# Trends in birth weight indicators between 2009 and 2021 in two districts in the southern region of the Buenos Aires Metropolitan Area

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## ABSTRACT

***Introduction.*** Birth weight is an indicator of perinatal health that is influenced by social, environmental, and health-related factors. The objective of this study is to analyze changes in birth weight indicators (birth weight, low birth weight, and small for gestational age) between 2009 and 2021, specifically in two municipalities in the southern region of the Buenos Aires Metropolitan Area (AMBA, by its Spanish acronym).

***Population and methods.*** We conducted a retrospective observational study using secondary data on live births collected by the Directorate of Health Statistics and Information (DEIS, by its Spanish acronym) of the Ministry of Health. Trends in birth weight, low birth weight (LBW, <2500 g), and small for gestational age (SGA, <10th percentile) were evaluated using joinpoint regression, and associations with maternal age and educational level were analyzed using a mixed-effects model.

***Results.*** Based on a database of 141 525 cases, a moderate upward trend in birth weight was observed, which was statistically significant ($p < 0.05$) in only one municipality. The proportion of cases born with indicators of low birth weight showed a significant reduction over time ($p < 0.05$), more pronounced for SGA (~4% annually) than for LBW (~1% annually). In addition, a nonlinear association was found between maternal age and birth weight, and a positive association with maternal educational level ($p < 0.001$).

***Conclusion.*** This analysis provides up-to-date information on birth weight indicators and their maternal determinants in two municipalities in the southern part of the AMBA.

***Keywords:*** *time series; birth weight; gestational age; small-for-gestational-age newborn.*

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## INTRODUCTION

Birth weight is a critical indicator of population health and is sensitive to a wide range of socioeconomic, environmental, and health-related factors. The relationship between birth weight and these factors over time can be assessed through secular trend analysis.[1,2] In this field, the study of births with low birth weight indicators (low birth weight [LBW] and small for gestational age [SGA]) is of particular interest, as they increase the risk of infant mortality, the development of noncommunicable diseases, and neurodevelopmental disorders.[3] Given the public health significance of birth weight indicators, this study aims to describe changes in these indicators over more than a decade in two municipalities in the southern suburbs of Buenos Aires, Argentina.

Globally, since the mid-20th century, there has been an increase in birth weight, linked to a reduction in maternal malnutrition, births to very young mothers, and tobacco and alcohol use during pregnancy,[4] as well as improvements in medical care and prenatal monitoring.[5] In some contexts, rising rates of maternal overweight and obesity may also be a contributing factor.[6]

In Argentina, during the period 1992-2002, a nationwide trend of declining birth weight and increasing LBW rates was observed.[7] This pattern was linked to the deterioration of the population's socioeconomic conditions during that decade. This study also revealed differences across geographic regions; however, the spatial scale used was broad, highlighting the value of more localized studies to complement the larger-scale perspective.

In this regard, the objective of this study was to analyze trends in birth weight and the proportions of LBW and SGA infants among live births in the municipalities of Berazategui and Florencio Varela during the 2009-2021 period, as well as their associations with maternal variables (age and educational level). In addition, pregnancy duration and the proportion of preterm births were studied.

## POPULATION AND METHODS

An observational, retrospective study using secondary data from a database of 150 894 live births of any age was conducted on pregnancy outcomes between 2009 and 2021 in Berazategui (Ber, n = 61 635) and Florencio Varela (FV, n = 89 259), Buenos Aires Province.

The selection of Berazategui and Florencio Varela as the focus of this analysis is based on the fact that they share characteristics common to the southern region of the AMBA, such as high unemployment rates, unmet basic needs, risk of food insecurity,[8,9] infrastructure and housing deficits,[10] and limited access to services.[11] Furthermore, both municipalities have relatively high birth rates, an extensive network of public health services, and low private coverage,[12] making them suitable for analyzing the dynamics of birth weight indicators in urban contexts with similar socioeconomic characteristics.

The data were obtained from public and private hospital records compiled by the Directorate of Health Statistics and Information (DEIS, by its Spanish acronym) of the Ministry of Health. The study was approved by the Research Ethics Committee of the El Cruce High-Complexity Network Hospital (Opinion No. 00284/2025).

