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Association between social environment and birth weight during the COVID-19 pandemic in a Brazilian metropolis

Associação entre meio social e peso ao nascer durante a pandemia da COVID-19 em metrópole Brasileira

Asociación entre el medio social y el peso al nacer durante la pandemia de COVID-19 en una metrópoli Brasileña

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ABSTRACT

Objective: to analyze the association between social environment factors and the impacts of the COVID-19 pandemic context on birth weight.

Methods: This is a cross-sectional study, nested in a cohort. Conducted in the first three months of the pandemic, in three public maternity hospitals in Belo Horizonte, Minas Gerais, Brazil. A sample of 1,684 postpartum women was included. Multinomial logistic regression was applied for the analysis.

Results: Physical inactivity during pregnancy increased the chance of low birth weight (RP = 3.84; 95%CI: 1.11-13.21; p: 0.033). Environmental variables such as the number of families earning up to half a minimum wage (RP = 1.00; 95%CI: 1.00-1.00; p: <0.001) and per capita income (RP= 1.01; 95%CI: 1.00-1.02; p: 0.002) showed statistically significant associations with low birth weight.

Conclusion: The findings show that both individual and contextual determinants directly influenced birth weight during the pandemic, reinforcing the need for actions that integrate obstetric care and social policies aimed at reducing inequalities.

Descriptors: Infant Newborn; Birth Weight; COVID-19; Epidemiology; Social Environment.

RESUMO

Objetivo: analisar a associação entre os fatores do ambiente social e as repercussões do contexto da pandemia da COVID-19 no peso ao nascer.

Método: Trata-se de um estudo transversal, aninhado a uma coorte. Realizado nos três meses iniciais da pandemia, em três maternidades públicas em Belo Horizonte, Minas Gerais, Brasil. Foi incluída uma amostra de 1684 puérperas. Para a análise, aplicou-se a regressão logística multinomial.

Resultados: A inatividade física durante a gestação aumentou a chance de baixo peso ao nascer (RP= 3,84; IC95%: 1,11-13,21; p:0,033). Variáveis ambientais como número de famílias que recebem até meio salário-mínimo (RP = 1,00; IC95%: 1,00-1,00; p: <0,001) e renda per capita (RP= 1,01; IC95%: 1,00-1,02; p:0,002) apresentaram associações estatisticamente significativas ao baixo peso ao nascer.

Conclusão: Os achados evidenciam que determinantes individuais e contextuais podem ter influenciado diretamente o peso ao nascer durante a pandemia, reforçando a necessidade de ações que integrem a atenção obstétrica e políticas sociais voltadas à redução das desigualdades.

Descritores: Recém-nascido; Peso ao Nascer; COVID-19; Epidemiologia; Meio social.

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RESUMEN

Objetivo: analizar la asociación entre los factores del entorno social y las repercusiones del contexto de la pandemia de COVID-19 en el peso al nacer.

Método: Se trata de un estudio transversal, anidado en una cohorte. Realizado en los primeros tres meses de la pandemia, en tres maternidades públicas de Belo Horizonte, Estado de Minas Gerais, Brasil. Se incluyó una muestra de 1684 puérperas. Para el análisis se aplicó la regresión logística multinomial.

Resultados: La inactividad física durante el embarazo aumentó la probabilidad de bajo peso al nacer (RP = 3,84; IC95%: 1,11-13,21; p:0,033). Variables ambientales como el número de familias que reciben hasta la mitad de un salario mínimo (RP = 1,00; IC95%: 1,00-1,00; p: <0,001) y el ingreso per cápita (RP= 1,01; IC95%: 1,00-1,02; p:0,002) mostraron asociaciones estadísticamente significativas con bajo peso al nacer.

Conclusión: Los hallazgos muestran que tanto los determinantes individuales como los contextuales influyeron directamente en el peso al nacer durante la pandemia, reforzando la necesidad de acciones que integren la atención obstétrica y las políticas sociales orientadas a reducir las desigualdades.

Descriptores: Recién Nacido; Peso al Nacer; COVID-19; Epidemiología; Medio Social.

INTRODUCTION

Birth weight is recognized as one of the main indicators of the conditions experienced by the fetus during gestation, reflecting the intrauterine environment and the potential for neonatal survival. According to a recent global estimate, in 2020, approximately 14.7% of live newborns worldwide were born weighing less than 2,500 grams (≈ 19.8 million babies)[1].

Birth weight below 2,500 grams is considered low birth weight, a condition noteworthy for its potential association with increased infant mortality and a higher likelihood of health complications in subsequent stages of child development[2,3]. It is also a parameter used to indirectly estimate the general health status at birth[4]. Changes in this indicator, especially when they suggest intrauterine growth restriction, require early identification and intervention[5].

