

## Low birth weight in a municipality in the southeast region of Brazil

*Baixo peso ao nascer em município da região sudeste do Brasil*

*Bajo peso al nacer en el municipio de región sudeste de Brasil*

**Carolina Queiroz de Souza Mendes<sup>1</sup>, Bruna Cristina de Almeida Cacella<sup>II</sup>,  
Myriam Aparecida Mandetta<sup>II</sup>, Maria Magda Ferreira Gomes Balieiro<sup>II</sup>**

<sup>1</sup> Hospital e Maternidade Santa Joana, