

## Methods

### Indicator

E4. Percentage of children ages 0 to 17 years living in census tracts where estimated hazardous air pollutant concentrations were greater than health benchmarks in 2014.

### Summary

EPA's Office of Air Quality Planning and Standards (OAQPS) estimated census tract annual average outdoor concentrations of 181<sup>i</sup> hazardous air pollutants (HAPs), also known as air toxics, as part of EPA's National Air Toxics Assessment (NATA) for the calendar year 2014. EPA used two air quality models to estimate these concentrations based on the 2014 emissions inventory of air toxics emissions from outdoor sources. The air quality models were the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) atmospheric dispersion model, used for all NATA air toxics modeled, and the Community Multiscale Air Quality (CMAQ) photochemical model, used for 52 of the air toxics in a hybrid approach.

The lifetime cancer risks posed by HAPs in each census tract were calculated by multiplying the ambient concentration of each HAP by the inhalation unit risk estimate (URE) of that HAP. The risk estimates for all modeled HAPs with cancer unit risk estimates then were summed together to provide a combined cancer risk estimate. The census tracts for which this value exceeded 1-in-100,000 and 1-in-10,000 were identified, producing two lists of census tracts. For each list of census tracts, the number of children ages 0 to 17 years in the identified census tracts was summed together. The resulting value then was divided by the number of children ages 0 to 17 years in all census tracts in the United States, yielding the percentage of children living in census tracts where the concentrations of carcinogenic hazardous air pollutants exceeded the two benchmark cancer risk levels. For non-cancer health benchmarks, census tracts in which the annual average concentration exceeded the reference concentration for any HAP were identified. The number of children ages 0 to 17 years in the identified census tracts was summed together. The resulting value was then divided by the number of children ages 0 to 17 years in all census tracts in the United States to yield the percentage of children living in census tracts where the concentration of one or more hazardous air pollutants exceeded the health benchmark for effects other than cancer. Table E4a provides the same set of results for the percentages of schoolchildren attending public or private elementary or secondary schools in census tracts where the concentrations of carcinogenic hazardous air pollutants exceeded the two benchmark cancer risk levels or where the concentration of one or more hazardous air pollutants exceeded the health benchmark for effects other than cancer. Table E4b provides the percentage of children living in census tracts where the cancer risk from estimated hazard air pollutant concentrations was at least one in 10,000 in 2014, by race/ethnicity and family income. Table

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<sup>i</sup> The NATA website reports that 180 HAPs were modeled in NATA 2014, plus diesel particulate matter. The count of HAPs considered for this indicator differs from the number reported on the NATA website as follows: rather than a single value for Polycyclic Organic Matter (POM), this analysis includes nine POM groups.

## Environments and Contaminants: Hazardous Air Pollutants

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E4c provides the percentage of children ages 0 to 17 years living in census tracts where the non-cancer risk from estimated hazardous air pollutant concentrations exceeded health benchmarks in 2014, by race/ethnicity and family income.

### Overview of Data Files

The following files are needed to calculate this indicator:

- Census tract annual average HAP concentrations. There is one ACCESS data table for each of the modeled HAPs. This table contains the state, county and census tract FIPS codes, the total annual average modeled concentration, and other information not used for these calculations. These ACCESS files were obtained from the NATA 2014 Web page: <https://www.epa.gov/national-air-toxics-assessment/2014-nata-assessment-results#modeled>

See “Pollutant Specific Results” under “2014 Modeled Ambient Concentrations, Exposures, and Risks.”

- For the nine individual air toxics groups of Polycyclic Organic Matter (POM), the Web page provides a file with the total concentrations summed over these 9 hazardous air pollutants. We obtained the census tract annual average files for these 9 individual hazardous air pollutants directly from EPA OAQPS.<sup>ii</sup>
- Health effects information. This Excel file NATA\_Pollutants.xlsx lists the cancer unit risk estimate (URE) for all carcinogenic HAPs and lists the reference concentrations (RfC) for HAPs with non-cancer health effects. We obtained this file from the Web page: <https://www.epa.gov/national-air-toxics-assessment/2014-nata-technical-support-document>  
The Excel file is included in the ZIP file folder “2014 NATA Supplemental Data Files.”
- American Community Survey 2010-2014 Census data. These files contain the state, county, and census tract FIPS codes, age group, sex, race/ethnicity group, income group (all, below poverty level, at or above poverty level) and average population for 2010-2014: We obtained these data from the following url:

<https://www.census.gov/programs-surveys/acs/data/summary-file.2014.html>

See “5-Year Summary File.”

Example SAS programs used to extract these data were obtained from the following url:

<https://www.census.gov/programs-surveys/acs/technical-documentation/summary-file-documentation.2014.html>

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# Environments and Contaminants: Hazardous Air Pollutants

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See “5-year SAS programs.”

The populations by census tract were obtained by summing across the ages 0 to 17 years inclusive and across both sexes.