Moreover, scientific evidence demonstrates that low birth weight is not only a significant predictor of perinatal death and morbidity but also increases the risk of chronic noncommunicable diseases (NCDs) in adulthood. The most common NCDs include cardiovascular disease, type 2 diabetes mellitus (T2DM), hypertension (HT), dyslipidemia, proteinuria, and chronic kidney disease (CKD)[6].

Several maternal and social factors, such as nutritional conditions, financial stability, and social factors, can play a determining role in birth weight outcomes[7]. During the COVID-19 pandemic, these issues were exacerbated, as increased economic and social stress limited access to adequate prenatal care, regular health monitoring, and essential supplementation, contributing to a rise in the incidence of newborns with low birth weight, particularly during lockdown periods[8].

Additionally, SARS-CoV-2 infection can affect fetal development, leading to premature birth, low birth weight, and impaired intrauterine growth[7]. The pandemic, which began in 2020, not only caused high mortality rates due to the virus but also worsened socioeconomic impacts, food security, fear of viral contamination, and especially disrupted the continuity of prenatal consultations, all of which influenced birth weight[8,9].

The impacts of the pandemic context on socioeconomic factors and maternal and child healthcare were also observed in different countries. A study conducted in Uruguay indicated that the health emergency triggered a significant social, economic, and psychological crisis, characterized by Gross Domestic Product (GDP) contraction, a decline in private consumption, and rising poverty rates[9].

Among the most vulnerable groups, there was a marked increase in poverty and unemployment, as well as changes in diet, with higher consumption of ultra-processed foods. Additionally, the pandemic affected the quality of perinatal care, especially in the public health system, where in-person consultations were replaced by phone calls, leading to delays in care, failures in monitoring pregnant women, and difficulties in accessing health services[3,9].

Considering the potential impact of the COVID-19 pandemic on various birth-related aspects, this study posed the guiding question: What are the repercussions of SARS-CoV-2 infection on the birth weight of newborns of women during the pandemic context?

Therefore, the objective of this study was to analyze the association between social environmental factors and the repercussions of the COVID-19 pandemic on birth weight.

METHOD

Study design and location

This is an observational, cross-sectional study, nested within a cohort study called "Childbirth and

breastfeeding in children of mothers infected with SARS-CoV-2." The participating institutions were three maternity hospitals part of the Unified Health System (*Sistema* Único *de Saúde* – SUS), located in the city of Belo Horizonte, Minas Gerais, from 2020 to 2022.

Sample

The sample was selected through random drawing among women who gave birth in the participating hospitals during the three months of high COVID-19 incidence (May, June, and July) in 2020 in Brazil.

The sample size was calculated using a cohort study design. The distribution of the number of pregnant women among the participating maternity hospitals was proportional to the total number of births registered in each institution. The parameters adopted were a 9:1 ratio between unexposed (without a COVID-19 diagnosis) and exposed (with a COVID-19 diagnosis) pregnant women, a 50% outcome prevalence, an odds ratio of 1.5, a 95% confidence level, and a statistical power of 80%. A total of 1,684 postpartum women were included in this analysis.

Inclusion and exclusion criteria

The study included all postpartum women who had a hospital delivery of a singleton pregnancy, whose newborns (NB) had a gestational age of 22 weeks or greater, a birth weight greater than 500 grams, and were live newborns, admitted to one of the three selected maternity hospitals at the time of delivery.

Women who were not fluent in Portuguese, had intellectual or hearing disabilities, were homeless, or under judicial custody were excluded[10].

Data collection

Data collection was conducted through electronic and/or physical medical records of the pregnant women and through a semi-structured questionnaire (sociodemographic data, hospitalization data, clinical data/obstetric history, and pregnancy and delivery data) developed by the researchers. Data collection was conducted by previously trained nursing professionals, nursing students, and graduate nursing students.

Variables

Based on the hypothesis formulated by this study, the object of study, and the availability of data, an analytical model of the factors associated with newborn weight was proposed (Chart 1), supported by the subdivision into proximal, intermediate, and distal factors (according to their position in the so-called "Chain of causality") (Figure 1).

Chart 1 – Description of individual variables, Belo Horizonte, Minas Gerais, Brazil. 2020.

Variable	Causal relationship	Category	Source of information
Sociodemographic data			
Age	Explanatory	In years	Interview
Education level	Explanatory	Illiterate Elementary school High school Higher education	Interview
Marital status	Explanatory	Single Lives with partner	Interview
Income	Explanatory	No income Up to 1 minimum wage 1 to 3 minimum wages 3 to 5 minimum wages More than 5 minimum wages	Interview

Chart 1 – Cont.

