***Methods section***

1. **Study area and time points**
2. **Census data**
3. **Asthma incidence and prevalence rates**
4. **Exposure assessment models**
5. **Concentration-response function**
6. **Burden of disease model**
7. **Statistical software**

***Results***

1. **Asthma incident cases**
2. **Attributable number of asthma incident cases**
3. **Attributable number of asthma incident cases by living location**
4. **Attributable number of asthma incident cases by median household income**

***Tables***

1. **Census data description**

|  |  |  |
| --- | --- | --- |
| Geographic characteristics | Total populated census blocks | 6,182,882 |
| Total census-designated urban areas | 3,590,278 |
| Demographic characteristics | Total population | 306,675,006 |
| Total population of children (birth – 18) | 73,690,271 (24%) |
| Mean (range) number of children in census blocks | 12 (0-2214) |
| Population of children by living location | Rural | 13,763,183 (19%) |
| Urban clusters (≥2,500 and <50,000 people) | 6,994,464 (9%) |
| Urbanized area (≥50,000 people) | 52,932,624 (72%) |
| Population of children by median household income | <20,000 | 2,614,804 (4%) |
| 20,000 to <35,000 | 12,770,843 (17%) |
| 35,000 to <50,000 | 18,573,954 (25%) |
| 50,000 to <75,000 | 21,953,876 (30%) |
| ≥75,000 | 17,763,239 (24%) |

1. **Summary of pollutant concentrations using populated census blocks only**

|  |  |
| --- | --- |
| **NO2 µg/m3** |  |
| Mean |  |
| Min |  |
| 25% |  |
| 50% |  |
| 75% |  |
| Max |  |

1. **Total childhood asthma incident cases, attributable number of cases, and percentage of cases due to NO2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | Asthma incident cases | AC | % of all asthma cases |
|  | Total | 754,893 | 132,829 | 17.6 |
| By living location (% of Total) | Rural | 142,559 (19%) | 13,951 (11%) | 9.8 |
| Urban cluster | 71,249 (9%) | 9,296 (7%) | 13.0 |
| Urbanized area | 541,085 (72%) | 109,581 (82%) | 20.3 |
| By median household income (% of Total) | <20,000 | 28,039 (4%) | 5,834 (4%) | 20.8 |
| 20,000 to <35,000 | 134,208 (18%) | 24,906 (19%) | 18.6 |
| 35,000 to <50,000 | 190,481 (25%) | 32,369 (24%) | 17.0 |
| 50,000 to <75,000 | 223,522 (30%) | 37,559 (28%) | 16.8 |
| ≥75,000 | 178,497 (24%) | 32,133 (24%) | 18.0 |

1. **Comparing results of state-specific asthma incidence cases with original incidence rate**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | Asthma incident cases | AC | % of all asthma cases |
|  | Total | 794,934 | 141,931 | 17.9 |
| By living location (% of Total) | Rural | 148,470 (19%) | 14,466 (10%) | 9.7 |
| Urban cluster | 75,453 (9%) | 9,844 (7%) | 13.0 |
| Urbanized area | 571,011 (72%) | 117,621 (83%) | 20.6 |
| By median household income (% of Total) | <20,000 | 28,207 (4%) | 5,892 (4%) | 20.9 |
| 20,000 to <35,000 | 137,765 (17%) | 25,794 (18%) | 18.7 |
| 35,000 to <50,000 | 200,367 (25%) | 34,549 (24%) | 17.2 |
| 50,000 to <75,000 | 236,827 (30%) | 40,540 (29%) | 17.1 |
| ≥75,000 | 191,621 (24%) | 35,128 (25%) | 18.3 |

1. **Comparing results of the burden of disease using state-specific estimates with original estimates (Cases and attributable cases)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | State cases | Origin cases | Diff | % Diff | State AC | Origin AC | Diff | % Diff |
| Total | 754,893 | 794,934 | -40,041 | -5.0% | 132,829 | 141,931 | -9,103 | -6.4% |
| Rural | 142,559 | 148,470 | -5,911 | -4.0% | 13,951 | 14,466 | -514 | -3.6% |
| Urban cluster | 71,249 | 75,453 | -4,204 | -5.6% | 9,296 | 9,844 | -549 | -5.6% |
| Urbanized area | 541,085 | 571,011 | -29,926 | -5.2% | 109,581 | 117,621 | -8,040 | -6.8% |
| <20,000 | 28,039 | 28,207 | -168 | -0.6% | 5,834 | 5,892 | -58 | -1.0% |
| 20,000 to <35,000 | 134,208 | 137,765 | -3,558 | -2.6% | 24,906 | 25,794 | -889 | -3.4% |
| 35,000 to <50,000 | 190,481 | 200,367 | -9,885 | -4.9% | 32,369 | 34,549 | -2,180 | -6.3% |
| 50,000 to <75,000 | 223,522 | 236,827 | -13,305 | -5.6% | 37,559 | 40,540 | -2,981 | -7.4% |
| ≥75,000 | 178,497 | 191,621 | -13,123 | -6.8% | 32,133 | 35,128 | -2,994 | -8.5% |