## Air Quality Data

Health effects information for the hazardous air pollutants studied in the National Air Toxics Assessment (NATA) for 2014 were obtained from the file NATA\_Pollutants.xlsx which is included in the ZIP file folder “2014 NATA Supplemental Data Files” on the Web page: <https://www.epa.gov/national-air-toxics-assessment/2014-nata-technical-support-document>

This file includes the cancer unit risk estimates (URE) and non-cancer reference concentrations (RfC) for each of the 181 HAPs modeled in NATA 2014. In addition, EPA OAQPS<sup>iii</sup> provided a file with URE and RfC values for nine individual air toxics groups of Polycyclic Organic Matter (POM). Some of the HAPs had no URE reported, and so were treated as having no cancer risk. Some of the HAPs had no RfC reported, and so were treated as having no non-cancer health benchmark. Several of the 181 HAPs had neither a reported URE nor a reported RfC.

Estimated census tract average annual outdoor ambient concentrations for the year 2014 were obtained from the Web page: Web page: <https://www.epa.gov/national-air-toxics-assessment/2014-nata-assessment-results#modeled>. See “Pollutant Specific Results” under “2014 Modeled Ambient Concentrations, Exposures, and Risks.”

We obtained ACCESS files with estimated concentrations for each of 174 HAPs. One of these HAPs was named “PAHPOM,” which we did not use. This denotes the total concentration summed over the nine individual air toxics groups of Polycyclic Organic Matter (POM). In order to apply appropriate UREs and RfCs to these 9 individual HAPs, we obtained census tract average concentration files in ACCESS format for these 9 individual HAPs directly from EPA OAQPS.<sup>iv</sup>

## Census Data

Census data were obtained from the American Community Survey 5-year 2010-2014 Census data. These files contain the state, county, and census tract FIPS codes, age group, sex, race/ethnicity group, income group (all, below poverty level, at or above poverty level) and average population for 2010-2014. We obtained these data from the following url:

<https://www.census.gov/programs-surveys/acs/data/summary-file.2014.html>

See “5-Year Summary File.”

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## Environments and Contaminants: Hazardous Air Pollutants

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Example SAS programs used to extract these data were obtained from the following url:

<https://www.census.gov/programs-surveys/acs/technical-documentation/summary-file-documentation.2014.html>

See “5-year SAS programs.”

We edited and applied the example SAS code to extract census tract population data from the following tables:

- B01001. Populations by sex and age.
- B01001A to B17001I. Populations by sex, age, and race/ethnicity.
- B17001. Populations by sex, age, and known poverty status.
- B17001A to B17001I. Populations by sex, age, race/ethnicity, and known poverty status.

The populations by census tract, race/ethnicity, and poverty status (including all) were obtained by summing across the ages 0 to 17 years inclusive and across both sexes.

The race/ethnicity groups used were as follows:

- White alone
- Black alone
- American Indian / Alaska Native (AIAN) alone
- Asian alone
- Native Hawaiian And Other Pacific Islander (NHOPI) alone
- Other Races (sum of tabulated populations for Some Other Race alone and Two or More Races)
- Hispanic

The poverty status groups used were as follows:

- All (includes persons with unknown poverty status)
- Below poverty level
- At or above poverty level

### Calculation of Indicator

Indicator E4 is calculated as follows. The same set of calculations is repeated for the populations of each race/ethnicity and poverty status group to give the results in Tables E4b and E4c.

1. For each census tract, the cancer risk for each carcinogenic HAP is estimated by multiplying the estimated annual average outdoor concentration ( $\mu\text{g}/\text{m}^3$ ) by the unit risk estimate, URE. The URE is an estimate of the excess cancer risk resulting from a lifetime of continuous exposure to a pollutant at a concentration of one microgram per cubic meter ( $1 \mu\text{g}/\text{m}^3$ ) in air. Thus,

## Environments and Contaminants: Hazardous Air Pollutants

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$$\text{Cancer risk (census tract T, HAP H)} = \text{Annual Concentration (census tract T, HAP H)} \times \text{URE (HAP H)}$$

2. The total cancer risk for each census tract is estimated by summing the cancer risks across all carcinogenic HAPs:

$$\text{Total cancer risk (census tract T)} = \sum \text{Cancer risk (census tract T, HAP H)}$$

where this sum is across all HAPs.

3. The set of census tracts with a total cancer risk greater than 1-in-100,000 is listed. These are the affected census tracts.

4. The total population of children 0-17 living in the step 3 census tracts is summed:

$$\text{Population affected} = \sum \text{Pop (census tract T), summed over the affected census tracts only}$$

5. The total U.S. population of children 0-17 is summed:

$$\text{U.S. Population} = \sum \text{Pop (census tracts C), summed over all census tracts in the United States}$$

6. The percentage of affected children is calculated by dividing the population affected by the total U.S. population:

$$\text{Percentage children affected} = [\text{Population affected} / \text{U.S. Population}] \times 100\%$$

The percentage affected in step 6 is the percentage of children exceeding the 1-in-100,000 cancer health benchmark.

A very similar calculation gives the percentage of children exceeding the 1-in-10,000 cancer health benchmark. The only change is to redefine the list of affected census tracts in step 3 as those census tracts exceeding the 1-in-10,000 cancer risk.

