**SUPPLEMENTARY MATERIAL**

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**Figure S1.** Logic model for the effect of migration on perinatal outcomes.

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**Figure S2.** Adjusted odds ratio of perinatal outcomes of live births born to international migrants compared to those born to Brazilian-born mothers by race/ethnicity and place of residence for selected health outcomes. *Odds ratio (OR) calculated by logistic regression adjusted for mother’s age, education, region of residence and year of birth.*

**Table S1.** Characteristics of demographic and socioeconomic characteristics of live births born between 2011 and 2018 by place of birth of the mother.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Live births from international migrant mothers (N=9,469)** | **Live births from Brazilian-born mothers (N=10,269,542)** | **All live births(N=10,279,011)** |
|  | N | % | N | % | N | % |
| ***Mother’s demographic characteristics*** |  |  |  |  |  |  |
| **Age** |  |  |  |  |  |  |
| 10-18 years | 628 | 6.6 | 1,820,058 | 17.7 | 1,820,686 | 17.7 |
| 19-39 years | 8,281 | 87.5 | 8,250,841 | 80.3 | 8,259,122 | 80.3 |
| 40-49 years | 560 | 5.9 | 198,643 | 1.9 | 199,203 | 1.9 |
| **Race/ethnicity** |  |  |  |  |  |  |
| White | 3,011 | 31.8 | 3,103,283 | 30.2 | 3,106,294 | 30.2 |
| Black | 2,634 | 27.8 | 818,398 | 8.0 | 821,032 | 8 |
| Asian | 113 | 1.2 | 39,968 | 0.4 | 40,081 | 0.4 |
| Brown/mixed | 3,572 | 37.7 | 6,205,110 | 60.4 | 6,208,682 | 60.4 |
| Indigenous | 139 | 1.5 | 102,783 | 1.0 | 102,922 | 1 |
| **Civil status** |  |  |  |  |  |  |
| Married | 5,182 | 54.7 | 5,048,155 | 49.2 | 5,053,337 | 49.2 |
| Single | 4,203 | 44.4 | 5,117,160 | 49.8 | 5,121,363 | 49.8 |
| Missing | 84 | 0.9 | 104,227 | 1.0 | 104,311 | 1 |
| **Literate** |  |  |  |  |  |  |
| Yes | 9,041 | 95.5 | 9,525,172 | 92.8 | 9,534,213 | 92.8 |
| No | 423 | 4.5 | 679,242 | 6.6 | 679,665 | 6.6 |
| Missing | 5 | 0.1 | 65,128 | 0.6 | 65,133 | 0.6 |
| **Education** |  |  |  |  |  |  |
| No | 126 | 1.3 | 90,762 | 0.9 | 90,888 | 0.9 |
| 1-3 years | 329 | 3.5 | 483,443 | 4.7 | 483,772 | 4.7 |
| 4-7 years | 1,959 | 20.7 | 2,753,401 | 26.8 | 2,755,360 | 26.8 |
| 8-11 years | 5,966 | 63 | 6,331,739 | 61.7 | 6,337,705 | 61.7 |
| >12 years | 1,089 | 11.5 | 610,197 | 5.9 | 611,286 | 5.9 |
| **Region of residence** |  |  |  |  |  |  |
| North | 656 | 6.9 | 1,300,066 | 12.7 | 1,300,722 | 12.7 |
| Northeast | 368 | 3.9 | 3,953,245 | 38.5 | 3,953,613 | 38.5 |
| Southeast | 4,121 | 43.5 | 3,169,972 | 30.9 | 3,174,093 | 30.9 |
| South | 3,432 | 36.2 | 1,143,240 | 11.1 | 1,146,672 | 11.2 |
| Central-west | 892 | 9.4 | 703,019 | 6.8 | 703,911 | 6.8 |
| **Area of residence** |  |  |  |  |  |  |