The primary variables were birth weight (in grams), the proportion of LBW births (percentage of births with weights below 2500 g), and the proportion of SGA births (percentage of births with weights below the 10th percentile). Secondary variables included the sex of the newborn, gestational age (recorded in whole weeks, without fractions; however, average values are expressed with decimals as a result of calculating means), the proportion of preterm births (percentage of births before 37 weeks), maternal age (under 15 years, 15-19, 20-24, 25 -29, 30-34, 35-39, 40-44, and 45 or older), and the mother's level of formal education. For this last variable, two categories were established to group the disparate responses (less than 7 years and 7 years or more of formal education), corresponding to levels 0-1 and 2-8 of UNESCO's International Standard Classification of Education (ISCED).[13]

For the database cleanup, the following exclusion criteria were applied: multiple pregnancies and missing information on birth weight, newborn sex, pregnancy type, and gestational age. In analyses involving maternal variables, cases with missing data for these variables were excluded. Weight percentiles and Z-scores were calculated using the InterGrowth21st reference.[14] It should be noted that this reference includes newborns between 24 and 42 weeks of gestation, inclusive; therefore, in the analyses of SGA and those using weight Z-scores, infants born outside this range were excluded.

To describe the trend in birth weight, the mean (x) and standard error of the mean (SEM) were calculated, along with the number of preterm births and low birth weight births per year and municipality. To assess temporal trends, the joinpoint regression method was used in the Joinpoint Regression Program software (version 5.4, National Cancer Institute, USA), with a maximum of 2 joinpoints, a permutation test for model selection, and pairwise comparisons between municipalities. The results were expressed as the annual percentage change (APC) based on values transformed on a logarithmic scale.

To explore the potential bias introduced by preterm births in the variation in birth weight, we examined trends in gestational duration and the percentage of preterm births. Then we repeated the analyses for the subgroup of live births at term (≥37 weeks' gestation).

To assess the association between maternal and neonatal variables, a generalized additive mixed model was fitted using the combined sample from both municipalities. Educational level and maternal age were included as fixed effects (available in the database as categories; each category was assigned the midpoint of its corresponding interval to approximate a continuous variable, and these values were incorporated into the model via linear and quadratic terms). The dependent variable was the weight Z-score. Year of birth was included as a random effect to control for heterogeneity potentially introduced by contextual factors (e.g., changes in public health policies and the quality of prenatal care, socioeconomic conditions) that vary over time. Analyses were performed in R 4.4.2[15] using the lme4 package.

## RESULTS

After applying the exclusion criteria, the database contained 141 525 single live births, of which 57 595 corresponded to 83 930 in Ber and 83 930 in FV (*Table 1*). The final dataset included approximately 94% of the cases collected by DEIS (*Figure 1*). For the SGA analyses, 141 398 cases were considered, restricted to births between 24 and 42 weeks. In both municipalities, live births increased until about the midpoint of the period (peaking in 2015 for Ber and in 2014 for FV) and then declined toward the end of the series (reaching lows in 2021 for Ber and in 2020 for FV) (*Table 1*). Birth weight showed a general upward trend, although with some variations: in Berazategui, temporary declines were observed between 2010–2013 and 2015–2018, with peaks in 2015 and 2020 (*Table 1*, *Figure 2a*). The joinpoint analysis was not significant for Ber. In FV, an increase with fluctuations was also observed, equivalent to an APC of 0.10%, which was statistically significant ($p$ <0.05), although its magnitude is small (*Supplementary Material*). The joinpoint models for weight differed significantly between municipalities (*Supplementary Material*).

The percentages of LBW and SGA show the opposite trend, with a marked reduction observed in both municipalities between the beginning and end of the period (*Figures 2b* and *2c*). The percentages of LBW and SGA are higher in FV throughout the entire period. According to the joinpoint analyses, the declines are significant for both variables in both Ber and FV, and there are no differences between municipalities (*Supplementary Material*).

