Rev Rene. 2021;22:e68012.
DOI: 10.15253/2175-6783.20212268012
www.periodicos.ufc.br/rene

Original Article

Prevalence and factors associated with low birth weight in full-term newborns*

Prevalência e fatores associados ao baixo peso em recém-nascidos a termo

How to cite this article:
Santos RMS, Marcon SS, Marquete VF, Gavioli A, Silva AMN, Vieira VCL, et al. Prevalence and factors associated with low birth weight in full-term newborns. Rev Rene. 2021;22:e68012. DOI: https://doi.org/10.15253/2175-6783.20212268012

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*Extracted from the dissertation "Acompanhamento da assistência pré-natal: fatores associados à adequação", Universidade Estadual de Maringá, 2020.

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ABSTRACT

Objective: to estimate the prevalence and verify the factors associated with low birth weight in full-term newborns. **Methods:** this is a retrospective study conducted with 24,744 newborns. Data were retrieved from the *Sistema de Informação sobre Nascidos Vivos* (Information System on Live Births). For the analysis, multiple logistic regression was used using the hierarchical model with maternal, gestational, and care variables. **Results:** the prevalence of low birth weight was 2.4%, with 51.0% of cases in male newborns, 73.7% in women aged 20-34 years; 56.5% were multiparous and 95.0% had eight years of education or more. In the multiple analysis, the association of low weight with the number of prenatal consultations, newborn's birth order, and sex were observed. **Conclusion:** the factors associated with low birth weight in full-term newborns were male sex, multiparity, and less than seven prenatal consultations.

Descriptors: Risk Factors; Infant, Low Birth Weight; Prevalence; Term Birth; Neonatal Nursing.

RESUMO

Objetivo: estimar a prevalência e verificar os fatores associados ao baixo peso em recém-nascidos a termo. **Métodos:** estudo retrospectivo realizado com 24.744 recém-nascidos. Os dados foram obtidos mediante a consulta ao Sistema de Informação sobre Nascidos Vivos. Na análise, foi empregada a regressão logística múltipla utilizando o modelo hierárquico com variáveis maternas, gestacionais e de assistência. **Resultados**: a prevalência de baixo peso ao nascer foi de 2,4%, sendo 51,0% dos casos em recém-nascido do sexo masculino, 73,7% em mulheres na faixa etária de 20-34 anos; 56,5% eram multíparas e 95,0% possuíam oito anos ou mais de estudo. Na análise múltipla, foi observada a associação de baixo peso com o número de consultas de pré-natal, ordem de nascimento e sexo do recém-nascido. **Conclusão:** os fatores associados ao baixo peso em recém-nascidos a termo foram: sexo masculino, multiparidade e realização de menos de sete consultas de pré-natal.

Descritores: Fatores de Risco; Recém-Nascido de Baixo Peso; Prevalência; Nascimento a Termo; Enfermagem Neonatal.

Received: Mar. 25th 2021; Accepted: June 8th 2021.

Introduction

Low birth weight, when less than 2,500g, is considered a public health problem, as it is associated with higher neonatal mortality. However, more specifically, two criteria are used to determine low birth weight: gestational age at delivery and fetal growth rate[1].

Low birth weight in preterm infants is generally a consequence of prematurity, but in full-term newborns – those with 37 weeks of pregnancy or more[2], it is the result of intrinsic and/or extrinsic factors that impact the potential for development. Thus, it is not unexpected that newborns with low birth weight have a worse prognosis in terms of survival and neural development[1].

Nearly 15 to 20.0% of children worldwide have low birth weight. According to the United Nations, the prevalence of low birth weight is 16.0% worldwide and 9.0% in Brazil and is impacted by the care, environmental and socioeconomic conditions that the mother experienced during pregnancy[3-4].

From 1996-2011, the evaluation of data from the Information System on Live Births showed the proportion of 8% of low birth weight in the 26 capitals and Brasília, with the highest rates found in the Southeast regions (8.4%) and South (8.0%) and the smallest in the Northeast (7.6%), Midwest (7.4%) and North (7.2%) regions[5].