The calculation for the other health effects benchmark proceeds as follows.

1. For each HAP with a reference concentration, we list the census tracts affected by non-cancer effects from that HAP. A census tract is affected by a given HAP if the ASPEN estimated annual average outdoor concentration exceeds the reference concentration.

2. We list the affected census tracts as any census tract that is affected by non-cancer effects from one or more of the modeled HAPs.

Now repeat the cancer risk steps 4, 5, and 6 above using the new list of affected census tracts. The percentage affected is the percentage of children exceeding the non-cancer health benchmark.

# Environments and Contaminants: Hazardous Air Pollutants

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## Children at Schools

Table E4a provides the percentages of schoolchildren attending public or private elementary or secondary schools in census tracts where the ambient concentrations of carcinogenic hazardous air pollutants exceeded the two benchmark cancer risk levels or where the concentration of one or more hazardous air pollutants exceeded the health benchmark for effects other than cancer.

The schools data used for these calculations were obtained from the U.S. Department of Education. Data on public schools for the school year 2013-2014 were obtained from the Public Elementary/Secondary School Universe Survey Data. Data on private schools for the school year 2013-2014 were obtained from the Private School Universe Survey:

- Public Elementary/Secondary School Universe Survey Data. Data was obtained for the school year 2013-2014 and all public elementary and secondary schools in the database. Selected variables used for these analyses were: total students enrolled, school location latitude and longitude (of the administrative office), school street address, state and county FIPS code.

These data were obtained from the following website:

<http://nces.ed.gov/ccd/>

- Private School Universe Survey Data. Data was obtained for the school year 2013-2014 and all private elementary and secondary schools in the database. Selected variables used for these analyses were: total students enrolled, school location latitude and longitude (based on the “school’s physical location”), school street address, school location state and county FIPS code, survey weight.

These data were obtained from the following website:

<http://nces.ed.gov/surveys/pss/pssdata.asp>

This analysis also used the NATA 2014 tract annual averages files:

- Census tract annual average HAP concentrations. There is one ACCESS data table for each of the modeled HAPs. This table contains the state, county and census tract FIPS codes, the total annual average modeled concentration, and other information not used for these calculations. These ACCESS files were obtained from the NATA 2014 Web page: <https://www.epa.gov/national-air-toxics-assessment/2014-nata-assessment-results#modeled>

See “Pollutant Specific Results” under “2014 Modeled Ambient Concentrations, Exposures, and Risks.”

## Environments and Contaminants: Hazardous Air Pollutants

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- For the nine individual air toxics groups of Polycyclic Organic Matter (POM), the Web page provides a file with the total concentrations summed over these 9 hazardous air pollutants. We obtained the census tract annual average files for these 9 individual hazardous air pollutants directly from EPA OAQPS.<sup>v</sup>

### Public Elementary/Secondary School Universe Survey Data.

The Common Core of Data (CCD) is a program of the U.S. Department of Education's National Center for Education Statistics that annually collects fiscal and non-fiscal data about all public schools, public school districts, and state education agencies in the United States. The data are supplied by state education agency officials and include information that describes schools and school districts, including name, address, and phone number; descriptive information about students and staff, including demographics; and fiscal data, including revenues and current expenditures.

### Private School Universe Survey.

In 1988, the National Center for Education Statistics (NCES) introduced a proposal to develop a private school data collection that would improve on the sporadic collection of private school data dating back to 1890 and improve on commercially available private school sampling frames. Since 1989, the U.S. Bureau of the Census has conducted the biennial Private School Universe Survey (PSS) for NCES. The PSS is designed to generate biennial data on the total number of private schools, students, and teachers, and to build a universe of private schools in the 50 states and the District of Columbia to serve as a sampling frame of private schools for NCES sample surveys. The target population for the PSS is all schools in the 50 states and the District of Columbia that are not supported primarily by public funds, provide classroom instruction for one or more of grades kindergarten through 12 (or comparable ungraded levels), and have one or more teachers. Since this database is a survey of private schools rather than a census of all private schools, the database includes a survey weight that is used to adjust the survey data to represent the entire population of all private schools.

### Calculation of Indicator

The public and private school data were compiled into a single database. For each school, the latitude and longitude were used to calculate the 11-digit census tract code containing the school using ArcGIS online software. In some cases the state and county FIPS codes in the database did not match the FIPS codes calculated from the latitude and longitude using ArcGIS, and for those cases the school address was used to find a better match, where possible.

For the private schools, the school populations were first adjusted by multiplying by the applicable survey weight. Then the school populations were summed across all county and tract combinations. Table E4a was calculated using the same methods as in the “Calculation of Measure” section, replacing census tract populations of children 0 to 17 years by total school

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## Environments and Contaminants: Hazardous Air Pollutants

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populations for each county / tract, and summing over all county / tract combinations in the schools database.

### **Questions and Comments**

Questions regarding these methods, and suggestions to improve the description of the methods, are welcome. Please use the “Contact Us” link at the bottom of any page in the America’s Children and the Environment website.