Variable	Causal relationship	Category	Source of information
Skin color	Explanatory	White Black Brown Yellow Indigenous	Interview
Pregnancy and birth data			
Birth weight	Outcome	Low weight Insufficient weight Adequate weight	Medical record
Total number of prenatal consultations	Explanatory	Less than 6 6 or more	Medical record
Parity	Explanatory	Primiparous Multiparous	Medical record
Birth route	Explanatory	Vaginal Cesarean	Medical record
Gestational age	Explanatory	Preterm Full term	Medical record
Nutritional follow-up	Explanatory	Yes No	Medical record
Gestational diabetes mellitus	Explanatory	Yes No	Medical record
Lifestyle			
Smoking	Explanatory	Yes No	Interview and medical record
Alcohol consumption	Explanatory	Yes No	Interview and medical record
Physical activity	Explanatory	Yes No	Interview and medical record

Source: Prepared for the purposes of this study.

Pandemic context

SARS-CoV-2 infection was verified based on the medical records of postpartum women provided by the hospitals. For symptomatic women, the confirmatory test used by the institutions and its results were investigated. In the absence of a confirmatory test, but in the presence of symptoms (such as fever, cough, and shortness of breath), the postpartum woman was considered a suspected case of SARS-CoV-2 (Chart 2).

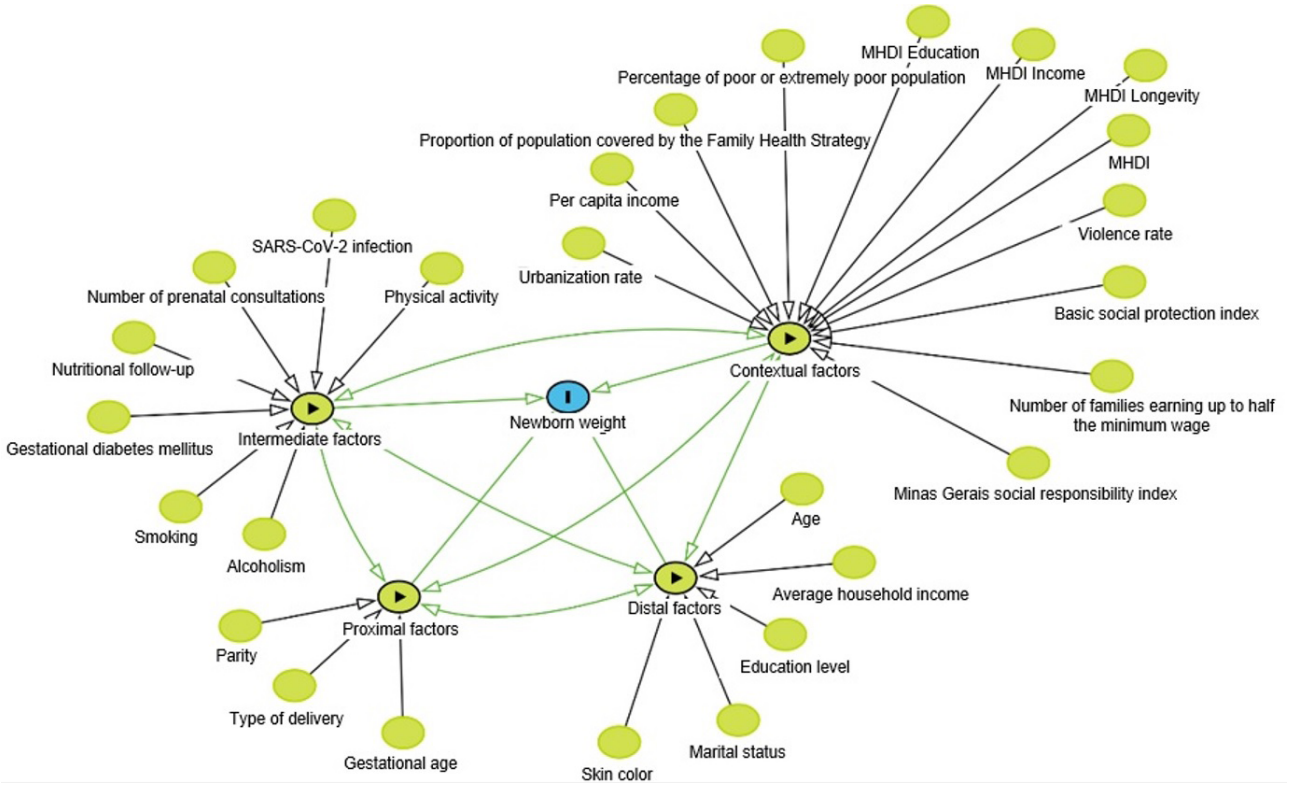
Chart 2 – Description of environmental variables, Belo Horizonte, Minas Gerais, Brazil. 2020-2025