The findings of worse outcomes in the Southeast and South regions, which are known to have better living conditions in the social and economic domains, led the authors to believe that this is related to the chance of having better quality prenatal care, which, in turn, allows a better follow-up of the gestational period, including in cases of gestational complications, enabling a full-term birth, even with low birth weight. In regions with little access to perinatal technology, the prevalence of fetal deaths and abortions is higher, so that full-term births tend to be healthier[5].

On the risk factors associated with low birth weight, a narrative review of publications in health sciences in the Americas, between 2010-2016, showed the agreement of research with the association of sociodemographic, biological, and behavioral factors concerning low birth weight and, therefore, of multifactorial nature. However, sociodemographic aspects and the health system itself are part of the peculiarities of prenatal care as a strategy for preventing low birth weight[6].

It is supposed that prenatal care, when adequate and started early, is a protective factor for low birth weight and prematurity, besides, It enables the detection and treatment of diseases/conditions that affect pregnancy previously, allowing for behavior changes, such as smoking, and the promotion of healthy habits that impact fetal development and growth[1].

Publishing available in the literature on birth weight, in general, emphasizes the factors associated with low birth weight in preterm infants[5-7], and there is still a gap in knowledge regarding low birth weight full-term births. Thus, the strength of this study lies in the fact that, in its analysis, it considered one of the variables that has a direct correlation with low birth weight – gestational time.

It is questioned, considering that the quality of prenatal care is directly linked to positive and negative neonatal outcomes and that low birth weight is an important health indicator[7-8]: What are the factors associated with low birth weight in full-term birth? To answer this question, the objective was to estimate the prevalence and verify the factors associated with low birth weight in full-term newborns.

Methods

A retrospective study carried out from the database of the Information System on Live Births, from 2014-2019, referring to live births in the city of Maringá, Paraná, Brazil. In its development and description, the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) was followed.

To outline the time frame under study we considered that in 2012, there were changes in the way of

recording data in the Birth Certificate, which changed from categorized to absolute numbers, respecting the one one-year interval for the needed adjustments, and 2019 because it was the last year providing complete data.

Data were retrieved in August 2020 by consulting the database available at the Information Technology Department of the Unified Health System. Between 2014 and 2019, 28,843 live births to women living in the city were registered in the database. Full-term births were considered eligible for the study, because, to avoid bias, conditions that classically have a relationship with low birth weight were excluded, namely: multiple pregnancies (888); congenital anomalies (254); age <14 years (18), and >49 years (5); prematurity (2,753); post-term (133) and also the nonexistence of information in the system (48), which resulted in a sample of 24,744 live full-term births, children of women aged 14 to 49 years, totaling 24,148 (97.6%) full-term-birth newborns without low birth weight and 596 (2.4%) with low birth weight.

It was defined that the hierarchical model of analysis of low weight in full-term births should consider variables belonging to three bases: proximal (maternal age, sex of the newborn, and birth order); intermediate (gestational age at the beginning of prenatal care and the number of prenatal consultations) and distal (marital status and maternal education)[9].

Thus, the dependent variable of the study was low birth weight, defined as weight less than 2,500g in full-term births (37 to 41 weeks and six days). The independent variables were classified into three types: a) Distal variables: marital status (with and without a partner) and education (none, 1 to 3, 4 to 7, ≥8 years); b) Intermediate variables (prenatal care): number of prenatal visits (none, 1 to 3, 4 to 6, ≥7) and gestational age at the beginning of prenatal care (≤12 weeks and after 12 weeks); c) Proximal variables: maternal age (14 to 19, 20 to 34, 35 to 49 years), newborn sex (male and female) and birth order of children (first, 2nd to 4th, ≥ 5th).

To summarize mother and babies' characteristics, frequency distributions were used. For this purpose, the percentage of full-term birth with low birth weight was calculated. Multiple logistic regression was used to investigate factors associated with full--term birth of low birth weight. For each variable, the Odds Ratio (OR) values and the respective Confidence Intervals (95% CI) were calculated.

