

# Supporting Information

## National and Intraurban Air Pollution Exposure Disparity Estimates in the United States: Impact of Data-Aggregation Spatial Scale

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## **Methods Supporting Information**

### **Details for urban area definitions**

For intra-urban analyses, we used the 2010 Census urban area boundaries ( $n = 481$  in contiguous US), which are defined based on block boundaries. Because block groups and tracts can be partially located within urban areas (i.e., they may contain blocks that are within an urban area and blocks that are not within an urban area), we instead defined urban areas based on tract boundaries. We defined a tract as located within an urban area if its population-weighted centroid coordinates are located inside that urban area's census-defined boundary. We then defined all block groups and blocks within each tract according to that tract's urban area definition. Because many counties and all states have a larger spatial scale than the urban area scale, we were able to compare three spatial levels of data aggregation in urban area level analyses: census tract, block group, and block.

### **Details for demographic data**

We analyzed race/ethnicity data in three different ways: (1) based on the 14 disaggregated Census racial/ethnic groups, (2) based on two summary racial/ethnic groups ([i] White alone, not Hispanic or Latino, [ii] all minoritized racial/ethnic groups [i.e., any group that is not "White alone, not Hispanic or Latino"]), and (3) based on six mutually exclusive summary racial/ethnic groups ([i] Hispanic or Latino, any race(s), and the following not Hispanic or Latino racial groups: [ii] White alone, [iii] Black or African American alone, [iv] Asian and Pacific Islander alone, [v] American Indian and Alaska Native alone, and [vi] other or two or more races).

We analyzed the following socioeconomic characteristics: three Census housing tenure groups (i.e., owned free and clear, owned with a mortgage, rented), the 16 Census annual household income categories, one summary low-income group (i.e., households with income less than two times the poverty level), and one summary language group (households with limited English proficiency, i.e., households in which no one over age 14 years speaks English well or very well).

### **Analysis of variability in air pollution and demographic data by spatial scale**

To compare spatial variability in air pollution data versus demographic data, we analyzed average differences in block-level NO<sub>2</sub> concentrations, PM<sub>2.5</sub> concentrations, and percent White (i.e., White alone, not Hispanic or Latino) residents between randomly sampled blocks at each spatial scale of data aggregation. We conducted separate analyses at the national scale and at the intra-urban scale.

For the national scale analysis, we analyzed a random sample of 10,000 blocks within the contiguous US with available CACES model air pollution estimates. We then paired each of the 10,000 randomly sampled blocks with (1) a randomly sampled block within the same block

group (i.e., to analyze within-block group variability), (2) a randomly sampled block within the same tract (i.e., to analyze within-tract variability), (3) a randomly sampled block within the same county (i.e., to analyze within-county variability), (4) a randomly sampled block within the same state (i.e., to analyze within-state variability), and (5) a randomly sampled block anywhere within the contiguous US (i.e., to analyze national variability). For each of the five sets of paired blocks (i.e., 10,000 paired blocks within same block group, same tract, same county, same state, and within contiguous US), we then calculated the median relative percent difference in block-level NO<sub>2</sub> concentration, PM<sub>2.5</sub> concentration, and percent White residents.

For the intra-urban scale analysis, we analyzed a random sample of 10,000 blocks within urban areas within the contiguous US with available CACES model air pollution estimates. We then paired each of the 10,000 sampled urban blocks with (1) a randomly sampled block within the same block group (i.e., to analyze within-block group variability), (2) a randomly sampled block within the same tract (i.e., to analyze within-tract variability), (3) a randomly sampled block within the same urban area (i.e., to analyze intra-urban variability). For each of the three sets of paired blocks (i.e., 10,000 paired blocks within same block group, same tract, and same urban area), we then calculated the median relative percent difference in block-level NO<sub>2</sub> concentration, and PM<sub>2.5</sub> concentration, and percent White residents.

## **Details for calculation of exposure metrics**

### ***Population-based exposure metrics***

We calculated exposure metrics for each pollutant for groups of people (i.e., sub-populations) defined based on demographic characteristics (racial/ethnic group, housing tenure status, household income category, and language). The population-weighted mean exposure indicates the air pollution concentration experienced by the average (mean) person within each sub-population. We calculated the population-weighted mean exposure,  $e$ , for each demographic sub-population,  $j$ , i.e., by race/ethnicity, housing tenure, household income, and language, at each spatial level, as follows:

$$\text{Equation 1} \quad e_j = \frac{\sum_{i=1}^n c_i p_{ij}}{\sum_{i=1}^n p_{ij}},$$

where  $c_i$  is the annual average outdoor air pollution concentration for each specific geographic unit  $i$  (i.e., a specific state, county, tract, block group, or block),  $p_{ij}$  is the population of demographic sub-population  $j$  in geographic unit  $i$ , and  $n$  is the total number of geographic units (i.e., total number of states, counties, tracts, block groups or blocks).

We followed a similar approach to calculate population-weighted median and 90<sup>th</sup> percentile exposures, which indicate the air pollution concentrations experienced by the median and 90<sup>th</sup> percentile most exposed person, respectively, within each sub-population. Whereas a standard (un-weighted) median and 90<sup>th</sup> percentile would count the air pollution concentration for each geographic unit (i.e., state, county, etc.) as “one observation” (regardless of the population of that geographic unit), here, we instead weight the air pollution concentration for each geographic unit by the population of a demographic sub-population of interest.

The *population-weighted  $n^{\text{th}}$  percentile concentration* indicates the air pollution concentration experienced by the  $n^{\text{th}}$  percentile most exposed person within each demographic sub-population. We calculated the concentration for the  $n^{\text{th}}$  percentile most exposed person of each demographic sub-population  $j$ ,  $e_{j,n}$ , for each pollutant, using a sorting algorithm as follows:

- **Step 1a:** Order each geographic unit by its annual average outdoor air pollution concentration from lowest to highest value.
- **Step 2a:** Calculate the cumulative population of the demographic sub-population for each geographic unit with increasing air pollution concentration.
- **Step 3a:** Identify the specific ordered geographic unit for which the cumulative population of the demographic sub-population is equal to (or contains)  $n$  percent of the total population of the demographic sub-population.
- **Step 4a:** Assign the concentration of that specific geographic unit (identified in **Step 3a**) as the *population-weighted  $n^{\text{th}}$  percentile concentration* for demographic sub-population  $j$ .

### ***Location-based exposure metrics***

We identified sub-sets of locations (geographic units) based on demographic characteristics (i.e., percentage of residents in racial/ethnic, housing tenure, income, or language groups). We grouped locations (and the people living within them) based on the following thresholds used in US state-level environmental justice policy:

- >40% minoritized racial/ethnic group residents<sup>1,2</sup>,
- >35% low-income households<sup>2</sup>,
- >25% households with limited English proficiency<sup>1</sup>.

We included the following as a supplemental analysis:

- >50% households rented.

Additionally, for the national population, we conducted a more detailed location-based analysis by race/ethnicity and, separately, by income. For these analyses, we binned locations (i.e., geographic units) using two different approaches: (1) using 20 equal bins (i.e., equal number of geographic units) by percent minoritized racial/ethnic group residents and, separately, by percent low-income residents, and (2) using 10 fixed intervals (i.e., 0-10%, 10-20%, etc.) by percent minoritized racial/ethnic group residents and, separately, by percent low-income residents, for each spatial scale of data aggregation.

We then calculated exposure metrics for each pollutant for the groups of people living within each sub-set of locations. Here, the population-weighted mean exposure indicates the air pollution concentration experienced by the average (mean) person living within each sub-set of locations (geographic units) defined based on the demographic characteristic thresholds above. We calculated the population-weighted mean concentration,  $e$ , for the total population living in each sub-set of geographic units,  $k$ , i.e., identified by percentage of residents in racial/ethnic, housing tenure, income, or language groups, at each spatial level, as follows:

$$\text{Equation 2} \quad e_k = \frac{\sum_{i=1}^n c_i p_i}{\sum_{i=1}^n p_i},$$

where  $c_i$  is the annual average outdoor air pollution concentration for each specific geographic unit  $i$  (i.e., a specific state, county, tract, block group, or block) in sub-set  $k$ ,  $p_i$  is the total population living in geographic unit  $i$ , and  $n$  is the total number of geographic units (i.e., total number of states, counties, tracts, block groups or blocks) in sub-set  $k$ .

We followed a similar approach to calculate population-weighted median and 90<sup>th</sup> percentile exposures, which indicate the air pollution concentrations experienced by the median and 90<sup>th</sup> percentile most exposed person, respectively, living within each sub-set of locations (geographic units). Whereas a standard (un-weighted) median and 90<sup>th</sup> percentile would count the air pollution concentration for each geographic unit (i.e., state, county, etc.) as “one observation” (regardless of the population of that geographic unit), here, we instead weight the air pollution concentration for each geographic unit by the total population for that geographic unit.

The *population-weighted  $n^{\text{th}}$  percentile concentration* indicates the air pollution concentration experienced by the  $n^{\text{th}}$  percentile most exposed person living within each sub-set of locations (geographic units) defined based on demographic characteristic thresholds. We calculated the concentration for the  $n^{\text{th}}$  percentile most exposed person living within each sub-set of locations  $k$ ,  $e_{k,n}$ , using a sorting algorithm as follows:

- **Step 1b:** Order each geographic unit by its annual average outdoor air pollution concentration from lowest to highest value.
- **Step 2b:** Calculate the cumulative total population for each geographic unit with increasing concentration.
- **Step 3b:** Identify the specific ordered geographic unit for which the cumulative total population is equal to (or contains)  $n$  percent of the total population.
- **Step 4b:** Assign the concentration of that specific geographic unit (identified in **Step 3b**) as the *population-weighted  $n^{\text{th}}$  percentile concentration* for sub-set of locations  $k$ .

## **Exposure disparity metrics**

### ***Population-based exposure disparity metrics***

We calculated the absolute exposure disparity for demographic sub-population  $j$ ,  $AD_j$ , compared to the total population,  $T$ , as follows:

$$\text{Equation 3} \quad AD_j = e_j - e_T,$$

where  $e$  represents one of three exposure statistics: population-weighted mean, median, or 90<sup>th</sup> percentile. Positive values of  $AD_j$  indicate that the demographic sub-population experiences higher levels of air pollution compared to the total population.

We calculated the relative exposure disparity as the relative percent difference for demographic sub-population  $j$ ,  $RD_j$ , compared to the total population,  $T$ , as follows:

$$\text{Equation 4} \quad RD_j = (100\%)(e_j - e_T)/((e_j + e_T)/2),$$

where  $e$  represents one of three exposure statistics: population-weighted mean, median, or 90<sup>th</sup> percentile. Positive values of  $RD_j$  indicate that the demographic sub-population experiences higher levels of air pollution compared to the total population.

#### ***Location-based exposure disparity metrics***

We calculated the absolute exposure disparity for geographic unit sub-set  $k$ ,  $AD_k$ , compared to the total population across all geographic units,  $T$ , as follows:

$$\text{Equation 5} \quad AD_k = e_k - e_T,$$

where  $e$  represents one of three exposure statistics: population-weighted mean, median, or 90<sup>th</sup> percentile. Positive values of  $AD_k$  indicate that air pollution levels are higher for the sub-set of locations compared to all locations.

We calculated the relative exposure disparity as the relative percent difference for geographic unit sub-set  $k$ ,  $RD_k$ , compared to the total population across all geographic units,  $T$ , as follows:

$$\text{Equation 6} \quad RD_k = (100\%)(e_k - e_T)/((e_k + e_T)/2),$$

where  $e$  represents one of three exposure statistics: population-weighted mean, median, or 90<sup>th</sup> percentile. Positive values of  $RD_k$  indicate that air pollution levels are higher for the sub-set of locations compared to all locations.

#### **References**

- (1) Massachusetts Law. *An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy*; Massachusetts, 2021; p Acts of 2021, Chapter 8, Section 56.
- (2) New Jersey Law. *An Act Concerning the Disproportionate Environmental and Public Health Impacts of Pollution on Overburdened Communities, and Supplementing Title 13 of the Revised Statutes*; New Jersey, 2020; p Acts of 2020, Chapter 92, Section C.13:1D-158.

**Table S1. Urban area outliers<sup>1</sup> identified in Figure 2 (panels a-l) with absolute difference<sup>2</sup> (in relative air pollution exposure disparity calculated using tract versus block data) at least five times greater than the interquartile range in absolute differences across all urban areas for that exposure disparity**

<i>FIPS code</i>	<i>Name</i>	<i>Total population</i>	<i>Mean<sup>3</sup> air pollution level (ppb NO<sub>2</sub>; μg m<sup>-3</sup> PM<sub>2.5</sub>)</i>	<i>Relative exposure disparity using tract data (%)</i>	<i>Relative exposure disparity using block data (%)</i>	<i>Absolute difference<sup>2</sup>: tract versus block data (%)</i>
<b>Figure 2(a) outliers: Relative NO<sub>2</sub> exposure disparity for White alone, not Hispanic or Latino, population</b>						
75988	Rocky Mount, NC	35,760	5.7	-2.3	-6.0	3.8
22069	Dalton, GA	61,459	6.4	-4.4	-7.3	2.9
60490	Mount Vernon, WA	46,914	7.4	-0.8	-3.6	2.8
32194	Gainesville, GA	77,997	6.1	-8.8	-11.4	2.6
10972	Brownsville, TX	171,665	6.5	-2.4	-4.9	2.4
11026	Brunswick, GA	25,346	5.1	-1.9	-4.0	2.1
<b>Figure 2(b) outliers: Relative NO<sub>2</sub> exposure disparity for Hispanic or Latino, any race(s), population</b>						
2629	Anniston--Oxford, AL	58,098	4.9	5.3	13.0	7.8
<b>Figure 2(c) outliers: Relative NO<sub>2</sub> exposure disparity for Black alone, not Hispanic or Latino, population</b>						
34246	Grand Island, NE	46,995	6.3	4.6	13.3	8.6
<b>Figure 2(d) outliers: Relative NO<sub>2</sub> exposure disparity for Asian and Pacific Islander alone, not Hispanic or Latino, population</b>						
79201	San Marcos, TX	17,868	6.2	-0.6	8.7	9.3
37594	Hattiesburg, MS	63,906	4.6	-0.1	7.4	7.4
75988	Rocky Mount, NC	35,760	5.7	-4.3	2.6	6.9
21745	Cumberland, MD--WV--PA	29,470	8.0	-4.3	-9.8	5.5
22285	Daphne--Fairhope, AL	29,650	3.1	4.7	10.1	5.4
<b>Figure 2(e) outliers: Relative NO<sub>2</sub> exposure disparity for other or two or more race(s), not Hispanic or Latino, population</b>						
53983	Mankato, MN	50,764	6.7	1.2	4.4	3.1
<b>Figure 2(f) outliers: Relative NO<sub>2</sub> exposure disparity for American Indian or Alaska Native alone, not Hispanic or Latino, population</b>						
N/A						
<b>Figure 2(g) outliers: Relative PM<sub>2.5</sub> exposure disparity for White alone, not Hispanic or Latino, population</b>						
11026	Brunswick, GA	25,346	9.9	-0.6	-1.9	1.3
69454	Pine Bluff, AR	35,406	12.5	-2.6	-3.6	0.9
22069	Dalton, GA	61,459	10.6	-0.5	-1.4	0.9
75988	Rocky Mount, NC	35,760	10.2	-0.8	-1.4	0.6
87220	Texas City, TX	73,470	9.8	-1.6	-2.1	0.5
33328	Gilroy--Morgan Hill, CA	72,675	6.4	-0.9	-1.4	0.5
60490	Mount Vernon, WA	46,914	6.7	0.3	-0.1	0.5
92890	Watsonville, CA	64,796	6.5	-10.5	-10.9	0.5
89974	Valdosta, GA	47,376	10.7	-2.1	-2.6	0.4
52984	Madera, CA	54,101	10.9	-0.6	-0.3	0.4
40213	Hot Springs, AR	28,090	11.6	-0.8	-1.2	0.4
36892	Harlingen, TX	95,838	10.6	-1.7	-2.0	0.4
61840	New Bern, NC	24,576	9.0	-3.5	-3.8	0.3
90730	Vineland, NJ	72,879	9.6	-1.9	-2.2	0.3
<b>Figure 2(h) outliers: Relative PM<sub>2.5</sub> exposure disparity for Hispanic or Latino, any race(s), population</b>						
83548	Spartanburg, SC	147,324	10.4	0.8	2.3	1.4
2629	Anniston--Oxford, AL	58,098	11.6	-0.1	1.3	1.4
60490	Mount Vernon, WA	46,914	6.7	-0.8	0.3	1.1
15184	Chambersburg, PA	34,966	10.8	1.6	2.7	1.1
6868	Bend, OR	70,567	4.8	2.5	3.6	1.0
22069	Dalton, GA	61,459	10.6	0.4	1.4	1.0
75745	Rock Hill, SC	94,747	11.1	0.4	1.4	1.0

61840	New Bern, NC	24,576	9.0	1.5	0.6	0.9
43345	Jonesboro, AR	38,384	11.0	2.3	3.3	0.9

**Figure 2(i) outliers: Relative PM<sub>2.5</sub> exposure disparity for Black alone, not Hispanic or Latino, population**

14158	Carson City, NV	39,119	5.3	-0.9	-5.2	4.3
46801	Lake Jackson--Angleton, TX	39,683	9.2	-0.7	-2.7	2.0
49339	Lewiston, ME	42,215	6.8	1.8	3.7	1.9
51499	Los Lunas, NM	43,210	4.4	0.8	-1.0	1.8
13591	Carbondale, IL	38,267	12.3	-1.8	-0.3	1.5
77230	St. Augustine, FL	38,575	8.9	4.5	6.0	1.5
40213	Hot Springs, AR	28,090	11.6	2.9	4.2	1.3
1927	Amarillo, TX	182,659	7.3	-0.6	-1.9	1.3
11026	Brunswick, GA	25,346	9.9	0.7	1.9	1.2

**Figure 2(j) outliers: Relative PM<sub>2.5</sub> exposure disparity for Asian and Pacific Islander alone, not Hispanic or Latino, population**

69454	Pine Bluff, AR	35,406	12.5	-2.6	-4.6	2.0
14401	Casa Grande, AZ	22,594	7.6	-0.5	-2.3	1.8

**Figure 2(k) outliers: Relative NO<sub>2</sub> exposure disparity for other or more than one race, not Hispanic or Latino, population**

93916	West Bend, WI	36,625	10.6	0.3	-0.5	0.8
69778	Pittsfield, MA	53,169	7.7	2.1	2.8	0.8
69454	Pine Bluff, AR	35,406	12.5	-0.4	0.3	0.7
24607	Dover--Rochester, NH--ME	69,328	6.8	0.2	0.9	0.7

**Figure 2(l) outliers: Relative PM<sub>2.5</sub> exposure disparity for American Indian or Alaska Native alone, not Hispanic or Latino, population**

8434	Bloomsburg--Berwick, PA	40,839	9.6	-0.2	1.7	1.9
27253	El Paso, TX--NM	702,173	7.7	1.2	-0.1	1.3
22960	DeKalb, IL	39,316	9.8	1.1	2.4	1.3

<sup>1</sup> Outliers identified in each panel of **Figure 2** as urban areas with an absolute difference at least five times greater than the interquartile range (difference between 75<sup>th</sup> percentile and 25<sup>th</sup> percentile) in absolute differences among all 481 urban areas.

<sup>2</sup> Absolute difference is calculated as the absolute value of the difference between the relative exposure disparity calculated using data aggregated at the tract level versus the relative exposure disparity calculated using data aggregated at the block level.

<sup>3</sup> Population-weighted mean air pollution level is calculated using data aggregated at the block level.



**Table S2. Difference in population-based exposure disparities calculated using block versus tract level data by racial/ethnic group**

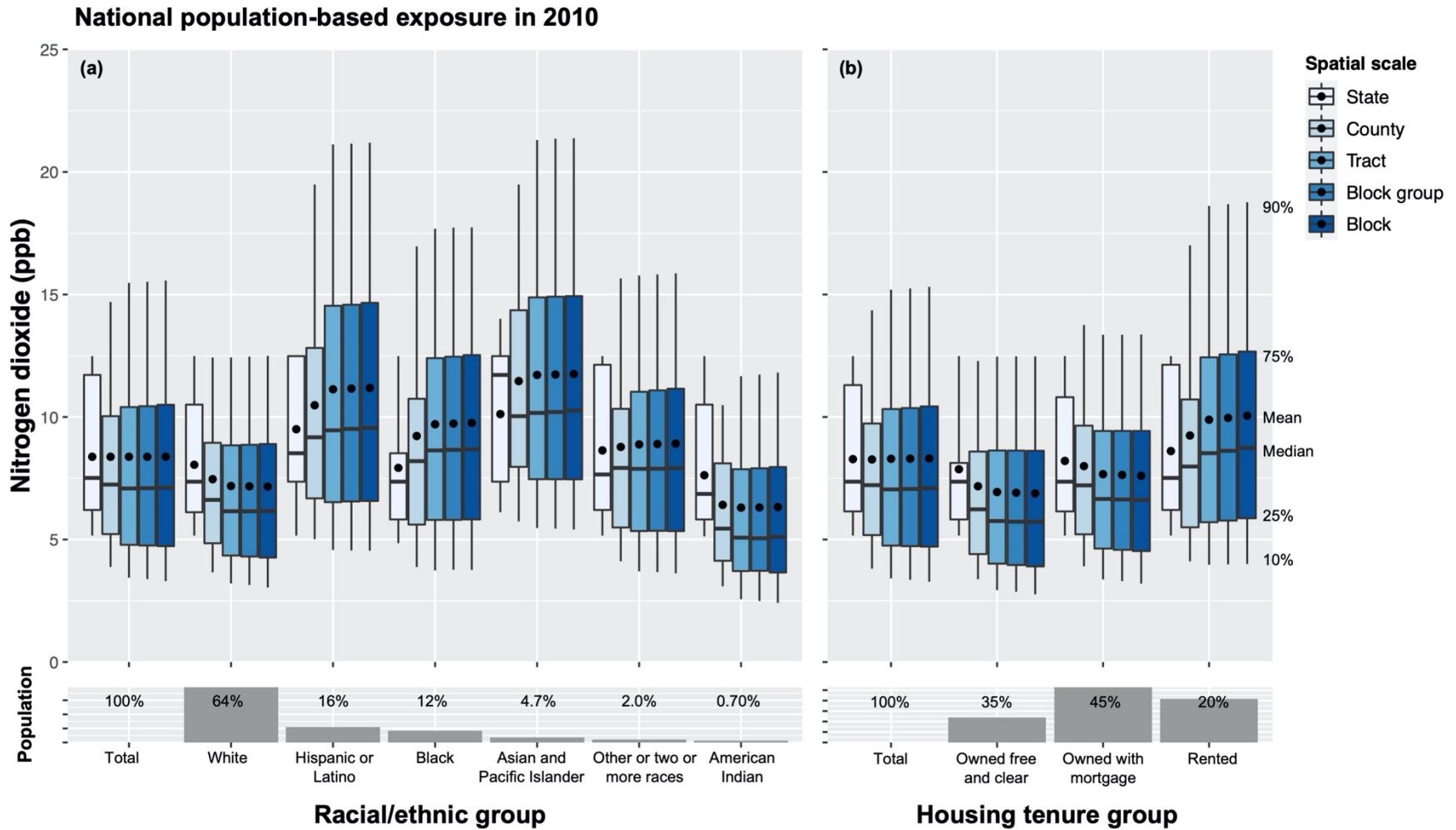
Metric	NO <sub>2</sub>			PM <sub>2.5</sub>		
	Mean (IQR <sup>1</sup> ) difference in exposure disparity by spatial scale <sup>2</sup> comparing block versus tract data	Mean (IQR <sup>1</sup> ) exposure disparity <sup>3</sup> based on block data	Mean (IQR <sup>1</sup> ) ratio <sup>4</sup> of difference in exposure disparity by spatial scale to exposure disparity	Mean (IQR <sup>1</sup> ) difference in exposure disparity by spatial scale <sup>2</sup> comparing block versus tract data	Mean (IQR <sup>1</sup> ) exposure disparity <sup>3</sup> based on block data	Mean (IQR <sup>1</sup> ) ratio <sup>4</sup> of difference in exposure disparity by spatial scale to exposure disparity
<b>Nation</b> (n = 6 racial/ethnic groups)						
Absolute disparity in mean exposure	<b>0.038 ppb</b> (0.024 - +0.049)	<b>1.9 ppb</b> (-0.79 - +2.5)	<b>0.027</b> (0.013 - 0.035)	<b>0.011 µg m<sup>-3</sup></b> (-0.0060 - +0.015)	<b>0.54 µg m<sup>-3</sup></b> (-0.18 - +0.12)	<b>0.074</b> (0.023 - 0.091)
Relative disparity in mean exposure	<b>0.40%</b> (0.31 - +0.45)	<b>21%</b> (-10 - +25)	<b>0.026</b> (0.013 - 0.033)	<b>0.12%</b> (-0.066 - +0.15)	<b>6.0%</b> (-2.0 - +1.3)	<b>0.074</b> (0.023 - 0.090)
<b>Intra-urban</b> (n = 2886: 481 urban areas x 6 racial/ethnic groups)						
Absolute disparity in mean exposure	<b>0.068 ppb</b> (-0.012 - +0.082)	<b>0.35 ppb</b> (-0.075 - +0.41)	<b>0.83</b> (0.092 - 0.45)	<b>0.017 µg m<sup>-3</sup></b> (-0.010 - +0.010)	<b>0.12 µg m<sup>-3</sup></b> (-0.050 - +0.11)	<b>0.84</b> (0.048 - 0.35)
Relative disparity in mean exposure	<b>0.95%</b> (-0.17 - +1.1)	<b>4.7%</b> (-1.1 - +5.5)	<b>0.83</b> (0.091 - 0.45)	<b>0.19%</b> (-0.11 - +0.11)	<b>1.2%</b> (-0.57 - +1.2)	<b>0.84</b> (0.047 - 0.35)

<sup>1</sup> IQR is interquartile range (25<sup>th</sup> percentile – 75<sup>th</sup> percentile).

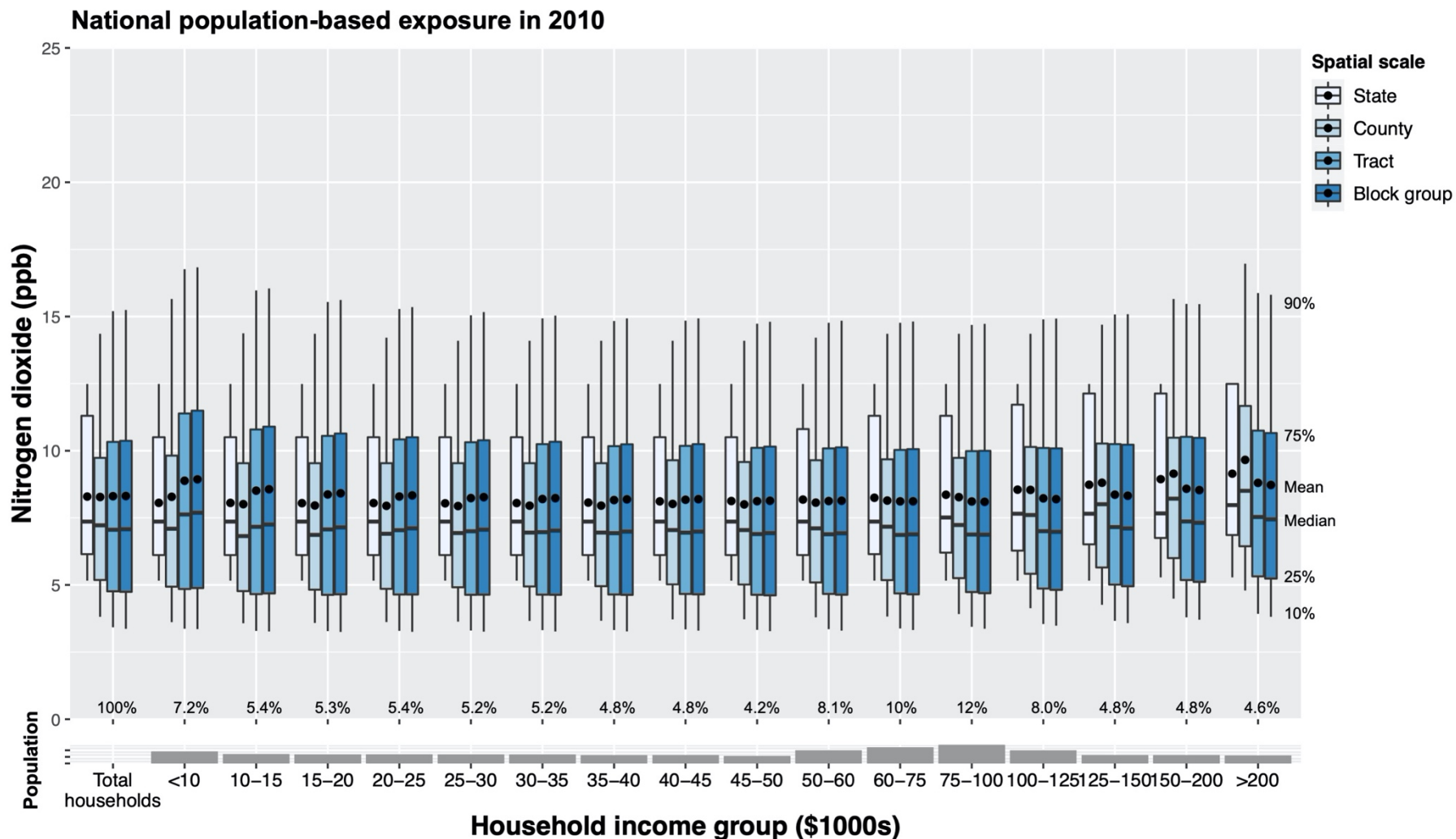
<sup>2</sup> Difference in exposure disparity by spatial scale calculated using block versus tract level data is calculated as follows for each racial/ethnic group, pollutant, and disparity metric: [Exposure disparity calculated using block data] – [Exposure disparity calculated using tract data]. Mean is calculated using the absolute value of each difference in exposure disparity. Mean and IQR in difference in exposure disparity are calculated based on the 6 racial/ethnic groups in **Figure 1** for the nation and based on the 6 racial/ethnic groups in 481 urban areas in **Figure 2**.

<sup>3</sup> Exposure disparity in mean exposure calculated using block level data for each racial/ethnic group compared to the total population. Mean is calculated using the absolute value of exposure disparity. Mean and IQR in exposure disparity are calculated based on the 6 racial/ethnic groups in **Figure 1** for the nation and based on the 6 racial/ethnic groups in 481 urban areas in **Figure 2**.

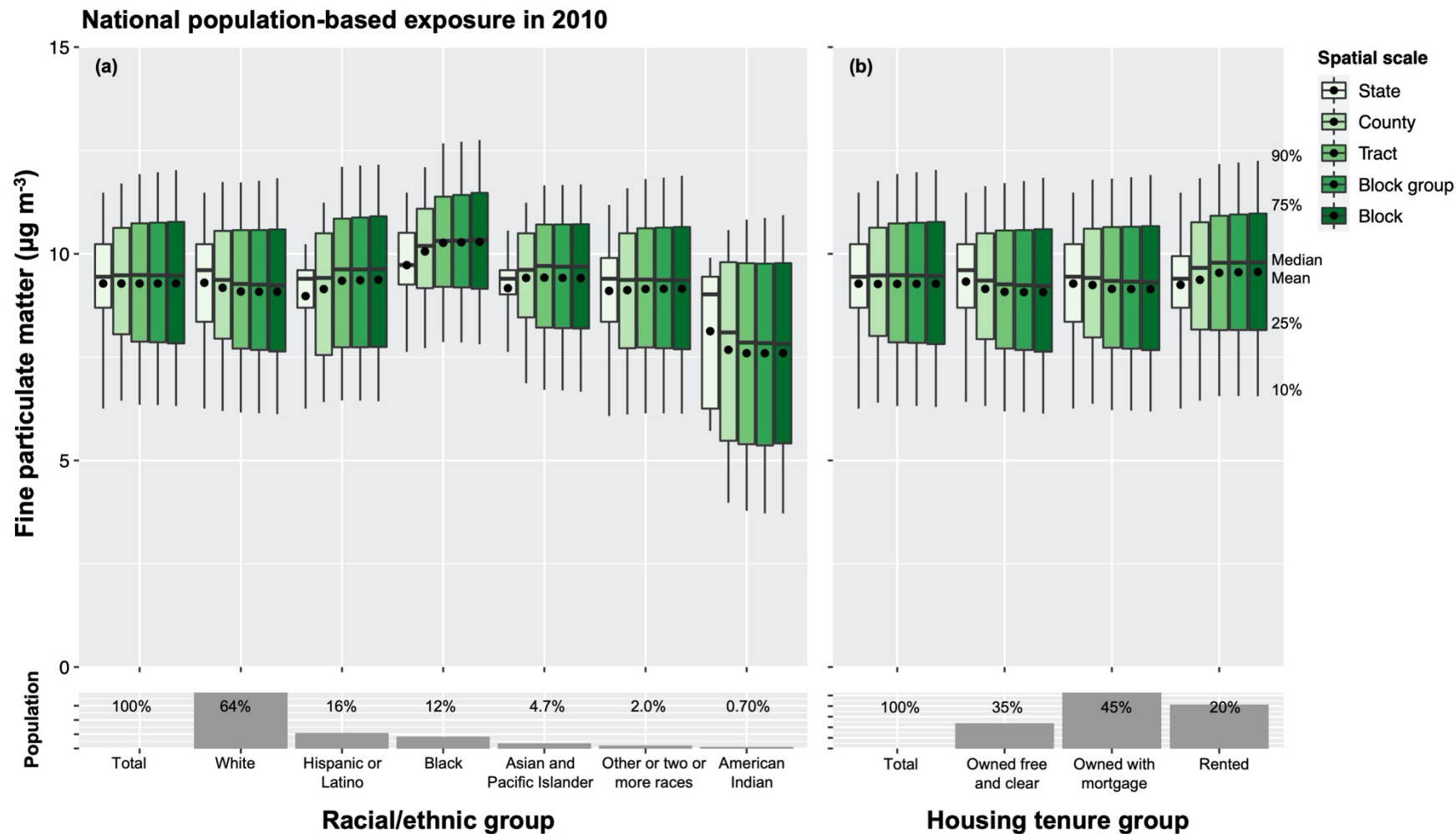
<sup>4</sup> Ratio is calculated as follows: |[Difference in exposure disparity by spatial scale comparing block versus tract data]/[Exposure disparity calculated using block data]|. Mean and IQR in exposure disparity are calculated based on the 6 racial/ethnic groups in **Figure 1** for the nation and based on the 6 racial/ethnic groups in 481 urban areas in **Figure 2**.



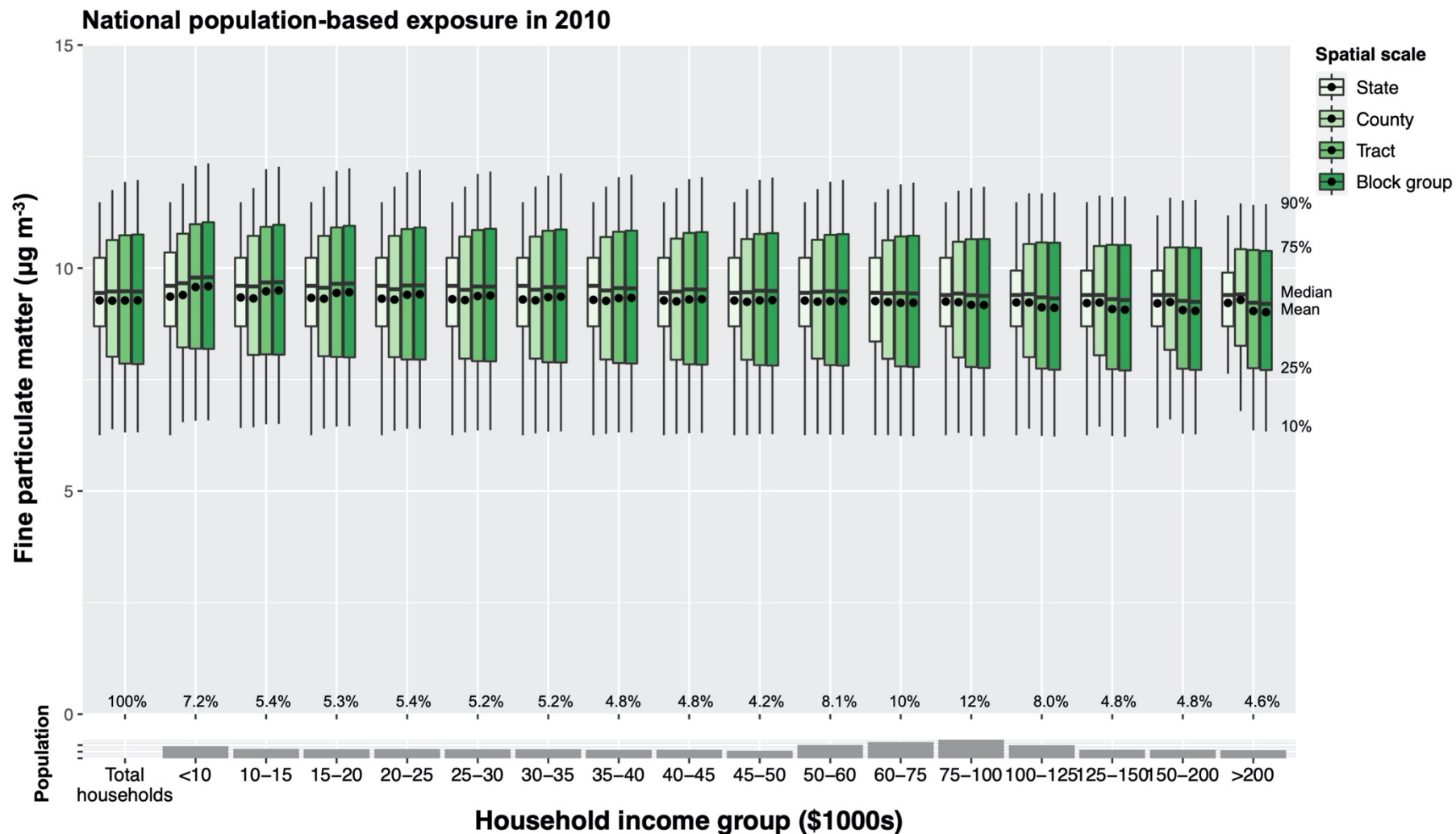
**Figure S1. National exposure (population-based) to nitrogen dioxide (ppb NO<sub>2</sub>) in 2010 calculated using five different spatial scales of data aggregation (state, county, tract, block group, block) for (a) six racial/ethnic groups and (b) three housing tenure groups. Color of box indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block). Circle indicates the population-weighted mean exposure. Box and whiskers indicate the 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> population-weighted percentiles of exposure. Population (%) for each group in 2010 is indicated in the lower panel. Racial/ethnic groups do not include Hispanic or Latino populations, except for the “Hispanic or Latino” group.**



*Figure S2. National exposure (population-based) to nitrogen dioxide (ppb NO<sub>2</sub>) in 2010 calculated using four different spatial scales of data aggregation (state, county, tract, block group) for 16 household annual income groups (in 1000s of 2010 US dollars, \$). Color of box indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block group). Circle indicates the population-weighted mean exposure. Box and whiskers indicate the 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> population-weighted percentiles of exposure. Population (%) for each group in 2010 is indicated in the lower panel.*

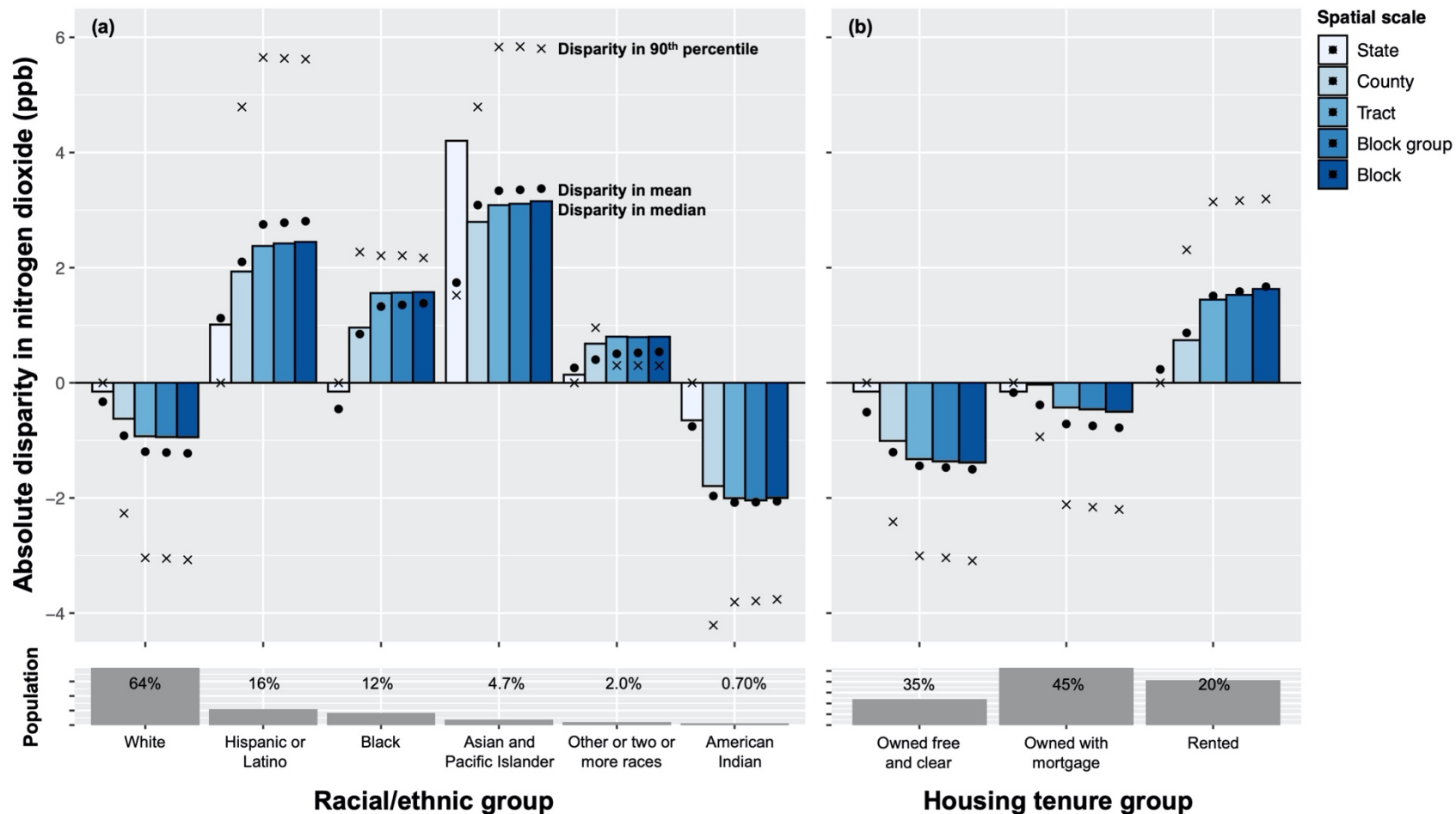


**Figure S3.** National exposure (population-based) to fine particulate matter ( $\mu\text{g m}^{-3}$   $\text{PM}_{2.5}$ ) in 2010 calculated using five different spatial scales of data aggregation (state, county, tract, block group, block) for (a) six racial/ethnic groups and (b) three housing tenure groups. Color of box indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block). Circle indicates the population-weighted mean exposure. Box and whiskers indicate the 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> population-weighted percentiles of exposure. Population (%) for each group in 2010 is indicated in the lower panel. Racial/ethnic groups do not include Hispanic or Latino populations, except for the “Hispanic or Latino” group.

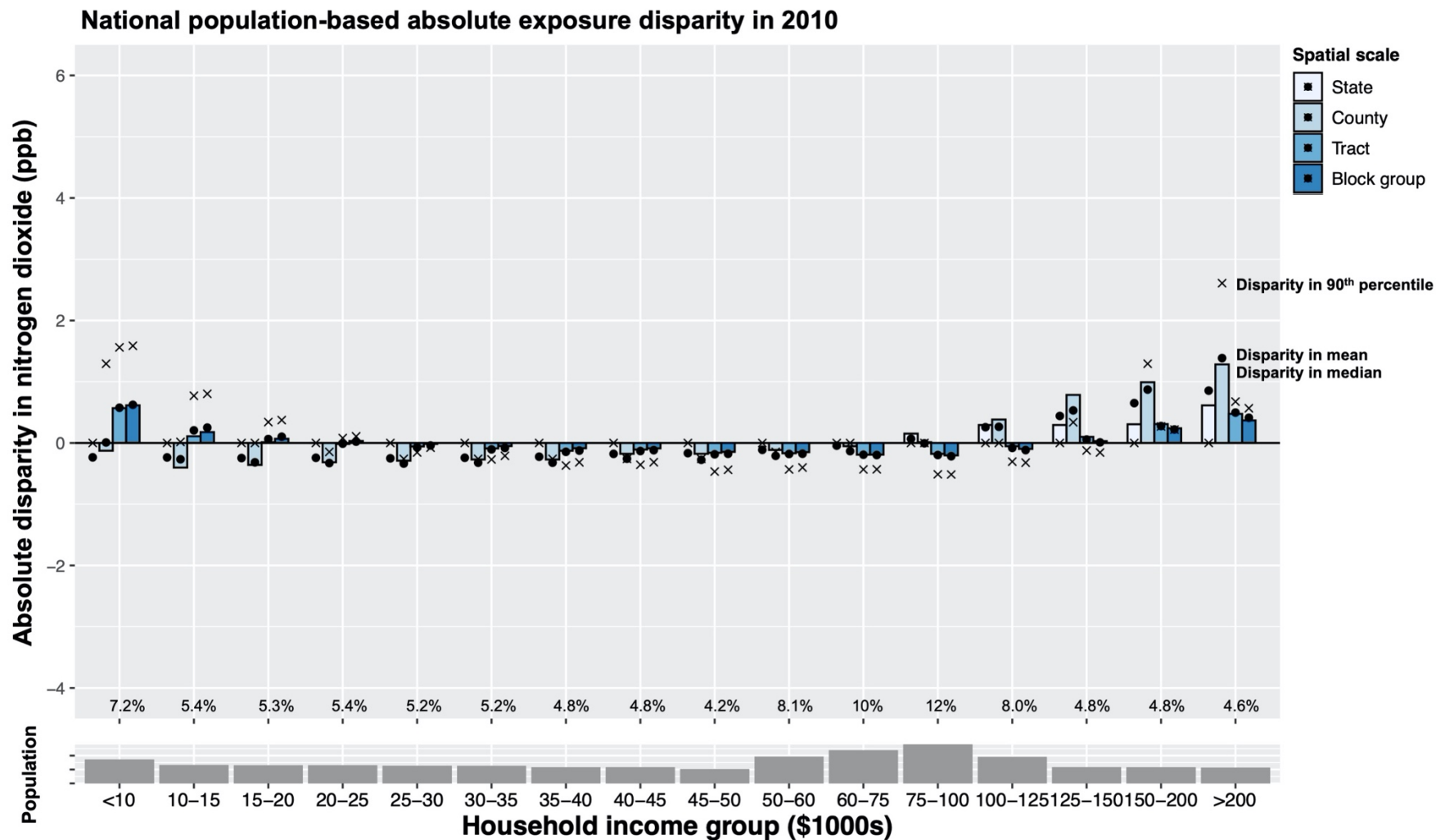


**Figure S4. National exposure (population-based) to fine particulate matter ( $\mu\text{g m}^{-3}$   $\text{PM}_{2.5}$ ) in 2010 calculated using four different spatial scales of data aggregation (state, county, tract, block group) for 16 household annual income groups (in 1000s of 2010 US dollars, \$). Color of box indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block group). Circle indicates the population-weighted mean exposure. Box and whiskers indicate the 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> population-weighted percentiles of exposure. Population (%) for each group in 2010 is indicated in the lower panel.**

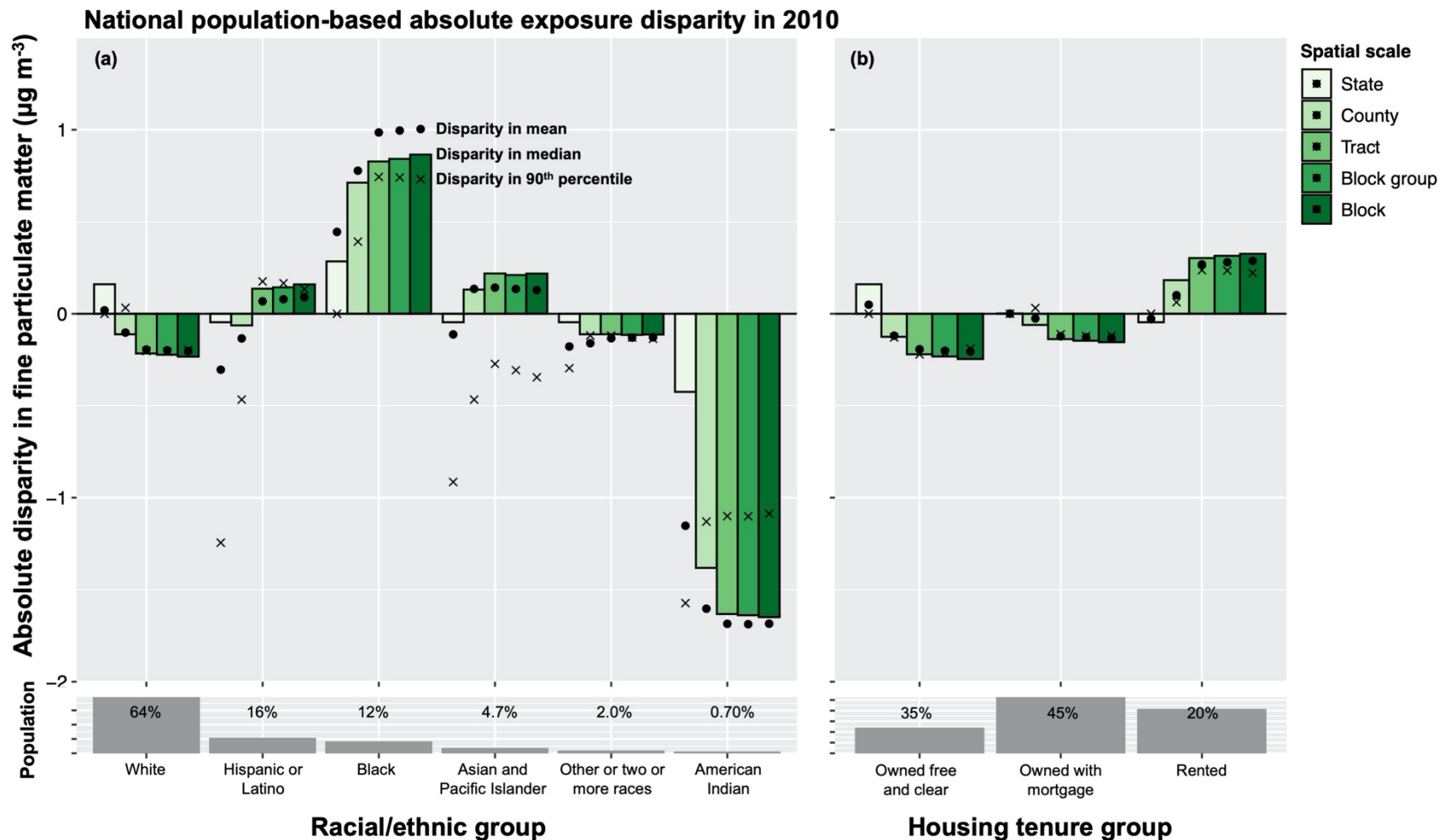
### National population-based absolute exposure disparity in 2010



*Figure S5. National absolute disparity in exposure (population-based) to nitrogen dioxide (ppb NO<sub>2</sub>) in 2010 calculated using five different spatial scales of data aggregation (state, county, tract, block group, block) for (a) six racial/ethnic groups and (b) three housing tenure groups. Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block). Bar indicates the absolute disparity in median exposure for each group compared to the median exposure for the total population, circle indicates the absolute disparity in population-weighted mean exposure, and the “x” indicates the absolute disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the group experiences higher levels of air pollution exposure compared to the total population. Population (%) for each group in 2010 is listed in the lower panel. Racial/ethnic groups do not include Hispanic or Latino populations, except for the “Hispanic or Latino” group.*

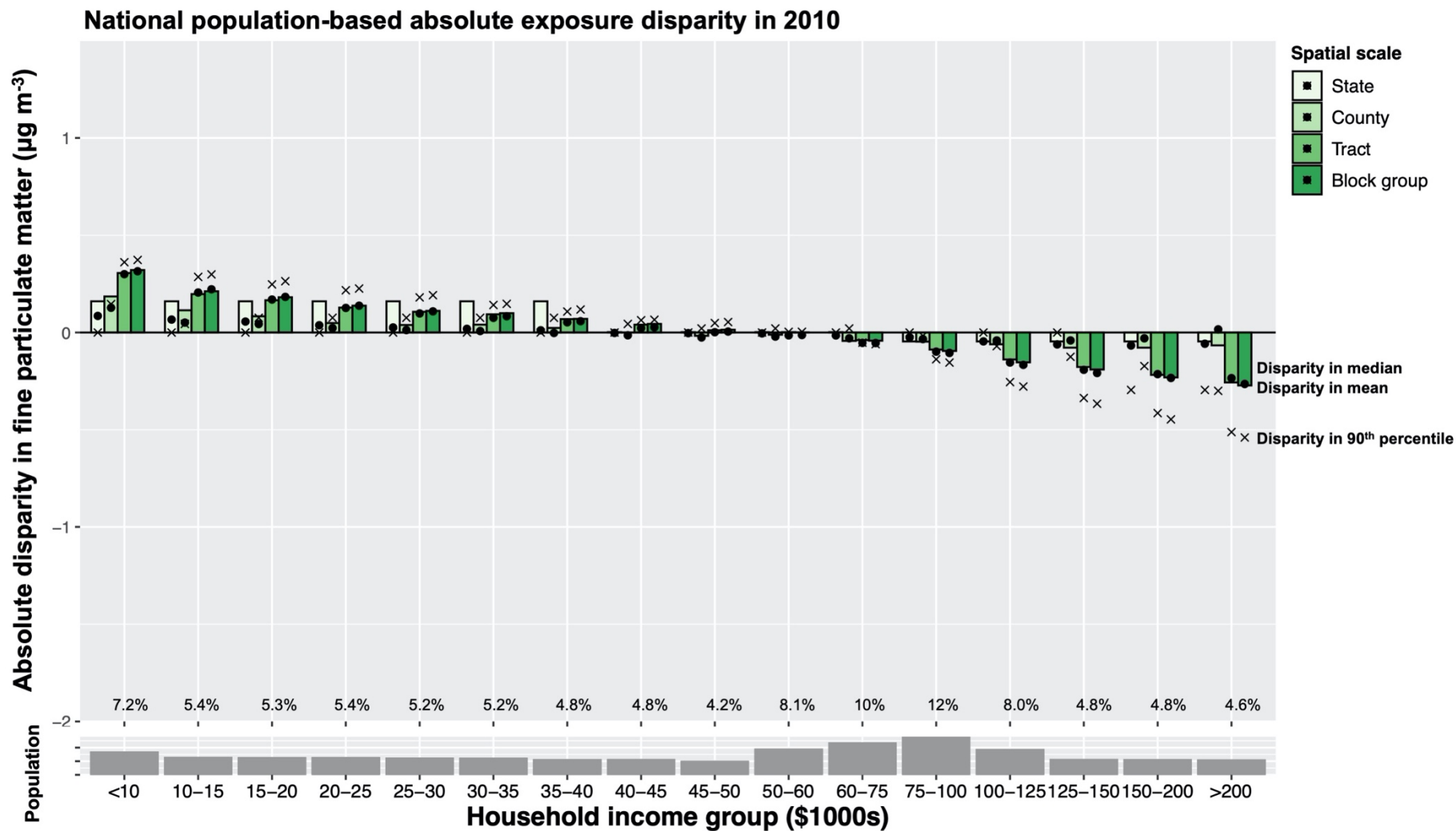


**Figure S6. National absolute disparity in exposure (population-based) to nitrogen dioxide (ppb NO<sub>2</sub>) in 2010 calculated using five different spatial scales of data aggregation (state, county, tract, block group) for 16 household annual income groups (in 1000s of 2010 US dollars, \$).** Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block group). Bar indicates the absolute disparity in median exposure for each group compared to the median exposure for the total population, circle indicates the absolute disparity in population-weighted mean exposure, and the “x” indicates the absolute disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the group experiences higher levels of air pollution exposure compared to the total population. Population (%) for each group in 2010 is listed in the lower panel.

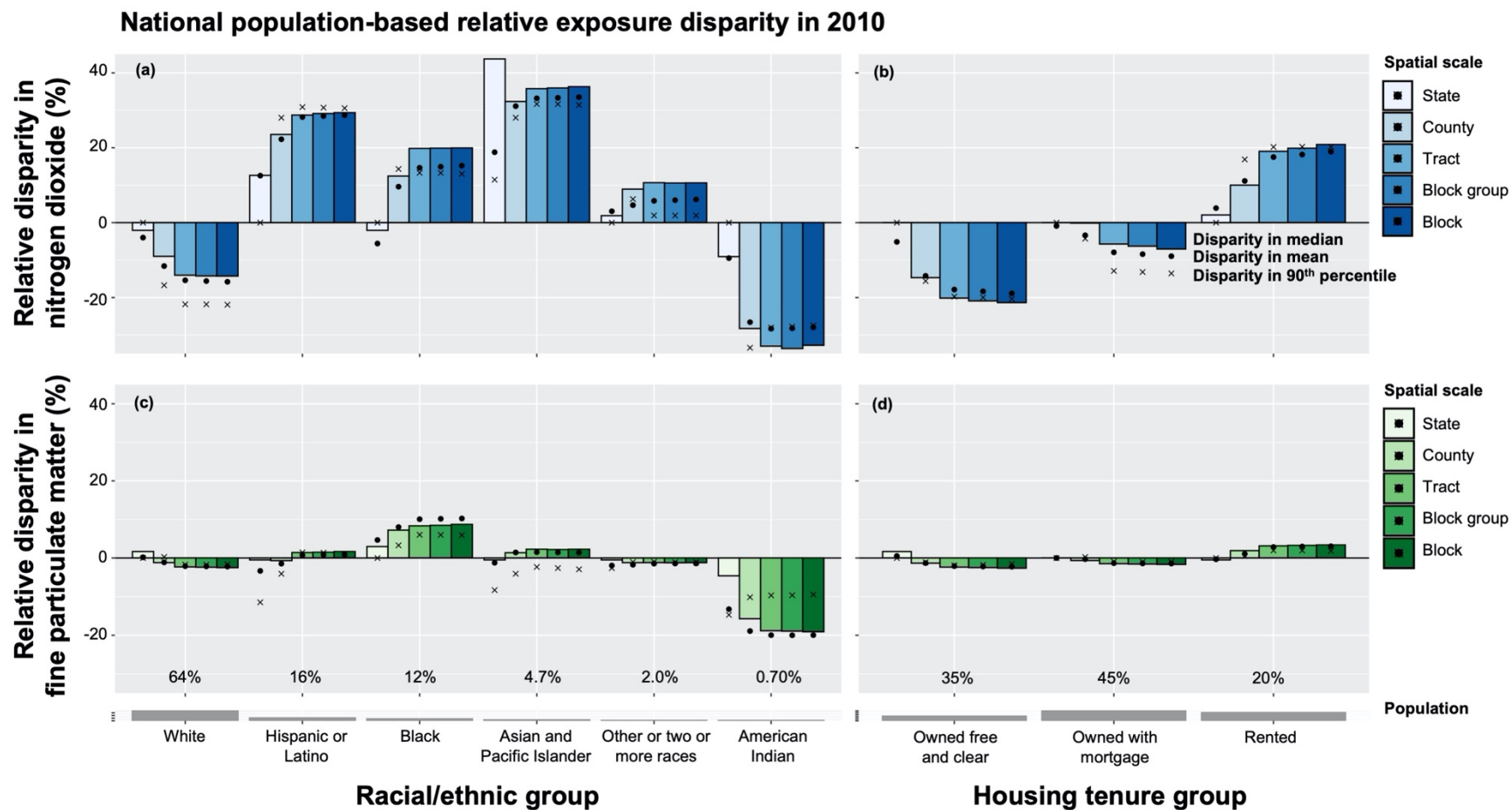


*Figure S7. National absolute disparity in exposure (population-based) to fine particulate matter ( $\mu\text{g m}^{-3}$   $\text{PM}_{2.5}$ ) in 2010 calculated using five different spatial scales of data aggregation (state, county, tract, block group, block) for (a) six racial/ethnic groups and (b) three housing tenure groups. Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block). Bar indicates the absolute disparity in median exposure for each group compared to the median exposure for the total population, circle indicates the absolute disparity in population-weighted mean exposure, and the “x” indicates the absolute disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the group experiences higher levels of air pollution exposure compared to the total population. Population (%) for each group in 2010 is listed in the lower panel. Racial/ethnic groups do not include Hispanic or Latino populations, except for the “Hispanic or Latino” group.*





**Figure S8. National absolute disparity in exposure (population-based) to fine particulate matter ( $\mu\text{g m}^{-3}$   $\text{PM}_{2.5}$ ) in 2010 calculated using four different spatial scales of data aggregation (state, county, tract, block group) for 16 household annual income groups (in 1000s of 2010 US dollars, \$). Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block group). Bar indicates the absolute disparity in median exposure for each group compared to the median exposure for the total population, circle indicates the absolute disparity in population-weighted mean exposure, and the “x” indicates the absolute disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the group experiences higher levels of air pollution exposure compared to the total population. Population (%) for each group in 2010 is listed in the lower panel.**



**Figure S9.** National relative disparity (%) in exposure (population-based) to (a, b) nitrogen dioxide and (c, d) fine particulate matter in 2010 calculated using five different spatial scales of data aggregation (state, county, tract, block group, block) for (a, c) six racial/ethnic groups and (b, d) three housing tenure groups. Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block). Bar indicates the relative disparity in median exposure for each group compared to the median exposure for the total population, circle indicates the relative disparity in population-weighted mean exposure, and the “x” indicates the relative disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the group experiences higher levels of air pollution exposure compared to the total population. Population (%) for each group in 2010 is listed in the lower panel. Racial/ethnic groups do not include Hispanic or Latino populations, except for the “Hispanic or Latino” group.

