**Supplementary materials**

**Table S1.** Stratified analysis of low birth weight by sex of child and place of residence among under-5 children in India, 2021.

|  |  |
| --- | --- |
| **Variables** | **Low birth weight** |
| **Male**  | **Female** | **Rural** | **Urban** |
| **In-utero PM2.5 exposure level** | **AOR** | **AOR** | **AOR** | **AOR** |
| <28.02 ® |   |   |   |   |
| 28.02-34.33 | 0.92\* [0.85, 0.99] | 0.95 [0.88, 1.02] | 0.93\* [0.87, 0.99] | 0.93 [0.84, 1.03] |
| 34.33-42.13 | 0.90\*\* [0.83, 0.97] | 0.93\* [0.86, 1.00]  | 0.95 [0.89, 1.01] | 0.83\*\*\* [0.76, 0.92] |
| 42.13-49.92 | 0.99 [0.92, 1.07] | 1.02 [0.95, 1.10] | 1.00 [0.94, 1.06] | 1.02 [0.92, 1.12] |
| 49.92-59.92 | 1.03[0.96, 1.11] | 1.06 [0.99, 1.14] | 1.03 [0.97, 1.09] | 1.09 [0.99, 1.20] |
| 59.92-73.21 | 0.98 [0.91, 1.06] | 0.94 [0.87, 1.01] | 0.95 [0.89, 1.01] | 0.98 [0.89, 1.08] |
| 73.21-93.84 | 1.11\*\* [1.03, 1.20] | 1.09\* [1.02, 1.18] | 1.10\*\* [1.03, 1.16] | 1.11\* [1.00, 1.22]  |
| >93.84 | 1.10\* [1.01, 1.17] | 1.03 [0.96, 1.11] | 1.05 [0.99, 1.12] | 1.09 [0.99, 1.20] |
| **Mother's level of education** |
| No education ® |   |   |   |   |
| Primary | 1.05 [0.99, 1.11] | 1.04 [0.98, 1.11] | 1 [0.96, 1.05] | 1.21\*\*\* [1.10, 1.34] |
| Secondary | 0.93\*\* [0.88, 0.97] | 0.97 [0.92, 1.01] | 0.95\*\* [0.914, 0.98] | 0.95 [0.88, 1.03] |
| Higher secondary | 0.78\*\*\* [0.73, 0.83] | 0.76\*\*\* [0.71, 0.813] | 0.75\*\*\* [0.71, 0.80] | 0.81\*\*\* [0.73, 0.88] |
| **Residence** |
| Urban ® |   |   |   |   |
| Rural | 0.95\* [0.91, 0.99] | 0.91\*\*\* [0.87, 0.95] |   |   |
| **Received of antenatal care** |
| Inadequate visits (<4 times) ® |   |   |   |   |
| Adequate visits (>4 times) | 0.99 [0.95, 1.02] | 0.98 [0.94, 1.00] | 0.97 [0.95, 1.00] | 1 [0.95, 1.04] |
| **Wealth quintile** |
| Poorest ® |   |   |   |   |
| poorer | 0.97 [0.92, 1.02] | 0.98 [0.93, 1.03] | 0.99 [0.95, 1.02] | 0.85\* [0.75, 0.97] |
| Middle | 0.90\*\*\* [0.85, 0.95] | 0.90\*\*\* [0.85, 0.96] | 0.91\*\*\* [0.87, 0.95] | 0.82\*\* [0.73, 0.94] |
| Richer | 0.94 [0.87, 1.00] | 0.90\*\* [ 0.84, 0.96] | 0.90\*\*\* [0.86, 0.95] | 0.87 [0.76, 1.00] |
| Richest | 0.87\*\*\* [0.80, 0.94] | 0.86\*\*\* [0.80, 0.93] | 0.90\*\* [0.84, 0.96] | 0.78\*\*\* [0.68, 0.90] |

Adjusted by birth order, teenage motherhood, maternal BMI, mothers age at birth, received of antenatal care, mothers use of tobacco, maternal height, drinking water facility, sanitation facility, use of solid cooking fuel. ®: Reference category, \* Significant at: p < 0.05; \*\*Significant at: p ≤ 0.01, \*\*\*Significant at: p ≤ 0.001

