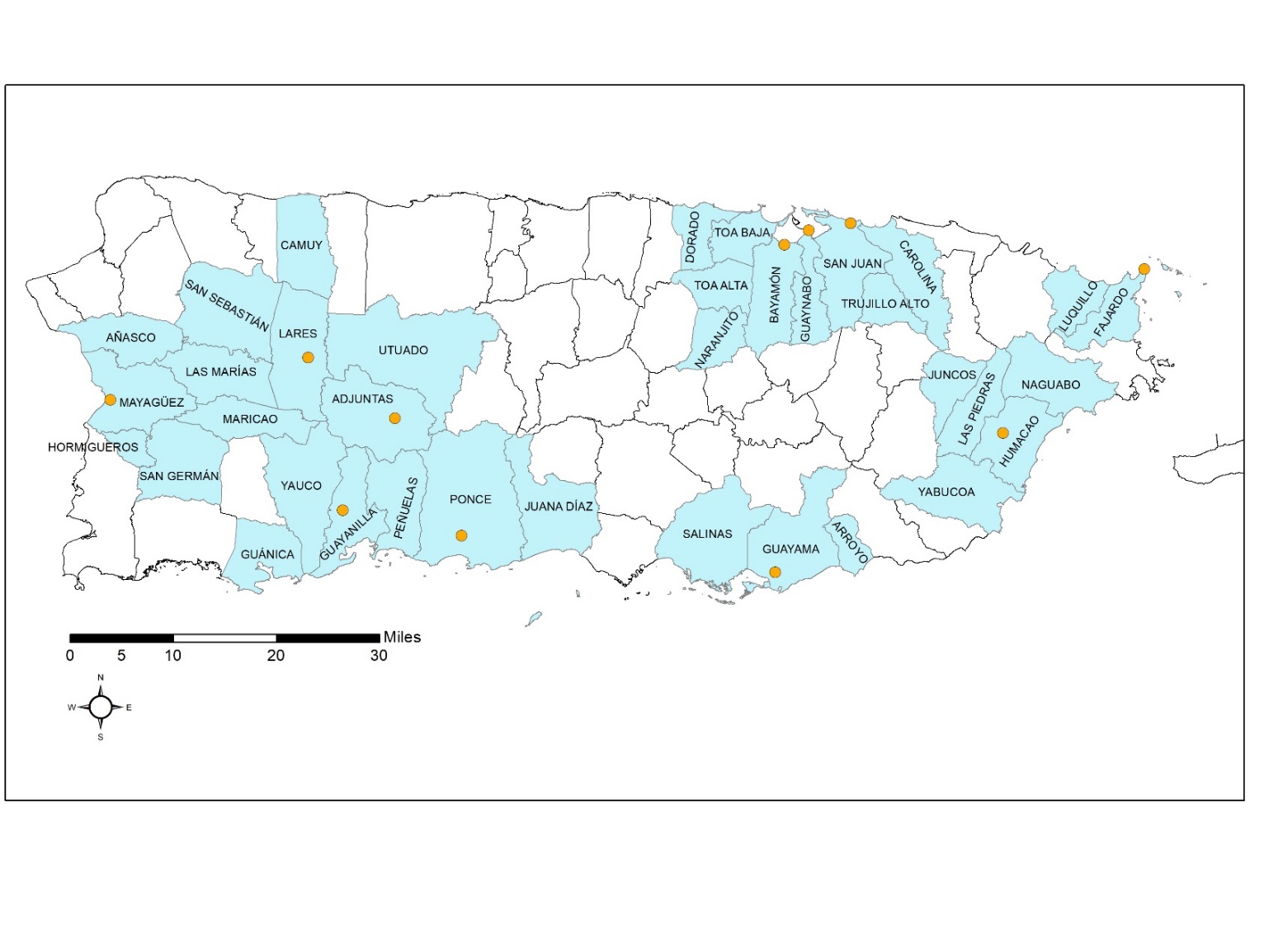
Supplementary material

**Low birth weight and PM2.5 in Puerto Rico**



eFigure 1. Map of Puerto Rico showing location of EPA monitors (gold dots) and the respective municipalities with at least 50% of their land area within 10 miles of a nearest monitor that were included in the analysis.

eTable 1. Comparison of characteristics of all births included and excluded in the analysis.\*

|  |  |  |
| --- | --- | --- |
| Characteristic | Included  *N* = 332,129 (73.8%) | Excluded  *N* = 117,948 (26.2%) |
| Sex |  |  |
| Male | 170,975 (51.5) | 60,478 (51.3) |
| Female | 161,153 (48.5) | 57,470 (48.7) |
| Estimated gestation, mean (SD), weeks | 37.9 (2.3) | 37.7 (2.6) |
| Estimated duration of pregnancy, weeks |  |  |
| <28 (extremely preterm) | 2,368 (0.7) | 1,130 (1.0) |
| 28 – <32 (very preterm) | 4,425 (1.3) | 1,981 (1.8) |
| 32 – <37 (moderate-late preterm) | 49,522 (14.9) | 18,580 (16.5) |
| 37 – 42 (normal) | 273,243 (82.3) | 90,309 (80.0) |
| > 42 | 2,571 (0.8) | 858 (0.8) |
| Residential zone |  |  |
| Urban | 217,705 (65.6) | 73,530 (62.4) |
| Rural | 114,336 (34.4) | 44,320 (37.6) |
| Birth weight, mean (SD), grams | 3,092.6 (525.0) | 3,022.2 (579.4) |
| Birth weight, grams |  |  |
| <1,000 (extremely LBW) | 1,745 (0.5) | 990 (0.8) |
| <1,500 (very LBW) | 4,003 (1.2) | 2,334 (1.9) |
| 1,500 – 2,499 (LBW) | 35,055 (10.6) | 17,841 (15.1) |
| 2,500 – 4,200 (normal BW) | 292,915 (88.2) | 98,667 (83.7) |
| > 4,200 | 4,159 (1.3) | 1,325 (1.1) |
| Insurance: Medicaid or charity | 18,592 (6.6) | 8,018 (7.2) |
| Number of other children (alive or deceased) |  |  |
| 0 | 137,413 (41.4) | 46,163 (39.1) |
| 1 | 103,058 (31.0) | 37,565 (31.9) |
| 2 | 53,817 (16.2) | 20,138 (17.1) |
| 3 | 21,874 (6.6) | 8,090 (6.9) |
| ≥4 | 15,965 (4.8) | 5,991 (5.1) |
| Mother’s level of education, years |  |  |
| 0 – 9 | 35,379 (10.7) | 12,098 (10.3) |
| 10 – 11 | 34,712 (10.5) | 11,351 (9.7) |
| 12 | 104,196 (31.4) | 38,282 (32.6) |
| 13 – 15 | 76,678 (23.1) | 26,655 (22.7) |
| ≥16 | 80,507 (24.3) | 29,161 (24.8) |
| Mother’s age, mean (SD), years | 25.4 (6.0) | 25.6 (6.0) |
| Mother’s race |  |  |
| Hispanic | 292,330 (88.1) | 104,438 (88.7) |
| Black | 39,514 (11.9) | 13,310 (11.3) |
| Marital status |  |  |
| Legally married | 139,037 (41.9) | 48,661 (41.3) |
| Not married, living together | 124,232 (37.4) | 44,014 (37.3) |
| Not living together | 68,805 (20.7) | 25,211 (21.4) |
| Number of prenatal visits |  |  |
| <10 | 87,488 (26.4) | 31,485 (26.8) |
| ≥10 | 244,245 (73.6) | 86,046 (73.2) |
| Maternal pre-pregnancy BMI\*\* |  |  |
| <25 | 94,235 (55.1) | 42,009 (54.4) |
| ≥25 | 76,719 (44.9) | 35,235 (45.6) |

\* N (%) unless otherwise specified.