1. **Comparing results of state-specific attributable fraction with original incidence estimates**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | State AF | Origin AF | Diff | % Diff |
| Total | 17.6% | 17.9% | -0.3% | -1.4% |
| Rural | 9.8% | 9.7% | 0.0% | 0.4% |
| Urban cluster | 13.0% | 13.0% | 0.0% | 0.0% |
| Urbanized area | 20.3% | 20.6% | -0.3% | -1.7% |
| <20,000 | 20.8% | 20.9% | -0.1% | -0.4% |
| 20,000 to <35,000 | 18.6% | 18.7% | -0.2% | -0.9% |
| 35,000 to <50,000 | 17.0% | 17.2% | -0.2% | -1.4% |
| 50,000 to <75,000 | 16.8% | 17.1% | -0.3% | -1.8% |
| ≥75,000 | 18.0% | 18.3% | -0.3% | -1.8% |

1. **Comparing results by state**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| State | State cases | Origin cases | Diff | % Diff | State AC | Origin AC | Diff | % Diff |
| Montana | 866 | 2,412 | -1,546 | -64.1% | 69 | 192 | -123 | -64.1% |
| Louisiana | 5,616 | 12,061 | -6,445 | -53.4% | 653 | 1,401 | -749 | -53.4% |
| Iowa | 4,193 | 7,853 | -3,660 | -46.6% | 519 | 971 | -453 | -46.6% |
| Illinois | 18,264 | 33,756 | -15,492 | -45.9% | 4,509 | 8,333 | -3,824 | -45.9% |
| New Mexico | 3,047 | 5,595 | -2,548 | -45.5% | 471 | 864 | -394 | -45.5% |
| Washington | 9,559 | 17,059 | -7,500 | -44.0% | 1,703 | 3,039 | -1,336 | -44.0% |
| Georgia | 19,165 | 26,878 | -7,713 | -28.7% | 2,772 | 3,887 | -1,115 | -28.7% |
| Kansas | 5,781 | 7,842 | -2,061 | -26.3% | 787 | 1,067 | -281 | -26.3% |
| Maine | 2,196 | 2,962 | -766 | -25.9% | 173 | 234 | -60 | -25.9% |
| California | 75,829 | 100,270 | -24,442 | -24.4% | 19,205 | 25,395 | -6,190 | -24.4% |
| Nebraska | 3,775 | 4,954 | -1,179 | -23.8% | 494 | 648 | -154 | -23.8% |
| New Jersey | 17,281 | 22,278 | -4,997 | -22.4% | 4,155 | 5,357 | -1,202 | -22.4% |
| Oklahoma | 8,619 | 10,029 | -1,410 | -14.1% | 1,154 | 1,342 | -189 | -14.1% |
| Utah | 8,142 | 9,396 | -1,254 | -13.3% | 1,672 | 1,929 | -258 | -13.3% |
| Maryland | 12,849 | 14,595 | -1,746 | -12.0% | 2,454 | 2,787 | -333 | -12.0% |
| Oregon | 8,517 | 9,347 | -829 | -8.9% | 1,180 | 1,295 | -115 | -8.9% |
| Delaware | 2,036 | 2,220 | -184 | -8.3% | 326 | 355 | -29 | -8.3% |
| Vermont | 1,285 | 1,394 | -110 | -7.9% | 126 | 136 | -11 | -7.9% |
| Connecticut | 8,265 | 8,814 | -549 | -6.2% | 1,502 | 1,601 | -100 | -6.2% |
| West Virginia | 4,003 | 4,179 | -176 | -4.2% | 578 | 603 | -25 | -4.2% |
| Alabama | 11,722 | 12,216 | -494 | -4.0% | 1,381 | 1,439 | -58 | -4.0% |
| Michigan | 24,356 | 25,287 | -931 | -3.7% | 4,056 | 4,211 | -155 | -3.7% |
| Kentucky | 10,650 | 11,040 | -389 | -3.5% | 1,591 | 1,649 | -58 | -3.5% |
| Virginia | 19,375 | 19,997 | -622 | -3.1% | 3,323 | 3,430 | -107 | -3.1% |