Variable	Description	Source
Violence rate	Number of rape, extortion by kidnapping, homicides, robbery, kidnapping, and unlawful imprisonment / total population in the coverage area of the Basic Health Unit * 10.000	IMRS – Minas Gerais Social Responsibility Index/ *Fundação João Pinheiro*[11]
Per capita income	Ratio between the total income of all individuals living in permanent private households and the total number of these individuals	IMRS – Minas Gerais Social Responsibility Index/ *Fundação João Pinheiro*[11]
Number of families receiving half the minimum wage	Total number of families registered in CadÚnico whose per capita income is equal to or less than ½ minimum wage.	IMRS – Minas Gerais Social Responsibility Index/ *Fundação João Pinheiro*[11]
Basic Social Protection Index	Composite indicator based on the availability of services for: Comprehensive Family Protection, social interaction and strengthening of bonds for children aged 0 to 6 years, and for older adults. Each service equals one point, for a maximum of three points. Aimed at socially vulnerable populations	IMRS – Minas Gerais Social Responsibility Index/ *Fundação João Pinheiro*[11]
Minas Gerais Human Development Index (MHDI)	Indicator composed of longevity, education, and income dimensions, ranging from 0 to 1.	IMRS – Minas Gerais Social Responsibility Index/ *Fundação João Pinheiro*[11]
Percentage of poor or extremely poor population	Proportion of individuals residing in the municipality with a per capita household income ≤ BRL 178.00/month	IMRS – Minas Gerais Social Responsibility Index/ *Fundação João Pinheiro*[11]
Proportion of families covered by the Family Health Strategy	Percentage of families registered and monitored by the Family Health Strategy in relation to the total number of families residing in the municipality.	IMRS – Minas Gerais Social Responsibility Index/ *Fundação João Pinheiro*[11]

Source: Prepared for the purposes of this study.w

Based on the study hypothesis, the available data, and the adopted theoretical model, a Directed Acyclic Graph (DAG) was constructed using the DAGitty® software, structured[12] according to a hierarchical causal chain logic including distal, contextual, proximal, and intermediate levels, focusing on the outcome "birth weight".

Figure 1 – Analytical model of factors associated with newborn birth weight. Directed Acyclic Graph (DAG), 2025.



In the presented figure, contextual factors encompass social, economic, political, and environmental aspects, such as MHDI, per capita income, urbanization rate, violence, and Family Health Strategy coverage. Distal factors include maternal sociodemographic characteristics, such as age, education, marital status, and household income. Proximal factors are directly related to pregnancy and delivery, such as gestational age, parity, mode of delivery, and skin color. Finally, intermediate factors refer to care and health conditions during pregnancy, such as number of prenatal consultations, nutritional follow-up, presence of comorbidities, and maternal habits. This analytical framework allows for a more comprehensive and qualified understanding of the influences on neonatal weight.

Data analysis

Data analysis was performed using the Stata® software, version 17.0. Multinomial logistic regression was applied to the categorized variable of newborn weight, considering a p-value of less than 0.05. According to birth weight, the categories created were: low birth weight for weights below 2500 grams, insufficient weight for weights between 2500 and 3000 grams, and adequate weight for weights equal to or above 3000 grams[1,2].

In the model, regarding the method for variable selection, a backward approach was considered, with a p-value greater than 0.20 for the exclusion of variables. The Mann-Whitney test was applied for social environment variables, and Pearson's chi-square test or Fisher's exact test was used to assess associations between categorical variables. This study also performed analysis with Bonferroni correction. For a better presentation of the results, tables and figures were included.

Ethical and financial aspects

The study "Childbirth and breastfeeding in children of mothers infected with SARS-CoV-2" was approved by the Research Ethics Committee of the *Universidade Federal de Minas Gerais* (COEP/UFMG) (CAAE: 32378920.6.1001.5149) and received financial support from the National Council for Scientific and

Technological Development (*Conselho Nacional de Desenvolvimento Científico e Tecnológico* – CNPq) and the Minas Gerais State Research Support Foundation (*Fundação de Amparo à Pesquisa do Estado de Minas Gerais* – FAPEMIG) – CNPq/MCTI/FNDCT Call No. 18/2021 – Range A – Emerging Groups (Process: 403481/2021-0) and Call 01/2021 – Universal Demand, respectively.

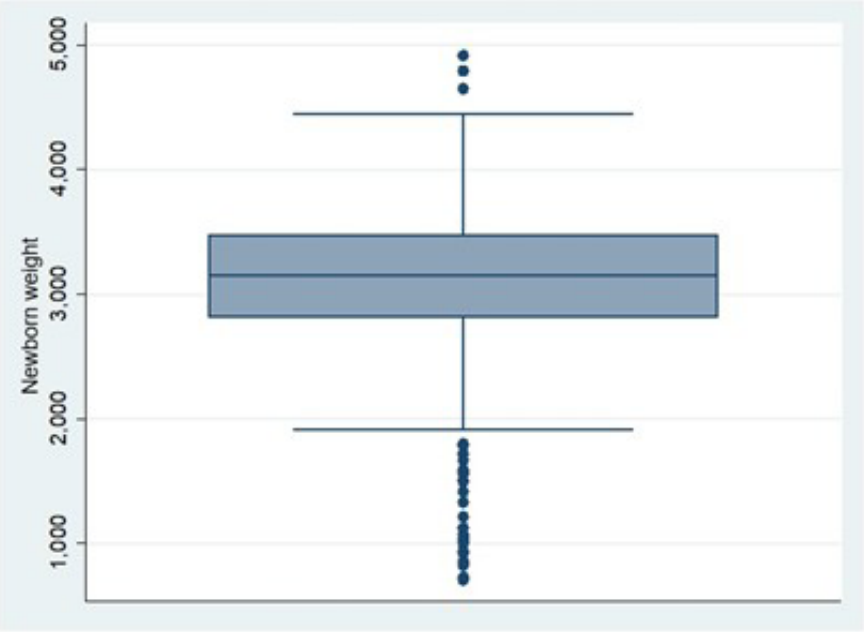
All directors of each maternity hospital signed the Informed Consent Form (ICF), in comploance with the ethical guidelines described in Resolution No. 466 of the National Health Council, dated December 12, 2012, which regulates research involving human beings. Due to the unwillingness to sign the informed consent form, all postpartum women had their consent recorded during the follow-up data collection stage via telephone. All procedures performed in studies involving human participants complied with the ethical standards of the institutional research committee, as well as the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