\*\*Available only for births occurring in 2005 onwards (*N* = 173,964), not included in the main analysis but used in some sensitivity analysis.

eTable 2. Characteristics associated with all (term and preterm) births in 37 municipalities Puerto Rico, 1999 – 2013\*

|  |  |  |  |
| --- | --- | --- | --- |
| Characteristic | All births  (*N* = 332,129) | LBW  (*n* = 35,055) | Not LBW  (*n* = 297,074) |
| Individual-level characteristics | | | |
| Sex |  |  |  |
| Male | 170,975 (51.5) | 16,418 (46.8) | 154,557 (52.0) |
| Female | 161,153 (48.5) | 18,637 (53.2) | 142,516 (48.0) |
| Estimated gestation length, mean (SD), weeks | 37.9 (2.3) | 35.2 (3.6) | 38.2 (1.8) |
| Estimated gestation length, weeks |  |  |  |
| <28 (extremely preterm) | 2,368 (0.7) | 1,742 (5.0) | 626 (0.2) |
| 28 – <32 (very preterm) | 4,425 (1.3) | 2,952 (8.4) | 1,473 (0.5) |
| 32 – <37 (moderate-late preterm) | 49,522 (14.9) | 15,622 (44.6) | 33,900 (11.4) |
| 37 – 42 (normal) | 273,243 (82.3) | 14,598 (41.6) | 258,645 (87.1) |
| > 42 | 2,571 (0.8) | 141 (0.4) | 2,430 (0.8) |
| Residential zone |  |  |  |
| Urban | 217,705 (65.6) | 22,515 (64.3) | 195,190 (65.7) |
| Rural | 114,336 (34.4) | 12,528 (35.7) | 101,808 (34.3) |
| Birth weight, mean (SD), grams | 3,092.6 (525.0) | 2,105.0 (455.4) | 3,209.1 (393.7) |
| Birth weight, grams |  |  |  |
| <1,000 (extremely LBW) | 1,745 (0.5) |  |  |
| <1,500 (very LBW) | 4,003 (1.2) |  |  |
| 1,500 – 2,499 (LBW) | 35,055 (10.6) |  |  |
| 2,500 – 4,200 (normal BW) | 292,915 (88.2) |  |  |
| > 4,200 | 4,159 (1.3) |  |  |
| Health insurance: Medicaid or charity | 18,592 (6.6) | 2,006 (6.8) | 16,586 (6.5) |
| Number of other children (alive or deceased) |  |  |  |
| 0 | 137,413 (41.4) | 15,983 (45.6) | 121,430 (40.9) |
| 1 | 103,058 (31.0) | 9,596 (27.4) | 93,462 (31.5) |
| 2 | 53,817 (16.2) | 5,100 (14.6) | 48,717 (16.4) |
| 3 | 21,874 (6.6) | 2,341 (6.7) | 19,533 (6.6) |
| ≥4 | 15,965 (4.8) | 2,035 (5.8) | 13,930 (4.7) |
| Mother’s level of education, years |  |  |  |
| 0 – 9 | 35,379 (10.7) | 4,596 (13.1) | 30,783 (10.4) |
| 10 – 11 | 34,712 (10.5) | 4,423 (12.7) | 30,289 (10.2) |
| 12 | 104,196 (31.4) | 11,258 (32.2) | 92,938 (31.3) |
| 13 – 15 | 76,678 (23.1) | 7,666 (21.9) | 69,012 (23.3) |
| ≥16 | 80,507 (24.3) | 7,027 (20.1) | 73,480 (24.8) |
| Mother’s age, mean (SD), years | 25.4 (6.0) | 25.0 (6.3) | 25.4 (6.0) |
| Mother’s race |  |  |  |
| Hispanic | 292,330 (88.1) | 30,749 (87.8) | 261,581 (88.1) |
| Black | 39,514 (11.9) | 4,276 (12.2) | 35,238 (11.9) |
| Marital status |  |  |  |
| Legally married | 139,037 (41.9) | 12,981 (37.0) | 126,056 (42.4) |
| Not married, living together | 124,232 (37.4) | 14,074 (40.2) | 110,158 (37.1) |
| Not living together | 68,805 (20.7) | 7,989 (22.8) | 60,816 (20.5) |
| Number of prenatal visits |  |  |  |
| <10 | 87,488 (26.4) | 15,338 (43.9) | 72,150 (24.3) |
| ≥10 | 244,245 (73.6) | 19,591 (56.1) | 224,654 (75.7) |
| Season of birth |  |  |  |
| January – March | 77,425 (23.3) | 8,102 (23.1) | 69,323 (23.3) |
| April – June | 73,225 (22.1) | 7,713 (22.0) | 65,512 (22.1) |
| July – September | 84,559 (25.5) | 9,130 (26.0) | 75,429 (25.4) |
| October – December | 96,920 (29.2) | 10,110 (28.9) | 86,810 (29.2) |
| Maternal BMI,\*\* mean (SD), kg/m2 |  |  |  |
| Pre-pregnancy | 25.5 (5.9) | 24.7 (6.0) | 25.5 (5.9) |
| At time of delivery | 30.1 (5.9) | 28.7 (6.0) | 30.3 (5.8) |
| Maternal BMI, pre-pregnancy\*\* |  |  |  |
| Underweight (< 18.5) | 12,144 (7.1) | 2,063 (11.0) | 10,081 (6.6) |
| Normal (18.5 – 24.9) | 82,091 (48.0) | 9,249 (49.4) | 72,842 (47.9) |
| Overweight (25 – 29.9) | 43,394 (25.4) | 4,145 (22.1) | 39,249 (25.8) |
| Obese (> 30) | 33,325 (19.5) | 3,268 (17.5) | 30,057 (19.7) |
| Municipal-level characteristics\*\*\* | | | |
| Median household income in 2013 inflation-adjusted US dollars, mean (SD) | 21,699 (5,574) | 21,404 (5,565) | 21,733 (5,575) |
| Population density per sq. mile, mean (SD) | 3,174 (2,590) | 3,046 (2,562) | 3,189 (2,592) |
| % adults (> 25 yr) with <high school education, %, mean (SD) | 26.5 (5.3) | 26.8 (5.4) | 26.5 (5.3) |
| % occupied units with 1+ of 4 severe housing problems, mean (SD)\*\*\*\* | 33.4 (7.6) | 33.3 (7.7) | 33.4 (7.6) |
| % population that is non-white non-Hispanic, mean (SD) | 33.3 (11.4) | 32.8 (11.8) | 33.3 (11.4) |
| Unemployment rate 2004-2013, %, mean (SD) | 12.6 (3.8) | 13.0 (3.9) | 12.6 (3.8) |
| Mean age adjusted diabetes prevalence 2004-2013, %, mean (SD) | 12.5 (1.3) | 12.6 (1.3) | 12.5 (1.3) |