### National population-based relative exposure disparity in 2010

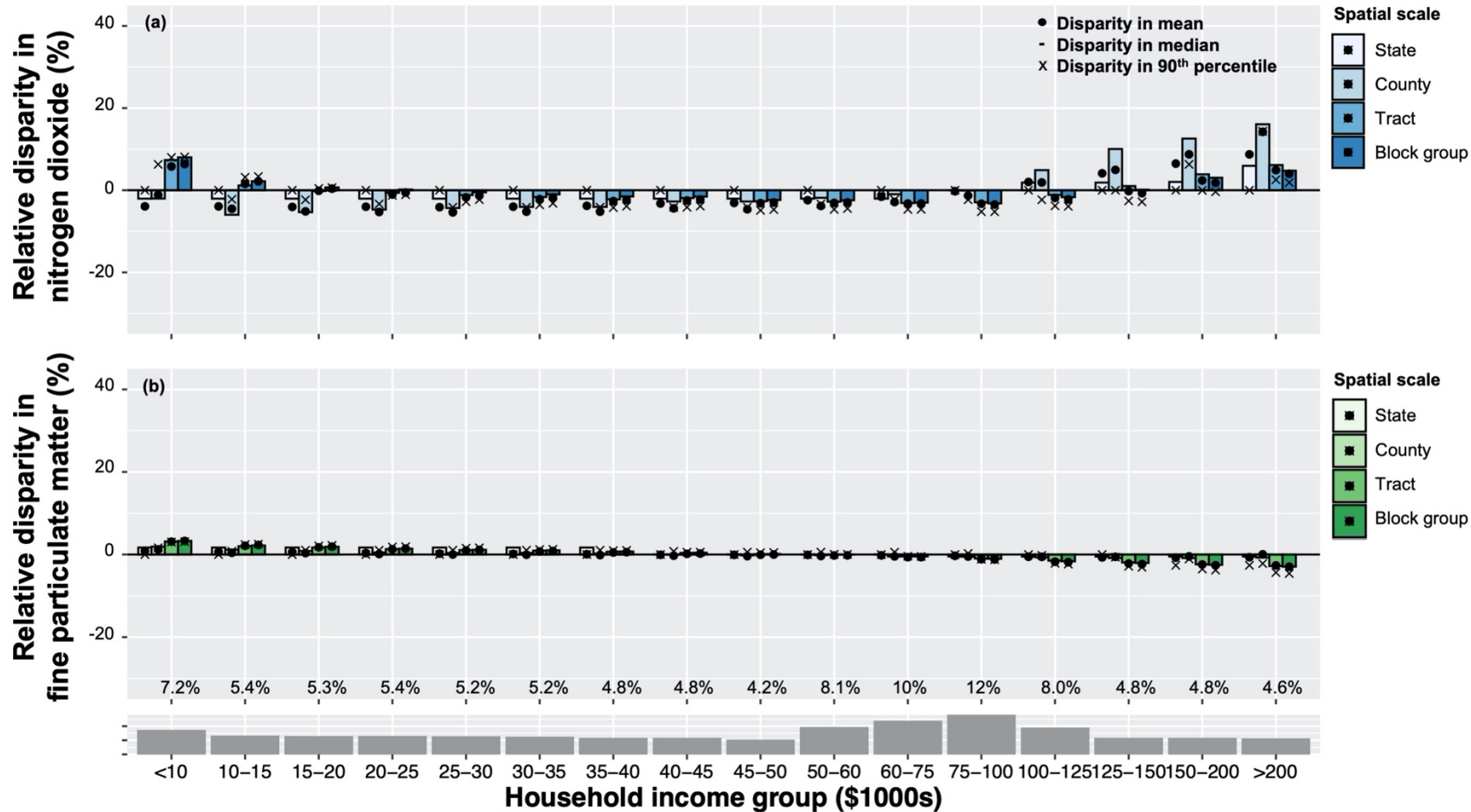
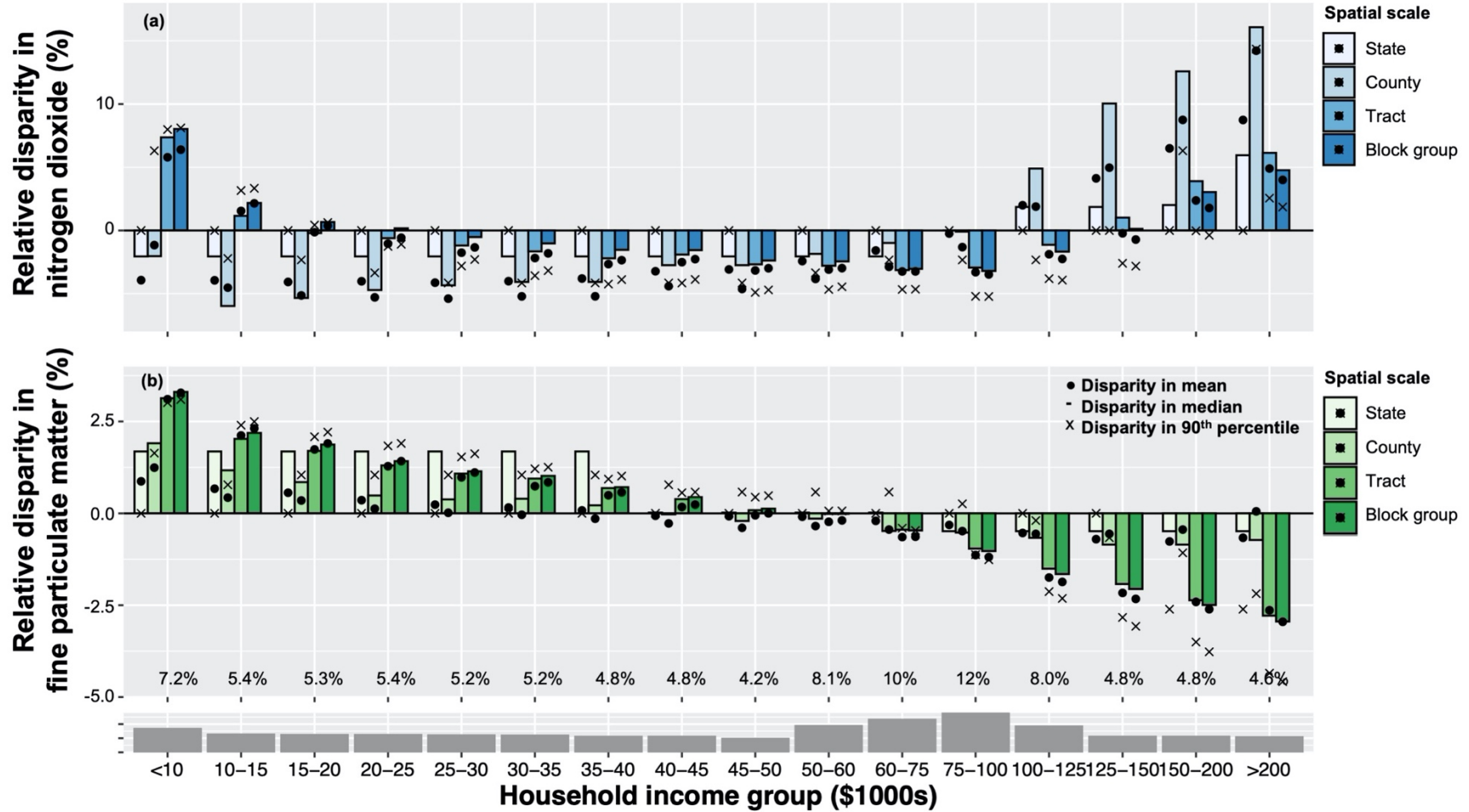
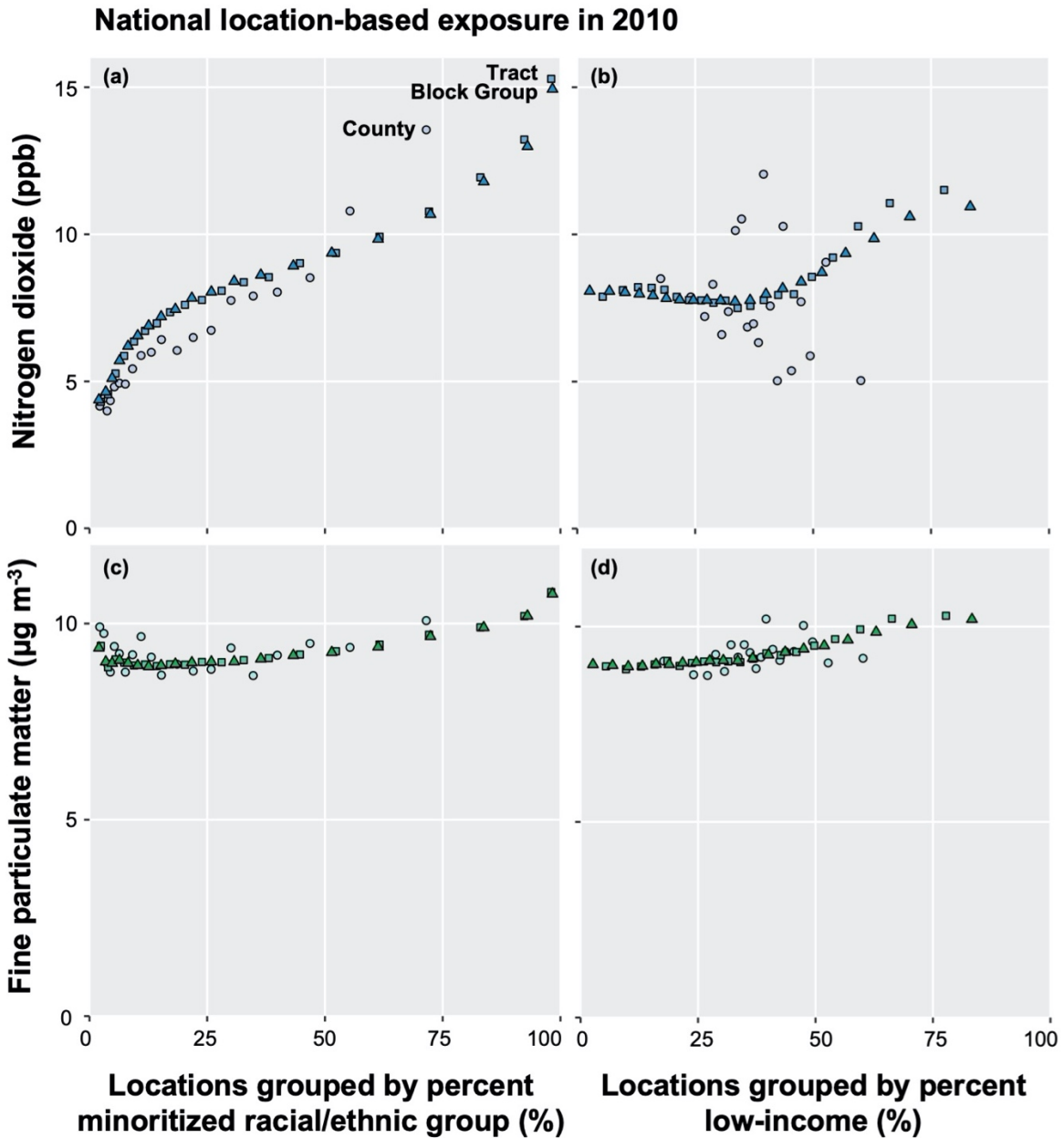


Figure S10. National relative disparity (%) in exposure (population-based) to (a) nitrogen dioxide and (b) fine particulate matter in 2010 calculated using four different spatial scales of data aggregation (state, county, tract, block group) for 16 household annual income groups (in 1000s of 2010 US dollars, \$). Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block group). Bar indicates the relative disparity in median exposure for each group compared to the median exposure for the total population, circle indicates the relative disparity in population-weighted mean exposure, and the “x” indicates the relative disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the group experiences higher levels of air pollution exposure compared to the total population. Population (%) for each group in 2010 is listed in the lower panel. (Figure S11 provides a version of this figure with the y-axes adjusted to the range of relative exposure disparity for each pollutant.)

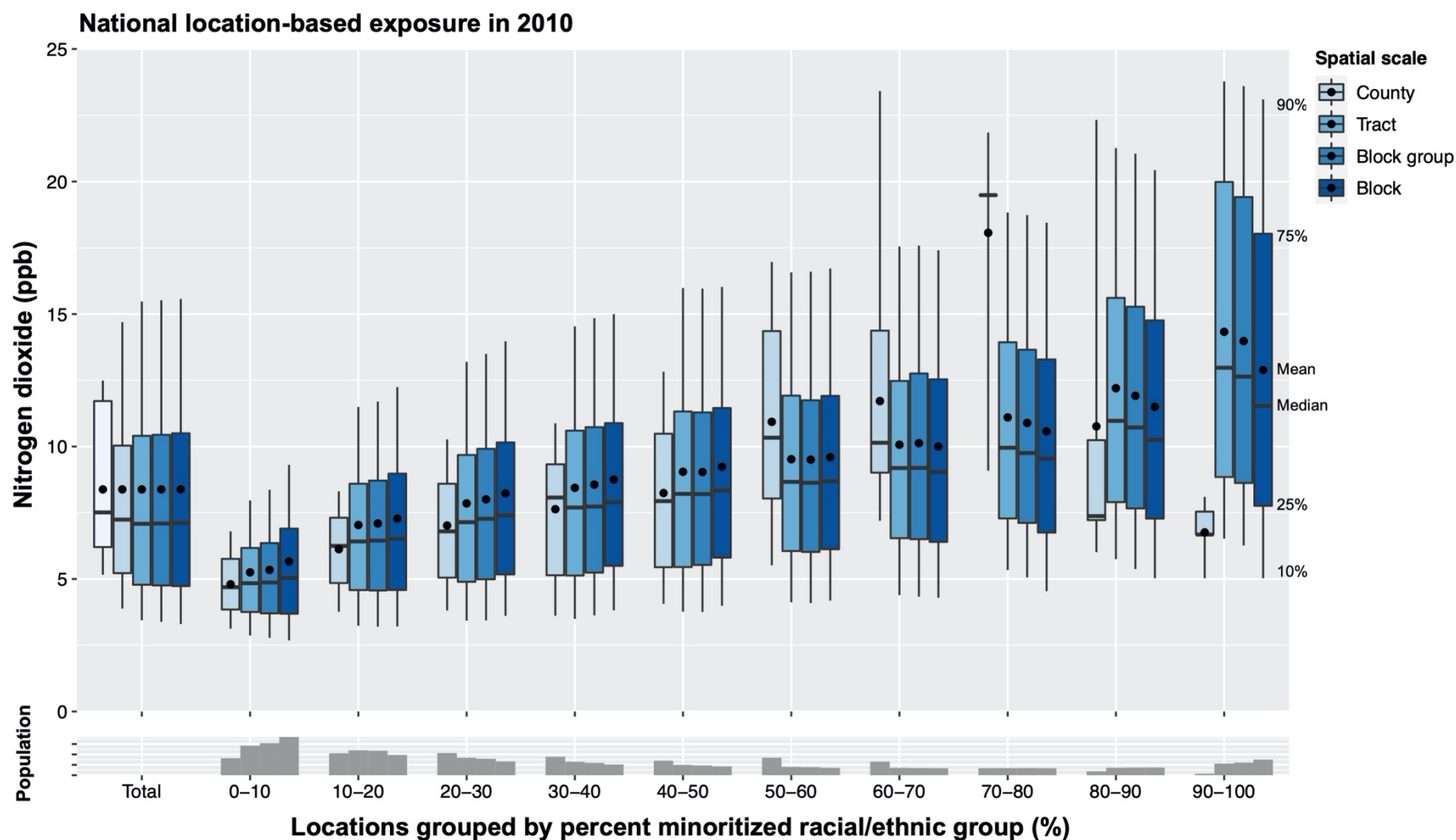
### National population-based relative exposure disparity in 2010



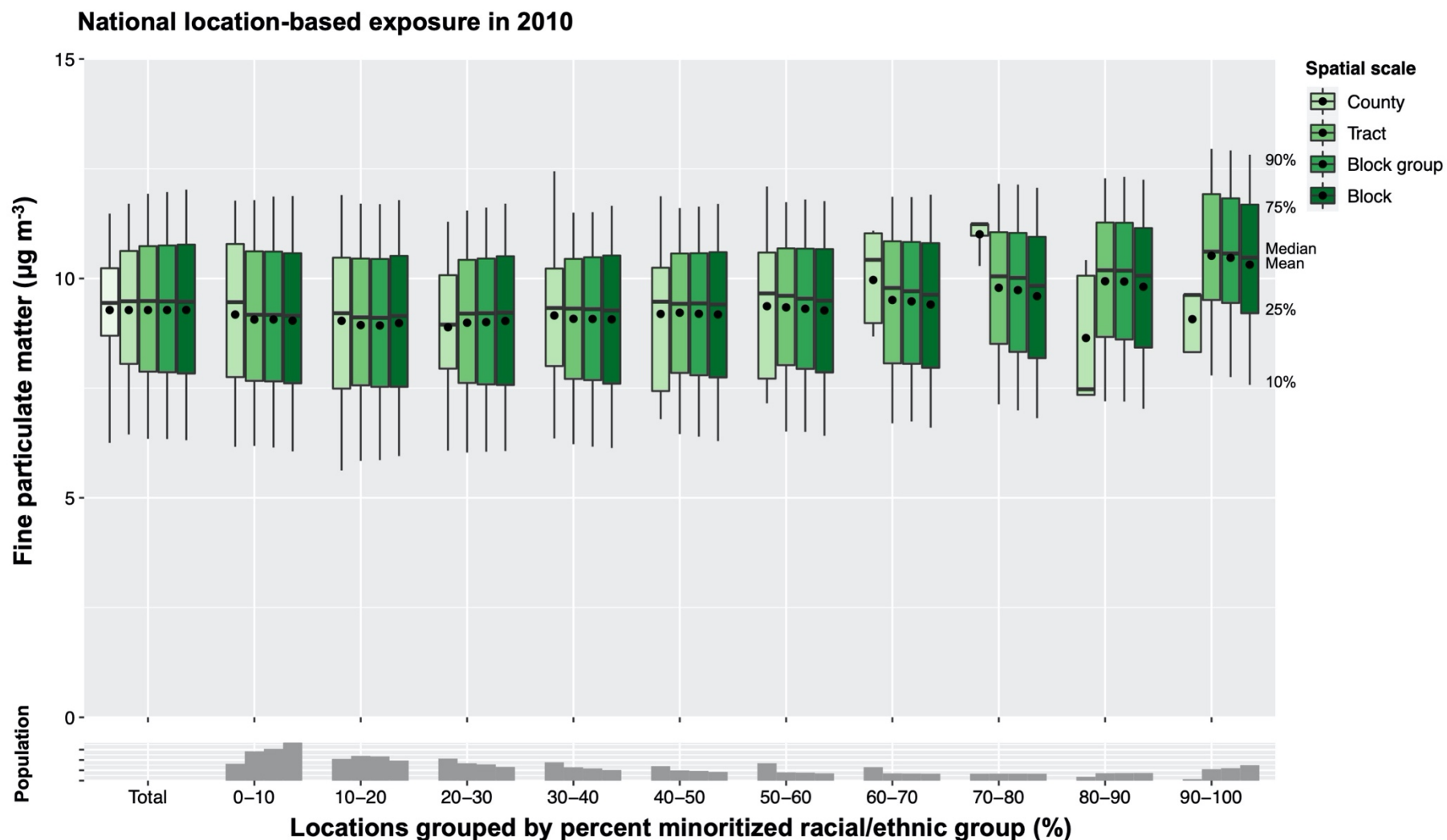
*Figure S11. National relative disparity (%) in exposure (population-based) to (a) nitrogen dioxide and (b) fine particulate matter in 2010 calculated using four different spatial scales of data aggregation (state, county, tract, block group) for 16 household annual income groups (in 1000s of 2010 US dollars, \$). Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block group). Bar indicates the relative disparity in median exposure for each group compared to the median exposure for the total population, circle indicates the relative disparity in population-weighted mean exposure, and the “x” indicates the relative disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the group experiences higher levels of air pollution exposure compared to the total population. Population (%) for each group in 2010 is listed in the lower panel. (This figure provides the same information as **Figure S10** with adjusted y-axes.)*



**Figure S12.** National mean exposure (location-based) to (a, b) nitrogen dioxide (ppb  $\text{NO}_2$ ) and (c, d) fine particulate matter ( $\mu\text{g m}^{-3}$   $\text{PM}_{2.5}$ ) in 2010 calculated using three different spatial scales of data aggregation (county, tract, block group) for locations binned by percentiles based on (a, c) percent minoritized racial/ethnic group residents and (b, d) percent low-income residents. Each icon represents the population-weighted mean exposure for 5% of locations (i.e., counties, tracts, block groups) binned by the percent minoritized racial/ethnic group residents (a, c) or percent low-income residents (b, d). Shape of icon indicates the spatial scale of data aggregation, with circle for county, square for tract, and triangle for block group. For example, in panel (a), the first circle icon on the left indicates the mean exposure for the 5% of counties with the lowest percentages of minoritized racial/ethnic group residents. “Minoritized racial/ethnic group” is defined as any census racial/ethnic group other than “White alone, not Hispanic or Latino,” and “low-income” is defined as households with annual income below two times the national poverty level.

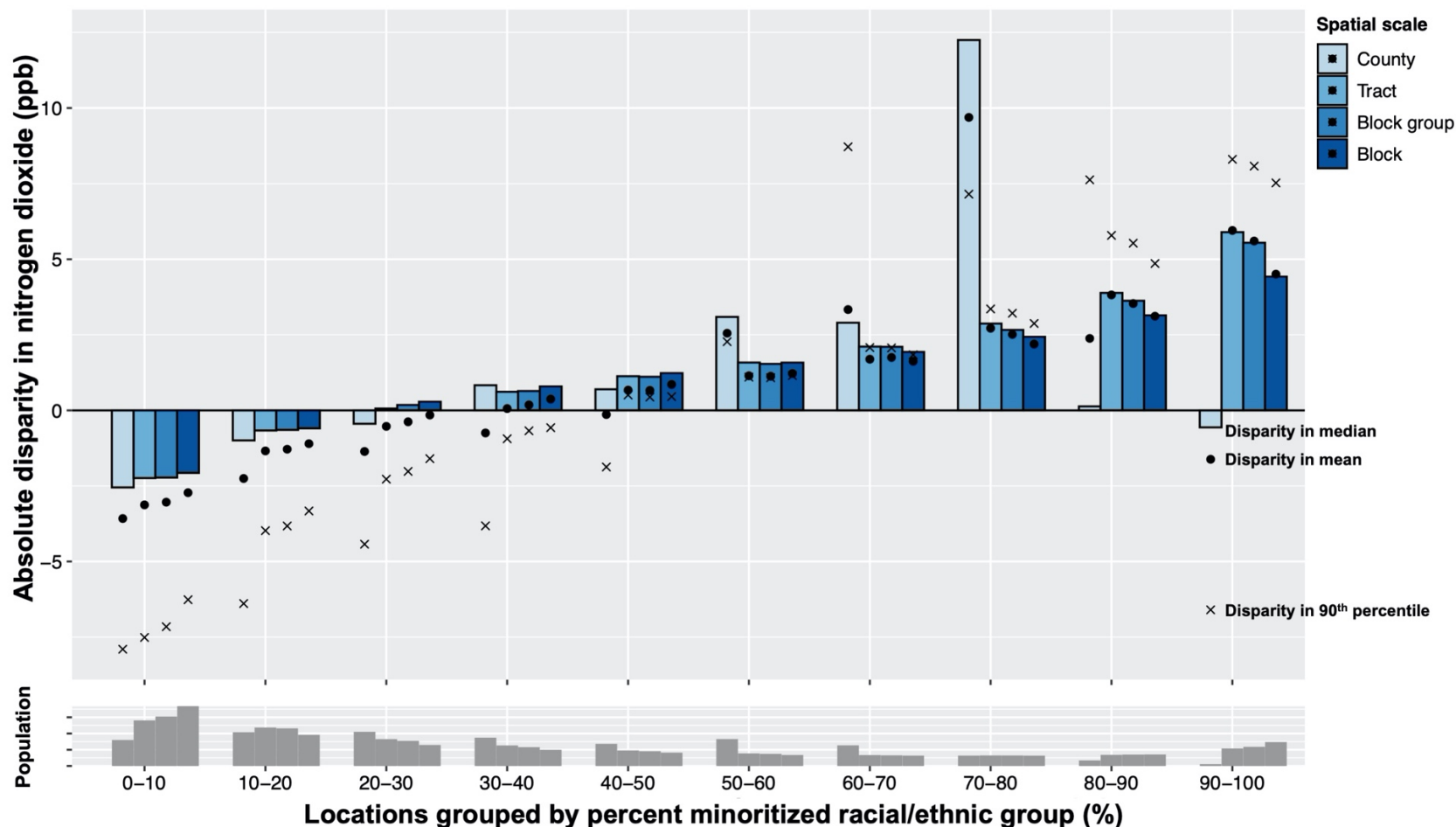


**Figure S13. National exposure (location-based) to nitrogen dioxide (ppb NO<sub>2</sub>) in 2010 calculated using four different spatial scales of data aggregation (county, tract, block group, block) for locations grouped by defined intervals of percent minoritized racial/ethnic group residents.** For example, the second set of boxes from the left (0-10%) indicate exposures for all counties, tracts, block groups, and blocks that have between 0% and 10% of residents from minoritized racial/ethnic groups. Color of box indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (county) and darkest color indicating finest spatial scale (block). Circle indicates the population-weighted mean exposure. Box and whiskers indicate the 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> population-weighted percentiles of exposure. “Minoritized racial/ethnic group” is defined as any census racial/ethnic group other than “White alone, not Hispanic or Latino.”