Data were compiled using the Statistical Package for Social Sciences software, version 25, and independent variables (distal, intermediate, and proximal) were categorized to perform descriptive statistical analysis. Then, binary logistic regression was performed using the Chi-square association test or Fisher's exact test. Finally, for the multiple analysis, using the Backward Stepwise method, variables with p≤0.20 were selected to be included in the final model, whose adequacy was verified using the Hosmer-Lemeshow test. For the significant variables in the final model, the odds ratio (Odds Ratio) and its respective 95% Confidence Interval (95%CI) were adopted as a measure of association.

The research was approved by the Committee on Ethics in Research involving Human Beings at the *Universidade Estadual de Maringá* under Opinion No. 3,794,215/2019.

Results

Of the 24,744 births under study, 596 (2.4%) newborns were classified as underweight. Of these births, it was observed, concerning proximal variables, that 430 (72.1%) women were between 20 and 34 years old, 272 (45.6%) were primiparous, 299 (50.2%) were between the second and the fourth pregnancy and 360 (60.4%) newborns were female. Regarding the intermediate variables, 88.8% of the women started prenatal care before the 12th week of pregnancy, and 91 (15.3%) of them had between four and six prenatal consultations. Finally, regarding the distal variables, 564 (94.6%) women had eight years of education or more.

In Table 1, it is observed that full-term birth

with low birth weight was more likely to occur in male newborns, in multiparous women with more than five children, in those who started prenatal care after the 12th week of pregnancy, in those who had less than seven prenatal consultations and who had no partners.

Table 1 – Frequency distribution and univariate analysis of full-term births. Maringá, PR, Brazil, 2020

Variables	Weight (grams)		p*	Odds Ratio (CI95%)†
	<2,499	>2,500		
Mother's age (years)				
14 - 19	45 (0.2)	1,842 (7.4)		1.0 (1.35–0.76)
20 - 34	430 (1.7)	17,808 (72.0)	0.583‡	0.9 (1.11–0.77)
35 - 49	121 (0.5)	4,498 (18.2)		1.1 (0.91–1.36)
Newborn sex				
Female	360 (1.5)	11,771 (47.5)		0.6 (0.75–0.53)
Male	236 (1.0)	12,377 (50.0)	<0.001§	1.6 (1.36–1.89)
Birth order				
First	272 (1.1)	9,844 (39.8)	0.008§	1.2 (1.04–1.44)
2 - 4	299 (1.2)	13,686 (55.3)		
≥5	15 (0.1)	262 (1.1)	0.008§	2.4 (1.41–3.92)
Beginning of prenatal care (weeks)				
≤12	529 (2.1)	22,167 (89.6)		–
> 12	67 (0.3)	1,968 (8.0)	<0.001§	1.4 (1.10–1.84)
Number of prenatal consultations				
1 - 3	112 (0.5)	3,077 (12.4)	<0.001‡	1.6 (1.29–1.95)
4 - 6	484 (1.9)	21,051 (85.1)		
Marital status				
With a partner	444 (1.8)	18,811 (76.3)		
Without a partner	152 (0.6)	5,258 (21.3)	0.037‡	1.2 (1.02–1.46)
Mother's education (years)				
None	–	10 (0.1)		–
1 - 3	3 (0.01)	44 (0.2)	0.803*‡	1.8 (0.46–7.46)
4 - 7	29 (0.1)	1,091 (4.7)		1.0 (0.68–1.48)
≥8	564 (2.3)	22,953 (92.9)		0.9 (1.3–0.64)

*Significance test at the 95% level; †CI: 95% Confidence Interval; ‡Chi-square test with Yates' correction; §Fisher's exact test

Table 2 shows the variables included in the binary logistic regression model. In the model presented, the variables newborn sex, gestational order, and the number of prenatal consultations were significant.