\* N (%) unless otherwise specified. Although available, data on smoking, alcohol use, and some risk factors were inadequately collected. As a result, we did not include these variables in the analysis.

\*\* Available only for births occurring in 2005 onwards (*N* = 173,964), not included in the main analysis but used in some sensitivity analysis.

\*\*\* These data are publicly available at <https://www.census.gov/programs-surveys/acs/data.html> and <https://www.huduser.gov/portal/datasets/cp.html>

\*\*\*\* These are designated by the US Department of Housing and Urban Development as overcrowding, lack of kitchen, lack of plumbing, and high housing cost.

The following is the number (%) of observations with missing data for various variables: Sex – 1 (0.0%), urban/rural residence – 88 (0.0%), medical insurance – 49,066 (14.8%), total children – 2 (0.0%), mother’s education – 657 (0.2%), mother’s age – 88 (0.0%), mother’s race – 285 (0.1%), marital status – 55 – (0.0%), and number of prenatal visits – 396 (0.1%). None of the other variables had any missing values.

eTable 3. Sensitivity analyses showing risk ratios and 95% confidence intervals of the association between low birth weight and PM2.5 exposure levels among term births for entire pregnancy and trimester-specific periods using a modified Poisson model\*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Entire pregnancy duration | | First trimester | | Second trimester | | Third trimester | |
| *N* | RR  (95% CI) | *N* | RR  (95% CI) | *N* | RR  (95% CI) | *N* | RR  (95% CI) |
| Primary model | All: 275,814  LBW: 14,739 | 1.03  (0.99, 1.06) | All: 275,814  LBW: 14,739 | 1.02  (1.00, 1.04) | All: 269,302  LBW: 14,371 | 1.02  (1.01, 1.05) | All: 268,189  LBW: 14,296 | 1.00  (0.97, 1.03) |
| Model including quadratic PM | All: 275,814  LBW: 14,739 | 1.02  (0.94, 1.13) |  |  |  |  |  |  |
| Model including quadratic gestation age | All: 275,814  LBW: 14,739 | 1.01  (0.97, 1.04) |  |  |  |  |  |  |
| Model excluding gestation age | All: 275,814  LBW: 14,739 | 1.00  (0.98, 1.04) |  |  |  |  |  |  |

\*All models are adjusted for individual-level covariates (mother’s age, number of other children [alive or deceased], infant’s sex, gestational age, season of birth, education level, urban/rural residence, marital status, number of prenatal visits attended, and year of birth) and area/municipality-level covariates (including population density, income per capita, proportion of non-white non-Hispanic residents, average unemployment rate, proportion of occupied housing units with at least one of four severe US Department of Housing and Urban Development-designated defects, percentage of residents with a less than high school level of education, and the age adjusted prevalence of diabetes mellitus).

eTable 4. Risk ratios and 95% CIs of low birth weight for a standard deviation increase in prenatal PM2.5 exposure among term births in 37 municipalities in Puerto Rico for the period 1999 – 2013, stratified by mother’s characteristics.\*

|  |  |  |  |
| --- | --- | --- | --- |
| Characteristic | Number of births (Number of LBW) | Risk ratio  (95% CI) | *P-value* |
| Age of mother (years) |  |  | 0.792 |
| ≤25 | 152,185 (9,144) | 1.00 (0.97, 1.04) |  |
| >25 | 123,576 (5,590) | 0.99 (0.95, 1.05) |  |
| Race/ethnicity |  |  | 0.166 |
| Hispanic | 242,931 (12,896) | 0.99 (0.97, 1.02) |  |
| Black | 32,660 (1,835) | 1.03 (0.95, 1.11) |  |
| Infant sex |  |  | 0.708 |
| Male | 140,669 (6,224) | 1.01 (0.97, 1.05) |  |
| Female | 135,145 (8,515) | 0.99 (0.96, 1.03) |  |
| Prenatal visits |  |  | 0.921 |
| <10 | 64,434 (4,524) | 0.98 (0.92, 1.04) |  |
| ≥10 | 211,157 (10,187) | 1.01 (0.98, 1.04) |  |
| Marital status |  |  | 0.021 |
| Married | 117,096 (5,322) | 0.98 (0.95, 1.02) |  |
| Not married | 158,678 (9,414) | 1.01 (0.97, 1.06) |  |
| Parity |  |  | 0.402 |
| First child | 116,051 (7,041) | 1.00 (0.96, 1.05) |  |
| Has previously given birth | 159,761 (7,698) | 1.00 (0.95, 1.05) |  |
| Residence |  |  | 0.988 |
| Urban | 181,362 (9,292) | 1.00 (0.97, 1.04) |  |
| Rural | 94,386 (5,444) | 1.00 (0.96, 1.04) |  |
| Education level |  |  | 0.067 |
| < high school | 56,451 (3,849) | 1.03 (0.97, 1.09) |  |
| > High school graduate | 218,832 (10,859) | 0.99 (0.96, 1.02) |  |
| Birth in “dust storm” months |  |  | 0.016 |
| Yes (May - October) | 137,602 (7,244) | 1.02 (0.99, 1.06) |  |
| No (November - April) | 138,212 (7,495) | 0.97 (0.93, 1.01) |  |
| Year of birth |  |  | 0.105 |
| 1999 – 2004 | 132,499 (6,434) | 1.01 (0.98, 1.04) |  |
| 2005 – 2013 | 143,315 (8,305) | 0.98 (0.94, 1.02) |  |
| Health insurance |  |  | 0.232 |
| Private or public employer | 220,203 (11,517) | 1.01 (0.97, 1.04) |  |
| Medicaid or charity | 15,484 (867) | 0.90 (0.79, 1.03) |  |
| Household income in municipality, 2013 inflation-adjusted US dollars |  |  | 0.220 |
| Below median for PR (USD 22,754) | 179,066 (9,766) | 1.00 (0.96, 1.04) |  |
| Above median | 96,748 (4,973) | 1.01 (0.96, 1.06) |  |
| % non-white non-Hispanic population in municipality |  |  | 0.485 |
| Below median for PR (35.7%) | 149,875 (8,072) | 1.00 (0.95, 1.05) |  |
| Above median | 125,939 (6,667) | 1.01 (0.97, 1.04) |  |
| Population density in municipality |  |  | 0.058 |
| Below median for PR (2,760/sq. mile) | 144,002 (8,160) | 0.98 (0.94, 1.02) |  |
| Above median | 131,812 (6,579) | 1.02 (0.99, 1.06) |  |
| Average unemployment rate in municipality 2004-2013 |  |  | 0.046 |
| Below median for PR (10.3%) | 142,058 (7,097) | 0.99 (0.97, 1.02) |  |
| Above median | 133,756 (7,642) | 1.02 (0.99, 1.06) |  |
| % occupied units with 1+ of 4 severe housing problems in municipality\*\* |  |  | 0.375 |
| Below median for PR (34.8%) | 179,711 (9,426) | 1.00 (0.96, 1.03) |  |
| Above median | 96,103 (5,313) | 1.02 (0.94, 1.09) |  |
| % adults > 25 years in municipality with < high school education |  |  | 0.108 |
| Below median for PR (23.9%) | 142,216 (7,136) | 1.02 (0.98, 1.05) |  |
| Above median | 133,598 (7,603) | 0.98 (0.94, 1.01) |  |
| Age adjusted diabetes prevalence in municipality 2004-2013 |  |  | 0.056 |
| Below median for PR (12.4%) | 142,058 (7,097) | 0.99 (0.95, 1.02) |  |
| Above median | 133,756 (7,642) | 1.01 (0.98, 1.05) |  |
| Maternal pre-pregnancy BMI\*\*\* |  |  | 0.139 |
| < 25 | 77,535 (5,073) | 0.97 (0.93, 1.02) |  |
| >=25 | 63,380 (3,046) | 1.00 (0.96, 1.06) |  |

