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Evolution of neonatal mortality in the Matanza-Riachuelo River Basin between 2010 and 2019. A comparison of Argentina, the province of Buenos Aires, and the City of Buenos Aires, 2019

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ABSTRACT

Introduction. The neonatal mortality rate (NMR) is an indicator of socioeconomic, environmental, and health care conditions. The Matanza-Riachuelo River Basin (MRRB) is the most polluted in Argentina.

Objective. To analyze neonatal mortality (NM) in the MRRB between 2010 and 2019 and compare it with overall data for Argentina, the province of Buenos Aires (PBA), and the City of Buenos Aires (CABA) in 2019.

Population and methods. Descriptive study based on vital statistics provided by the Ministry of Health.

Results. In 2019, the NMR was 6.4‰ in the MRRB, 6.2‰ in Argentina; 6‰ in PBA; and 5.1‰ in CABA. The risk of NM in the MRRB was higher than in CABA (RR: 1.32, 95% CI: 1.08–1.61). Between 2010 and 2019, the NMR decreased in the MRRB, PBA, and Argentina; but not in CABA.

The risk of NM due to perinatal conditions in the MRRB was higher than in CABA (RR: 1.30, 95% CI: 1.01–1.67).

The risk of death among very low birth weight (VLBW) live births (LBs) in the MRRB was higher than in CABA (RR: 1.70, 95% CI: 1.33–2.18) and lower than in Argentina (RR: 0.78, 95% CI: 0.70–0.87).

Conclusion. The evolution of NMR between 2010 and 2019 was similar in the MRRB, Argentina, and PBA. In 2019, the structure of causes and the risk of NM were similar in the MRRB, PBA, and Argentina, with a higher risk due to perinatal conditions and among VLBW LBs. The NMR among VLBW LBs was lower in the MRRB than in Argentina.

Keywords: *infant mortality; environmental health; public health.*

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INTRODUCTION

The neonatal mortality rate (NMR) describes the risk of death in the first 27 days of life and is the fraction of infant mortality that best depicts the accessibility, timeliness, and quality of health care, especially that provided in tertiary care neonatal services.[1–3]

The structure of causes of neonatal mortality (NM) in Argentina reflects, on the one side, preconception and prenatal environmental exposure, and, in turn, the need for adequate antenatal, labor, and neonatal tertiary care.[1–6]

Thus, approximately two-thirds of NM cases are caused by perinatal conditions (mainly prematurity and low birth weight), while the remaining third of cases are mostly due to congenital malformations.[5] These 2 groups of causes are also related to exposure to environmental degradation.[7]

Low birth weight (LBW, less than 2500 g) is closely related to NM and is conditioned by exposure to environmental pollutants.[8] Live births (LBs) with a low birth weight (LBW) require high-quality tertiary care. Argentina has a low incidence of LBW, similar to developed countries, but the NMR is higher than in those countries.[5]

In Argentina in 2014, the NMR of very low birth weight (VLBW) LBs was 4.6 times higher than that of LBW LBs and 182 times higher than that of those with a sufficient birth weight.[5]

The Matanza-Riachuelo river flows for 64 km from the west of the province of Buenos Aires (PBA) to the Río de la Plata. Its basin encompasses 2200 km^2. Open dumps, the dumping of sewage and industrial waste from more than 25 000 industrial facilities and service activities pollute the water, soil, and air of the Matanza-Riachuelo River Basin (MRRB).[9]

The MRRB is the most polluted in Argentina, one of the 5 most polluted in Latin America, and one of the 30 most polluted in the world.[10–13] With more than 4 million inhabitants, it is a densely populated area where pollution exposure coexists with poor housing conditions and important socioeconomic vulnerabilities.[11,12]

The objective of this study was to analyze the evolution and characteristics of NM in the MRRB between 2010 and 2019 and to make a comparison with Argentina, the PBA, and the City of Buenos Aires (CABA) in 2019.

POPULATION AND METHODS

This was a descriptive study on neonatal mortality in the MRRB, compared to Argentina, the PBA, and the CABA, based on the database of vital statistics of the Health Statistics and Information Department (Dirección de Estadística e Información en Salud, DEIS) from the National Ministry of Health of Argentina for the 2010–2019 period.

This analysis included data on all LBs and all deaths of neonates younger than 28 days occurred in the MRRB, Argentina, the PBA, and the CABA, recorded by jurisdiction of maternal place of residence.