RESULTS

The sample consisted of 1,684 women, with a mean age of 30 years (SD 6.48 years), completed high school (59.80%), single (61.15%), had an average household income of up to one minimum wage (39.10%), and skin color self-reported as brown (58.40%). Approximately 79.19% of pregnant women had six or more prenatal visits, and 62.78% were multiparous.

The predominant mode of delivery was vaginal, at 72.55%, 87.58% had a gestational age of 37 weeks or more, and in 61.76% of cases, newborn weight was considered adequate, that is, above 3,000 grams (Figure 2).

Figure 2 – Distribution of newborn weights in the sample.



Source: Prepared for the purposes of this study, 2025.

Regarding COVID-19 infection, 4.36% of the sample tested positive through a confirmatory test or the presence of symptoms, thus classifying as suspected cases of SARS-CoV-2 infection. Furthermore, 17.84% of pregnant women reported receiving nutritional follow-up, 36.09% engaged in physical activity before and after childbirth, 6.68% used tobacco/cigarettes, 6.02% used alcohol, and 15.74% had gestational diabetes mellitus (GDM). Pregnant women with elementary education level were more prevalent, with 31.03% associated with low weight. (Table 1).

Table 1 – Association between sociodemographic variables and newborn weight. Belo Horizonte, Minas Gerais. Brazil. 2020

Variables	Total	Low Weight n (%)	Insufficient Weight n (%)	Adequate Weight n (%)	p-value
Education level	398	38(9.55)	105(26.38)	255(64.07)	
Higher Education	53(13.32)	5(9.43)	14(26.42)	34(64.15)	
High School	238(59.80)	26(10.92)	59(24.79)	153(64.29)	0.568
Elementary School	87(21.86)	4(4.6)	27(31.03)	56(64.37)	
Primary Education	20(5.03)	3(15.00)	5(25.00)	12(60.00)	
Marital Status	399	38(9.52)	105(26.32)	256(64.16)	
Single	244(61.15)	22(9.02)	61(25.00)	161(65.98)	0.632
Living with partner	155(38.58)	16(10.32)	44(28.39)	256(61.29)	
Average Household Income	399	38(9.52)	105(26.32)	256(64.16)	
No income	36(9.02)	4(11.11)	6(16.67)	26(72.22)	
Up to one minimum wage	156(39.10)	11(7.05)	46(29.49)	99(63.46)	
From 1 to 3 minimum wages	142(35.59)	16(11.27)	38(26.76)	88(61.97)	0.396
From 3 to 5 minimum wages	35(8.77)	5(14.29)	7(20.00)	23(65.71)	
More than 5 minimum wages	13(3.26)	2(15.38)	5(38.46)	6(46.15)	
Does not know	17(4.26)	0(0.00)	3(17.65)	14(82.35)	
Color/Race	399	38(9.52)	105(26.32)	256(64.16)	
White	71(17.79)	8(11.27)	26(36.62)	37(52.11)	
Black	80(20.05)	8(10.00)	18(22.50)	54(67.50)	
Brown	233(58.40)	21(9.01)	58(24.89)	154(66.09)	0.547
Yellow	13(3.26)	1(7.69)	3(23.08)	9(69.23)	
Indigenous	2(0.50)	0(0.00)	0(0.00)	2(100.00)	

Source: Prepared for the purposes of this study, 2025.

Table 2 presents the variables related to pregnancy and the pregnant woman's activities.

Regarding parity, among multiparous women, 64.63% had newborns classified as having adequate birth weight, and among primiparous women, this percentage was 57.83%. Regarding birth mode, the percentage was higher for vaginal delivery, at 63.96%, compared to cesarean section for adequate birth weight. As for gestational age (which explains the low birth weight factor, less than 37 weeks), 63.16% were considered low weight, and for those with 37 weeks or more, 69.03% were considered adequate birth weight.