| Urban | 8,693 | 91.8 | 7,593,967 | 73.9 | 7,602,660 | 74 |
| Rural | 710 | 7.5 | 2,537,071 | 24.7 | 2,537,781 | 24.7 |
| Missing | 66 | 0.7 | 138,504 | 1.3 | 138,570 | 1.3 |
| **Border municipality** |  |  |  |  |  |  |
| Yes | 2,576 | 72.8 | 698,966 | 6.8 | 701,542 | 6.8 |
| No | 6,893 | 27.2 | 9,570,576 | 93.2 | 9,577,469 | 93.2 |
|  |  |  |  |  |  |  |
| ***Mothers socioeconomic characteristics*** |  |  |  |  |  |
| **Household type** |  |  |  |  |  |  |
| Private and permanent | 7,917 | 83.6 | 9,471,771 | 92.2 | 9,479,688 | 92.2 |
| Private but improvised or collective | 866 | 9.1 | 388,517 | 3.8 | 389,383 | 3.8 |
| Missing | 686 | 7.2 | 409,254 | 4.0 | 409,940 | 4 |
| **Material of the household** |  |  |  |  |  |  |
| Masonry / brick | 7,015 | 74.1 | 7,141,091 | 69.5 | 7,148,106 | 69.5 |
| Coated or Uncoated Taipa, wood, others | 252 | 2.7 | 1,412,932 | 13.8 | 1,413,184 | 13.7 |
| Wood | 1,357 | 14.3 | 1,463,553 | 14.3 | 1,464,910 | 14.3 |
| Missing | 845 | 8.9 | 251,966 | 2.5 | 252,811 | 2.5 |
| **Water supply** |  |  |  |  |  |  |
| Public network | 7,703 | 81.3 | 6,883,419 | 67.0 | 6,891,122 | 67 |
| Well, natural source from the ground | 720 | 7.6 | 2,269,475 | 22.1 | 2,270,195 | 22.1 |
| Other (e.g., rivers) | 201 | 2.1 | 864,701 | 8.4 | 864,902 | 8.4 |
| Missing | 845 | 8.9 | 251,947 | 2.5 | 252,792 | 2.5 |
| **Sewage disposal** |  |  |  |  |  |  |
| Public network | 5,461 | 57.7 | 4,206,091 | 41.0 | 4,211,552 | 41 |
| Septic tank | 1,094 | 11.6 | 1,494,210 | 14.5 | 1,495,304 | 14.5 |
| Rudimentary Trench, open ditch, water or others | 1,735 | 18.3 | 2,553,596 | 24.9 | 2,555,331 | 24.9 |
| Others (role, river, etc) | 248 | 2.6 | 1,660,776 | 16.2 | 1,661,024 | 16.2 |
| Missing | 931 | 9.8 | 354,869 | 3.5 | 355,800 | 3.5 |
| **Waste disposal/ garbage collection** |  |  |  |  |  |  |
| Collected directly/indirectly | 7,937 | 83.8 | 7,262,290 | 70.7 | 7,270,227 | 70.7 |
| Burned or buried | 501 | 5.3 | 1,898,133 | 18.5 | 1,898,634 | 18.5 |
| Other outdoor disposal | 186 | 2.0 | 857,182 | 8.3 | 857,368 | 8.3 |
| Missing | 845 | 8.9 | 251,937 | 2.5 | 252,782 | 2.5 |
| **Electricity** |  |  |  |  |  |  |
| Electric with meter | 6,930 | 73.2 | 7,589,833 | 73.9 | 7,596,763 | 73.9 |
| Electric with community meter | 1,141 | 12.0 | 582,242 | 5.7 | 583,383 | 5.7 |
| Informal electric lights or no electricity | 319 | 3.4 | 735,304 | 7.2 | 735,623 | 7.2 |
| No electricity | 234 | 2.5 | 1,110,419 | 10.8 | 1,110,653 | 10.8 |
| Missing | 845 | 8.9 | 251,744 | 2.5 | 252,589 | 2.5 |
| **Received Bolsa Familia benefit at any time** |  |  |  |  |  |  |
| No | 2,856 | 30.2 | 872,459 | 8.5 | 875,315 | 8.5 |
| Yes | 6,613 | 69.8 | 9,397,083 | 91.5 | 9,403,696 | 91.5 |