| New Hampshire | 3,017 | 3,099 | -82 | -2.6% | 329 | 338 | -9 | -2.6% |
| Arkansas | 7,476 | 7,675 | -199 | -2.6% | 864 | 887 | -23 | -2.6% |
| Massachusetts | 14,910 | 15,307 | -396 | -2.6% | 2,473 | 2,539 | -66 | -2.6% |
| South Carolina | 11,354 | 11,656 | -302 | -2.6% | 1,254 | 1,287 | -33 | -2.6% |
| Tennessee | 15,720 | 16,138 | -418 | -2.6% | 2,438 | 2,503 | -65 | -2.6% |
| South Dakota | 2,131 | 2,188 | -57 | -2.6% | 161 | 165 | -4 | -2.6% |
| Colorado | 12,879 | 13,221 | -342 | -2.6% | 3,009 | 3,089 | -80 | -2.6% |
| North Carolina | 23,976 | 24,613 | -637 | -2.6% | 3,099 | 3,182 | -82 | -2.6% |
| Florida | 42,055 | 43,173 | -1,118 | -2.6% | 5,360 | 5,502 | -142 | -2.6% |
| Nevada | 7,170 | 7,174 | -4 | -0.1% | 1,430 | 1,431 | -1 | -0.1% |
| Wyoming | 1,482 | 1,461 | 22 | 1.5% | 144 | 141 | 2 | 1.5% |
| Minnesota | 14,061 | 13,852 | 210 | 1.5% | 2,124 | 2,093 | 32 | 1.5% |
| Wisconsin | 14,694 | 14,450 | 244 | 1.7% | 2,154 | 2,118 | 36 | 1.7% |
| Idaho | 4,724 | 4,629 | 96 | 2.1% | 593 | 581 | 12 | 2.1% |
| North Dakota | 1,652 | 1,617 | 36 | 2.2% | 142 | 139 | 3 | 2.2% |
| Missouri | 15,821 | 15,377 | 445 | 2.9% | 1,898 | 1,845 | 53 | 2.9% |
| Pennsylvania | 31,619 | 30,120 | 1,499 | 5.0% | 6,310 | 6,011 | 299 | 5.0% |
| Rhode Island | 2,679 | 2,416 | 263 | 10.9% | 422 | 380 | 41 | 10.9% |
| Mississippi | 9,101 | 8,151 | 951 | 11.7% | 929 | 832 | 97 | 11.7% |
| New York | 53,600 | 46,655 | 6,945 | 14.9% | 13,504 | 11,754 | 1,750 | 14.9% |
| Ohio | 36,060 | 29,458 | 6,602 | 22.4% | 6,165 | 5,036 | 1,129 | 22.4% |
| Indiana | 21,263 | 17,350 | 3,913 | 22.6% | 3,852 | 3,143 | 709 | 22.6% |
| Arizona | 21,538 | 17,573 | 3,965 | 22.6% | 4,623 | 3,772 | 851 | 22.6% |
| D.C. | 1,433 | 1,088 | 346 | 31.8% | 386 | 293 | 93 | 31.8% |
| Texas | 99,084 | 74,065 | 25,019 | 33.8% | 14,316 | 10,701 | 3,615 | 33.8% |

1. **Air pollution concentration by state**
2. **Air pollution concentration by strata**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Mean | Min | Median | Max |
| Total |  |  |  |  |  |
| By living location | Rural |  |  |  |  |
| Urban cluster |  |  |  |  |
| Urbanized area |  |  |  |  |
| By median household income | <20,000 |  |  |  |  |
| 20,000 to <35,000 |  |  |  |  |
| 35,000 to <50,000 |  |  |  |  |
| 50,000 to <75,000 |  |  |  |  |
| ≥75,000 |  |  |  |  |

1. **Childhood asthma survey summary by count**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **2006** | **2007** | **2008** | **2009** | **2010** |
| Children sample | 55,094 | 59,487 | 61,862 | 59,821 | 57,200 |
| Ever asthma | 7,168 | 7,971 | 8,255 | 8,126 | 7,483 |
| Incident case | 154 | 173 | 169 | 153 | 160 |
| At-risk | 48,080 | 51,689 | 53,776 | 51,848 | 49,877 |