Table 2 – Gestational variables and activities of pregnant women associated with newborn weight. Belo Horizonte, Minas Gerais. Brazil. 2025

Variables	Total	Low Weight n (%)	Insufficient Weight n (%)	Adequate Weight n (%)	p-value
Prenatal consultations	1091	115(10.54)	281(25.76)	695(63.70)	
Less than 6	227(20.81)	24(10.57)	56(24.67)	147(64.76)	0.929
6 or more	864(79.19)	91(10.53)	225(26.04)	548(63.43)	
		A	**B**	**A**	
Parity	1,459	163(11.17)	390(26.73)	906(62.10)	
Primiparous	543(37.22)	79(14.55)	150(27.62)	314(57.83)	**0.003**
Multiparous	916(62.78)	84(9.17)	240(26.20)	592(64.63)	
		AB	**A**	**B**	
Type of delivery	1.537	174(11.32)	409(26.61)	954(62.07)	
Vaginal	1110(72.55)	99(8.92)	301(27.12)	710(63.96)	**<0.001**
Cesarean section	427(27.91)	75(17.56)	108(25.29)	244(57.14)	
		A	**A**	**A**	
Gestational age	1,530	175(11.44)	406(26.54)	949(62.03)	
Less than 37 weeks	190(12.42)	120(63.16)	46(24.21)	24(12.63)	**<0.001**
37 weeks or more	1,340(87.58)	55(4.10)	360(26.87)	925(69.03)	
COVID-19	642	79(12.31)	179(27.88)	384(59.81)	
No	614(95.64)	75(12.21)	173(28.18)	366(59.61)	0.723
Yes	28(4.36)	4(14.29)	6(21.43)	18(64.29)	

Table 2 – Cont.

Variables	Total	Low Weight n (%)	Insufficient Weight n (%)	Adequate Weight n (%)	p-value
Nutritional follow-up	398	38(7.64)	104(30.25)	256(62.1)	
No	327(82.16)	32(9.79)	85(25.99)	210(64.22)	0.979
Yes	71(17.84)	6(8.45)	19(26.76)	46(64.79)	
Physical activity	399	38(9.52)	105(26.32)	256(64.16)	
Yes	144(36.09)	10(6.94)	33(22.92)	101(70.14)	0.153
No	255(63.91)	28(10.98)	72(28.24)	155(60.78)	
Smoking	399	38(9.52)	105(26.32)	256(64.16)	
No	374(93.73)	37(9.89)	95(25.40)	242(64.71)	0.275
Yes	25(6.68)	1(4.00)	10(40.00)	14(56.00)	
Alcoholism	399	38(9.52)	105(26.32)	256(64.16)	
No	375(93.98)	36(9.60)	100(26.67)	239(63.73)	0.895
Yes	24(6.02)	2(8.33)	5(20.93)	17(70.83)	
Gestational Diabetes Mellitus	1,512	175(11.57)	398(26.32)	939(62.10)	
No	1,274(84.26)	153(12.01)	344(27.00)	777(60.99)	0.121
Yes	238(15.74)	22(9.24)	54(22.69)	162(68.07)	

Source: Prepared for the purposes of this study, 2025.
Notes: * p<0,05 in bold, Fisher's exact test or Pearson's chi-square test; †equal letters mean similarity between group proportions.

Table 3 presents the median values and interquartile ranges for each of the social environment variables, for each newborn weight category.

Considering newborns with low birth weight, the urbanization rate of the municipalities where the mothers lived was 98.90%. The median number of families earning up to half the minimum wage was 18,798, and the proportion of families covered by the Family Health Strategy was 67.22%. The basic social protection index was 2 points, per capita income was BRL 686.42, the Minas Gerais Social Responsibility Index (MSI) was 0.66, and the percentage of poor or extremely poor population was 11.69%. The Minas Gerais Human Development Index (MHDI) was 0.73, divided into Income (0.72), Longevity (0.86), and Education (0.65). Finally, the median violence rate was 401.84, the highest among the three categories.

Table 3 – Association between environmental variables and newborn weight. Belo Horizonte, Minas Gerais. Brazil. 2025