**Table S2.** Stratified analysis of preterm birth by sex of child and place of residence among under-5 children in India, 2021.

|  |  |
| --- | --- |
| **Variables** | **Preterm birth** |
| **Female** | **Male** | **Urban** | **Rural** |
| **In-utero PM2.5 exposure level** | **AOR** | **AOR** | **AOR** | **AOR** |
| <28.02 ® |   |   |   |   |
| 28.02-34.33 | 0.94 [0.85, 1.03] | 0.95 [0.87, 1.04] | 0.86\* [0.76, 0.97] | 0.98 [0.91, 1.07] |
| 34.33-42.13 | 1.05 [0.96, 1.16] | 1.01 [0.93, 1.11] | 0.83\*\* [0.74, 0.94] | 1.13\*\* [1.05, 1.23] |
| 42.13-49.92 | 1.36\*\*\* [1.24, 1.49] | 1.20\*\*\* [1.09, 1.30] | 1.12\* [1.00, 1.26] | 1.34\*\*\* [1.24, 1.44] |
| 49.92-59.92 | 1.44\*\*\* [1.32, 1.58] | 1.34\*\*\* [1.23, 1.46] | 1.26\*\*\* [1.12, 1.41] | 1.45\*\*\* [1.35, 1.56] |
| 59.92-73.21 | 1.40\*\*\* [1.28, 1.54] | 1.29\*\*\* [1.18, 1.40] | 1.16\*\* [1.03, 1.30] | 1.42\*\*\* [1.32, 1.58] |
| 73.21-93.84 | 1.35\*\*\* [1.23, 1.48] | 1.24\*\*\* [1.14, 1.35] | 1.26\*\*\* [1.13, 1.41] | 1.32\*\*\* [1.22, 1.42] |
| >93.84 | 1.54\*\*\* [1.41, 1.68] | 1.51\*\*\* [1.38, 1.63] | 1.27\*\*\* [1.14, 1.42] | 1.63\*\*\* [1.52, 1.75] |
| **Mother's level of education** |
| No education ® |   |   |   |   |
| Primary | 0.94 [0.88, 1.01] | 0.89\*\*\* [0.83, 0.95] | 1.04 [0.92, 1.16] | 0.89\*\*\* [0.84, 0.94] |
| Secondary | 0.90\*\*\* [0.85, 0.95] | 0.89\*\*\* [0.85, 0.94] | 0.89\* [0.81, 0.98] | 0.89\*\*\* [0.85, 0.93] |
| Higher secondary | 0.90\*\* [0.83, 0.97] | 0.97 [0.90, 1.04] | 0.95 [0.86, 1.06] | 0.92\*\* [0.87, 0.98] |
| **Residence** |
| Urban ® |   |   |   |   |
| Rural | 1.17\*\*\* [1.10, 1.23] | 1.09\*\*\* [1.03, 1.14] |   |   |
| **Received of antenatal care** |
| Inadequate visits (<4 times) ® |   |   |   |   |
| Adequate visits (>4 times) | 0.90\*\*\* [0.86, 0.93] | 0.88\*\*\* [0.85, 0.92] | 0.87\*\*\* [0.82, 0.92] | 0.90\*\*\* [0.87, 0.92] |
| **Wealth quintile** |
| Poorest ® |   |   |   |   |
| poorer | 1.07\* [1.00, 1.14] | 1.09\*\* [1.03, 1.16] | 1.02 [0.86, 1.20] | 1.09\*\*\* [1.04, 1.14] |
| Middle | 1 [0.93, 1.07] | 1.07\* [1.00, 1.15] | 1.09 [0.92, 1.29] | 1.03 [0.98, 1.09] |
| Richer | 1.03 [0.95, 1.11] | 1.15\*\*\* [1.06, 1.24] | 1.19 [0.99, 1.42] | 1.07\* [1.00, 1.13] |
| Richest | 1.1 [1.00, 1.19] | 1.15\*\* [1.05, 1.26] | 1.22\* [1.01, 1.46] | 1.10\* [1.02, 1.19] |

Adjusted by birth order, teenage motherhood, maternal BMI, mothers age at birth, received of antenatal care, mothers use of tobacco, maternal height, drinking water facility, sanitation facility, use of solid cooking fuel ®: Reference category, \* Significant at: p < 0.05; \*\*Significant at: p ≤ 0.01, \*\*\*Significant at: p ≤ 0.001