1. **Childhood asthma survey summary by weights**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **2006** | **2007** | **2008** | **2009** | **2010** | **Mean** |
| Weighted sample | 50,674,742 | 43,661,381 | 53,327,550 | 47,747,373 | 39,975,264 | 47,077,262 |
| Ever asthma | 6,493,224 | 5,763,409 | 7,218,400 | 6,279,938 | 5,158,455 | 6,182,685 |
| Incident case | 404,276 | 312,917 | 385,818 | 297,546 | 319,743 | 344,060 |
| At-risk | 30,825,589 | 36,050,557 | 26,491,259 | 25,942,087 | 22,900,850 | 28,442,068 |
| IR per 1,000 | 13.1 | 8.7 | 14.6 | 11.5 | 14.0 | 12.1 |
| PRV per 100 | 12.8 | 13.2 | 13.5 | 13.2 | 12.9 | 13.1 |

1. **Childhood asthma survey summary by state (Total of 2006-2010)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **State** | **BRFSS sample** | **Ever asthma** | **ACBS Sample** | **Incident case** | **At-risk** |
| Arizona | 5,535 | 699 | 103 | 10 | 4,846 |
| California | 11,801 | 1,543 | 172 | 13 | 10,271 |
| Connecticut | 7,112 | 1,132 | 549 | 47 | 6,027 |
| D.C. | 4,101 | 685 | 69 | 6 | 3,422 |
| Georgia | 9,433 | 1,455 | 545 | 26 | 8,004 |
| Illinois | 6,187 | 778 | 122 | 6 | 5,415 |
| Indiana | 9,824 | 1,361 | 500 | 41 | 8,504 |
| Iowa | 8,084 | 724 | 245 | 19 | 7,379 |
| Kansas | 14,699 | 1,839 | 827 | 50 | 12,910 |
| Louisiana | 8,829 | 1,214 | 88 | 4 | 7,619 |
| Maine | 4,523 | 644 | 376 | 23 | 3,902 |
| Maryland | 13,093 | 1,897 | 624 | 44 | 11,240 |
| Michigan | 10,762 | 1,524 | 680 | 43 | 9,281 |
| Mississippi | 10,816 | 1,527 | 208 | 14 | 9,303 |
| Missouri | 5,646 | 814 | 262 | 20 | 4,852 |
| Montana | 8,609 | 909 | 286 | 17 | 7,717 |
| Nebraska | 17,883 | 1,644 | 717 | 53 | 16,292 |
| New Hampshire | 5,285 | 664 | 232 | 19 | 4,640 |
| New Jersey | 15,410 | 2,230 | 458 | 32 | 13,212 |
| New Mexico | 5,554 | 765 | 287 | 17 | 4,806 |
| New York | 7,083 | 1,079 | 404 | 28 | 6,032 |
| Ohio | 7,989 | 1,138 | 351 | 32 | 6,883 |
| Oklahoma | 8,611 | 1,291 | 299 | 21 | 7,341 |
| Oregon | 4,793 | 579 | 165 | 13 | 4,227 |
| Pennsylvania | 14,760 | 2,090 | 209 | 12 | 12,682 |
| Rhode Island | 7,127 | 1,209 | 169 | 11 | 5,929 |
| Texas | 16,749 | 2,293 | 780 | 55 | 14,511 |
| Utah | 14,417 | 1,617 | 573 | 45 | 12,845 |
| Vermont | 8,784 | 1,220 | 597 | 40 | 7,604 |
| Washington | 9,706 | 1,165 | 594 | 33 | 8,574 |
| West Virginia | 5,089 | 663 | 85 | 5 | 4,431 |
| Wisconsin | 5,170 | 611 | 140 | 10 | 4,569 |