To analyze NM according to the structure of causes, rates were used for comparison. The NMR, cause-specific NMR, birth-weight-specific NMR, and proportional mortality by cause were estimated.

The NMR related neonatal deaths (0 to 27 days of life) occurred over one year to the number of recorded LBs over that same year in the corresponding jurisdiction and was expressed per 1000 LBs.

The cause-specific NMR included deaths from a specified cause among neonates younger than 28 days in relation to the number of recorded LBs over the same year in that jurisdiction and was expressed per 1000 LBs.

The birth-weight-specific NMR related deaths in neonates younger than 28 days with LBW and VLBW to LBs with LBW and VLBW, respectively. In both cases, it was expressed per 1000 LBs.

The birth weight ranges analyzed were LBW (LBs with less than 2500 g), VLBW (LBs with less than 1500 g), and sufficient weight (LBs with 2500 g or more).

Proportional mortality by cause described the ratio between neonatal deaths due to a specified cause and total neonatal deaths, expressed as a percentage.

The information from the MRRB was estimated by integrating data from 14 municipalities from the PBA and the 4 communes of the CABA that compose it (highest level of disaggregation of the information from the DEIS).

The 14 municipalities from the PBA included in the MRRB are Almirante Brown, Avellaneda, Cañuelas, Esteban Echeverría, Ezeiza, General Las Heras, La Matanza, Lanús, Lomas de Zamora, Marcos Paz, Merlo, Morón, Presidente Perón, and San Vicente. The MRRB includes the following communes of the CABA: 4, 7, 8, and 9.

The relative risk (RR) (95% confidence interval [CI]) of death in the first 27 days of life was estimated considering neonatal death as an event and maternal residence in the MRRB as exposure,

compared to the CABA, the PBA, and Argentina; and the risk of death by the main causes of death and birth weight ranges in the MRRB were analyzed in relation to the same jurisdictions of maternal place of residence. Given that RR assesses the risk of an event happening in an exposed group (maternal residence in the MRRB) compared to the risk of the same event happening in an unexposed group (children of mothers who do not live in the MRRB), when estimating this indicator in the comparison jurisdictions, deaths and LBs of neonates whose mothers lived in the communes or municipalities comprised by the MRRB were excluded.[14]

To establish the evolution of NMR, data for the 2010–2019 period were analyzed. The other analyses corresponded to 2019.

The data processing software programs Microsoft Excel and Epidat 3.1 were used.

This study was conducted based on secondary sources, without using personal data; therefore, no informed consent nor protocol approval by the ethics committee were required.

RESULTS

In 2019, 86 316 LBs and 551 neonatal deaths were recorded in the MRRB. The NMR was 6.4‰ in the MRRB, 6.2‰ in Argentina; 6‰ in the PBA; and 5.1‰ in the CABA (*Table 1*).

A downward, although fluctuating, trend was observed over the 2010–2019 period in the NMR in the MRRB (14.7%), Argentina (21.5%), and the PBA (21.1%). In these 3 jurisdictions, an increase was observed in 2019 compared to 2018. Fluctuations were observed in the CABA, the district with the lowest NMR among those analyzed here, with an NMR of 4.6‰ in 2010 and 5.1‰ in 2019 (*Figure 1*).

The structure of causes of NM was similar in the MRRB, Argentina, the PBA, and the CABA: conditions originating in the perinatal period were the leading cause of death, followed by deaths due to congenital malformations. Both causes, possibly related to environmental exposure, accounted for approximately 95% of neonatal deaths in each jurisdiction in 2019 (*Table 2*).

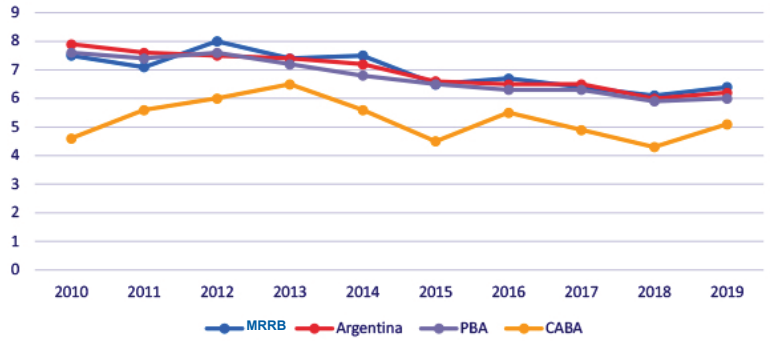
The NMR due to perinatal conditions was

Table 1. Live births, deaths among neonates younger than 28 days, and neonatal mortality rate, by jurisdiction of maternal place of residence. 2019. Matanza-Riachuelo River Basin, City of Buenos Aires, province of Buenos Aires, and Argentina