**Table S2.** Crude odds ratio of perinatal outcomes of live births born to international migrants compared to those born to Brazilian-born birth mothers.

|  |  |
| --- | --- |
|  | **Live births from international migrant mothers versus Brazilian-born mothers** |
|  | **WhiteOR (95%CI)** | **BlackOR (95%CI)** | **AsianOR (95%CI)** | **Brown/mixedOR (95%CI)** | **IndigenousOR (95%CI)** |
| ***Pre-pregnancy risk factors*** |  |  |  |  |  |
| **Previous foetal loss** |  |  |  |  |  |
| No | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Yes | 1.19 (1.09-1.30) | 0.90 (0.82-1.00) | 1.01 (0.64-1.59) | 1.41 (1.30-1.52) | 2.03 (1.41-2.92) |
|  |  |  |  |  |  |
| ***Antenatal care*** |  |  |  |  |  |
| **Delayed antenatal care** |  |  |  |  |  |
| No (started in first trimester) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Yes (>1st trimester) | 1.05 (0.96-1.15) | 0.81 (0.74-0.89) | 0.86 (0.55-1.36) | 1.10 (1.02-1.19) | 0.70 (0.49-1.00) |
|  |  |  |  |  |  |
| ***Adverse pregnancy outcomes*** |  |  |  |  |  |
| **Prematury** |  |  |  |  |  |
| Term (>=37 weeks) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Premature (<37 weeks) | 0.94 (0.83-1.06) | 0.81 (0.71-0.93) | 0.08 (0.01-0.56) | 0.82 (0.73-0.92) | 0.36 (0.18-0.73) |
| **Birth weight** |  |  |  |  |  |
| >=2500g |  1.00 |  1.00 |  1.00 |  1.00 |  1.00 |
| <2500g | 0.86 (0.74-0.99) | 0.92 (0.80-1.07) | 0.24 (0.06-0.97) | 0.63 (0.54-0.74) | 0.21 (0.05-0.83) |
| **Weight for gestational age (0 vs 1)** |  |  |  |  |  |
| AGA | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| SGA | 0.84 (0.72-0.99) | 0.91 (0.79-1.04) | 0.37 (0.12-1.19) | 0.64 (0.55-0.75) | 0.19 (0.05-0.77) |
| LGA | 1.29 (1.18-1.42) | 0.73 (0.65-0.82) | 1.75 (1.15-2.67) | 1.45 (1.34-1.57) | 2.05 (1.43-2.94) |
| **APGAR at 5 minutes** |  |  |  |  |  |
| >=7 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| <7 | 0.72 (0.47-1.10) | 1.44 (1.08-1.90) | 0.82 (0.11-5.90) | 0.71 (0.5-1.02) | 1.08 (0.27-4.36) |
| **Congenital anomaly** |  |  |  |  |  |
| No | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Yes | 1.11 (0.77-1.62) | 2.14 (1.6-2.84) | 1.13 (0.16-8.10) | 1.32 (0.95-1.83) | 0.99 (0.14-7.07) |
|  |  |  |  |  |  |
| ***Neonatal mortality*** |  |  |  |  |  |
| **Neonatal mortality2** |  |  |  |  |  |
| No | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Yes | 0.94 (0.59-1.50) | 1.18 (0.79-1.76) | - | 0.79 (0.51-1.22) | 1.75 (0.43-7.08) |

**2** Not enough events among Asian category.

AGA: Adequate for gestational age, SGA: Small for gestational age, LGA: Large for gestational age

**Table S3.** Crude odds ratio of perinatal outcomes of live births born to international migrants compared to those born to Brazilian-born birth mothers for people living in border and non-border areas.