Table 2 – Adjusted binary logistic regression model coefficients to explain low birth weight. Maringá, PR, Brazil, 2020

Variables	β*	p†	Odds Ratio	‡CI95% for Odds Ratio	
				Inferior	Superior
Constant	-3.116	<0.001	0.044	–	–
Mother's age	0.070	0.186	1.073	0.966	1.191
Newborn sex	0.455	<0.001	1.577	1.333	1.865
Gestational order	-0.190	0.023	0.827	0.703	0.974
Gestational age at the beginning of prenatal care	0.178	0.223	1.195	0.897	1.591
Prenatal care consultation	-0.333	<0.001	0.717	0.599	0.858
Marital status	0.103	0.303	1.108	0.911	1.348
Mother's education	0.035	0.847	1.035	0.729	1.470

*β: Coefficient; †Significance test at the 95% level; ‡CI: 95% Confidence Interval

Table 3 shows the result of the binary logistic regression of the proximal, intermediate, and distal variables on full-term birth with low birth weight, in which it is observed that the regression model used showed good adequacy, as the overall percentages were 97.6%, that is: having attended less than seven prenatal consultations, the woman being multiparous and the newborn being male explain almost all cases of low birth weight in full-term newborns.

Table 3 – Binary logistic regression model for the prediction of birth weight of full-term newborns of mothers aged 14 to 49 years. Maringá, PR, Brazil, 2020

Variables	Birth weight less than 2,500 grams				
	β*	p†	Odds Ratio	‡Odds Ratio CI 95%	
				Inferior	Superior
Number of prenatal consultations					
< 7	0.494	<0.001	1.64	1.32	2.02
Gestational order					
Multiparous	0.240	<0.001	1.27	1.07	1.50
Newborn sex					
Male	0.453	<0.001	1.57	1.33	1.86

*β: Coefficient; †Significance test at the 95% level; ‡CI: 95% Confidence Interval

Discussion

The study has limitations, as it uses secondary data from the Information System on Live Births, which is subject to flaws when filling out, especially deficiency of information, added to the impossibility of exploring important variables, such as the presence of gestational diseases, as well as those related, for example, to maternal habits and nutrition. Moreover, as these are cross-sectional studies, it is impossible to analyze conditions with low prevalence and to determine the absolute risk. Despite this, its results are valid as it considers variables that have been proven to be associated with low birth weight, such as gestational age at the time of delivery. Also, factors associated with full-term birth with low birth weight were identified in a specific geographic area, expanding, and reinforcing knowledge on this issue and even fostering future studies with different methodological designs.

It is noteworthy that the identification of factors associated with low birth weight allows health professionals to plan actions and carry out prenatal care to avoid negative outcomes, besides contributing to the promotion of health policies. The professional nurse, through the coordination of the team, has a key role in the management of care for women in the reproductive period, especially during pregnancy, with an emphasis on early uptake and health education, to promote healthy habits and the health of the binomial - mother and baby.

The cause of low birth weight is multifactorial and, among the factors, includes the sex and size of the newborn; weight gain; the mother's calorie intake, and other habits through pregnancy, such as smoking and drinking alcohol and/or other drugs, as well as socioeconomic status; the race or ethnic origin; maternal weight and age at the time of delivery[5].

The prevalence of full-term birth with low birth weight found was three times lower than in a study carried out in Paraisópolis, Brazil[3], which probably results from the fact that the gestational age, at the time of delivery, was not a limiting factor for inclusion criteria of the mother in that study. In turn, among teenage mothers, the prevalence of low birth weight was 10%[10]. It is noteworthy that, in this study, factors typically associated with low birth weight were excluded, such as prematurity, the presence of congenital anomalies, and multiple pregnancies, which may justify the difference regarding the prevalence found in other studies[7-8].

Some maternal and pregnancy conditions can be permeated by prenatal care. In this sense, the findings of this study demonstrate that having fewer than six consultations was a risk factor for low birth weight, which is consistent with the results observed in a maternity hospital, which showed a higher frequency of low birth weight among the mothers who attended less than six prenatal consultations. The authors concluded that the quality of care received during pregnancy and access to it interfere in the number of cases of low birth weight[11]. The results found also corroborate a study carried out in Kuito-Angola, which found that only 15.6% of postpartum women, who had a baby with low birth weight, had six or more prenatal consultations[12].