Jurisdiction of maternal place of residence	Live births	Deaths among neonates under 28 days old	Neonatal mortality rate
MRRB	86 316	551	6.4‰
Argentina	625 441	3905	6.2‰
PBA	227 596	1371	6.0‰
CABA	33 981	173	5.1‰

MRRB: Matanza-Riachuelo River Basin. CABA: City of Buenos Aires. PBA: province of Buenos Aires.
Source: Developed by the authors based on data provided by the Health Statistics and Information Department of the Ministry of Health of Argentina. 2019.

Figure 1. Neonatal mortality per 1000 live births, 2010–2019 period. Matanza-Riachuelo River Basin, City of Buenos Aires, province of Buenos Aires, and Argentina



MRRB: Matanza-Riachuelo River Basin. CABA: City of Buenos Aires. PBA: province of Buenos Aires.
Source: Developed by the authors based on data provided by the Health Statistics and Information Department of the National Ministry of Health of Argentina. 2019.

similar in the 4 jurisdictions. The same was observed for the NMR due to congenital malformations (*Table 2*).

The percentage of LBs with LBW was similar in the 4 jurisdictions analyzed: 7.7% in the MRRB, 7.6% in Argentina and the PBA, and 8.1% in the CABA (*Table 3*). The risk of LBW was similar in the 4 jurisdictions (*Table 4*).

In addition, the percentage of LBs with VLBW was 1.4% in the MRRB, 1.2% in Argentina and the PBA, and 1.9% in the CABA (*Table 3*). The risk of births with VLBW was higher in the MRRB than in Argentina (RR: 1.24, 95% CI: 1.16–1.31) and in the PBA (RR: 1.17, 95% CI: 1.09–1.26), but lower than in the CABA (RR: 0.66, 95% CI: 0.60–0.74) (*Table 4*).

Table 2. Neonatal mortality by cause and jurisdiction of maternal place of residence. 2019. Matanza-Riachuelo River Basin, City of Buenos Aires, province of Buenos Aires, and Argentina

		Total	Perinatal conditions	Congenital malformations	Other causes
MRRB	Neonatal deaths	551	361	157	33
	NMR (per 1000 live births)	6.4	4.2	1.8	0.4
	Proportional mortality	100%	65.5%	28.5%	6%
Argentina	Neonatal deaths	3905	2631	1112	162
	NMR (per 1000 live births)	6.2	4.2	1.8	0.2
	Proportional mortality	100%	67.4%	28.5%	4.1%
PBA	Neonatal deaths	1371	898	397	76
	NMR (per 1000 live births)	6	3.9	1.7	0.3
	Proportional mortality	100%	65.5%	29%	5.5%
CABA	Neonatal deaths	173	113	55	5
	NMR (per 1000 live births)	5.1	3.3	1.6	0.1
	Proportional mortality	100%	65.3%	31.8%	2.9%

MRRB: Matanza-Riachuelo River Basin. CABA: City of Buenos Aires. PBA: province of Buenos Aires. NMR: neonatal mortality rate. Source: Developed by the authors based on data provided by the Health Statistics and Information Department of the National Ministry of Health of Argentina. 2019.

The risk of neonatal death in the MRRB was similar to that in the PBA and Argentina, but higher than in the CABA (RR: 1.32, 95% CI: 1.08–1.61). The risk of neonatal death due to perinatal conditions in the MRRB was similar in the PBA and Argentina and 30% higher than in the CABA (RR: 1.30, 95% CI: 1.01–1.67) (*Table 5*).

The NMR of LBs with LBW in the MRRB (54.2‰) was lower than in Argentina (57.7‰) and higher than in the CABA (44.1‰) and the PBA (49.7‰) (*Table 3*). No statistically significant differences were found in the risk of death among LBs with LBW (*Table 5*).

The NMR of LBs with VLBW in the MRRB (236.7‰) was lower than in Argentina (264.7‰) and the PBA (241.7‰) but higher than in the CABA (142.4%). The risk of death among LBs with VLBW was 70% higher in the MRRB than in the CABA (RR: 1.70, 95% CI: 1.33–2.18), lower than in Argentina (RR: 0.78, 95% CI: 0.70–0.87), and similar to the PBA (*Table 5*).