\* All estimates are from fully adjusted models, with adjustment for individual-level covariates (mother’s age, number of other children [alive or deceased], infant’s sex, gestational age, season of birth, education level, urban/rural residence, marital status, number of prenatal visits attended, and year of birth) and area/municipality-level covariates (including population density, income per capita, proportion of non-white non-Hispanic residents, average unemployment rate, proportion of occupied housing units with at least one of four severe US Department of Housing and Urban Development-designated defects, percentage of residents with a less than high school level of education, and the age adjusted prevalence of diabetes mellitus).

\*\* These are designated by the US Department of Housing and Urban Development as overcrowding, lack of kitchen, lack of plumbing, and high housing cost.

\*\*\* Available only for births occurring in 2005 onwards (*N* = 143,315), not included in the main analysis but used in some sensitivity analysis.

PR – Puerto Rico, USD – US Dollars

eTable 5. Risk ratios and 95% CIs of low birth weight for a standard deviation increase in prenatal PM2.5 exposure among term births in 37 municipalities in births in Puerto Rico for the period 1999 – 2013 restricted to mothers’ first birth, stratified by mother’s characteristics.\*

|  |  |  |  |
| --- | --- | --- | --- |
| Characteristic | Number of births (Number of LBW) | Risk ratio  (95% CI) | *P-value* |
| Age of mother (years) |  |  | 0.639 |
| ≤25 | 80,431 (5,213) | 1.01 (0.97, 1.05) |  |
| >25 | 35,595 (1,826) | 0.98 (0.91, 1.06) |  |
| Race/ethnicity |  |  | 0.131 |
| Hispanic | 102,957 (6,237) | 1.00 (0.97, 1.02) |  |
| Black | 12,993 (800) | 1.05 (0.91, 1.20) |  |
| Infant sex |  |  | 0.330 |
| Male | 59,232 (3,096) | 0.99 (0.92, 1.05) |  |
| Female | 56,819 (3,945) | 1.02 (0.97, 1.07) |  |
| Prenatal visits |  |  | 0.510 |
| <10 | 22,096 (1,890) | 0.98 (0.92, 1.05) |  |
| ≥10 | 93,884 (5,142) | 1.02 (0.97, 1.08) |  |
| Marital status |  |  | 0.143 |
| Married | 46,802 (2,452) | 0.98 (0.93, 1.04) |  |
| Not married | 69,235 (4,588) | 1.02 (0.97, 1.07) |  |
| Residence |  |  | 0.298 |
| Urban | 76,787 (4,471) | 1.01 (0.95, 1.06) |  |
| Rural | 39,236 (2,568) | 1.00 (0.95, 1.05) |  |
| Education level |  |  | 0.076 |
| Did not complete high school | 22,935 (1,727) | 1.03 (0.97, 1.10) |  |
| High school graduate and above | 92,880 (5,301) | 0.99 (0.94, 1.03) |  |
| Birth in “dust storm” months |  |  | 0.003 |
| Yes (May - October) | 57,459 (3,413) | 1.04 (0.98, 1.10) |  |
| No (November - April) | 58,592 (3,628) | 0.96 (0.91, 1.02) |  |
| Year of birth |  |  | 0.107 |
| 1999 – 2004 | 54,168 (3,043) | 1.01 (0.96, 1.05) |  |
| 2005 – 2013 | 61,883 (3,998) | 0.98 (0.93, 1.04) |  |
| Health insurance |  |  | 0.889 |
| Private or public employer | 92,047 (5,487) | 1.00 (0.96, 1.04) |  |
| Medicaid or charity | 6,338 (411) | 1.03 (0.87, 1.21) |  |
| Household income in municipality, 2013 inflation-adjusted US dollars |  |  | 0.950 |
| Below median for PR ( USD 22,754) | 74,168 (4,610) | 1.01 (0.95, 1.07) |  |
| Above median | 41,883 (2,431) | 1.00 (0.95, 1.05) |  |
| Proportion of non-white non-Hispanic population in municipality |  |  | 0.994 |
| Below median for PR (35.7%) | 62,684 (3,846) | 1.01 (0.95, 1.09) |  |
| Above median | 53,367 (3,195) | 0.99 (0.95, 1.04) |  |
| Population density in municipality |  |  | 0.031 |
| Below median for PR (2,760/square mile ) | 59,027 (3,823) | 0.98 (0.94, 1.02) |  |
| Above median | 57,024 (3,218) | 1.04 (0.98, 1.10) |  |
| Average unemployment rate in municipality 2004-2013 |  |  | 0.109 |
| Below median for PR (10.3%) | 61,176 (3,474) | 0.98 (0.94, 1.02) |  |
| Above median | 54,875 (3,567) | 1.03 (0.97, 1.09) |  |
| Percent of occupied units with 1 or more of 4 severe housing problems in municipality\*\*\* |  |  | 0.105 |
| Below median for PR (34.8%) | 76,641 (4,574) | 1.04 (1.00, 1.09) |  |
| Above median | 39,410 (2,467) | 0.99 (0.92, 1.06) |  |
| Proportion of adults > 25 years in municipality with less than high school education |  |  | 0.429 |
| Below median for PR (23.9%) | 61,162 (3,479) | 1.02 (0.96, 1.09) |  |
| Above median | 54,889 (3,562) | 0.99 (0.94, 1.03) |  |
| Age adjusted diabetes prevalence in municipality 2004-2013 |  |  | 0.148 |
| Below median for PR (12.4%) | 61,176 (3,474) | 0.98 (0.94, 1.03) |  |
| Above median | 54,875 (3,567) | 1.03 (0.97, 1.09) |  |
| Maternal pre-pregnancy BMI\*\* |  |  | 0.135 |
| < 25 | 37,763 (2,654) | 0.96 (0.91, 1.02) |  |
| >=25 | 23,081 (1,234) | 1.02 (0.94, 1.10) |  |