*Figure S14. National exposure (location-based) to fine particulate matter ( $\mu\text{g m}^{-3}$   $\text{PM}_{2.5}$ ) in 2010 calculated using four different spatial scales of data aggregation (county, tract, block group, block) for locations grouped by defined intervals of percent minoritized racial/ethnic group residents. For example, the second set of boxes from the left (0-10%) indicate exposures for all counties, tracts, block groups, and blocks that have between 0% and 10% of residents from minoritized racial/ethnic groups. Color of box indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (county) and darkest color indicating finest spatial scale (block). Circle indicates the population-weighted mean exposure. Box and whiskers indicate the 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> population-weighted percentiles of exposure. “Minoritized racial/ethnic group” is defined as any census racial/ethnic group other than “White alone, not Hispanic or Latino.”*

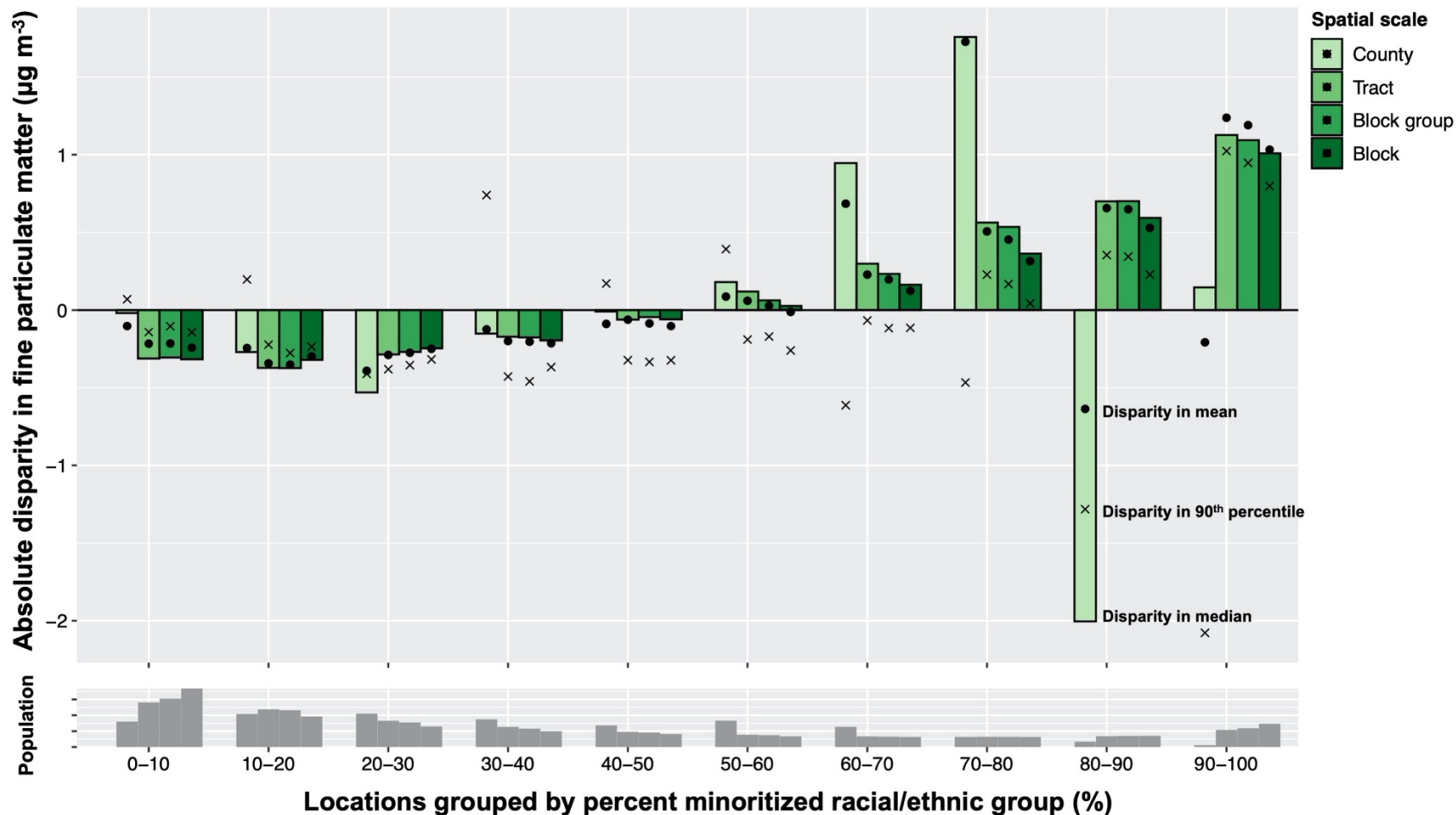
### National location-based absolute exposure disparity in 2010



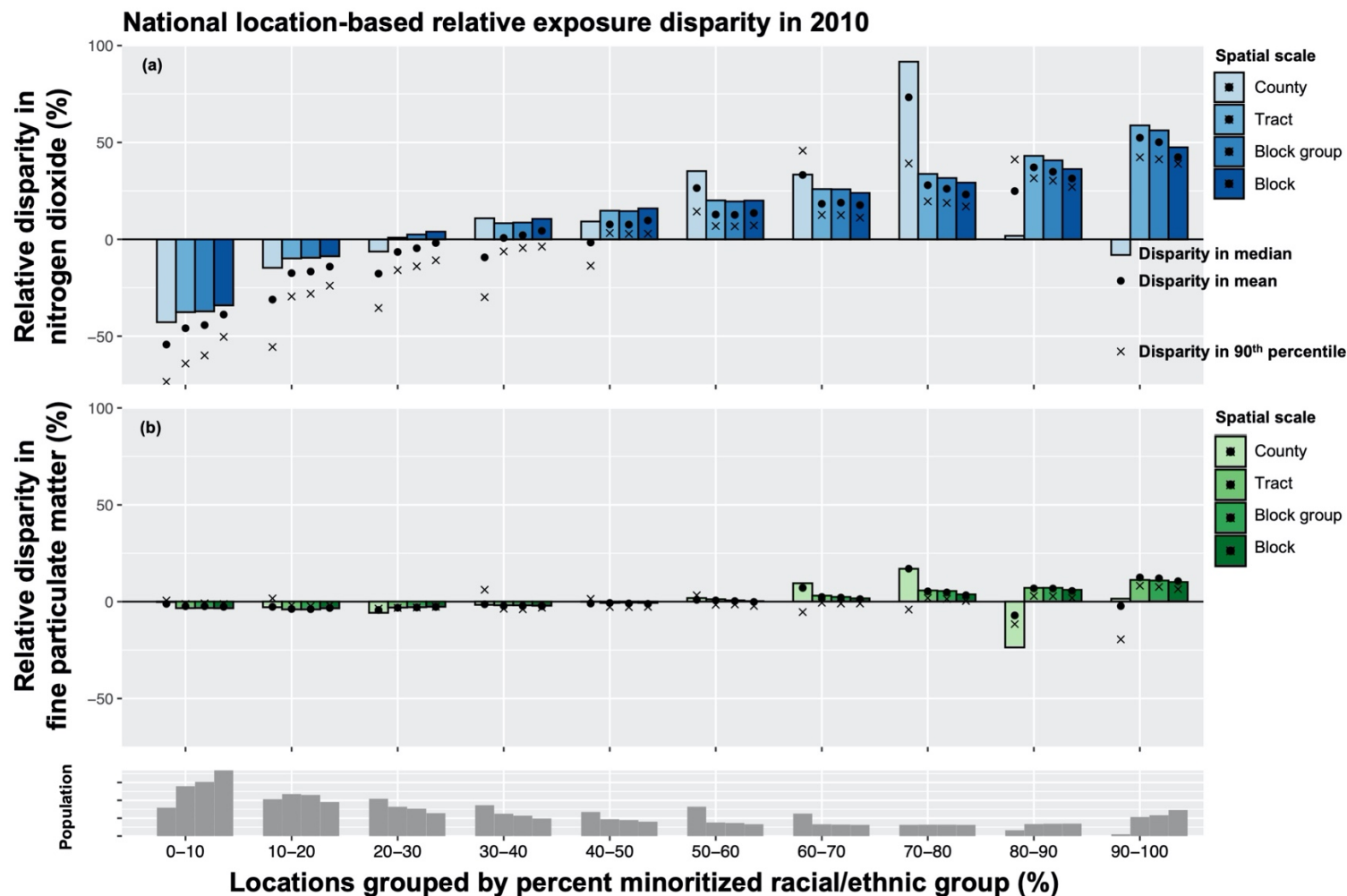
**Figure S15.** National absolute disparity in exposure (location-based) to nitrogen dioxide (ppb NO<sub>2</sub>) in 2010 calculated using four different spatial scales of data aggregation (county, tract, block group, block) for populations in locations grouped by defined intervals of percent minoritized racial/ethnic group residents. For example, the first set of bars on the left (0-10%) indicate absolute exposure disparity for the population living in the subset of locations that have between 0% and 10% of residents from minoritized racial/ethnic groups compared to all locations. Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (county) and darkest color indicating finest spatial scale (block). Bar indicates the absolute disparity in median exposure for each group compared to the median exposure for the total population, circle indicates the absolute disparity in population-weighted mean exposure, and the “x” indicates the absolute disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the population living within the subset of locations experiences higher levels of air pollution exposure compared to the total population (across all locations). “Minoritized racial/ethnic group” is defined as any census racial/ethnic group other than “White alone, not Hispanic or Latino.”



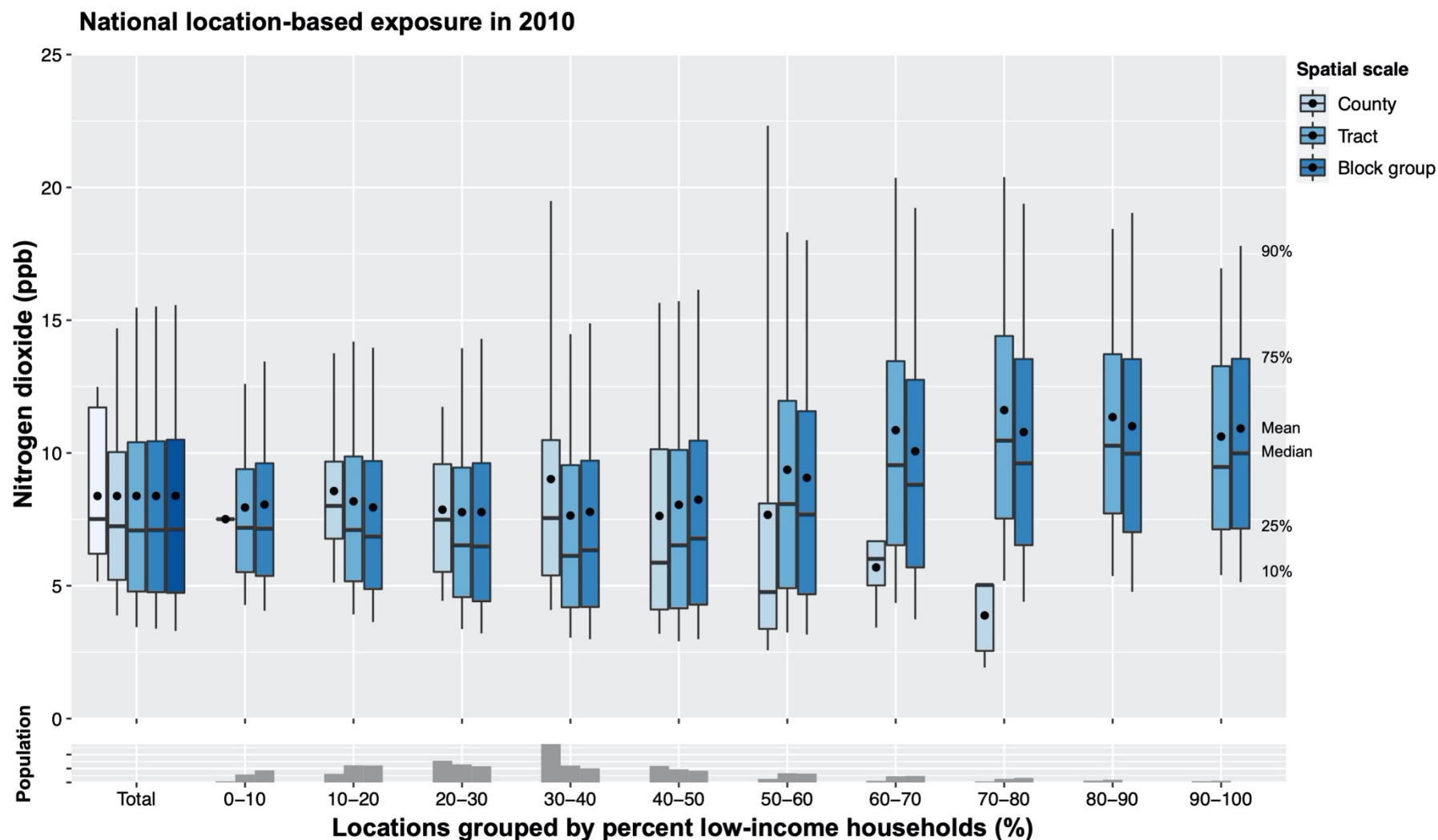
### National location-based absolute exposure disparity in 2010



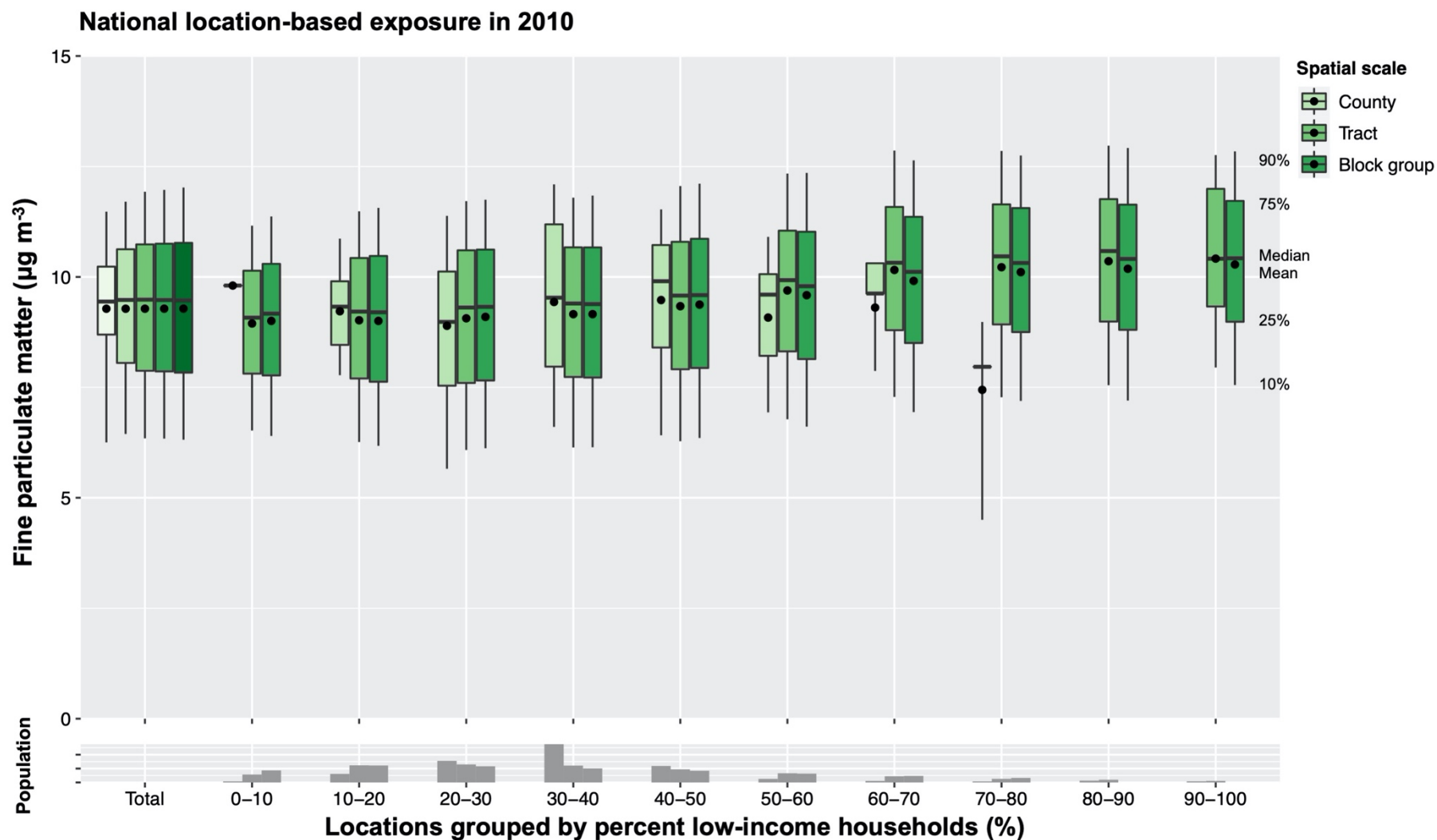
*Figure S16. National absolute disparity in exposure (location-based) to fine particulate matter ( $\mu\text{g m}^{-3}$   $\text{PM}_{2.5}$ ) in 2010 calculated using four different spatial scales of data aggregation (county, tract, block group, block) for populations in locations grouped by defined intervals of percent minoritized racial/ethnic group residents. For example, the first set of bars on the left (0-10%) indicate absolute exposure disparity for the population living in the subset of locations that have between 0% and 10% of residents from minoritized racial/ethnic groups compared to all locations. Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (county) and darkest color indicating finest spatial scale (block). Bar indicates the absolute disparity in median exposure for each group compared to the median exposure for the total population, circle indicates the absolute disparity in population-weighted mean exposure, and the “x” indicates the absolute disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the population living within the subset of locations experiences higher levels of air pollution exposure compared to the total population (across all locations). “Minoritized racial/ethnic group” is defined as any census racial/ethnic group other than “White alone, not Hispanic or Latino.”*



**Figure S17. National relative disparity (%) in exposure (location-based) to (a) nitrogen dioxide and (b) fine particulate matter in 2010 calculated using four different spatial scales of data aggregation (county, tract, block group, block) for populations in locations grouped by defined intervals of percent minoritized racial/ethnic group residents.** For example, the first set of bars on the left (0-10%) indicate absolute exposure disparity for the population living in the subset of locations that have between 0% and 10% of residents from minoritized racial/ethnic groups compared to all locations. Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (county) and darkest color indicating finest spatial scale (block). Bar indicates the relative disparity in median exposure for each group compared to the median exposure for the total population, circle indicates the relative disparity in population-weighted mean exposure, and the “x” indicates the relative disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the population living within the subset of locations experiences higher levels of air pollution exposure compared to the total population (across all locations). “Minoritized racial/ethnic group” is defined as any census racial/ethnic group other than “White alone, not Hispanic or Latino.”