|  |  |
| --- | --- |
|  | **Live births from migrant versus Brazilian-born birth mothers** |
|  | **Non-borderOR (95%CI)** | **Non-borderORadj1(95%CI)** | **BorderOR (95%CI)** | **BorderORadj1(95%CI)** |
| ***Pre-pregnancy risk factors*** |  |  |  |  |
| **Previous foetal loss** |   |   |   |   |
| No | 1.00 | 1.00 | 1.00 | 1.00 |
| Yes | 1.31 (1.23-1.38) | 1.24 (1.17-1.31) | 1.03 (0.93-1.14) | 0.99 (0.89-1.09) |
|  |  |  |  |  |
| ***Antenatal care*** |   |  |   |  |
| **Delayed antenatal care** |   |  |   |  |
| No (started in first trimester) | 1.00 | 1.00 | 1.00 | 1.00 |
| Yes (>1st trimester) | 1.01 (0.96-1.07) | 1.27 (1.21-1.35) | 0.83 (0.76-0.91) | 1.03 (0.94-1.14) |
|  |  |  |  |  |
| ***Adverse pregnancy outcomes*** |  |  |  |  |
| **Prematurity** |  |  |  |  |
| Term (>=37 weeks) | 1.00 | 1.00 | 1.00 | 1.00 |
| Premature (<37 weeks) | 0.81 (0.75-0.88) | 0.86 (0.79-0.93) | 0.87 (0.76-0.88) | 0.93 (0.82-1.05) |
| **Birth weight** |   |   |   |   |
| >=2500g | 1.00 | 1.00 | 1.00 | 1.00 |
| <2500g | 0.82 (0.74-0.91) | 0.74 (0.67-0.82) | 0.80 (0.68-0.95) | 0.76 (0.64-0.90) |
| **Weight for gestational age**  |   |   |   |   |
| AGA | 1.00 | 1.00 | 1.00 | 1.00 |
| SGA | 0.77 (0.70-0.86) | 0.80 (0.72-0.88) | 0.90 (0.76-1.05) | 0.93 (0.79-1.10) |
| LGA | 1.21 (1.14-1.29) | 1.33 (1.26-1.42) | 1.06 (0.95-1.17) | 1.12 (1.01-1.24) |
| **APGAR at 5 minutes** |   |   |   |   |
| >=7 | 1.00 | 1.00 | 1.00 | 1.00 |
| <7 | 1.02 (0.82-1.27) | 1.11 (0.89-1.39) | 0.87 (0.58-1.30) | 0.90 (0.60-1.35) |
| **Congenital anomaly** |   |   |   |   |
| No | 1.00 | 1.00 | 1.00 | 1.00 |
| Yes | 1.80 (1.47-2.19) | 1.57 (1.29-1.91) | 0.82 (0.50-1.37) | 0.74 (0.45-1.23) |
|  |   |   |   |   |
| ***Neonatal mortality*** |   |   |   |   |
| **Child death within 28 days** |   |   |   |   |
| No | 1.00 |  1.00 | 1.00 |  1.00 |
| Yes | 0.96 (0.72-1.28) | 0.98 (0.73-1.31) | 0.99 (0.62-1.58) | 1.02 (0.64-1.63) |

1Adjusted for birth mother’s race/ethnicity, age, education, region of residence and year of birth.

AGA: Adequate for gestational age, SGA: Small for gestational age, LGA: Large for gestational age