\* All estimates are from fully adjusted models, with adjustment for individual-level covariates (mother’s age, number of other children [alive or deceased], infant’s sex, gestational age, season of birth, education level, urban/rural residence, marital status, number of prenatal visits attended, and year of conception) and area/municipality-level covariates (including population density, income per capita, proportion of non-white non-Hispanic residents, average unemployment rate, proportion of occupied housing units with at least one of four severe US Department of Housing and Urban Development-designated defects, percentage of residents with a less than high school level of education, and the age adjusted prevalence of diabetes mellitus).

\*\*Available only for births occurring from 2005 onwards (*N* = 143,315), not included in the main analysis but used in some sensitivity analysis.

\*\*\* These are designated by the US Department of Housing and Urban Development as overcrowding, lack of kitchen, lack of plumbing, and high housing cost.

PR – Puerto Rico, USD – US Dollars

eTable 6. Sensitivity analysis showing association between low birth weight and prenatal PM2.5 exposure among term births in 37 municipalities in Puerto Rico (1999 – 2013), when a variable available for only part of the follow-up period (maternal BMI) is included or analysis is restricted to mothers’ first births.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | *N* | Modified Poisson model  Risk ratio for LBW per SD increase in PM2.5 exposure | Linear model  Average change in birth per SD increase in PM2.5 exposure | Ordinal logistic model  Odds ratio for VLBW versus LBW or normal birth weight per SD increase in PM2.5 exposure | Modified Poisson model  Risk ratio for VLBW per SD increase in PM2.5 exposure |
| RR (95% CI) | Beta (95% CI) | OR (95% CI) | RR (95% CI) |
| Model 4 | All: 140,915  LBW: 8,119 | 1.02 (0.96, 1.10) | -8.0 (-13.9, 2.1) | 1.00 (0.94, 1.07) | 1.40 (1.05, 1.89) |
| Model 5 | All: 116,051  LBW: 7,041 | 1.03 (0.98, 1.08) | -5.0 (-9.2, 1.9) | 1.01 (0.96, 1.06) | 1.03 (0.89, 1.21) |

Model 4: Model 3 (Table 3 in main analysis) plus maternal BMI, which was available only for part of the follow-up period due to enhanced data collection in Puerto Rico from 2005 onward.

Model 5: Model 3 (Table 3 in main analysis) restricted to only births at which mothers reported having only one child.

LBW – low birth weight, VLBW – very low birth weight, SD – standard deviation, CI – confidence intervals

eTable 7. Risk ratios (95% confidence intervals) for associations between low birth weight and covariates among all births in fully-adjusted modified Poisson model.\*

|  |  |  |
| --- | --- | --- |
| Covariate | RR (95% CI) | *p*-value |
|
| Individual-level covariates | | |
| Infant sex |  |  |
| Male | 1.00 (Ref) |  |
| Female | 1.24 (1.22, 1.26) | <0.001 |
| Mother’s age (years) | 1.01 (1.00, 1.01) | <0.001 |
| Number of prenatal visits |  |  |
| <10 | 1.00 (Ref) |  |
| ≥10 | 0.69 (0.67, 0.72) | <0.001 |
| Mother’s education, years of school completed |  |  |
| 0 – 9 | 1.00 (Ref) |  |
| 10 – 11 | 0.98 (0.93, 1.05) | 0.644 |
| 12 | 0.91 (0.86, 0.96) | 0.001 |
| 13 – 15 | 0.88 (0.82, 0.93) | <0.001 |
| ≥16 | 0.80 (0.74, 0.87) | <0.001 |
| Mother’s race |  |  |
| Hispanic | 1.00 (Ref) |  |
| Black | 0.99 (0.94, 1.04) | 0.767 |
| Marital status |  |  |
| Married, living with partner | 1.00 (Ref) |  |
| Not married, co-habiting with partner | 1.03 (1.01, 1.06) | 0.007 |
| Not married, not living with any partner | 1.01 (0.98, 1.05) | 0.447 |
| Medical insurance |  |  |
| Other private or public | 1.00 (Ref) |  |
| Medicaid or charity | 0.93 (0.89, 0.98) | 0.004 |
| Number of other children (living or deceased) |  |  |
| 0 | 1.00 (Ref) |  |
| 1 | 0.76 (0.74, 0.79) | <0.001 |
| 2 | 0.74 (0.71, 0.77) | <0.001 |
| 3 | 0.76 (0.73, 0.79) | <0.001 |
| ≥4 | 0.82 (0.78, 0.87) | <0.001 |
| Residence |  |  |
| Urban | 1.00 (Ref) |  |
| Rural | 0.98 (0.95, 1.01) | 0.209 |
| Gestational age (1 week difference) | 0.80 (0.79, 0.81) | <0.001 |
| Season of birth |  |  |
| January – March | 1.00 (Ref) |  |
| April – June | 0.99 (0.96, 1.02) | 0.675 |
| July – September | 1.02 (0.99, 1.05) | 0.260 |
| October – December | 0.98 (0.95, 1.02) | 0.259 |
| Maternal pre-pregnancy BMI\*\* |  |  |
| < 25 | 1.00 (Ref) |  |
| >= 25 | 0.77 (0.75, 0.80) | <0.001 |
| Municipal-level covariates\*\*\* | | |
|  |  |  |
| Household income, 2013 inflation-adjusted US dollars |  |  |
| Below median for PR (USD 22,754) | 1.00 (ref) |  |
| Above median | 0.96 (0.92, 1.01) | 0.132 |
| Population density |  |  |
| Below median for PR (2,760/square mile) | 1.00 (ref) |  |
| Above median | 0.93 (0.88, 0.98) | 0.004 |
| % adults > 25 years with < high school education |  |  |
| Below median for PR (23.9%) | 1.00 (ref) |  |
| Above median | 1.06 (0.97, 1.15) | 0.195 |
| % occupied units with 1+ of 4 severe housing problems \*\*\*\* |  |  |
| Below median for PR (34.8%) | 1.00 (ref) |  |
| Above median | 1.00 (0.98, 1.02) | 0.987 |
| % non-white non-Hispanic population |  |  |
| Below median for PR (35.7%) | 1.00 (ref) |  |
| Above median | 0.97 (0.92, 1.02) | 0.284 |
| Average unemployment rate, 2004-2013 |  |  |
| Below median for PR (10.3%) | 1.00 (ref) |  |
| Above median | 1.08 (0.96, 1.21) | 0.186 |
| Age adjusted diabetes prevalence, 2004-2013 |  |  |
| Below median for PR (12.4%) | 1.00 (ref) |  |
| Above median | 1.06 (0.95, 1.19) | 0.317 |