**Table S3.** Marginal effect of PM2.5 with LBW among under-5 children in India, 2021.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Octiles** | **Marginal effect**  | **Std. Err.** | **z** | **P>z** | **Confidence interval** |
| <28.02  | 0.18 | 0.003 | 59.07 | 0 | [0.175 - 0.187] |
| 28.02-34.33 | 0.17 | 0.003 | 65.29 | 0 | [0.166 - 0.176] |
| 34.33-42.13 | 0.17 | 0.002 | 67.93 | 0 | [0.163 - 0.173] |
| 42.13-49.92 | 0.18 | 0.002 | 75.11 | 0 | [0. 177 - 0.186] |
| 49.92-59.92 | 0.19 | 0.002 | 78.26 | 0 | [0. 183 - 0.192] |
| 59.92-73.21 | 0.18 | 0.002 | 78.87 | 0 | [0. 170 - 0.179] |
| 73.21-93.84 | 0.20 | 0.002 | 83.39 | 0 | [0. 191 - 0.200] |
| >93.84 | 0.19 | 0.002 | 83.81 | 0 | [0. 185 - 0.194] |

Adjusted by sex of child, birth order, teenage motherhood, mother’s education, maternal BMI, mothers age at birth, received of antenatal care, mothers use of tobacco, maternal height, drinking water facility, sanitation facility, use of solid cooking fuel, wealth quintiles, Std Err: Standard error, ®: Reference category, \* Significant at: p < 0.05; \*\*Significant at: p ≤ 0.01, \*\*\*Significant at: p ≤ 0.001

**Table S4.** Marginal effect of PM2.5 with PTB among under-5 children in India, 2021.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Octiles** | **Marginal effect** | **Std. Err.** | **z** | **P>z** | **Confidence interval** |
| <28.02  | 0.10 | 0.00 | 43.60 | 0.00 | [0.099 - 0.109] |
| 28.02-34.33 | 0.10 | 0.00 | 48.13 | 0.00 | [0.095 - 0.103] |
| 34.33-42.13 | 0.11 | 0.00 | 52.04 | 0.00 | [0.103 - 0.111] |
| 42.13-49.92 | 0.13 | 0.00 | 60.30 | 0.00 | [0.124 - 0.133] |
| 49.92-59.92 | 0.14 | 0.00 | 64.63 | 0.00 | [0.135 - 0.143] |
| 59.92-73.21 | 0.14 | 0.00 | 66.99 | 0.00 | [0.131 - 0.139] |
| 73.21-93.84 | 0.13 | 0.00 | 65.10 | 0.00 | [0.126 - 0.134] |
| >93.84 | 0.15 | 0.00 | 72.46 | 0.00 | [0.146 - 0.154] |

Adjusted by sex of child, birth order, teenage motherhood, mother’s education, maternal BMI, mothers age at birth, received of antenatal care, mothers use of tobacco, maternal height, drinking water facility, sanitation facility, use of solid cooking fuel, wealth quintiles., Std Err: Standard error, ®: Reference category, \* Significant at: p < 0.05; \*\*Significant at: p ≤ 0.01, \*\*\*Significant at: p ≤ 0.001

**Table S5.** Results of OLS regression analysis of low birth weight among under-5 children in India, 2021.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | Coefficient | SE | t-statistic | Probability | Robust SE | Robust t- statistics | Robust probability | VIF |
| Intercept | 13.17662 | 0.8917 | 14.776 | 0.000\* | 0.85611 | 15.39126 | 0.0000\* | ------  |
| District level avg.of PM2.5 | 0.0877 | 0.0084 | 10.428 | 0.0000\* | 0.0082 | 10.5814 | 0.0000\* | 1.281 |
| Rural residence | 0.0121 | 0.0114 | 1.0625 | 0.2883 | 0.0111 | 1.0866 | 0.2775 | 1.52 |
| No education of mother | 0.0384 | 0.0184 | 2.087 | 0.0371\* | 0.0187 | 2.053 | 0.0404 | 1.62 |
| Child from poorestquantile | 0.0107 | 0.013 | 0.8228 | 0.4108 | 0.0127 | 0.8438 | 0.399 | 1.82 |
| Receive of antenatalcare (4>) | -0.0614 | 0.0133 | -4.599 | 0.000\* | 0.0134 | -4.5505 | 0.000\* | 1.48 |