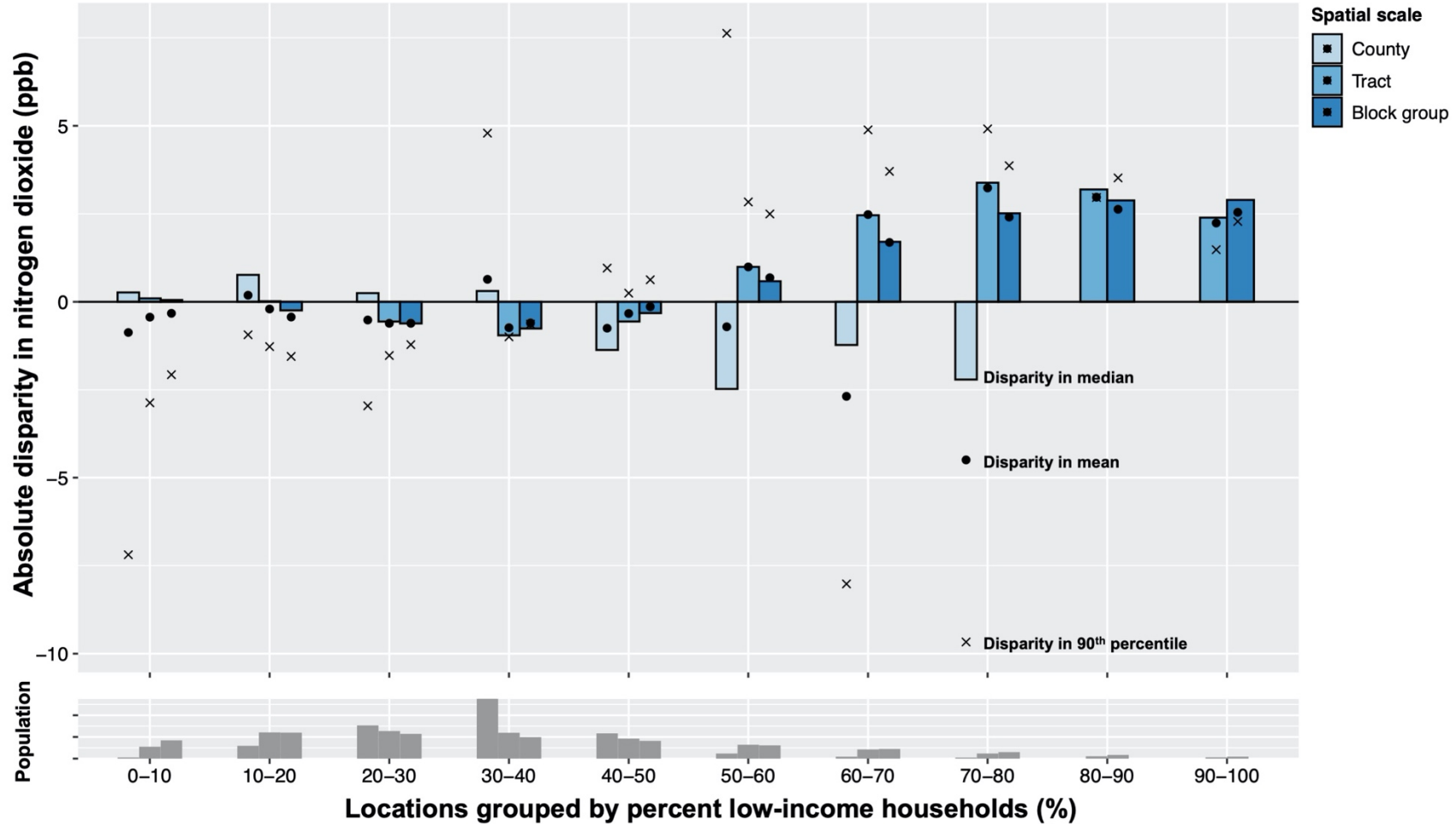


**Figure S18. National exposure (location-based) to nitrogen dioxide (ppb NO<sub>2</sub>) in 2010 calculated using three different spatial scales of data aggregation (county, tract, block group) for locations grouped by defined intervals of low-income residents.** For example, the second set of boxes from the left (0-10%) indicate exposures for all counties, tracts, and block groups that have between 0% and 10% of households defined as low-income. Color of box indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (county) and darkest color indicating finest spatial scale (block group). Circle indicates the population-weighted mean exposure. Box and whiskers indicate the 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> population-weighted percentiles of exposure. “Low-income” is defined as households with annual income below two times the national poverty level.

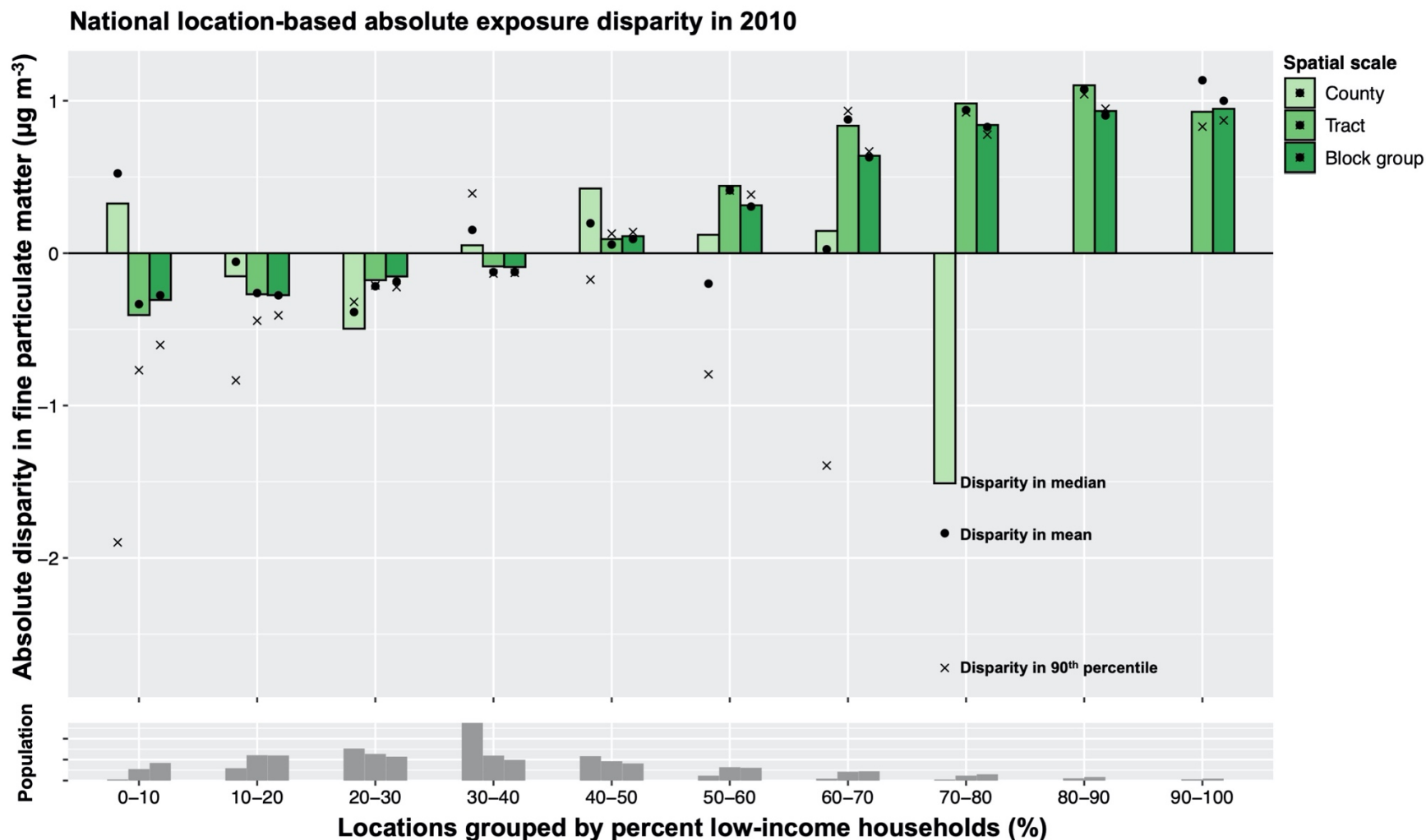


**Figure S19.** National exposure (location-based) to fine particulate matter ( $\mu\text{g m}^{-3}$   $\text{PM}_{2.5}$ ) in 2010 calculated using three different spatial scales of data aggregation (county, tract, block group) for locations grouped by defined intervals of low-income residents. For example, the second set of boxes from the left (0-10%) indicate exposures for all counties, tracts, and block groups that have between 0% and 10% of households defined as low-income. Color of box indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (county) and darkest color indicating finest spatial scale (block group). Circle indicates the population-weighted mean exposure. Box and whiskers indicate the 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> population-weighted percentiles of exposure. “Low-income” is defined as households with annual income below two times the national poverty level.

### National location-based absolute exposure disparity in 2010



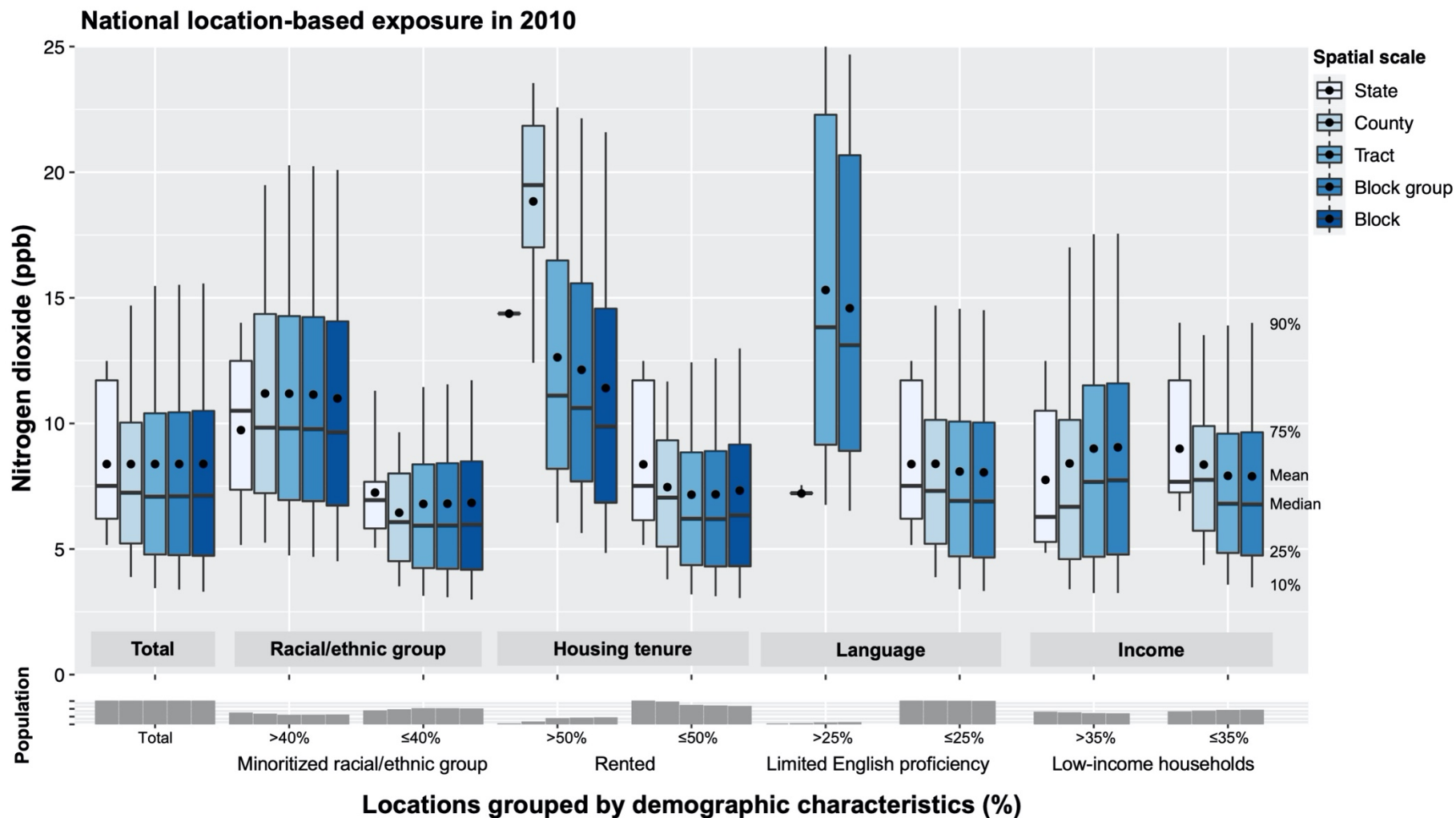
**Figure S20. National absolute disparity in exposure (location-based) to nitrogen dioxide (ppb NO<sub>2</sub>) in 2010 calculated using three different spatial scales of data aggregation (county, tract, block group) for populations in locations grouped by defined intervals of low-income residents.** For example, the first set of bars on the left (0-10%) indicate absolute exposure disparity for the population living in the subset of locations that have between 0% and 10% households defined as low-income compared to all locations. Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (county) and darkest color indicating finest spatial scale (block group). Bar indicates the absolute disparity in median exposure for each group compared to the median exposure for the total population, circle indicates the absolute disparity in population-weighted mean exposure, and the “x” indicates the absolute disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the population living within the subset of locations experiences higher levels of air pollution exposure compared to the total population (across all locations). “Low-income” is defined as households with annual income below two times the national poverty level.



*Figure S21. National absolute disparity in exposure (location-based) to fine particulate matter ( $\mu\text{g m}^{-3}$   $\text{PM}_{2.5}$ ) in 2010 calculated using three different spatial scales of data aggregation (county, tract, block group) for populations in locations grouped by defined intervals of low-income residents. For example, the first set of bars on the left (0-10%) indicate absolute exposure disparity for the population living in the subset of locations that have between 0% and 10% households defined as low-income compared to all locations. Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (county) and darkest color indicating finest spatial scale (block group). Bar indicates the absolute disparity in median exposure for each group compared to the median exposure for the total population, circle indicates the absolute disparity in population-weighted mean exposure, and the “x” indicates the absolute disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the population living within the subset of locations experiences higher levels of air pollution exposure compared to the total population (across all locations). “Low-income” is defined as households with annual income below two times the national poverty level.*

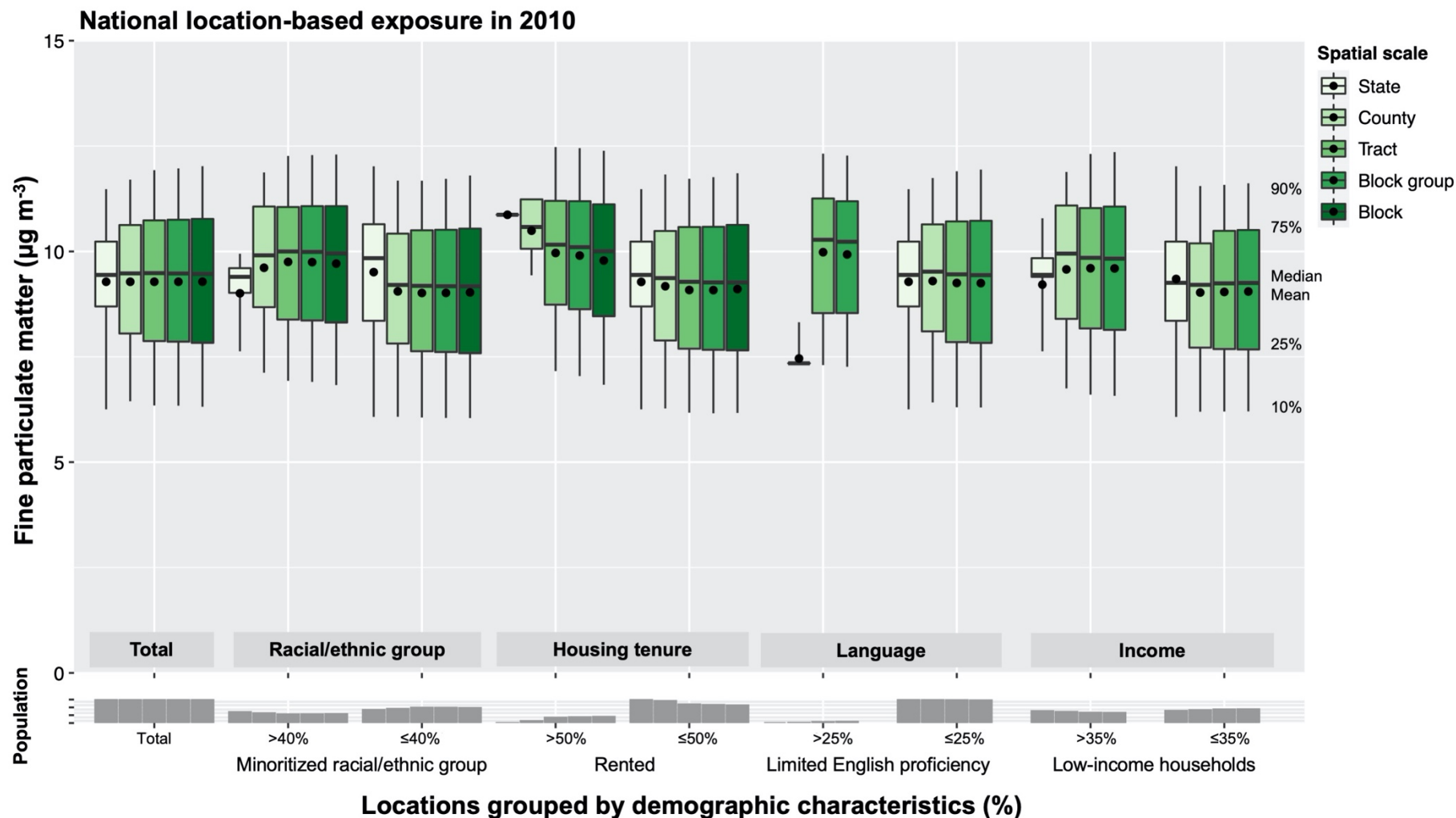


**Figure S22. National relative disparity (%) in exposure (location-based) to (a) nitrogen dioxide and (b) fine particulate matter in 2010 calculated using three different spatial scales of data aggregation (county, tract, block group) for populations in locations grouped by defined intervals of low-income residents. For example, the first set of bars on the left (0-10%) indicate the relative exposure disparity for the population living in the subset of locations that have between 0% and 10% households defined as low-income compared to all locations. Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (county) and darkest color indicating finest spatial scale (block group). Bar indicates the relative disparity in median exposure for each group compared to the median exposure for the total population, circle indicates the relative disparity in population-weighted mean exposure, and the “x” indicates the relative disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the population living within the subset of locations experiences higher levels of air pollution exposure compared to the total population (across all locations). “Low-income” is defined as households with annual income below two times the national poverty level.**



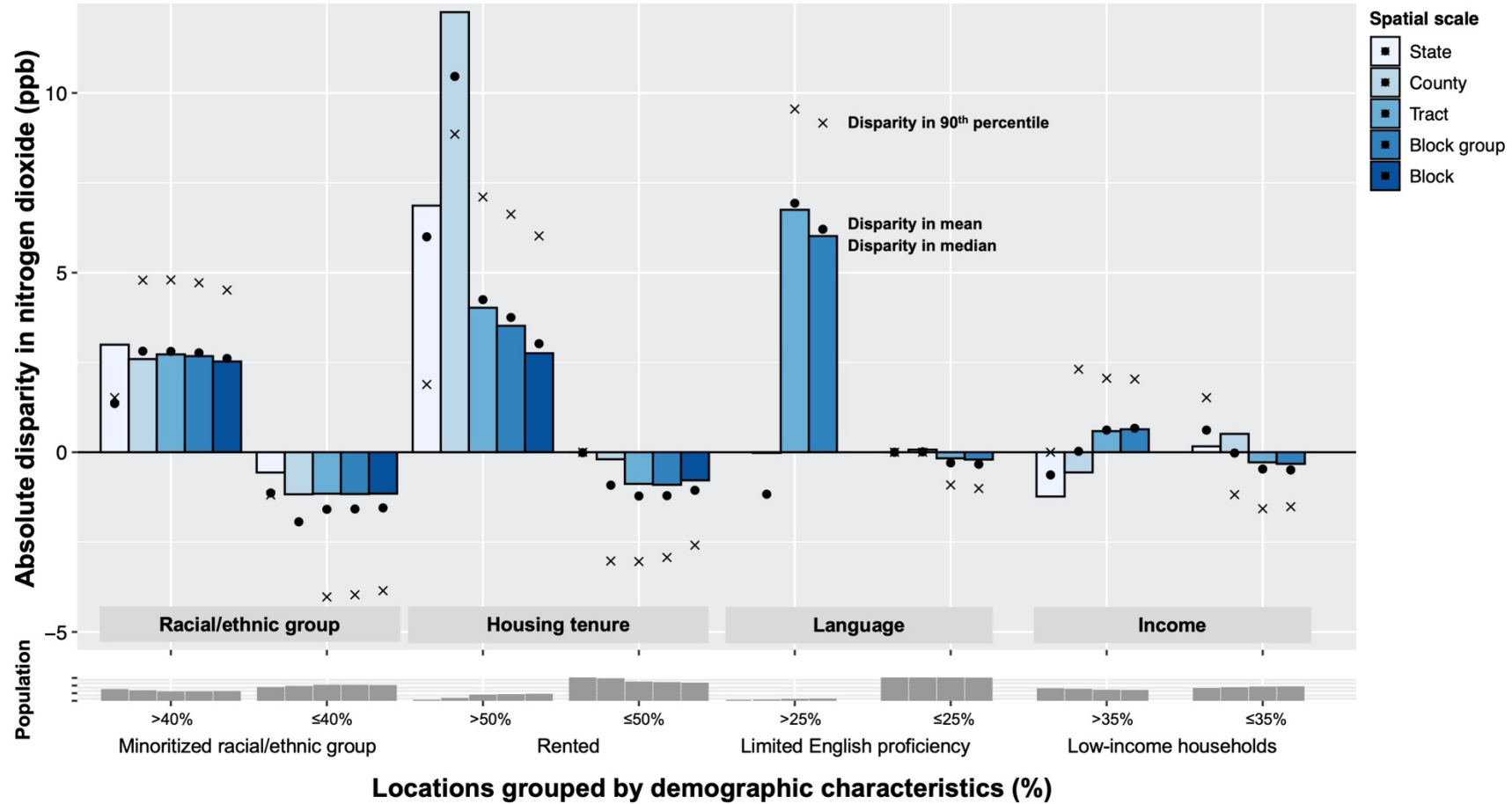
**Figure S23. National exposure (location-based) to nitrogen dioxide (ppb NO<sub>2</sub>) in 2010 calculated using five different spatial scales of data aggregation (state, county, tract, block group, block) for locations grouped based on racial/ethnic group, housing tenure, household income, and language.** Color of box indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block). Circle indicates the population-weighted mean exposure. Box and whiskers indicate the 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> population-weighted percentiles of exposure. “Minoritized racial/ethnic group” is defined as any census racial/ethnic group other than “White alone, not Hispanic or Latino,” “low-income” is defined as households with annual income below two times the national poverty level, and “limited English proficiency” is defined as households in which no one age 14 years and over speaks English well or very well (i.e., census linguistically isolated households). Thresholds used for grouping locations based on racial/ethnic group, household income, and language are based on US state environmental justice policies<sup>1,2</sup>