\*All models are adjusted for individual-level covariates (mother’s age, number of other children [alive or deceased], infant’s sex, gestational age, season of birth, education level, urban/rural residence, marital status, number of prenatal visits attended, and year of birth) and area/municipality-level covariates (including population density, income per capita, proportion of non-white non-Hispanic residents, average unemployment rate, proportion of occupied housing units with at least one of four severe US Department of Housing and Urban Development-designated defects, percentage of residents with a less than high school level of education, and the age adjusted prevalence of diabetes mellitus).

\*\* Available only for births occurring in 2005 onwards (*N* = 173,964), not included in the main analysis but used in sensitivity analysis.

\*\*\* These data are publicly available at <https://www.census.gov/programs-surveys/acs/data.html> and <https://www.huduser.gov/portal/datasets/cp.html>

\*\*\*\* These are designated by the US Department of Housing and Urban Development as overcrowding, lack of kitchen, lack of plumbing, and high housing cost.

eTable 8. Association between low birth weight and prenatal PM2.5 exposure among all births in Puerto Rico (1999 – 2013), based on single-stage models.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | *N* | Modified Poisson model Risk ratio for LBW per SD increase in PM2.5 exposure | Linear model  Average change in birth weight per SD increase in PM2.5 exposure | Ordinal logistic model  Odds ratio for VLBW versus LBW or normal birth weight per SD increase in PM2.5 exposure | Modified Poisson model Risk ratio for VLBW per SD increase in PM2.5 exposure |
| RR (95% CI) | Beta (95% CI) | OR (95% CI) | RR (95% CI) |
| Model 1 | All: 332,129  LBW: 35,055 | 0.95 (0.93, 0.97) | 23.0 (16.5, 29.4) | 0.95 (0.93, 0.97) | 1.00 (0.96, 1.04) |
| Model 2 | All: 332,129  LBW: 35,055 | 0.99 (0.97, 1.01) | 5.8 (2.7, 8.9) | 0.99 (0.97, 1.01) | 1.03 (0.99, 1.07) |
| Model 3 | All: 332,129  LBW: 35,055 | 1.02 (0.99, 1.05) | 0.4 (-2.8, 3.7) | 1.03 (1.00, 1.05) | 1.07 (1.03, 1.12) |

Model 1: Unadjusted associations.

Model 2: Adjusted for individual-level covariates, including mother’s age, number of other children (alive or deceased), infant’s sex, gestational age, education level, urban/rural residence, marital status, number of prenatal visits attended, and year of birth.

Model 3: Model 2 plus adjustment for area/municipality-level covariates, including population density, household income, proportion of non-white non-Hispanic residents, average unemployment rate, proportion of occupied housing units with at least one of four severe US Department of Housing and Urban Development-designated defects, percentage of residents with a less than high school level of education, and the age adjusted prevalence of diabetes mellitus.

LBW – low birth weight, VLBW – very low birth weight, SD – standard deviation, CI – confidence intervals

eTable 9. Association between low birth weight and prenatal PM2.5 exposure among all births in Puerto Rico (1999 – 2013), based on a two-stage model.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Odds ratio for LBW per SD increase in mean PM2.5 across the entire pregnancy  (coefficient of intercept from 2-stage model) | | Odds ratio for LBW per SD increase in trend across the entire pregnancy  (coefficient of slope from 2-stage model) | |
| OR (95% CI) | *p*-value | OR (95% CI) | *p*-value |
| Model 1A | 0.99 (0.97, 1.02) | 0.497 | 1.03 (0.99, 1.07) | 0.121 |
| Model 1B | 1.05 (1.02, 1.08) | 0.002 | 1.03 (0.99, 1.06) | 0.133 |
| Model 2A | 0.98 (0.96, 1.01) | 0.167 | - | - |
| Model 2B | 1.04 (1.01, 1.07) | 0.034 | - | - |

Model 1A: A two-stage model accounting for the effect of the linear trend in exposure on the outcome by including random intercepts and random slopes in stage 1. Stage 2 of the model incorporates individual-level covariates, including mother’s age, number of other children (alive or deceased), infant’s sex, gestational age, season or birth, education level, urban/rural residence, marital status, number of prenatal visits attended, and year of birth. The interpretation of coefficients is described in the main text.

Model 1B: A two-stage model accounting for the effect of the linear trend in exposure on the outcome by including random intercepts and random slopes in Stage 1. Stage 2 of the model additionally controls for individual and municipal-level covariates, i.e. Model 1A plus adjustment for area/municipality-level covariates, including population density, income per capita, proportion of non-white non-Hispanic residents, average unemployment rate, proportion of occupied housing units with at least one of four severe US Department of Housing and Urban Development-designated defects, percentage of residents with a less than high school level of education, and the age adjusted prevalence of diabetes mellitus. The interpretation of coefficients is described in the main text.

Models 2A and 2B are analogous to 1A and 1B, respectively, except that Stage 1 models only include intercepts, as the Stage 1 slopes were not statistically significant in Model 1.

LBW – low birth weight, VLBW – very low birth weight, IQR – interquartile range, CI – confidence intervals, SD – standard deviation.

eTable 10. Sensitivity analyses showing risk ratios and 95% confidence intervals of the association between low birth weight and PM2.5 exposure levels among all births for entire pregnancy and trimester-specific periods using a modified Poisson model\*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Entire pregnancy duration | | First trimester | | Second trimester | | Third trimester | |
| *N* | RR  (95% CI) | *N* | RR  (95% CI) | *N* | RR  (95% CI) | *N* | RR  (95% CI) |
| Primary model – all births | All: 332,129  LBW: 35,055 | 1.02  (0.99, 1.05) | All: 332,129  LBW: 35,055 | 1.00  (0.99, 1.02) | All: 324,335  LBW: 34,177 | 1.02  (1.01, 1.04) | All: 321,071  LBW: 32,790 | 1.01  (0.99, 1.02) |
| Model including quadratic PM – all births | All: 332,129  LBW: 35,055 | 0.94  (0.84, 1.05) |  |  |  |  |  |  |
| Model including quadratic gestation age – all births | All: 332,129  LBW: 35,055 | 1.02  (1.00, 1.04) |  |  |  |  |  |  |
| Model excluding gestation age – all births | All: 332,129  LBW: 35,055 | 0.98  (0.96, 1.02) |  |  |  |  |  |  |