**Table S4.** Adjusted odds ratio of perinatal outcomes of live births born to international migrants compared to those born to Brazilian-born mothers by race/ethnicity and place of residence.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **White** | **Black** | **Asian** | **Brown/mixed**  | **Indigenous** |
| ***ORadj1 (95%CI)*** | **Non-border** | **Border** | **Non-border** | **Border** | **Non-border** | **Border** | **Non-border** | **Border** | **Non-border** | **Border** |
| **Pre-pregnancy risk factors** |  |  |  |  |  |  |  |  |  |  |
| ***Previous foetal loss*2** |  |  |  |  |  |  |  |  |  |  |
| *No* | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| *Yes* | 1.23 (1.09-1.38) | 1.06 (0.91-1.24) | 0.95 (0.85-1.05) | 0.68 (0.46-1.00) | 1.12 (0.69-1.81) | 0.32 (0.04-2.5) | 1.52 (1.39-1.67) | 0.97 (0.83-1.14) | - | - |
|  |  |  |  |  |  |  |  |  |  |  |
| **Antenatal care** |  |  |  |  |  |  |  |  |  |  |
| ***Delayed antenatal care*** |  |  |  |  |  |  |  |  |  |  |
| *No (started in first trimester)* | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| *Yes (>1st trimester)* | 1.20 (1.07-1.35) | 1.03 (0.9-1.19) | 1.15 (1.05-1.27) | 0.83 (0.6-1.16) | 1.02 (0.62-1.7) | 2.15 (0.67-6.88) | 1.48 (1.35-1.62) | 1.08 (0.94-1.24) | 1.29 (0.88-1.89) | 3.63 (0.73-18.08) |
|  |  |  |  |  |  |  |  |  |  |  |
| **Adverse pregnancy outcomes** |  |  |  |  |  |  |  |  |  |  |
| ***Prematurity*2** |  |  |  |  |  |  |  |  |  |  |
| *Term (>=37 weeks)* | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| *Premature (<37 weeks)* | 0.92 (0.79-1.08) | 1.00 (0.83-1.21) | 0.92 (0.8-1.06) | 0.73 (0.45-1.19) | - | - | 0.81 (0.70-0.93) | 0.95 (0.78-1.15) | 0.49 (0.23-1.05) | 0.55 (0.07-4.36) |
| ***Birth weight*2** |  |  |  |  |  |  |  |  |  |  |
| *>=2500g* | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| *<2500g* | 0.85 (0.71-1.03) | 0.81 (0.64-1.02) | 0.91 (0.79-1.06) | 0.79 (0.46-1.36) | - | - | 0.54 (0.45-0.66) | 0.71 (0.54-0.94) | - | - |
| ***Weight for gestational age*2** |  |  |  |  |  |  |  |  |  |  |
| *AGA* | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| *SGA* | 0.77 (0.62-0.96) | 0.99 (0.78-1.24) | 0.99 (0.85-1.14) | 1.39 (0.91-2.12) | - | - | 0.64 (0.52-0.77) | 0.78 (0.6-1.02) | 0.12 (0.02-0.84) | 1.77 (0.2-15.9) |
| *LGA* | 1.40 (1.24-1.58) | 1.18 (1.01-1.37) | 0.81 (0.71-0.92) | 0.69 (0.46-1.05) | 2.32 (1.5-3.6) | 0.40 (0.05-3.12) | 1.75 (1.6-1.93) | 1.14 (0.97-1.33) | 2.55 (1.76-3.7) | 2.50 (0.56-11.19) |
| ***APGAR at 5 minutes*2** |  |  |  |  |  |  |  |  |  |  |
| *>=7* | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| *<7* | 0.58 (0.31-1.08) | 0.99 (0.56-1.76) | 1.77 (1.32-2.36) | 1.13 (0.36-3.56) | - | - | 0.79 (0.52-1.22) | 0.8 (0.42-1.55) | - | - |
| ***Congenital abnormalities*2** |  |  |  |  |  |  |  |  |  |  |
| *No* | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| *Yes* | 1.18 (0.75-1.86) | 0.90 (0.46-1.73) | 2.13 (1.59-2.84) | 0.47 (0.07-3.36) | - | - | 1.37 (0.96-1.96) | 0.63 (0.26-1.52) | - | - |
|  |  |  |  |  |  |  |  |  |  |  |
| **Neonatal mortality** |  |  |  |  |  |  |  |  |  |  |
| ***Child death ≤28 days*2** |  |  |  |  |  |  |  |  |  |  |
| *No* | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| *Yes* | 0.71 (0.36-1.43) | 1.28 (0.69-2.39) | 1.39 (0.93-2.09) | 2.50 (0.9-6.91) | - | - | 0.76 (0.44-1.31) | 0.90 (0.43-1.89) | 1.16 (0.16-8.32) | 11.30 (1.44-88.63) |

1Adjusted for birth mother’s race/ethnicity, age, education, region of residence and year of birth.

**2** Not enough events among Asian and/or Indigenous category.

AGA: Adequate for gestational age, SGA: Small for gestational age, LGA: Large for gestational age