \# total population tract}_i / \# \text{ total population tract}_i$$

$$\text{SE for \# in poverty tract}_i = \text{MOE for \# in poverty tract}_i / 1.645$$

$$\text{CV for \# in poverty tract}_i = \text{SE for \# in poverty tract}_i / \# \text{ in poverty tract}_i$$

$$\text{CV for \% people in poverty tract}_i = \sqrt{(\text{CV \# in poverty tract})^2 + (\text{CV \# total population in tract})^2}$$

CVs can be converted to CV% by multiplying by 100

SE = standard error of the estimate, MOE = margin of error of the estimate, CV = coefficient of variation for the estimate.

A final result combining both ACS versions for comparing to PA-DEP designations was obtained by averaging the calculated % poverty and CV% for % poverty from the 2 different ACS.

Table S5: Racial and economic demographics by quartiles of BC exposure in Allegheny County, PA.

	County	1st Quartile	2nd Quartile	3 rd Quartile	4 th Quartile
Total Population (% of county)	1,222,708	384,055 (31.4%) ¹	330,526 (27%) ¹	277,811 (22.7%) ¹	230,316 (18.8%) ¹
White Population (% of county)	992,824 (81.2%) ¹	337,958 (34.0%) ²	267,904 (27.0%) ²	215,559 (21.7%) ²	171,403 (17.3%) ²
Non-White Population (% of county)	229,884 (18.8%) ¹	46,097 (20.1%) ²	62,622 (27.2%) ²	62,252 (27.1%) ²	58,913 (25.6%) ²
People Below Poverty (% of county)	160,678 (13.1%) ¹	29,003 (18.1%) ²	37,061 (23.1%) ²	41,614 (25.9%) ²	53,000 (33.0%) ²

¹Denotes percent of total population in Allegheny County.

²Denotes percent of total for that sub-group in Allegheny County

Table S6. Racial and economic demographics by quartiles of NO₂ exposure in Allegheny County, PA.

	County	1st Quartile	2nd Quartile	3 rd Quartile	4 th Quartile
Total Population (% of county)	1,222,708	423,883 (34.7%) ¹	319,215 (26.1%) ¹	261,720 (21.4%) ¹	217,890 (17.8%) ¹
White Population (% of county)	992,824 (81.2%) ¹	386,007 (38.9%) ²	268,377 (27.0%) ²	199,503 (20.1%) ²	136,189 (13.7%) ²
Non-White Population (% of county)	229,884 (18.8%) ¹	37,876 (16.5%) ²	50,838 (22.1%) ²	59,469 (25.9%) ²	81,701 (35.5%) ²
People Below Poverty (% of county)	160,678 (13.1%) ¹	24,429 (15.2%) ²	33,759 (21.0%) ²	40,378 (25.1%) ²	61,112 (38.7%) ²

¹Denotes percent of total population in Allegheny County.

²Denotes percent of total for that sub-group in Allegheny County

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