The average number of weeks of gestation decreased (*Figure 3a*), with a significant trend that was more pronounced in Ber than in FV (APC = -0.05 and -0.02, respectively; $p$ <0.05). Although the variation in the annual average gestational age was significant throughout the series, the change between the maximum and minimum was approximately 2 days in Ber and even smaller in FV. In addition, the percentage of preterm births decreased, although this trend was significant only for FV, with an annual change of -1.55, whereas for Ber the APC was -0.51 (*Supplementary Material*). This reduction in preterm births could partially explain the trends in birth weight; therefore, the analyses were repeated for term births only (≥37 weeks of gestation). In this group, the mean birth weight showed an increasing trend, similar to when all births were included (*Figure 3c*). The rate of change over the period is statistically significant for FV (APC = 0.09; $p$ <0.05), but not for Ber (*Supplementary Material*). The downward trend in LBW is even clearer when only full-term births are analyzed (*Supplementary Material*). The joinpoint analysis indicated that the reduction in LBW in this group was statistically significant in both municipalities, with APC values of -3.68% in Ber and -3.05% in FV (*Supplementary Material*).

For the mixed-effects model, a total of 128 993 cases with complete data for maternal and neonatal variables were included (*Supplementary Material*). The extreme age groups (under 15 and over 45 years) were excluded due to the small number of cases. The data were checked to ensure they met the assumptions of normality, homoscedasticity, and absence of multicollinearity. The results of the mixed

**Table 1. Description of the cases included in the analyzed database, by year and municipality**

| Distric | Year | N | N at term | x̄ weight (g) | SE weight (g) | Birth weight at term (g) | SE birth weight at term (g) | LBW (n) | LBW at term (n) | SGA* (n) |
|---|---|---|---|---|---|---|---|---|---|---|
| Ber | 2009 | 4311 | 3914 | 3269.87 | 8.94 | 3351.11 | 8.08 | 344 | 151 | 327 |
| | 2010 | 4212 | 3849 | 3287.27 | 9.26 | 3366.43 | 8.42 | 346 | 158 | 351 |
| | 2011 | 4992 | 4582 | 3279.71 | 8.25 | 3361.51 | 7.18 | 387 | 153 | 323 |
| | 2012 | 4903 | 4498 | 3278.17 | 8.19 | 3353.73 | 7.35 | 371 | 165 | 379 |
| | 2013 | 4915 | 4497 | 3265.66 | 8.24 | 3339.12 | 7.53 | 374 | 175 | 366 |
| | 2014 | 5018 | 4649 | 3279.12 | 7.82 | 3344.42 | 7.06 | 328 | 153 | 336 |
| | 2015 | 5189 | 4758 | 3298.91 | 7.99 | 3382.98 | 6.91 | 368 | 140 | 272 |
| | 2016 | 4982 | 4545 | 3286.88 | 8.26 | 3376.58 | 7.10 | 360 | 126 | 275 |
| | 2017 | 4668 | 4266 | 3268.95 | 8.44 | 3356.67 | 7.22 | 348 | 133 | 282 |
| | 2018 | 4431 | 4018 | 3263.49 | 8.59 | 3358.12 | 7.31 | 345 | 119 | 229 |
| | 2019 | 3748 | 3458 | 3278.79 | 9.17 | 3356.94 | 7.99 | 258 | 107 | 207 |
| | 2020 | 3208 | 2982 | 3298.54 | 10.03 | 3376.68 | 8.58 | 209 | 84 | 149 |
| | 2021 | 3018 | 2766 | 3287.28 | 10.16 | 3372.41 | 8.81 | 198 | 54 | 131 |
| FV | 2009 | 6236 | 5644 | 3245.20 | 7.77 | 3326.75 | 7.13 | 591 | 316 | 688 |
| | 2010 | 5860 | 5338 | 3259.32 | 7.91 | 3340.78 | 7.20 | 533 | 281 | 621 |
| | 2011 | 6849 | 6267 | 3267.85 | 7.54 | 3362.85 | 6.50 | 612 | 251 | 613 |
| | 2012 | 6846 | 6232 | 3275.34 | 7.30 | 3358.02 | 6.54 | 567 | 255 | 616 |
| | 2013 | 7004 | 6435 | 3267.86 | 7.15 | 3345.47 | 6.37 | 561 | 278 | 667 |
| | 2014 | 7672 | 7062 | 3264.08 | 6.63 | 3343.87 | 5.80 | 598 | 252 | 600 |
| | 2015 | 6870 | 6294 | 3280.17 | 7.24 | 3364.09 | 6.45 | 564 | 252 | 572 |
| | 2016 | 6680 | 6104 | 3271.12 | 7.25 | 3357.92 | 6.43 | 547 | 231 | 548 |
| | 2017 | 6438 | 5876 | 3252.65 | 7.53 | 3343.86 | 6.64 | 588 | 265 | 576 |
| | 2018 | 7056 | 6505 | 3275.90 | 7.02 | 3359.00 | 6.12 | 579 | 246 | 534 |
| | 2019 | 6191 | 5760 | 3293.73 | 7.36 | 3370.04 | 6.46 | 468 | 207 | 401 |
| | 2020 | 4946 | 4572 | 3309.41 | 8.21 | 3382.43 | 7.32 | 354 | 159 | 317 |
| | 2021 | 5282 | 4863 | 3292.34 | 8.14 | 3381.26 | 6.99 | 418 | 173 | 330 |