SE: Standard error, VIF: Variance Inflation Factor, \* Significant p-value <0.05

**Table S6.** Ordinary Least Square (OLS) diagnosis of low birth weight among under-5 children in India, 2021.

|  |  |  |  |
| --- | --- | --- | --- |
| Number of observation | 706 | Akaike's information Criterion (AICs) | 4317.105 |
| Multiple R-Squared | 0.1729 | Adjusted R-Squared | 0.16706 |
| Joint F-Statistic | 29.2813 | Prob (> F), (5,700) degrees: | 0.000\* |
| Joint Wald-Statistic | 150.245 | Prob (> chi-squared), (5) df. | 0.000\* |
| Koenkar (BP) statistics | 2.7399 | Prob (> chi-squared), (5) df. | 0.73995 |
| Jarque-Bera Statistics | 0.3275 | Prob (> chi-squared), (2) df. | 0.8489 |

**Table S7.** Geographically weighted regression model of low birth weight among under-5 children in India, 2021.

|  |  |
| --- | --- |
| Explanatory variables | District level average of PM2.5, rural residence, mothers no education, child from poorest wealth quintile, inadequate visit of antenatal care |
| Residual squares | 13244.5019 |
| Effective number | 32.992 |
| Sigma | 4.43616 |
| Akaike's information Criteria (AICs) | 4127.74903 |
| Multiple R-squared | 0.40258 |
| Adjusted R-squared | 0.374185 |

**Table S8.** Results of OLS regression analysis of preterm birth weight among under-5 children in India, 2021.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | Coefficient | standard error | t-statistic | Probability | Robust standard error | Robust t- statistics | Robust probability | VIF |
| Intercept | 5.2 | 1.322 | 3.9338 | 0.0001\* | 1.118 | 4.6517 | 0.0000\* |  -------- |
| District level avg. of PM2.5 | 0.006 | 0.0124 | 0.5015 | 0.6161 | 0.0119 | 0.5241 | 0.5994 | 1.281 |
| Rural residence | 0.016 | 0.0116 | 0.9597 | 0.3375 | 0.0168 | 0.964 | 0.3353 | 1.52 |
| No education of mother | 0.035 | 0.0272 | 1.3018 | 0.1934 | 0.027 | 1.309 | 0.1909 | 1.62 |
| Child from poorest quantile | -0.111 | 0.019 | -5.771 | 0.000\* | 0.0194 | -5.7402 | 0.000\* | 1.82 |
| Receive of antenatal care (4>) | 0.1826 | 0.019 | 9.229 | 0.000\* | 0.0184 | 9.9158 | 0.000\* | 1.47 |

SE: Standard error, VIF: Variance Inflation Factor, \* Significant p-value <0.05

**Table S9.** OLS regression diagnosis of preterm birth weight among under-5 children in India, 2021.

|  |  |  |  |
| --- | --- | --- | --- |
| Number of observation | 706 | Akaike's information Criterion (AICs) | 4873.183 |
| Multiple R-Squared | 0.143 | Adjusted R-Squared | 0.1374 |
| Joint F-Statistic | 23.474 | Prob (> F), (5,700) degrees | 0.000\* |
| Joint Wald-Statistic | 145.779 | Prob (> chi-squared), (5) df. | 0.000\* |
| Koenkar (BP) statistics | 29.7556 | Prob (> chi-squared), (5) df. | 0.000\* |
| Jarque-Bera Statistics | 246.901 | Prob (> chi-squared), (2) df. | 0.000\* |

**Table S10.** Geographically weighted regression of preterm birth among under-5 children in India, 2021.

|  |  |
| --- | --- |
| Explanatory variables | District level average of PM2.5, rural residence, mothers no education, child from poorest wealth quintile, inadequate visit of antenatal care |
| Residual squares | 34074.937 |
| Effective number | 32.992 |
| sigma | 7.11553 |
| Akaike's information Criteria (AICs) | 4794.9046 |
| Multiple R-squared | 0.2759577 |
| Adjusted R-squared | 0.241539 |