In the MRRB, the risk of death in the neonatal period among LBs with VLBW was 4.3 times higher and 170 times higher than among LBs with a sufficient birth weight.

DISCUSSION

A downward trend in the NMR in the MRRB was observed between 2010 and 2019, although it was not consistent. In the PBA and Argentina, the evolution was similar, as well as the decrease observed in Latin America and the Caribbean (21.9%) and worldwide (20.1%).[15]

In 2019, the NMR in the MRRB, Argentina, and the PBA was lower than that observed in Latin America (9.4‰) and worldwide (17.4‰), strongly driven by the NMR of the poorest countries (22‰). Ninety-nine percent of neonatal deaths occur in middle- or low-income countries, especially in Africa and South Asia, which have made the least progress in reducing neonatal deaths.[16]

In Argentina, a downward trend in infant mortality has been documented, although its unequal distribution by jurisdiction and the

Table 3. Live births and deaths by birth weight and jurisdiction of maternal place of residence. 2019. Matanza-Riachuelo River Basin, City of Buenos Aires, province of Buenos Aires, and Argentina

		Live births		Neonatal deaths		
		Absolute number	Percentage	Absolute number	Percentage	Specific NMR
MRRB	LBs < 1500 g	1170	1.4%	277	50.3%	236.8‰
	LBs < 2500 g	6640	7.7%	360	65.3%	54.2‰
	LBs ≥ 2500 g	78 539	91%	107	19.4%	1.4‰
	No data	1137	1.3%	84	15.2%	Not applicable
	Total LBs	86 316	100%	551	100%	6.4‰
Argentina	LBs < 1500 g	7806	1.2%	2066	52.9%	264.7‰
	LBs < 2500 g	47 292	7.6%	2731	69.9%	57.7‰
	LBs ≥ 2500 g	573 314	91.7%	825	21.1%	1.4‰
	No data	4835	0.8%	349	8.9%	Not applicable
	Total LBs	625 441	100%	3905	100%	6.2‰
PBA	LBs < 1500 g	2747	1.2%	664	48.4%	241.7‰
	LBs < 2500 g	17 440	7.7%	866	63.2%	49.7‰
	LBs ≥ 2500 g	206 597	90.8%	265	19.3%	1.3‰
	No data	3559	1.6%	240	17.5%	Not applicable
	Total LBs	227 596	100%	1371	100%	6‰
CABA	LBs < 1500 g	660	1.9%	94	54.3%	142.4‰
	LBs < 2500 g	2769	8.1%	122	70.5%	44.1‰
	LBs ≥ 2500 g	31 061	91.4%	38	22%	1.2‰
	No data	151	0.4%	13	7.5%	Not applicable
	Total LBs	33 981	100%	173	100%	5.1‰

MRRB: Matanza-Riachuelo River Basin. CABA: City of Buenos Aires. PBA: province of Buenos Aires. LBs: live births. NMR: neonatal mortality rate.
Source: Developed by the authors based on data provided by the Health Statistics and Information Department of the National Ministry of Health of Argentina. 2019.

inequality associated with social conditions have not always accompanied such reduction.[15] These inequalities could be evidenced by disaggregating the information according to geographic, socioeconomic, and health care access criteria, among others.[17–20]

Although this has not been analyzed in this study, it should be considered in the interpretation of the results, since it is estimated that the 4 jurisdictions analyzed here are not homogeneous, but rather have significant inequalities.

Table 4. Comparison of the risk of births with a low birth weight and a very low birth weight among the Matanza-Riachuelo River Basin, Argentina, the province of Buenos Aires, and the City of Buenos Aires expressed as relative risk and 95% confidence interval. 2019

		LBW births	VLBW births
Argentina	RR	1.00	1.24
	95% CI	0.98–1.03	1.16–1.31
PBA	RR	0.98	1.17
	95% CI	0.94–1.01	1.09–1.26
CABA	RR	1.00	0.66
	95% CI	0.95–1.06	0.60–0.74

CABA: City of Buenos Aires. PBA: province of Buenos Aires. LBW: low birth weight. VLBW: very low birth weight. RR: relative risk.
Source: Developed by the authors based on data provided by the Health Statistics and Information Department of the National Ministry of Health of Argentina. 2019.