1. **Childhood asthma survey weighted summary by state (Total of 2006-2010)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **State** | **Weighted sample** | **Ever asthma** | **Incident case** | **At-risk** | **IR per 1000** | **PRV per 100** |
| Arizona | 6,631,643 | 866,487 | 42,622 | 2,802,422 | 15.2 | 13.1 |
| California | 36,944,762 | 4,513,981 | 156,599 | 16,850,453 | 9.3 | 12.2 |
| Connecticut | 3,216,911 | 515,372 | 32,939 | 2,734,478 | 12.0 | 16.0 |
| D.C. | 550,985 | 109,403 | 3,184 | 179,493 | 17.7 | 19.9 |
| Georgia | 12,211,232 | 1,847,944 | 94,786 | 10,458,074 | 9.1 | 15.1 |
| Illinois | 12,758,371 | 1,580,896 | 37,799 | 5,673,571 | 6.7 | 12.4 |
| Indiana | 7,837,910 | 1,006,366 | 105,219 | 6,936,762 | 15.2 | 12.8 |
| Iowa | 3,410,014 | 287,609 | 11,510 | 1,829,734 | 6.3 | 8.4 |
| Kansas | 3,428,398 | 396,147 | 27,509 | 3,059,760 | 9.0 | 11.6 |
| Louisiana | 2,178,496 | 282,443 | 5,379 | 931,966 | 5.8 | 13.0 |
| Maine | 825,221 | 109,120 | 6,662 | 722,763 | 9.2 | 13.2 |
| Maryland | 6,754,689 | 1,002,976 | 64,871 | 5,816,584 | 11.2 | 14.8 |
| Michigan | 11,990,510 | 1,625,547 | 126,102 | 10,491,065 | 12.0 | 13.6 |
| Mississippi | 3,630,503 | 515,551 | 18,264 | 1,300,917 | 14.0 | 14.2 |
| Missouri | 5,518,464 | 766,864 | 46,410 | 3,600,272 | 12.9 | 13.9 |
| Montana | 1,059,004 | 102,944 | 3,296 | 768,012 | 4.3 | 9.7 |
| Nebraska | 2,201,248 | 204,905 | 18,262 | 2,014,605 | 9.1 | 9.3 |
| New Hampshire | 886,427 | 107,549 | 9,423 | 788,302 | 12.0 | 12.1 |
| New Jersey | 8,196,056 | 1,168,380 | 51,472 | 5,274,310 | 9.8 | 14.3 |
| New Mexico | 1,497,760 | 179,121 | 8,857 | 1,327,496 | 6.7 | 12.0 |
| New York | 17,587,681 | 2,781,426 | 221,226 | 15,027,481 | 14.7 | 15.8 |
| Ohio | 8,133,870 | 997,198 | 71,568 | 4,755,245 | 15.1 | 12.3 |
| Oklahoma | 3,491,913 | 487,287 | 24,628 | 2,285,659 | 10.8 | 14.0 |
| Oregon | 2,525,767 | 281,481 | 8,328 | 752,768 | 11.1 | 11.1 |
| Pennsylvania | 13,667,687 | 1,905,109 | 62,292 | 4,733,925 | 13.2 | 13.9 |
| Rhode Island | 907,043 | 145,915 | 5,476 | 384,117 | 14.3 | 16.1 |
| Texas | 26,030,068 | 3,420,044 | 381,999 | 22,992,023 | 16.6 | 13.1 |
| Utah | 3,963,227 | 404,738 | 30,221 | 2,902,955 | 10.4 | 10.2 |
| Vermont | 646,239 | 89,457 | 6,498 | 563,280 | 11.5 | 13.8 |
| Washington | 3,063,863 | 330,138 | 18,647 | 2,752,373 | 6.8 | 10.8 |
| West Virginia | 1,877,224 | 238,133 | 3,847 | 325,031 | 11.8 | 12.7 |
| Wisconsin | 3,890,403 | 410,615 | 14,404 | 1,174,447 | 12.3 | 10.6 |

***Figures***

**“Never asthma”, “Newly diagnosed asthma case” and “At-risk population” from the Behavioral Risk Factor Surveillance System (BRFSS) and Asthma Call-back Survey (ACBS) data sets, 2006–2010.**

***Boxplots***

1. **NO2 concentration**
2. **NO2 concentration by living location**
3. **NO2 concentration by median income grp**
4. **NO2 concentration by living location stratified into median income grp**
5. **NO2 concentration by median income grp stratified into living location**
6. **NO2 concentration by state**
7. **NO2 concentration by state and living location**
8. **NO2 concentration by state and median income grp**
9. **Attributable Fraction (AF)**
10. **AFconcentration by living location**
11. **AFconcentration by median income grp**
12. **AFconcentration by living location stratified into median income grp**
13. **AFconcentration by median income grp stratified into living location**
14. **AF by state and living location**
15. **AF by state and median income grp**

***Scatter plots***

1. **Total population by NO2 concentration**
2. **Total population by NO2 concentration and living location by color**
3. **Total population by NO2 concentration and Income by color**