The findings of these studies showed that prenatal care must start as early as possible and consultations should be regular, as recommended by the Ministry of Health. It is pointed out that adequate prenatal care is considered not only concerning the number of consultations, but also for the quality of the actions offered. Furthermore, sociodemographic aspects and the organization of the health system itself interfere in the specificities of prenatal care as a strategy for preventing low birth weight[13].

Primiparity was a protective factor for low birth weight and multiparity was a risk factor. A possible explanation for this result is the possibility that multiparous women do not always seek professional help in the face of complications that they identify as "minor", but which may interfere with the progress of the pregnancy. The biological mechanisms of how the number

of pregnancies may influence the incidence of low birth weight are not well known, although studies show that the rate of low birth weight tends to be higher in the first child than in the second and third[14-17].

It is noteworthy that, in the city under study, the rate of cesarean sections is very high, which may justify the association found between multiparous women and low birth weight. In Brazil, the interventionist model still prevails, because of the following difficulties: professionals' culture; lack of trained human resources; management; lack of structure; deficiency of information by the population; class interest; myths and paradigms. Added to this, the right of women to choose for a cesarean section is highlighted and that, in cases of previous cesarean sections, the procedure is justified by being iterated and risk of going into labor[15-16].

Regarding the sex of the newborn, a meta-analysis, which included 10 studies carried out between 2000-2018 in six Brazilian states, also identified that males had greater chances of neonatal mortality[18]. It is noteworthy that, besides the fact that the sex of the newborn is not a factor that can be modified, it was also not found studies that would clarify reasons why newborn males have greater chances of mortality and low birth weight[3-4].

The quality of care through the gestational period is crucial to reduce obstetric and neonatal risks and complications. For the child, for example, adequate monitoring of this period has important implications related to birth conditions, as it helps to prevent low birth weight, prematurity, and perinatal death. Notably, it is not the number of consultations, alone, that guarantees the quality of care received, since, in cases of a high-risk pregnancy, due to the condition itself, going to health services and the performance of exams tend to be more frequent. It is observed, therefore, a contradiction, since it is precisely in cases of high-risk pregnancy that there are greater possibilities of intrauterine growth restriction, resulting in low birth weight[19].

Thus, the importance of public policies considering these factors is highlighted, to create proposals such as the training of professionals, besides providing access with equity, aiming at the quality of prenatal care.

In Brazil, a growing trend has been observed in the rates of low birth weight in newborns (including preterm and full-term), especially in children of mothers who did not attend prenatal care, and a decrease in those who attended more than seven consultations. Furthermore, the decrease in low birth weight rates was greater in the Southeast and South regions, regions where a higher frequency of women with more than eight years of education and greater coverage of prenatal care were also observed[5], reinforced by the findings of this study.

These findings show the relevance of knowing the profile of the population, as this allows evaluating the extent to which assistance policies, strategies, and programs address the needs and characteristics of women at the local level and, based on this, focus assistance to specific needs of the population served[20].

In this context, the nurse's role as a manager and educator in health is highlighted, as their activities include evaluating the rate of coverage of prenatal care in their area of coverage implement continuing education with its team to do active search and groups of pregnant women to guide on care during pregnancy and postpartum. In this way, nurses can also be more active in reproductive planning to guide on the number of pregnancies among women, besides including multiparous women in the classification of high-risk prenatal care and promoting better monitoring of pregnancy with this classification.

Conclusion

In full-term newborns, low birth weight was associated with male sex, multiparity, and less than seven prenatal consultations.

Collaborations

Santos RMS and Gavioli A collaborated for the conception and design, analysis and interpretation of data, and writing of the article. Marquete VF, Silva AMN, Vieira VCL, and Marques AG collaborated in the writing of the article and relevant critical review of the intellectual content. Marcon SS collaborated in the relevant critical review of the intellectual content and approval of the final version to be published.

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