\*All models are adjusted for individual-level covariates (mother’s age, number of other children [alive or deceased], infant’s sex, gestational age, season of birth, education level, urban/rural residence, marital status, number of prenatal visits attended, and year of birth) and area/municipality-level covariates (including population density, income per capita, proportion of non-white non-Hispanic residents, average unemployment rate, proportion of occupied housing units with at least one of four severe US Department of Housing and Urban Development-designated defects, percentage of residents with a less than high school level of education, and the age adjusted prevalence of diabetes mellitus).

eTable 11. Sensitivity analysis showing association between low birth weight and prenatal PM2.5 exposure among all births in 37 municipalities in Puerto Rico (1999 – 2013), when a variable available for only part of the follow-up period (maternal BMI) is included or analysis is restricted to mothers’ first births.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | *N* | Modified Poisson model  Risk ratio for LBW per SD increase in PM2.5 exposure | Linear model  Average change in birth per SD increase in PM2.5 exposure | Ordinal logistic model  Odds ratio for VLBW versus LBW or normal birth weight per SD increase in PM2.5 exposure | Modified Poisson model  Risk ratio for VLBW per SD increase in PM2.5 exposure |
| RR (95% CI) | Beta (95% CI) | OR (95% CI) | RR (95% CI) |
| Model 4 | All: 170,954  LBW: 18,725 | 1.01 (0.97, 1.07) | 5.3 (-1.6, 12.2) | 1.01 (0.96, 1.06) | 1.11 (1.02, 1.20) |
| Model 5 | All: 137,413  LBW: 15,983 | 1.02 (0.98, 1.05) | -4.3 (-8.7, 0.2) | 1.02 (0.98, 1.06) | 1.02 (0.96, 1.09) |

Model 4: Model 3 in eTable 8 plus maternal BMI, which was available only for part of the follow-up period due to enhanced data collection in Puerto Rico from 2005 onward.

Model 5: Model 3 in eTable 8 restricted to only births at which mothers reported having only one child.

LBW – low birth weight, VLBW – very low birth weight, SD – standard deviation, CI – confidence intervals

eTable 12. Risk ratios and 95% CIs of low birth weight for a standard deviation increase in prenatal PM2.5 exposure among all births in 37 municipalities in in Puerto Rico for the period 1999 – 2013, stratified by mother’s characteristics.\*

|  |  |  |  |
| --- | --- | --- | --- |
| Characteristic | Number of births (Number of LBW) | Risk ratio  (95% CI) | *P-value* |
| Age of mother (years) |  |  | 0.298 |
| ≤25 | 183,642 (20,652) | 1.02 (0.99, 1.05) |  |
| >25 | 148,399 (14,379) | 1.01 (0.98, 1.04) |  |
| Race/ethnicity |  |  | 0.827 |
| Hispanic | 292,330 (30,749) | 1.01 (0.99, 1.03) |  |
| Black | 39,514 (4,276) | 1.03 (0.96, 1.10) |  |
| Infant sex |  |  | 0.262 |
| Male | 170,975 (16,418) | 1.02 (1.00, 1.06) |  |
| Female | 161,153 (18,637) | 1.00 (0.97, 1.03) |  |
| Prenatal visits |  |  | 0.061 |
| <10 | 87,488 (15,338) | 1.00 (0.97, 1.02) |  |
| ≥10 | 244,245 (19,591) | 1.03 (1.00, 1.07) |  |
| Marital status |  |  | 0.003 |
| Married | 139,037 (12,981) | 1.00 (0.97, 1.03) |  |
| Not married | 193,037 (22,063) | 1.02 (1.00, 1.05) |  |
| Parity |  |  | 0.678 |
| First child | 137,413 (15,983) | 1.01 (0.97, 1.04) |  |
| Has previously given birth | 194,714 (19,072) | 1.02 (0.99, 1.04) |  |
| Residence |  |  | 0.108 |
| Urban | 217,705 (22,515) | 1.03 (1.00, 1.05) |  |
| Rural | 114,336 (12,528) | 1.00 (0.97, 1.02) |  |
| Education level |  |  | 0.001 |
| Did not complete high school | 70,091 (9,019) | 1.03 (0.99, 1.07) |  |
| High school graduate and above | 261,381 (25,951) | 1.01 (0.98, 1.03) |  |
| Birth in “dust storm” months |  |  | 0.024 |
| Yes (May - October) | 166,401 (17,711) | 1.02 (0.99, 1.05) |  |
| No (November - April) | 165,728 (17,344) | 1.00 (0.97, 1.03) |  |
| Year of birth |  |  | 0.256 |
| 1999 – 2004 | 158,165 (15,902) | 1.01 (0.98, 1.03) |  |
| 2005 – 2013 | 173,964 (19,153) | 1.01 (0.98, 1.04) |  |
| Health insurance |  |  | 0.179 |
| Private or public employer | 264,471 (27,603) | 1.00 (0.97, 1.02) |  |
| Medicaid or charity | 18,592 (2,006) | 0.94 (0.90, 0.99) |  |
| Municipality household income, 2013 inflation-adjusted US dollars |  |  | 0.428 |
| Below median (USD 22,754) | 216,822 (23,565) | 1.01 (0.98, 1.05) |  |
| Above median | 115,307 (11,490) | 1.00 (0.98, 1.02) |  |
| Municipality % non-white, non-Hispanic population |  |  | 0.465 |
| Below median (35.7%) | 181,305 (19,469) | 1.00 (0.96, 1.04) |  |
| Above median | 150,824 (15,586) | 1.02 (1.00, 1.04) |  |
| Municipality population density |  |  | 0.131 |
| Below median (2,760/sq. mile) | 174,766 (19,358) | 1.00 (0.97, 1.02) |  |
| Above median | 157,363 (15,697) | 1.02 (0.99, 1.06) |  |
| Municipality average unemployment rate, 2004-2013 |  |  | 0.095 |
| Below median (10.3%) | 169,392 (16,809) | 1.00 (0.97, 1.02) |  |
| Above median | 162,737 (18,246) | 1.02 (0.99, 1.06) |  |
| Municipality % occupied units with 1+ of 4 severe housing problems\*\*\* |  |  | 0.890 |
| Below median (34.8%) | 216,487 (22,643) | 1.02 (1.00, 1.05) |  |
| Above median | 115,642 (12,412) | 0.99 (0.95, 1.03) |  |
| Municipality proportion of adults > 25 years with <high school education |  |  | 0.066 |
| Below median (23.9%) | 169,569 (16,879) | 1.03 (0.99, 1.07) |  |
| Above median | 162,560 (18,176) | 0.99 (0.96, 1.01) |  |
| Municipality age adjusted diabetes prevalence, 2004-2013 |  |  | 0.074 |
| Below median (12.4%) | 169,392 (16,809) | 1.00 (0.97, 1.03) |  |
| Above median | 162,737 (18,246) | 1.02 (0.99, 1.06) |  |
| Maternal pre-pregnancy BMI\*\* |  |  | 0.116 |
| < 25 | 94,235 (11,312) | 1.00 (0.97, 1.03) |  |
| >=25 | 76,719 (7,413) | 1.03 (0.99, 1.06) |  |

\* All estimates are from fully adjusted models, with adjustment for individual-level covariates (mother’s age, number of other children [alive or deceased], infant’s sex, gestational age, education level, urban/rural residence, marital status, number of prenatal visits attended, and year of conception) and area/municipality-level covariates (including population density, income per capita, proportion of non-white non-Hispanic residents, average unemployment rate, proportion of occupied housing units with at least one of four severe US Department of Housing and Urban Development-designated defects, percentage of residents with a less than high school level of education, and the age adjusted prevalence of diabetes mellitus).