**As explained in the main text. a total of 141 398 cases were included for the SGA variable, since the reference used to estimate the percentiles includes births occurring between 24 and 42 weeks.*
*N: number of births; SE: standard error; LBW: low birth weight (<2500 g); SGA: small for gestational age; Ber: Berazategui; FV: Florencio Varela.*

model show a significant association and a nonlinear relationship between maternal age and birth weight (*Table 2*). Furthermore, higher maternal educational attainment was positively and significantly associated with birth weight (*Table 2*). Average birth weight increases with rising maternal age up to 30-39 years and then decreases after age 40 (*Supplementary Material*). The percentage of LBW (<2500 g) in relation to maternal age shows an inverse relationship, with higher values at the extremes of the age range. A similar pattern is observed in the relationship between the percentage of SGA births and maternal age (*Supplementary Material*).

## DISCUSSION

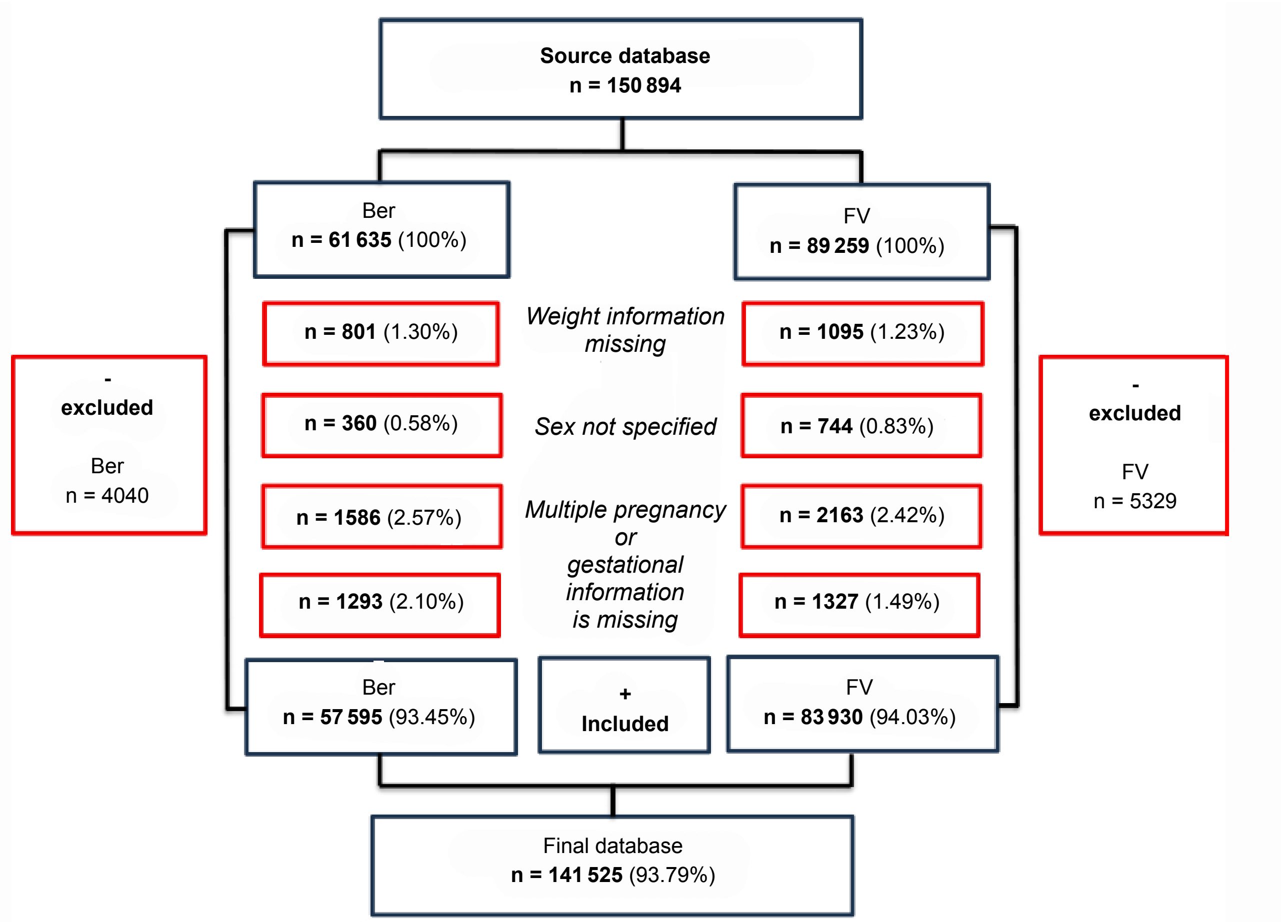
The average increase in birth weight observed here is consistent with a global trend documented in recent decades in Latin America and worldwide,[4,5] as well as with the decline in the proportion of SGA births, which has also been described recently in other populations.[16] About gestational age, we observed a reduction in preterm births along with a slight decrease in the average duration of pregnancy, possibly associated with a lower gestational age at term births.

