*Appendix S1:*

**Additional Methods:**

*National Health and Nutritional Examination Surveys*

Additional details on NHANES sampling design and data collection are available in the NHANES analytic guidelines11 and NHANES laboratory procedure manual12.

*Blood Lead Limit of Detection*

The limit of detection (LOD) for blood lead was 0.3 µg/dL for 2001–2004, 0.25 µg/dL for 2005–2012, and 0.07 for 2013–2016. When the blood lead value was below the LOD, the value used is the detection limit divided by the square root of two12. In our study population, 46 children had a reported BLL below the LOD.

*Statistical Analysis*

Year home was built (pre-1950 versus 1950 or later) was only available in NHANES until 2010. Hence, we assessed age of housing as a potential confounder in a subset analysis from 2001–2010. We considered sex, age group, and race/ethnicity as potential effect modifiers. To evaluate interaction of all dichotomous outcomes, we compared logistic models with covariates and all interaction terms with models containing only covariates. Also, a backwards elimination approach dropped non-statistically significant interaction terms from the model one at a time until only statistically significant terms remained. A two-sided p-value of <0.05 was regarded as statistically significant.

*Supplemental Tables (S1-S5):*

**Table S1**. Blood lead level (BLL) by outcome among children age 1–11 years: NHANES

2001–2016 (n=14,751) †**.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Respiratory outcomes** | **Number with outcome** | **Geometric mean BLL (95% CI)** | **BLL ≥5 µg/dL**  **%**‡**(95% CI)** |
| Current asthma |  |  |  |
| Yes | 1,440 | 1.01 (0.94–1.08) | 2.3 (1.5–3.6) |
| No | 13,260 | 0.99 (0.95–1.02) | 1.7 (1.4–2.1) |
| Eosinophils |  |  |  |
| **≥**500 cells/µL | 2,169 | 1.05 (1.00–1.10) | 2.0 (1.4–2.9) |
| <500 cells/µL | 12,513 | 0.98 (0.95–1.01) | 1.7 (1.4–2.1) |

†Number and percent of missing values: current asthma [n=51, (0.3%)], eosinophils

[n=69, (0.5%)].

‡Percentages listed are weighted row percentages.

**Table S2**. Prevalence of current asthma, eosinophilia, and blood lead level (BLL) by age group: NHANES 2001–2016.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Survey respondents** | **Current asthma** | | **Eosinophils ≥500 cells/µL** | | **BLL ≥5 µg/dL** | |
| **Characteristic** | **n**† | **%**‡**(95% CI)** | **p-value**§ | **%**‡**(95% CI)** | **p-value**§ | **%**‡**(95% CI)** | **p-value**§ |
| Total | 14,751 | 8.9 (8.3–9.4) |  | 14.5 (13.7–15.3) |  | 1.8 (1.4–2.2) |  |
| Age group |  |  | <0.001 |  | <0.001 | <0.001 | |
| 1–2 years | 3,172 | 6.2 (5.3–7.3) |  | 13.4 (12.1–14.9) |  | 4.6 (3.7–5.6) |  |
| 3–5 years | 3,579 | 8.0 (7.1–9.2) |  | 13.2 (11.9–14.6) |  | 2.2 (1.6–3.0) |  |
| 6–8 years | 3,926 | 9.5 (8.4–10.8) |  | 17.2 (15.7–18.8) |  | 1.3 (0.8–1.9) |  |
| 9–11 years | 4,074 | 10.3 (9.3–11.4) |  | 13.6 (12.3–14.9) |  | 0.5 (0.3–0.8) |  |

†Number and percent of missing values: current asthma [n=51, (0.3%)], eosinophils [n=69, (0.5%)], health insurance [n=59, (0.4%)], household reference person education [n=434, (2.9%)], poverty income ratio [n=868, (5.9%)], household smoker [(n=129, (0.9%)].

‡Percentages listed are weighted row percentages.

§Chi-square p-value.

**Table S3**. Age-stratified adjusted prevalence ratios† (aPR) of asthma and eosinophils for U.S. children

age 1–2, 3–5, 6–8, and 9–11 years by blood lead level (BLL): NHANES 2001–2016 (n=14,751).

|  |  |  |
| --- | --- | --- |
|  | **Current Asthma**  **aPR (95% CI)** | **Eosinophils**  **≥500 cells/µl**  **aPR (95% CI)** |
| **1–2 Year Olds (n=3,172)** | | |
| BLL |  |  |
| <5 µg/dL | referent | referent |
| ≥5 µg/dL | 1.15 (0.70–1.89) | 1.08 (0.75–1.57) |
| BLL Quartiles‡ |  |  |
| Quartile 1 | referent | referent |
| Quartile 2 | 1.94 (1.21–3.11) | 0.82 (0.58–1.14) |
| Quartile 3 | 1.61 (0.93–2.79) | 1.15 (0.81–1.63) |
| Quartile 4 | 1.61§ (0.87–3.00) | 1.11 (0.79–1.56) |
| **3–5 Year Olds (n=3,579)** | | |
| BLL |  |  |
| <5 µg/dL | referent | referent |
| ≥5 µg/dL | 1.10 (0.60–2.03) | 1.10 (0.62–1.95) |
| BLL Quartiles‡ |  |  |
| Quartile 1 | referent | referent |
| Quartile 2 | 0.96 (0.63–1.46) | 0.95 (0.70–1.29) |
| Quartile 3 | 1.17 (0.77–1.78) | 1.01 (0.70–1.46) |
| Quartile 4 | 1.20 (0.77–1.89) | 1.31 (0.89–1.93) |
| **6–8 Year Olds (n=3,926)** | | |
| BLL |  |  |
| <5 µg/dL | referent | referent |
| ≥5 µg/dL | 0.83§ (0.38–1.82) | 0.93 (0.53–1.65) |
| BLL Quartiles‡ |  |  |
| Quartile 1 | referent | referent |
| Quartile 2 | 1.06 (0.71–1.59) | 0.85 (0.64–1.12) |
| Quartile 3 | 0.83 (0.55–1.25) | 1.25 (0.94–1.67) |
| Quartile 4 | 1.00 (0.64–1.58) | 1.40 (1.02–1.93) |
| **9-11 Year Olds (n=4,074)** | | |
| BLL |  |  |
| <5 µg/dL | referent | referent |
| ≥5 µg/dL | 0.44§ (0.07–2.83) | 2.10§ (0.92–4.83) |
| BLL Quartiles‡ |  |  |
| Quartile 1 | referent | referent |
| Quartile 2 | 0.66 (0.47–0.92) | 1.15 (0.87–1.53) |
| Quartile 3 | 0.85 (0.60–1.20) | 1.21 (0.91–1.61) |
| Quartile 4 | 0.59 (0.39–0.91) | 1.57 (1.16–2.11) |