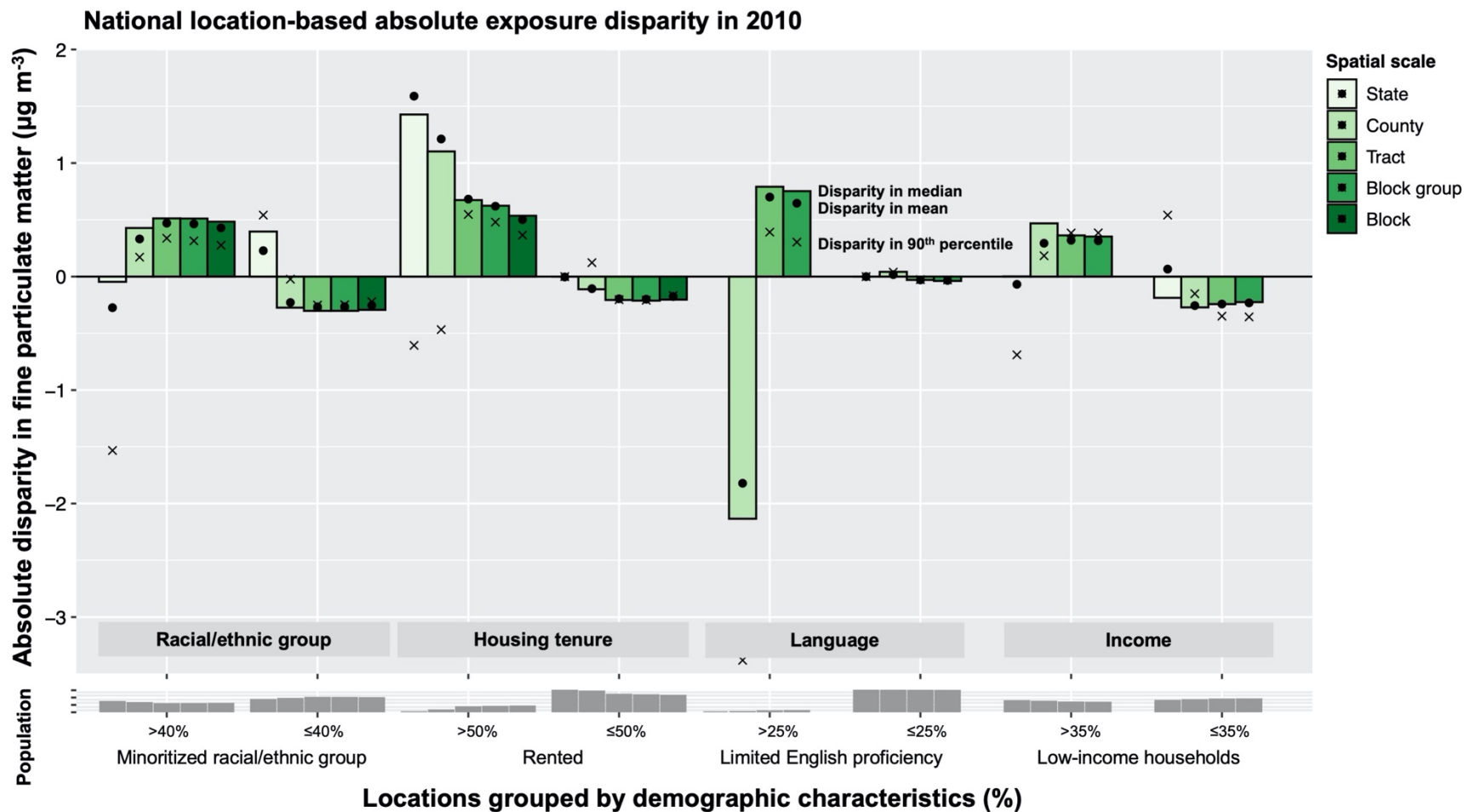


**Figure S24. National exposure (location-based) to fine particulate matter ( $\mu\text{g m}^{-3}$   $\text{PM}_{2.5}$ ) in 2010 calculated using five different spatial scales of data aggregation (state, county, tract, block group, block) for locations grouped based on racial/ethnic group, housing tenure, household income, and language. Color of box indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block). Circle indicates the population-weighted mean exposure. Box and whiskers indicate the 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> population-weighted percentiles of exposure. “Minoritized racial/ethnic group” is defined as any census racial/ethnic group other than “White alone, not Hispanic or Latino,” “low-income” is defined as households with annual income below two times the national poverty level, and “limited English proficiency” is defined as households in which no one age 14 years and over speaks English well or very well (i.e., census linguistically isolated households). Thresholds used for grouping locations based on racial/ethnic group, household income, and language are based on US state environmental justice policies<sup>1,2</sup>.**

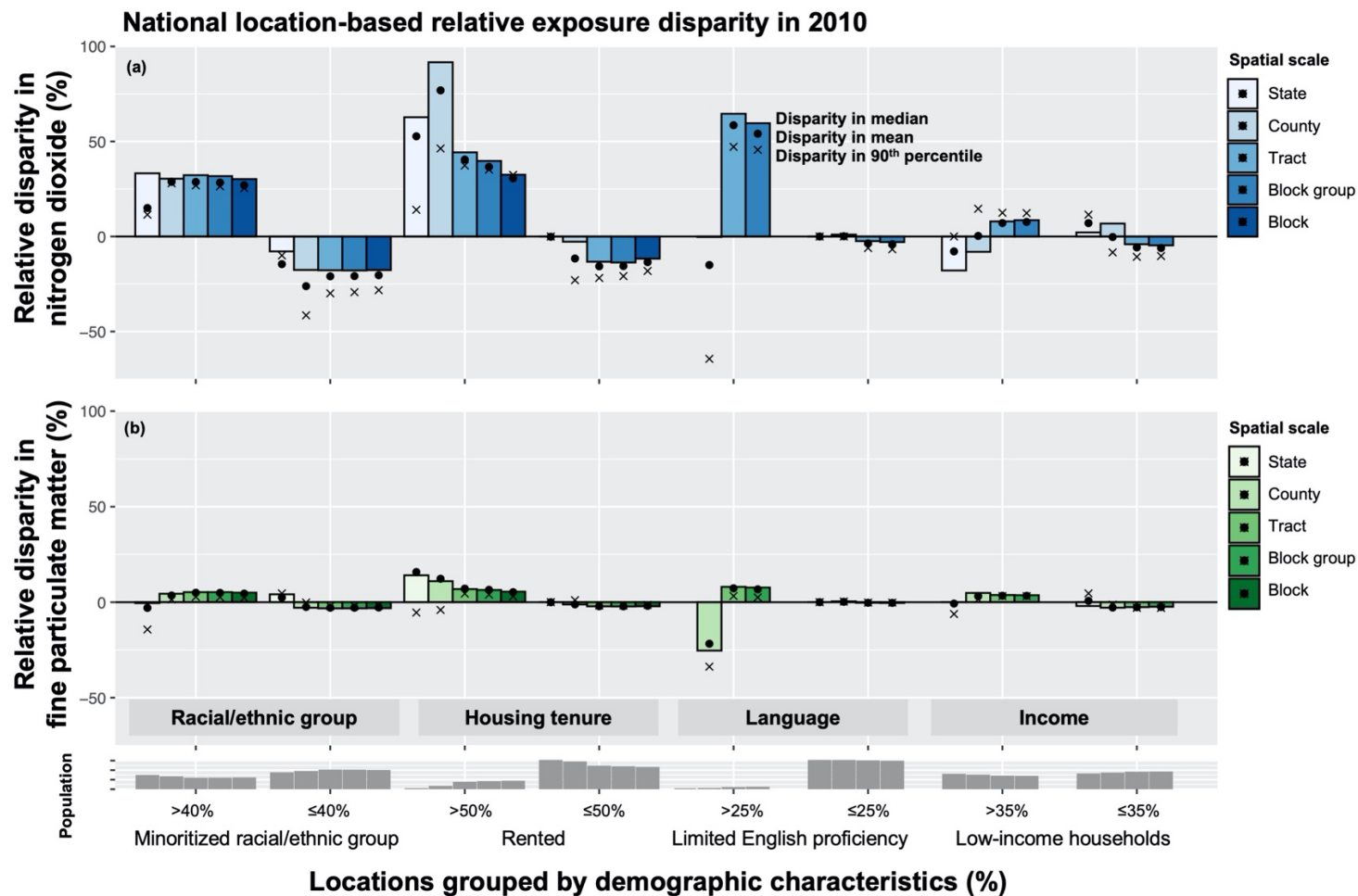
### National location-based absolute exposure disparity in 2010



**Figure S25. National absolute disparity in exposure (location-based) to nitrogen dioxide (ppb NO<sub>2</sub>) in 2010 calculated using five different spatial scales of data aggregation (state, county, tract, block group, block) for locations grouped based on racial/ethnic group, housing tenure, household income, and language.** Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block). Bar indicates the absolute disparity in median exposure for each group compared to the median exposure for the total population (across all locations), circle indicates the absolute disparity in population-weighted mean exposure, and the “x” indicates the absolute disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the population living within the subset of locations experiences higher levels of air pollution exposure compared to the total population (across all locations). “Minoritized racial/ethnic group” is defined as any census racial/ethnic group other than “White alone, not Hispanic or Latino,” “low-income” is defined as households with annual income below two times the national poverty level, and “limited English proficiency” is defined as households in which no one age 14 years and over speaks English well or very well (i.e., census linguistically isolated households). Thresholds used for grouping locations based on racial/ethnic group, household income, and language are based on US state environmental justice policies<sup>1,2</sup>.

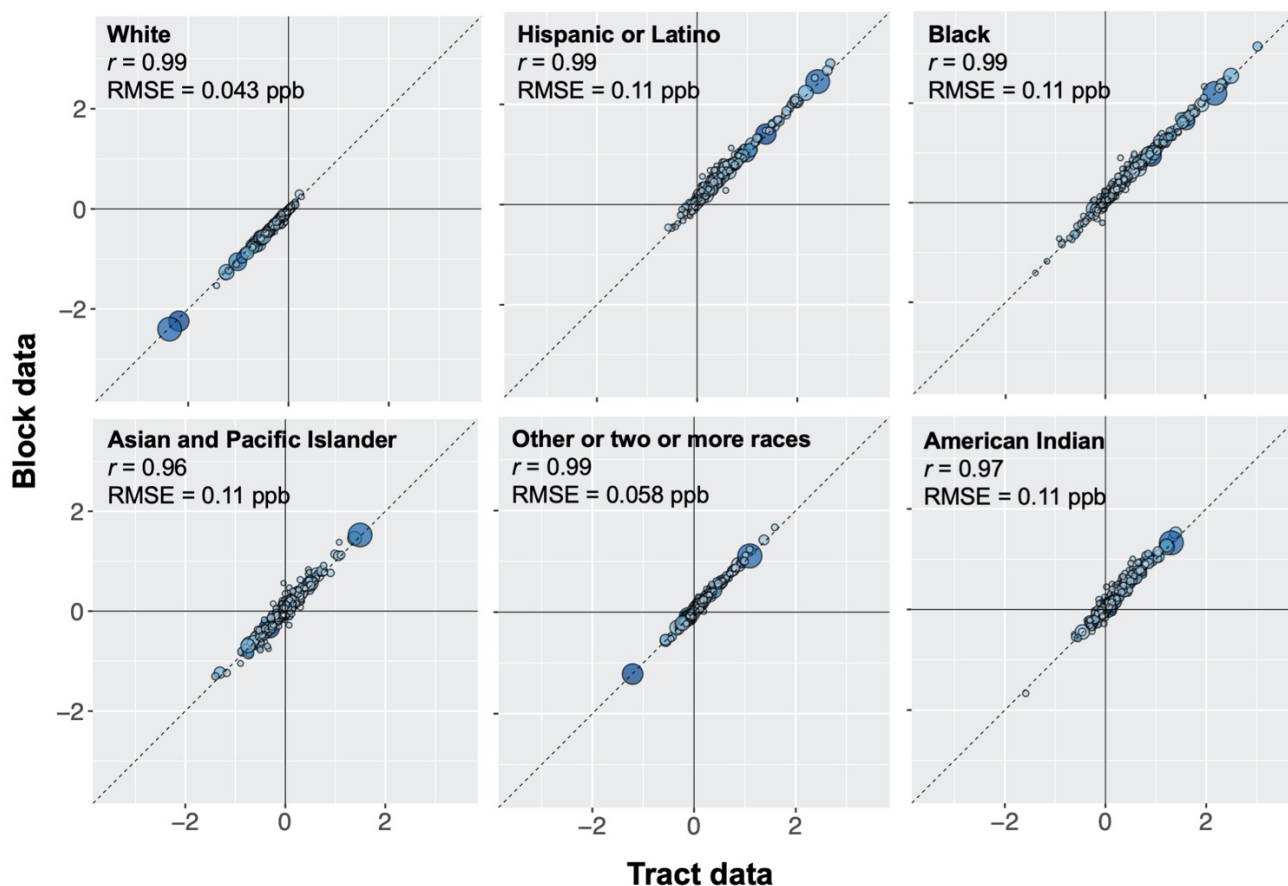


**Figure S26. National absolute disparity in exposure (location-based) to fine particulate matter ( $\mu\text{g m}^{-3}$   $\text{PM}_{2.5}$ ) in 2010 calculated using five different spatial scales of data aggregation (state, county, tract, block group, block) for locations grouped based on racial/ethnic group, housing tenure, household income, and language. Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block). Bar indicates the absolute disparity in median exposure for each group compared to the median exposure for the total population (across all locations), circle indicates the absolute disparity in population-weighted mean exposure, and the “x” indicates the absolute disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the population living within the subset of locations experiences higher levels of air pollution exposure compared to the total population (across all locations). “Minoritized racial/ethnic group” is defined as any census racial/ethnic group other than “White alone, not Hispanic or Latino,” “low-income” is defined as households with annual income below two times the national poverty level, and “limited English proficiency” is defined as households in which no one age 14 years and over speaks English well or very well (i.e., census linguistically isolated households). Thresholds used for grouping locations based on racial/ethnic group, household income, and language are based on US state environmental justice policies<sup>1,2</sup>.**



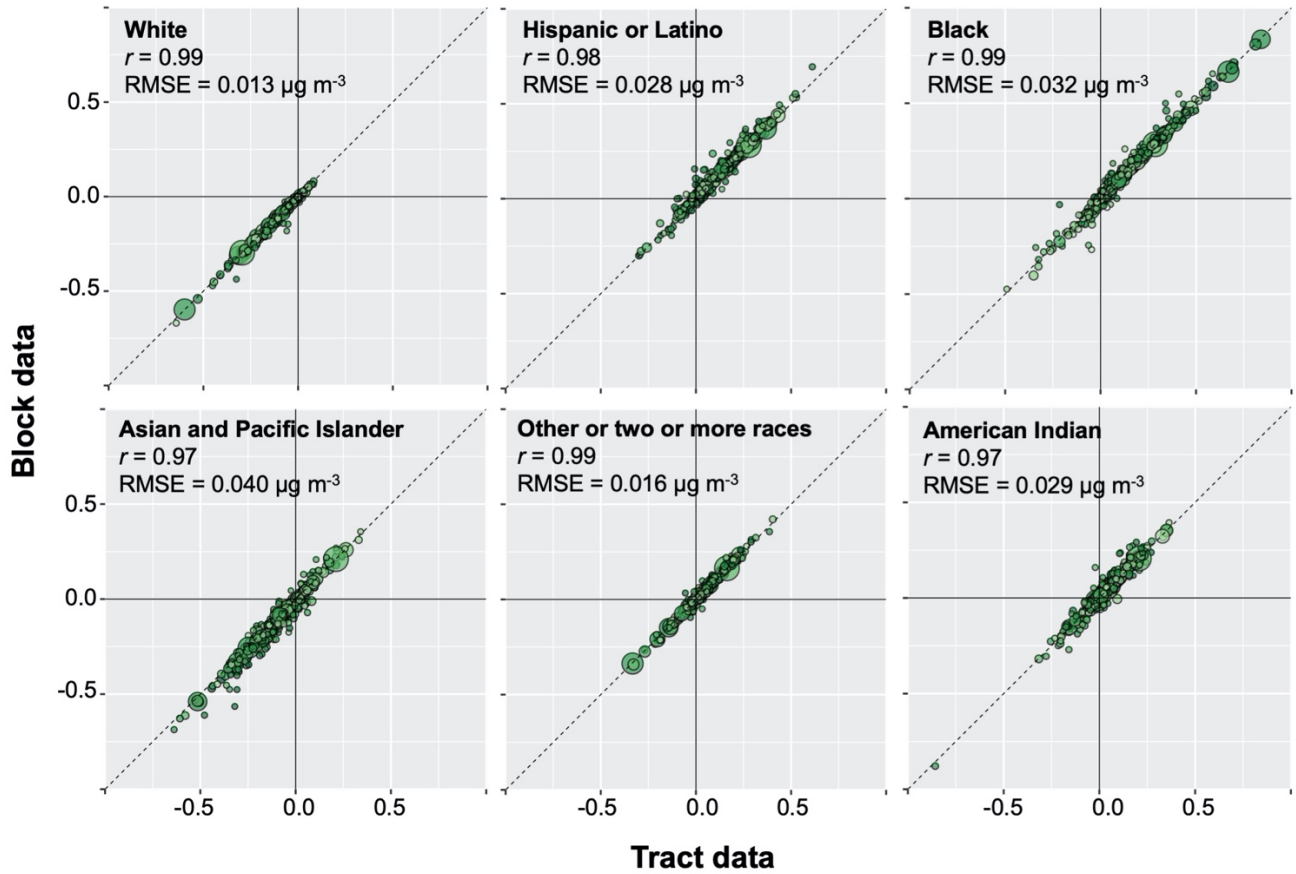
**Figure S27. National relative disparity (%) in exposure (location-based) to (a) nitrogen dioxide and (b) fine particulate matter in 2010 calculated using five different spatial scales of data aggregation (state, county, tract, block group, block) for locations grouped based on racial/ethnic group, housing tenure, household income, and language.** Color of bar indicates spatial scale of data aggregation, with lightest color indicating the coarsest spatial scale (state) and darkest color indicating finest spatial scale (block). Bar indicates the relative disparity in median exposure for each group compared to the median exposure for the total population (across all locations), circle indicates the relative disparity in population-weighted mean exposure, and the “x” indicates the relative disparity in 90<sup>th</sup> percentile exposure. Positive values indicate that the population living within the subset of locations experiences higher levels of air pollution exposure compared to the total population (across all locations). “Minoritized racial/ethnic group” is defined as any census racial/ethnic group other than “White alone, not Hispanic or Latino,” “low-income” is defined as households with annual income below two times the national poverty level, and “limited English proficiency” is defined as households in which no one age 14 years and over speaks English well or very well (i.e., census linguistically isolated households). Thresholds used for grouping locations based on racial/ethnic group, household income, and language are based on US state environmental justice policies<sup>1,2</sup>.