Another trend that aligns with the national picture is the decline in births beginning in the mid-2010s.[17]

Previously, changes in birth weight and the proportion of low birth weight infants have been linked to variations in gestational age[2,18] and to a limited decrease in gestational age that was not accompanied by a decrease in birth weight; however, it should be noted that the analysis was based on average weights and did not examine the distribution by subcategories of prematurity, nor did it model their combined effect on weight.

Birth weight and the classification of LBW are important variables in assessing perinatal prognosis.[20] However, the inclusion of a wide

**Figura 1. Database construction flowchart showing details of excluded cases by municipality according to each criterion**




*Ber: Berazategui; FV: Florencio Varela.*

range of gestational ages introduces variability in birth weight; therefore, these results should be interpreted with this limitation in mind. In addition, the percentage of SGA, a variable standardized by gestational age, was analyzed, and reductions were observed in both municipalities over time, indicating that intrauterine growth patterns tended to shift toward greater weight-for-gestational-age adequacy.

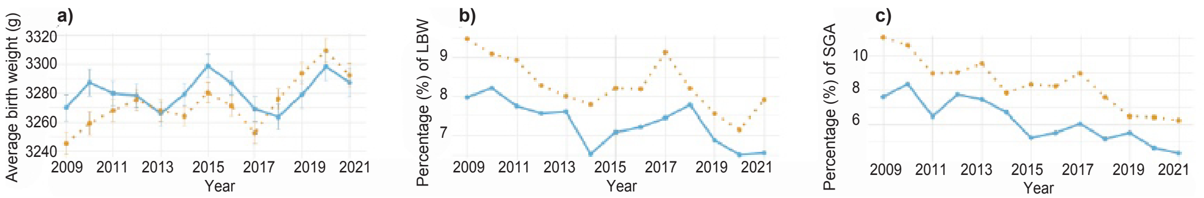
Although the change in birth weight was statistically significant for one of the municipalities (FV), in both cases the cumulative increase over the series was only a few grams, so the clinical and epidemiological implications are likely to be

**Table 2. Results of the generalized additive mixed model for birth weight (Z-score) as a function of maternal age, its quadratic term, and maternal educational level**

| | Birth weight | | | |
|---|---|---|---|---|
| **Fixed effects** | **β (estimator)** | **SE** | **95%CI** | ***p*-value** |
| Intercept | -0.86 | 0.05 | -0.95 - -0.75 | <0.001 |
| Maternal age | 0.07 | | 0.064 – 0.078 | <0.001 |
| Maternal age β2 | -0.001 | | -0.0012 - -0.0009 | <0.001 |
| Educational level | 0.04 | 0,01 | 0.0240 – 0.0509 | <0.001 |