Table 5. Comparison of the risk of neonatal death among the Matanza-Riachuelo River Basin, Argentina, the province of Buenos Aires, and the City of Buenos Aires expressed as relative risk and 95% confidence interval by cause and birth weight range. 2019

		NMR	NMR by perinatal condition	NMR by congenital malformation	NMR among LBW neonates	NMR among VLBW neonates
Argentina	RR	1.03	0.99	1.01	0.89	0.78
	95% CI	0.94–1.12	0.89–1.11	0.85–1.20	0.71–1.12	0.70–0.87
PBA	RR	1.10	1.11	1.03	1.13	1.00
	95% CI	0.99–1.22	0.98–1.26	0.85–1.26	0.86–1.49	0.88–1.15
CABA	RR	1.32	1.30	1.28	1.50	1.70
	95% CI	1.08–1.61	1.01–1.67	0.88–1.87	0.87–2.60	1.33–2.18

CABA: City of Buenos Aires. PBA: province of Buenos Aires. NMR: neonatal mortality rate. LBW: low birth weight. VLBW: very low birth weight. RR: relative risk.
Source: Developed by the authors based on data provided by the Health Statistics and Information Department of the National Ministry of Health of Argentina. 2019.

The leading causes of NM in the 4 jurisdictions analyzed were perinatal conditions, followed by congenital malformations; both causes accounted for 95% of NM. Worldwide, these causes accounted for only 85% of NM, followed by respiratory and diarrheal diseases.[21]

The relative relevance of perinatal conditions is increasing worldwide, while in Argentina it is decreasing as the relative importance of congenital malformations increases.[4]

The percentage of LBs with LBW in the MRRB is similar to that in the CABA, the PBA, Argentina, and developed countries.[5,15] However, the NMR is higher in the MRRB, Argentina, and the PBA than in developed countries and in the CABA, which may be explained by the differences in the quality and equipment of neonatology services, mainly those of tertiary care facilities, and the regionalization of perinatal care.[15,22,23]

The differences in the risk of NM due to perinatal conditions and in LBs with VLBW in the MRRB compared to the CABA highlight the differences in terms of accessibility, coverage, and quality of health care services, especially neonatal tertiary care services.

The risk of NM due to congenital malformations did not show statistically significant differences among the jurisdictions analyzed. The information available to analyze the incidence of congenital malformations in the MRRB does not allow a comparison with the CABA, the PBA, and Argentina because the existing records—provided by the National Registry of Congenital Anomalies (Registro Nacional de Anomalías Congénitas de Argentina, RENAC)—are based on reporting by some health care providers, which leads to localization biases among providers from tertiary care facilities, such as Garrahan, Posadas, and Sardá hospitals, which are located in the MRRB and drive the indicators by overestimating their magnitude, without having mechanisms to adjust their estimation.[24]

Warranting an effective coverage of perinatal care, which starts with environmental care, health care for women of childbearing age, support and care during pregnancy with risk identification in order to adapt care and the level of care required for labor, compliance with essential obstetric and neonatal conditions so that all maternity wards are safe, as well as the regionalization of perinatal care should reduce the gaps observed in the risk of NM in the MRRB, Argentina, and the PBA compared to the CABA.

To properly interpret the birth-weight-specific NMR, it is important to take into account that this information was not recorded in 15.2% of the neonatal deaths in the MRRB. The NMR was higher in the MRRB than in Argentina, the PBA, and the CABA; however, the NMR of LBs with VLBW was lower in the MRRB than in Argentina and the PBA. These differences may only reflect the lack of birth weight data at the time of death in some locations, and not a differential risk.

Among the weaknesses of this study, it should be noted that we used data from the DEIS and that underreporting of the event (birth or death), an incorrect identification, or failure to record the cause of death or other relevant information, such as birth weight, etc., may have affected the results of the analysis. Notwithstanding this, it is worth

noting that more than 99.5% of births in Argentina take place in health care facilities and that the concurrent recording of the death statistics report and the death certificate are a mandatory requirement for burial, therefore reducing any potential under-recording of these events. ■

CONCLUSION

The evolution of NMR between 2010 and 2019 was similar in the MRRB, Argentina, and the PBA, but higher in the CABA. In 2019, the structure of causes and the risk of NM were similar in the MRRB, the PBA, and Argentina, but higher in the CABA, with a higher risk due to perinatal conditions and among VLBW LBs. The NMR among VLBW LBs was lower in the MRRB than in Argentina.

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