Variables	Low weight (n =80)		Insufficient weight (n = 205)		Adequate weight (n = 468)		Overall (n = 753)		p-value
	Median	IQR	Median	IQR	Median	IQR	Median	IQR	
Urbanization rate of municipalities	98.90	5.75	100.00	0.26	100.00	1.10	100.00	1.10	**0.0001**
Number of families earning up to half the minimum wage	18798.00	118439.50	122308.00	103510.00	122308.00	97731.00	122308.00	97731.00	**0.0001**
Proportion of families covered by the Family Health Strategy	67.22	16.80	67.22	3.40	67.22	3.40	67.22	5.02	**0.0280**
Basic social protection index	2.00	1.00	2.00	0.00	2.00	1.00	2.00	1.00	0.2413
Per capita income	686.42	965.37	1497.29	939.67	1497.29	939.67	1497.29	939.67	**0.0364**
Minas Gerais Social Responsibility Index	0.66	0.11	0.74	0.11	0.74	0.11	0.74	0.11	**0.0368**
Percentage of poor or extremely poor population	11.69	9.96	8.34	9.96	8.34	9.96	8.34	9.96	0.8613
Minas Gerais Human Development Index (MHDI)	0.73	0.12	0.81	0.10	0.81	0.10	0.81	0.10	**0.0138**
MHDI Income	0.72	0.17	0.84	0.16	0.84	0.16	0.84	0.16	**0.0376**
MHDI Longevity	0.86	0.02	0.86	0.02	0.86	0.02	0.86	0.02	0.3503
MHDI Education	0.65	0.15	0.74	0.12	0.74	0.11	0.74	0.12	**0.0059**
Violence rate	401.84	335.57	522.10	260.94	522.10	271.23	522.10	271.23	**0.0004**

Source: Prepared for the purposes of this study, 2025.
Notes: * Median and Mann-Whitney test.

The final model for the variables parity, physical activity, number of families earning up to half the minimum wage, per capita income, and violence rate is shown in Table 4.

Statistically significant associations were observed, assessing the increased odds of low birth weight in relation to primiparity. Regarding the practice of physical exercise during pregnancy, those who did not exercise were more likely to have low birth weight children.

In addition to individual factors, contextual factors were also associated with the outcome of this study (Table 4): the number of families with income below half the minimum wage, per capita income, and violence rate were all associated with low birth weight.

Table 4 – Final model of the association between social environment and low birth weight. Belo Horizonte, Minas Gerais. Brazil. 2025

Variables	Reference	Low Birth Weight				
		Coef.	PR	IC Inf	IC Sup	p-value
Parity	Primiparous	-1.18	0.31	0.09	1.03	**0.056**
Physical activity	Not performed	1.34	3.84	1.11	13.21	**0.033**
Number of families earning up to half the minimum wage	–	0.00	1.00	1.00	1.00	**<0.001**
Per capita income	–	0.01	1.01	1.00	1.02	**0.002**
Violence rate	–	0.01	1.01	1.00	1.01	**0.044**

Source: Prepared for the purposes of this study, 2025.

DISCUSSION

This study demonstrated that, in addition to individual factors, contextual factors were associated with the outcome of low birth weight.

Although not statistically significant, approximately one-fifth of pregnant women had fewer than six prenatal visits during the pandemic, characterizing inadequate prenatal care. This finding is relevant, as national literature shows that insufficient prenatal care is associated with worse maternal and neonatal outcomes, reinforcing the need for strategies that ensure continuity and quality of care even in adverse contexts[13].

Parity, defined as the number of previous pregnancies a woman has had, is a determining factor in newborn birth weight. The literature presents divergent results: while some studies indicate that primiparous women are at higher risk of delivering low birth weight infants compared to multiparous women, others suggest the opposite. In a study conducted in Governador Valadares, Minas Gerais, being a first-time mother significantly increased the risk of low birth weight low birth weight[14], a finding similar to that of the present study, in which primiparity was associated with a higher likelihood of this outcome compared to multiparity.

In contrast, a study conducted in India demonstrated that multiparous women had a higher proportion of low birth weight newborns, diverging from the findings of this study[15]. Primiparity may be associated with a higher risk of low birth weight due to factors such as uteroplacental adaptation and maternal hormonal differences[16]. In the pandemic context, this relationship was possibly intensified by additional factors such as maternal stress, reduced access to prenatal care, and socioeconomic impacts, which negatively affected nutrition and pregnancy health[17].

Systematic reviews have also indicated that the COVID-19 pandemic worsened neonatal outcomes, with an increase in preterm births and low birth weight, particularly among pregnant women in situations of

greater social vulnerability and with limited access to adequate healthcare[18].

It was also found that the lack of physical activity during pregnancy was associated with a higher prevalence rate of low birth weight newborns, indicating inactivity as a relevant factor in adverse neonatal outcomes. These findings partially contrast with the results of a systematic review with a meta-analysis of randomized clinical trials, which demonstrated that prenatal exercise reduces the risk of macrosomia, with no significant association with low birth weight or small for gestational age, suggesting a protective effect mainly against excessive fetal weight[19].

During the COVID-19 pandemic, clinical trials showed that virtually supervised exercise programs were effective in reducing excessive gestational weight gain and increasing the proportion of newborns with adequate birth weight, in addition to positively impacting other maternal behaviors, such as reducing smoking[20]. In contrast, a cohort study conducted during the same period found that physical inactivity was associated with a higher risk of excessive weight gain, gestational diabetes, preeclampsia, and preterm birth[21].

Thus, the results of the present study align with the literature in reinforcing the importance of maintaining adequate levels of physical activity during pregnancy, especially in vulnerable contexts such as the one experienced during the pandemic, when mobility restrictions and psychosocial burdens increased pregnant women's exposure to risks of adverse perinatal outcomes.