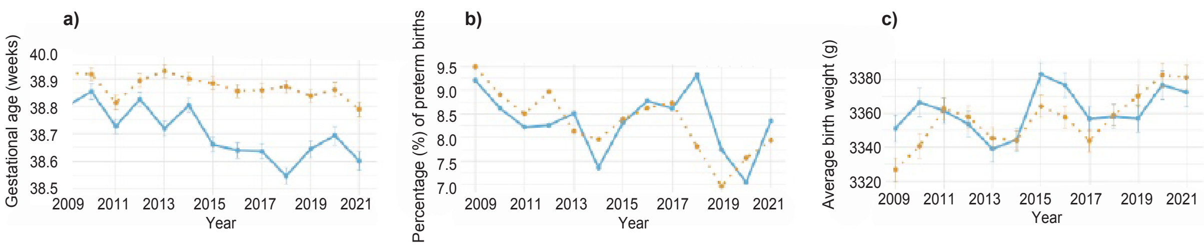
*Random intercept variance (year): 0.0012 (SD = 0.034). Residual variance: 1.2328 (SD = 1.110).*
*β: regression coefficient; SE: standard error; CI: confidence interval.*

**Figure 2. Birth weight, low birth weight, and small for gestational age**




*a). Average weight by year and municipality for the total sample analyzed.*
*b). Percentage of low birth weight.*
*c). Percentage of small for gestational age.*
*Dotted line: FV; Solid line: Ber. For clarity, the Y-axis does not start at zero. The bars indicate the standard error.*
*LBW: low birth weight; SGA: small for gestational age; Ber: Berazategui; FV: Florencio Varela.*

**Figure 3. Gestational age and preterm births**




***a)** Average gestational age at birth by year and municipality.*
***b)** Percentage of preterm births.*
***c)** Average birth weight of full-term births.*
*Dotted line: FV; Solid line: Ber.*
*For clarity, the Y-axis does not start at zero. The bars indicate the standard error.*
*a. Gestational age is expressed in weeks with a decimal fraction (for example, 38.5 is equivalent to 38 and a half weeks).*
*FV: Florencio Varela; Ber: Berazategui.*

limited. In contrast, the magnitude of the change for the LBW and SGA variables was notable (APC: ~1.35% and ~4%, respectively), even when compared with findings in other populations of diverse origins and characteristics.[21-23] The epidemiological and public health relevance of reducing the percentage of births with low birth weight indicators lies in their association with lower neonatal morbidity and mortality, as well as with reduced risks throughout the life course and reduced resource utilization and health system costs.[24] In fact, in 2012, the World Health Organization set a goal for the following decade to reduce the number of births with low birth weight by 30% worldwide, which emphasizes that reducing LBW is a key global public health priority.[25]

On the other hand, while the association between birth weight and maternal age showed a pattern similar to that observed in other populations—with lower birth weights at the extremes of age,[26]—the positive relationship between maternal educational level and birth weight found here is consistent with previous studies that have identified a protective effect against low birth weight associated with higher levels of maternal education.[27] However, this association should not be interpreted in causal terms, as educational level may reflect a broader set of socioeconomic and living conditions that influence maternal and perinatal health.

The data from this study allows us to identify trends in birth weight across a large sample of the population, although they have limitations. First, the survey may have an underreporting rate of approximately 6%,[28] and in turn, nearly 10% of cases were excluded due to missing information. Second, the database does not include key variables, such as facility type, prenatal checkups, medical interventions, or maternal nutritional status, which limits the ability to test specific hypotheses. Finally, as noted, trends in birth weight must be interpreted with consideration for heterogeneity in gestational age.

## CONCLUSION

Taken together, these findings provide recent local evidence on trends in birth weight indicators and highlight the importance of maternal sociodemographic factors in perinatal health analysis. ■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The supplementary material provided with this article is presented as submitted by the authors. It is available at: https://www.sap.org.ar/docs/publicaciones/archivosarg/2026/10885_AO_Gonzalez_Anexo.pdf

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