### Intra-urban absolute disparity in mean exposure to nitrogen dioxide (ppb)



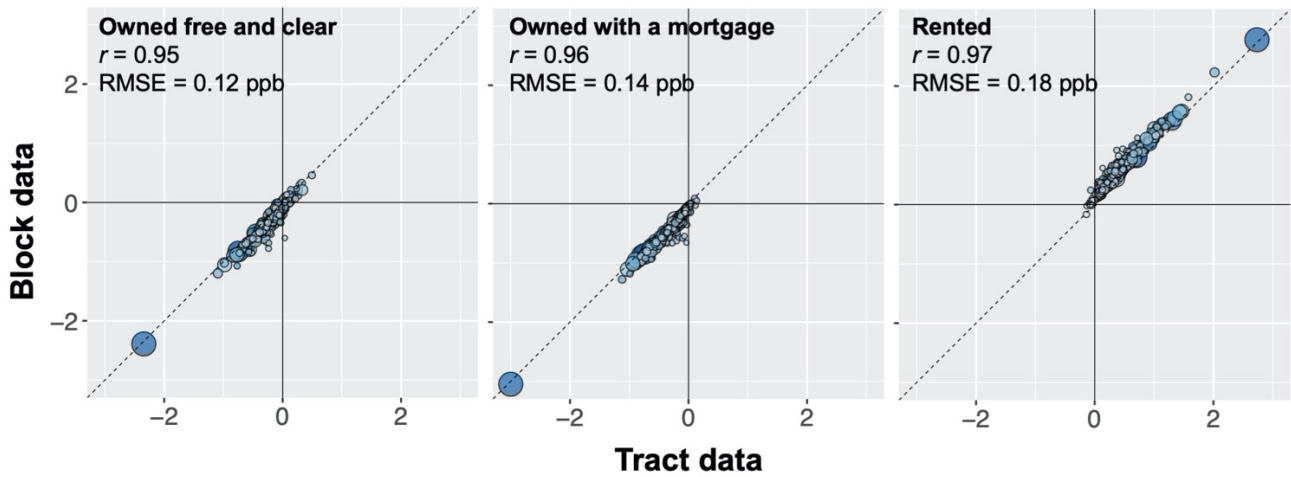
*Figure S28. Intra-urban absolute disparity in mean exposure (population-based) to nitrogen dioxide (ppb NO<sub>2</sub>) in 2010 calculated using block versus tract spatial scale of data aggregation for six racial/ethnic groups compared to the total population (n = 481 urban areas). Color of circle indicates the urban area mean pollution level, and area of circle indicates the population of the urban area. Positive values indicate that the population-weighted mean concentration is higher for that racial/ethnic group than for the total population within that urban area. The dashed line (1:1) represents perfect agreement between disparities calculated using block versus tract data. (Racial/ethnic groups do not include Hispanic or Latino populations, except for the “Hispanic or Latino” group.)*

### Intra-urban absolute disparity in mean exposure to fine particulate matter ( $\mu\text{g m}^{-3}$ )



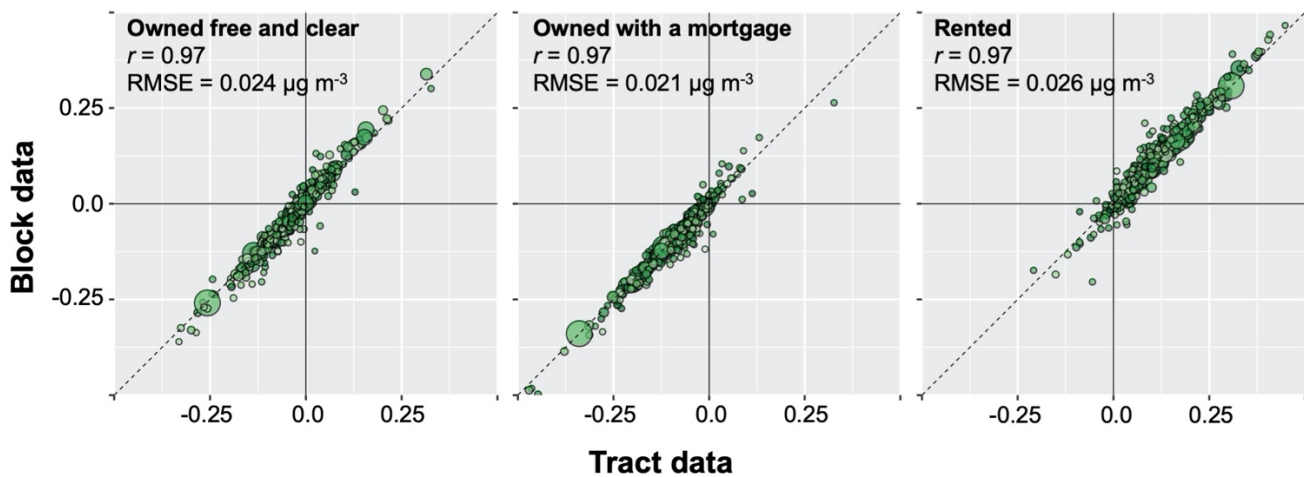
**Figure S29. Intra-urban absolute disparity in mean exposure (population-based) to fine particulate matter ( $\mu\text{g m}^{-3}$   $\text{PM}_{2.5}$ ) in 2010 calculated using block versus tract spatial scale of data aggregation for six racial/ethnic groups compared to the total population ( $n = 481$  urban areas). Color of circle indicates the urban area mean pollution level, and area of circle indicates the population of the urban area. Positive values indicate that the population-weighted mean concentration is higher for that racial/ethnic group than for the total population within that urban area. The dashed line (1:1) represents perfect agreement between disparities calculated using block versus tract data. (Racial/ethnic groups do not include Hispanic or Latino populations, except for the “Hispanic or Latino” group.)**

### Intra-urban absolute disparity in mean exposure to nitrogen dioxide (ppb)

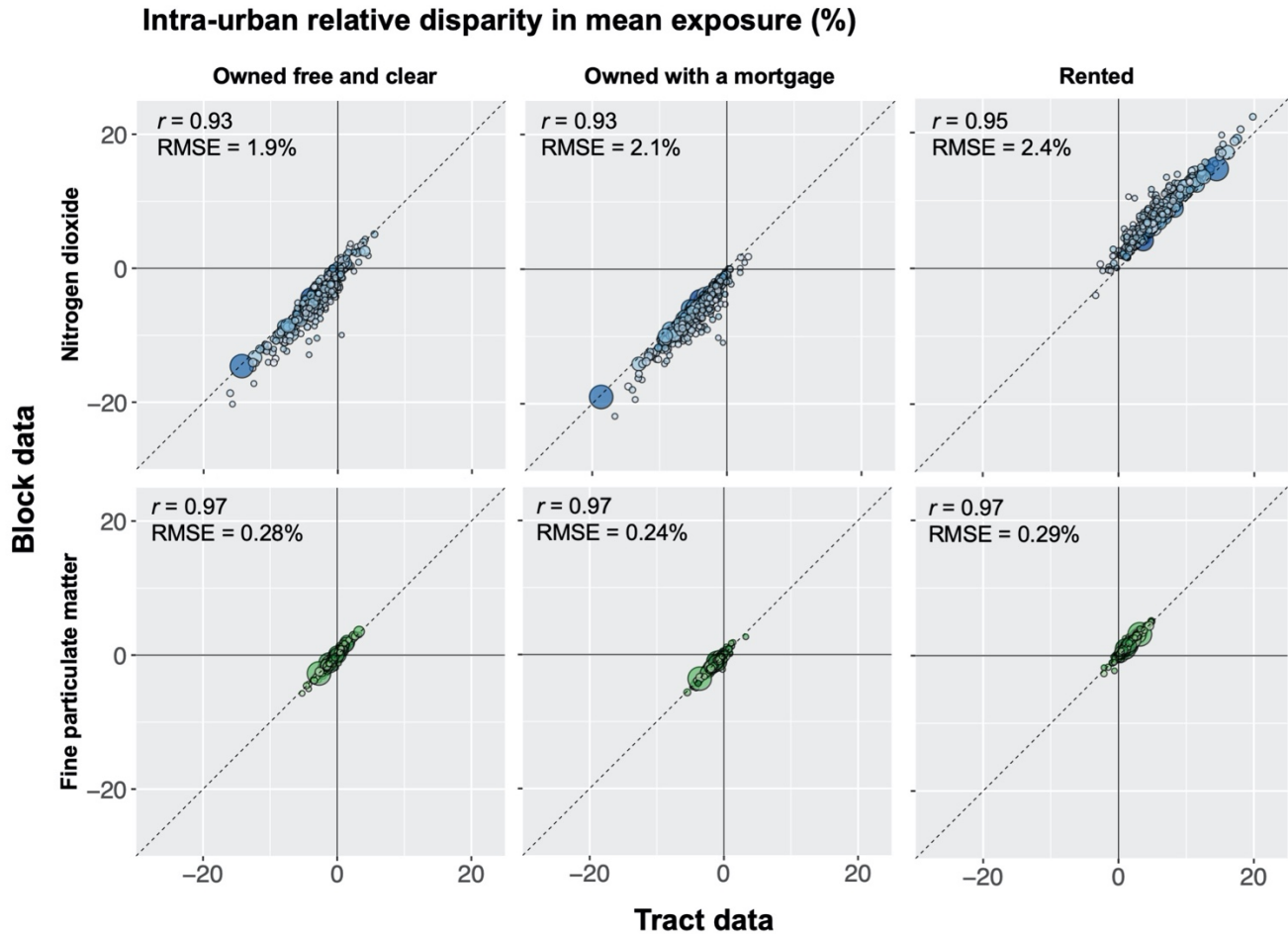


*Figure S30. Intra-urban absolute disparity in mean exposure (population-based) to nitrogen dioxide (ppb NO<sub>2</sub>) in 2010 calculated using block versus tract spatial scale of data aggregation for three housing tenure groups compared to the total population (n = 481 urban areas). Color of circle indicates the urban area mean pollution level, and area of circle indicates the population of the urban area. Positive values indicate that the population-weighted mean concentration is higher for that housing tenure group than for the total population within that urban area. The dashed line (1:1) represents perfect agreement between disparities calculated using block versus tract data.*

### Intra-urban absolute disparity in mean exposure to fine particulate matter ( $\mu\text{g m}^{-3}$ )



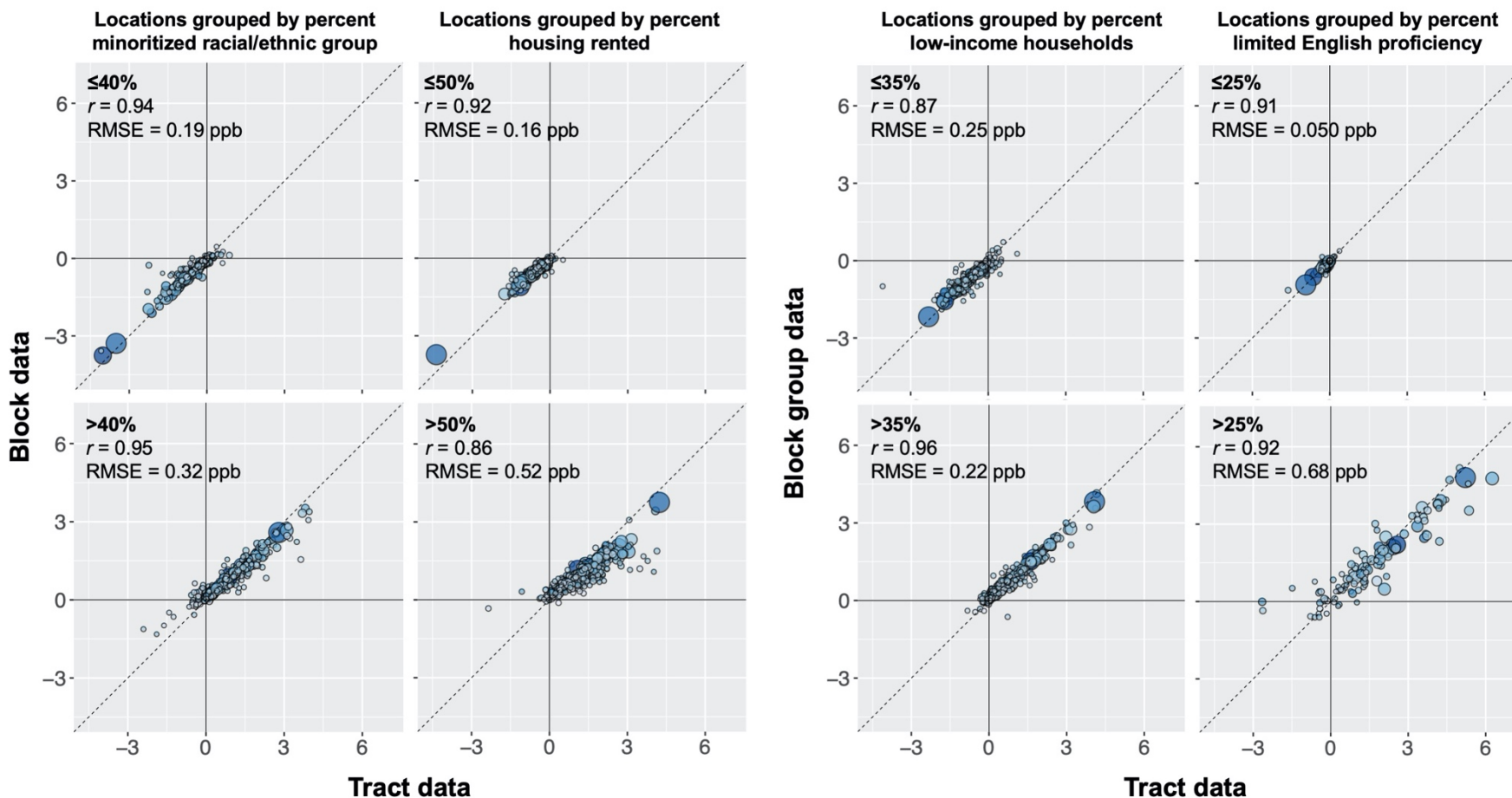
*Figure S31. Intra-urban absolute disparity in mean exposure (population-based) to fine particulate matter ( $\mu\text{g m}^{-3}$  PM<sub>2.5</sub>) in 2010 calculated using block versus tract spatial scale of data aggregation for three housing tenure groups compared to the total population (n = 481 urban areas). Color of circle indicates the urban area mean pollution level, and area of circle indicates the population of the urban area. Positive values indicate that the population-weighted mean concentration is higher for that housing tenure group than for the total population within that urban area. The dashed line (1:1) represents perfect agreement between disparities calculated using block versus tract data.*



*Figure S32. Intra-urban relative disparity (%) in mean exposure (population-based) to nitrogen dioxide and fine particulate matter in 2010 calculated using block versus tract spatial scale of data aggregation for three housing tenure groups compared to the total population ( $n = 481$  urban areas). Color of circle indicates the urban area mean pollution level, and area of circle indicates the population of the urban area. Positive values indicate that the population-weighted mean concentration is higher for that housing tenure group than for the total population within that urban area. The dashed line (1:1) represents perfect agreement between disparities calculated using block versus tract data.*

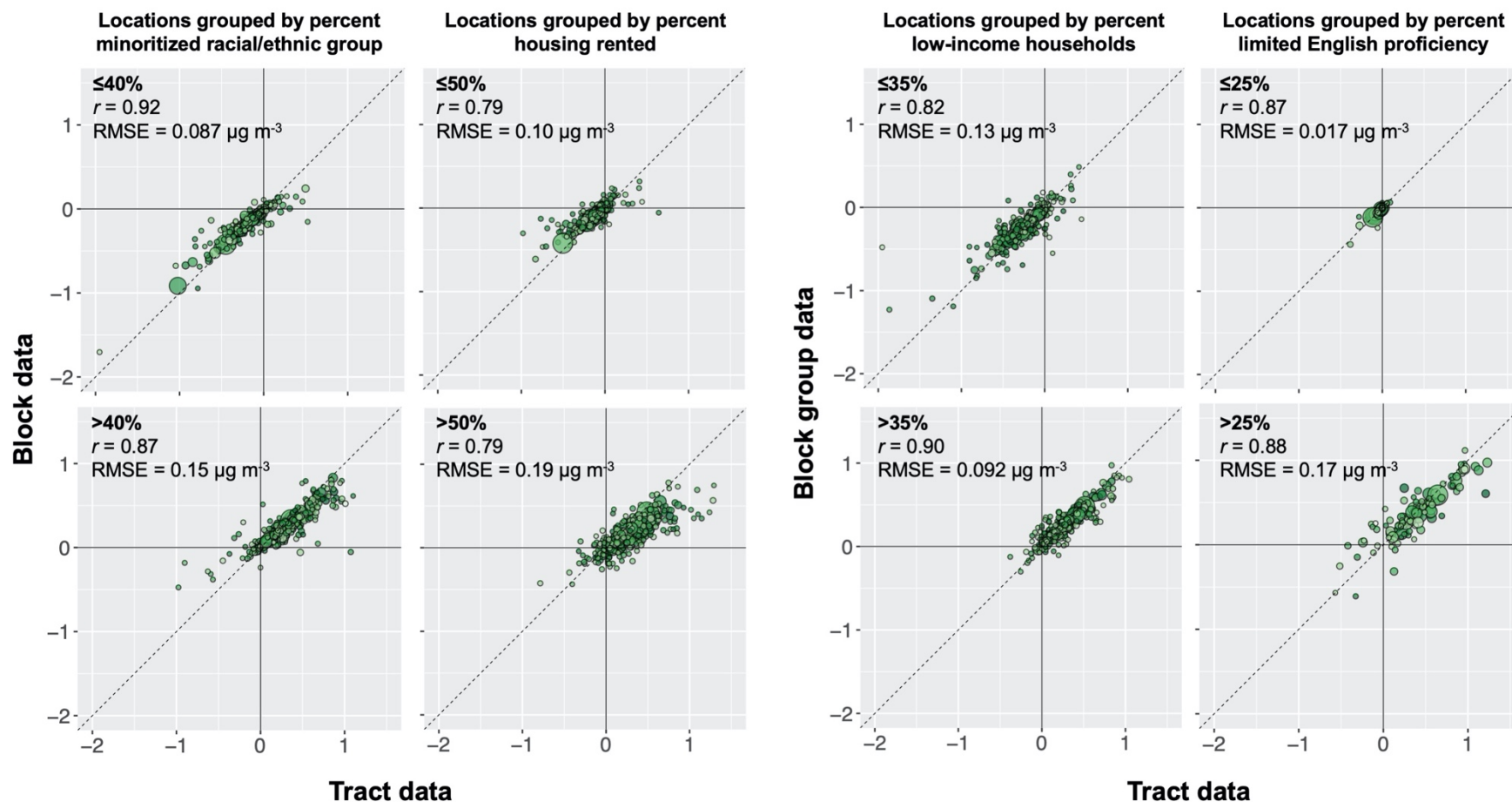


### Intra-urban location-based absolute disparity in mean exposure nitrogen dioxide (ppb)

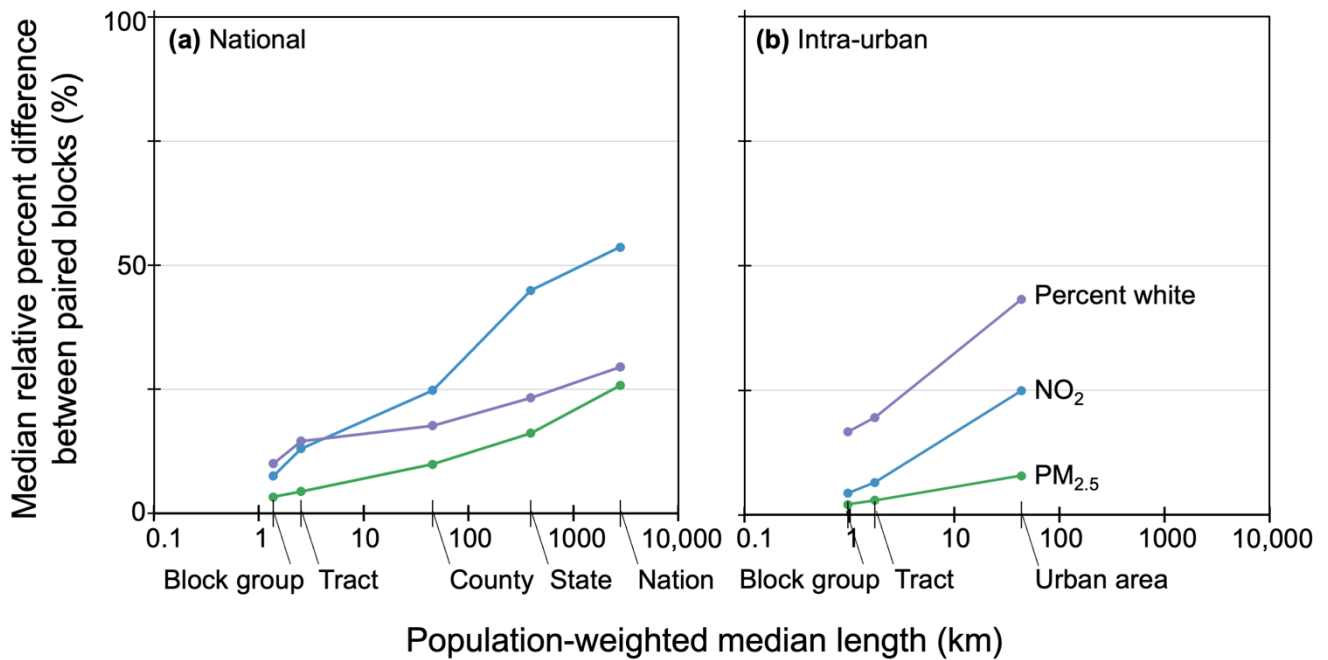


**Figure S33. Intra-urban absolute disparity in mean exposure (location-based) to nitrogen dioxide (ppb NO<sub>2</sub>) in 2010 calculated using block versus tract spatial scale of data aggregation for locations grouped by percent minoritized racial/ethnic group population and by percent housing rented (left panels) and using block group versus tract spatial scale of data aggregation for locations grouped by percent low-income households and percent limited English proficiency (right panels) (n = 481 urban areas).** Color of circle indicates the urban area mean pollution level, and area of circle indicates the population of the urban area. Positive values indicate that the population-weighted mean concentration is higher for the population in the subset of locations than for the total population within that urban area. The dashed line (1:1) represents perfect agreement between disparities calculated using block (or block group) versus tract data. Thresholds used for grouping locations based on racial/ethnic group, household income, and language are based on US state environmental justice policies<sup>1,2</sup>.

### Intra-urban location-based absolute disparity in fine particulate matter ( $\mu\text{g m}^{-3}$ )



**Figure S34. Intra-urban absolute disparity in mean exposure (location-based) to fine particulate matter ( $\mu\text{g m}^{-3}$   $\text{PM}_{2.5}$ ) in 2010 calculated using block versus tract spatial scale of data aggregation for locations grouped by percent minoritized racial/ethnic group population and by percent housing rented (left panels) and using block group vs. tract spatial scale of data aggregation for locations grouped by percent low-income households and percent limited English proficiency (right panels) ( $n = 481$  urban areas). Color of circle indicates the urban area mean pollution level, and area of circle indicates the population of the urban area. Positive values indicate that the population-weighted mean concentration is higher for the population in the subset of locations than for the total population within that urban area. The dashed line (1:1) represents perfect agreement between disparities calculated using block (or block group) versus tract data. Thresholds used for grouping locations based on racial/ethnic group, household income, and language are based on US state environmental justice policies<sup>1,2</sup>.**



**Figure S35. Median relative percent difference (%) in percent White (i.e., White alone, not Hispanic or Latino) population, nitrogen dioxide (NO<sub>2</sub>) concentration, and fine particulate matter (PM<sub>2.5</sub>) concentration within different spatial scales of data aggregation at the (a) national scale and (b) intra-urban scale. The population-weighted median length (km) for each spatial scale (i.e., block groups, tracts, etc.) is calculated as in Table 1 and presented here in log-scale. This figure illustrates differences in variability in race/ethnicity and in air pollution by spatial scale, with higher values (i.e., higher median relative percent differences) indicating higher variability among blocks at that spatial scale. Median relative percent differences are calculated based on random samples of 10,000 blocks in the contiguous US; details are in SI section “Analysis of variability in air pollution and demographic data by spatial scale”.**