†Prevalence ratios were adjusted for the following covariates: sex, race/ethnicity (Non-Hispanic black,

Non-Hispanic white, Mexican American, Other), health insurance (Medicaid,

other insurance, no coverage), season of interview (May–October and November–April), poverty

income ratio (<1.3 and ≥1.3), presence of household smoker, and survey cycle.

‡Quartiles for 1–2 year olds: Quartile 1 (≤0.91); Quartile 2 (0.91–1.50); Quartile 3 (1.50–2.38);

Quartile 4 (>2.38). Quartiles for 3–5 year olds: Quartile 1 (≤0.77); Quartile 2 (0.77–1.20);

Quartile 3 (1.20–1.90); Quartile 4 (>1.90). Quartiles for 6–8 year olds: Quartile 1 (≤0.62);

Quartile 2 (0.62–0.93); Quartile 3 (0.93–1.50); Quartile 4 (>1.50). Quartiles for 9–11 year olds:

Quartile 1 (≤0.55); Quartile 2 (0.55–0.82); Quartile 3 (0.82–1.30); Quartile 4 (>1.30).

§ Relative standard error of estimate is >30, statistic is potentially unreliable.

**Table S4.** Household smoker stratified adjusted prevalence ratios of asthma and eosinophils for U.S. children by blood lead level

(BLL) and other select covariates: NHANES 2001–2016.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Yes Household Smoker (n=2,236)** | | **No Household Smoker (n=12,386)** | |
|  | **Asthma**  **aPR (95% CI)** | **Eosinophils**  **≥500 cells/µl**  **aPR (95% CI)** | **Asthma**  **aPR (95% CI)** | **Eosinophils**  **≥500 cells/µl**  **aPR (95% CI)** |
| BLL |  |  |  |  |
| <5 µg/dL | referent | referent | referent | referent |
| ≥5 µg/dL | 1.09 (0.64–1.85) | 1.49 (0.91–2.43) | 1.09 (0.66–1.80) | 0.96 (0.68–1.34) |
| BLL Quartiles† |  |  |  |  |
| Quartile 1 | referent | referent | referent | referent |
| Quartile 2 | 0.97 (0.59–1.59) | 1.45 (0.94–2.23) | 0.90 (0.71–1.13) | 1.10 (0.91–1.33) |
| Quartile 3 | 1.11 (0.75–1.64) | 1.66 (1.10–2.49) | 0.99 (0.78–1.25) | 1.27 (1.04–1.54) |
| Quartile 4 | 1.45 (0.89–2.36) | 2.23 (1.52–3.27) | 0.88 (0.65–1.18) | 1.35 (1.10–1.66) |

†Quartiles for participants with a household smoker: Quartile 1 (≤0.93); Quartile 2 (0.93–1.50); Quartile 3 (1.50–2.42);

Quartile 4 (>2.42). Quartiles for participants with no household smoker: Quartile 1 (≤0.69); Quartile 2 (0.69–1.10);

Quartile 3 (1.10–1.80); Quartile 4 (>1.80).

**Table S5**. Adjusted prevalence ratios (aPR) of APE and non-APE for U.S. children age 1–11 years

by blood lead level (BLL): NHANES 2001–2016 (n=14,751).

|  |  |  |
| --- | --- | --- |
|  | **APE**†  **aPR (95% CI)** | **Non-APE**  **aPR (95% CI)** |
| BLL |  |  |
| <5 µg/dL | referent | referent |
| ≥5 µg/dL | 1.00‡ (0.50–2.01) | 1.12 (0.74–1.71) |
| BLL Quartiles |  |  |
| Q1 (<0.68 µg/dL) | referent | referent |
| Q2 (0.68–1.05 µg/dL) | 0.65 (0.44–0.96) | 0.98 (0.75–1.28) |
| Q3 (1.05–1.71 µg/dL) | 0.92 (0.61–1.40) | 0.96 (0.75–1.24) |
| Q4 (>1.71 µg/dL) | 0.85 (0.52–1.38) | 0.93 (0.69–1.25) |

†Abbreviations: APE (asthma with peripheral eosinophilia), non-APE (asthma with no peripheral

eosinophilia).

‡ Relative standard error of estimate is >30, statistic is potentially unreliable.