The number of families with an income below half the minimum wage showed a statistically significant association with low birth weight, reflecting the direct impact of economic vulnerability on neonatal outcomes. Additionally, per capita income was also associated with low birth weight, suggesting that differences between regions may create socioeconomic heterogeneity capable of negatively influencing maternal and child health.

Studies conducted in different contexts support these findings, showing that the repercussions of the COVID-19 pandemic intensified social inequalities and negatively impacted perinatal outcomes. Brazilian national data indicated a progressive increase in the prevalence of low birth weight throughout the pandemic, highlighting the influence of socioeconomic context on maternal and child health[22].

Similarly, Brazilian predictive analysis demonstrated that factors such as low maternal education, food insecurity, and reduced access to prenatal care are important determinants of the risk of low birth weight[23]. Furthermore, research conducted in Brazil found that food insecurity during pregnancy was associated with a higher prevalence of low birth weight[24], a finding corroborated by a nationwide study in India, which observed an increased likelihood of low birth weight in newborns from more vulnerable areas during the pandemic[25].

Consistent results were also reported in a case-control study conducted in Jordan, which demonstrated the influence of maternal and socioeconomic determinants on the risk of low birth weight, reinforcing the importance of social context in determining this outcome[26]. This evidence highlights the importance of public policies aimed at mitigating social inequalities, ensuring access to nutritional resources, adequate supplementation, and qualified prenatal care, in order to prevent adverse outcomes associated with low birth weight.

Higher rates of violence were also found to increase the likelihood of low birth weight compared to adequate weight. The COVID-19 pandemic brought to light a range of social and public health impacts, with particularly pronounced effects on populations in more vulnerable contexts. Exposure to violence is associated with increased levels of fear and psychological stress, which directly affect maternal-fetal health.

Evidence indicates that increased maternal stress is linked to a higher risk of preterm birth and low birth weight[27]. This phenomenon was widely described during the pandemic, a period in which domestic violence against pregnant women increased, associated with a higher likelihood of low birth weight and premature births[28]. national systematic reviews also confirm that maternal stress and anxiety, intensified by experiences of violence or social insecurity, have a negative effect on fetal growth[29].

In Brazil, studies showed that domestic violence against pregnant women intensified during the pandemic, exacerbating inequalities and perinatal risk[30]. These results indicate that violence, in its multiple forms, functions as a social determinant of health, underscoring the need for integrated maternal and child protection policies in vulnerable settings.

that the assessment of birth weight in this study was conducted during the early stages of the COVID-19 pandemic. However, considering the extended duration of this period and its multiple phases, it is possible that other studies may yield different results. Given the profound socioeconomic impacts of the pandemic, which will likely last for several years, there is a pressing need for new longitudinal studies to more comprehensively investigate its effects on maternal and child health.

In this context, considering that the COVID-19 pandemic constituted a serious public health issue in the Brazilian setting, the findings of this study represent relevant contributions both to professional practice and to the advancement of scientific knowledge. By identifying associations with low birth weight, the study provides important support for health institutions and government agencies, enabling the planning of strategies and programs aimed at improving maternal and child healthcare in Brazil.

Among the limitations of this study, it is noteworthy that, although the sample consisted of pregnant women treated at three large public maternity hospitals, it does not fully reflect the pregnant population of the municipality under analysis. Another aspect worth considering is the small number of participants who reported COVID-19 symptoms, which may have limited the study's ability to identify possible associations between this condition and birth weight. Finally, within the context of the metropolitan area under investigation, it addresses the influence of the environment on birth weight during one of the most critical periods of the COVID-19 pandemic, considering a population in a situation of greater social vulnerability.

CONCLUSION

This study analyzed the association between social environmental factors and the impact of the COVID-19 pandemic on birth weight. The results showed that, in addition to clinical determinants such as prematurity and physical activity during pregnancy, contextual factors, including per capita income, the number of families with incomes below half the minimum wage, and violence rates, significantly influenced the occurrence of low birth weight. It was also found that the pandemic exacerbated social inequalities and intensified existing vulnerabilities, negatively impacting perinatal outcomes.

These evidence reinforces the importance of understanding birth weight not only as a result of individual biological factors, but also as an expression of the social and environmental conditions in which pregnancy develops. Therefore, it is essential to strengthen intersectoral strategies that integrate health, social assistance, and public safety actions to ensure comprehensive care for pregnant women and reduce inequities in maternal and child health, especially in adverse contexts such as the pandemic.

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Data and material availability

Access to the dataset is available upon request from the corresponding author. As it involves sensitive data obtained through specific ethical and institutional authorization, any sharing, even after anonymization, requires strict information security measures, in accordance with the guidelines provided by the Research Ethics Committee of UFMG. Therefore, the database remains restricted to the research team, and any external access requests must be evaluated on a case-by-case basis.

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