\*\*Available only for births occurring in 2005 onwards (*N* = 173,964), not included in the main analysis but used in some sensitivity analysis.

\*\*\* These are designated by the US Department of Housing and Urban Development as overcrowding, lack of kitchen, lack of plumbing, and high housing cost.

PR – Puerto Rico, USD – US Dollars

eTable 13. Risk ratios and 95% CIs of low birth weight for a standard deviation increase in prenatal PM2.5 exposure among all births in 37 municipalities in in Puerto Rico for the period 1999 – 2013 restricted to mothers’ first birth, stratified by mother’s characteristics.\*

|  |  |  |  |
| --- | --- | --- | --- |
| Characteristic | Number of births (Number of LBW) | Risk ratio  (95% CI) | *P-value* |
| Age of mother (years) |  |  | 0.760 |
| ≤25 | 95,569 (11,390) | 1.01 (0.97, 1.04) |  |
| >25 | 41,805 (4,585) | 1.00 (0.95, 1.06) |  |
| Race/ethnicity |  |  | 0.235 |
| Hispanic | 121,832 (14,119) | 1.00 (0.97, 1.04) |  |
| Black | 15,459 (1,853) | 1.06 (0.97, 1.15) |  |
| Infant sex |  |  | 0.992 |
| Male | 70,820 (7,654) | 1.01 (0.96, 1.05) |  |
| Female | 66,593 (8,329) | 1.00 (0.97, 1.04) |  |
| Prenatal visits |  |  | 0.703 |
| <10 | 30,722 (6,646) | 0.98 (0.94, 1.02) |  |
| ≥10 | 106,572 (9,296) | 1.03 (0.98, 1.09) |  |
| Marital status |  |  | 0.157 |
| Married | 54,806 (5,804) | 0.99 (0.95, 1.05) |  |
| Not married | 82,583 (10,173) | 1.01 (0.98, 1.05) |  |
| Residence |  |  | 0.017 |
| Urban | 90,682 (10,340) | 1.04 (1.00, 1.08) |  |
| Rural | 46,695 (5,637) | 0.97 (0.94, 1.01) |  |
| Education level |  |  | 0.740 |
| Did not complete high school | 27,931 (3,895) | 1.01 (0.96, 1.05) |  |
| High school graduate and above | 109,204 (12,055) | 1.01 (0.97, 1.05) |  |
| Birth in “dust storm” months |  |  | 0.053 |
| Yes (May - October) | 68,226 (7,998) | 1.02 (0.99, 1.06) |  |
| No (November - April) | 69,187 (7,985) | 1.00 (0.96, 1.04) |  |
| Year of birth |  |  | 0.827 |
| 1999 – 2004 | 63,980 (7,174) | 1.00 (0.96, 1.04) |  |
| 2005 – 2013 | 73,433 (8,809) | 1.01 (0.96, 1.06) |  |
| Health insurance |  |  | 0.607 |
| Private or public employer | 108,970 (12,617) | 0.99 (0.96, 1.01) |  |
| Medicaid or charity | 7,490 (892) | 1.00 (0.92, 1.08) |  |
| Municipality household income, 2013 inflation-adjusted US dollars |  |  | 0.970 |
| Below median ( USD 22,754) | 88,208 (10,518) | 1.01 (0.96, 1.07) |  |
| Above median | 49,205 (5,465) | 0.98 (0.93, 1.02) |  |
| % non-white non-Hispanic population |  |  | 0.959 |
| Below median (35.7%) | 74,394 (8,743) | 1.01 (0.95, 1.07) |  |
| Above median | 63,019 (7,240) | 1.00 (0.97, 1.03) |  |
| Municipality population density |  |  | 0.169 |
| Below median (2,760/sq. mile) | 70,456 (8,651) | 0.99 (0.96, 1.03) |  |
| Above median | 66,957 (7,332) | 1.02 (0.95, 1.11) |  |
| Municipality average unemployment rate, 2004-2013 |  |  | 0.263 |
| Below median (10.3%) | 71,753 (7,874) | 0.99 (0.96, 1.03) |  |
| Above median | 65,660 (8,109) | 1.02 (0.95, 1.10) |  |
| Municipality % occupied units with 1+ of 4 severe housing problems \*\*\* |  |  | 0.271 |
| Below median (34.8%) | 90,638 (10,421) | 1.04 (0.99, 1.08) |  |
| Above median | 46,775 (5,562) | 0.97 (0.93, 1.02) |  |
| Municipality % adults > 25 years with <high school education |  |  | 0.187 |
| Below median (23.9%) | 71,721 (7,868) | 1.02 (0.95, 1.11) |  |
| Above median | 65,692 (8,115) | 0.98 (0.95, 1.02) |  |
| Municipality age adjusted diabetes prevalence, 2004-2013 |  |  | 0.183 |
| Below median (12.4%) | 71,753 (7,874) | 0.99 (0.95, 1.03) |  |
| Above median | 65,660 (8,109) | 1.02 (0.95, 1.10) |  |
| Maternal pre-pregnancy BMI\*\* |  |  | 0.084 |
| < 25 | 44,781 (5,639) | 0.99 (0.95, 1.04) |  |
| >=25 | 27,414 (2,978) | 1.03 (0.97, 1.10) |  |

\* All estimates are from fully adjusted models, with adjustment for individual-level covariates (mother’s age, number of other children [alive or deceased], infant’s sex, gestational age, education level, urban/rural residence, marital status, number of prenatal visits attended, and year of conception) and area/municipality-level covariates (including population density, income per capita, proportion of non-white non-Hispanic residents, average unemployment rate, proportion of occupied housing units with at least one of four severe US Department of Housing and Urban Development-designated defects, percentage of residents with a less than high school level of education, and the age adjusted prevalence of diabetes mellitus).

\*\*Available only for births occurring in 2005 onwards (*N* = 173,964), not included in the main analysis but used in some sensitivity analysis.

\*\*\* These are designated by the US Department of Housing and Urban Development as overcrowding, lack of kitchen, lack of plumbing, and high housing cost.

PR – Puerto Rico, USD – US Dollars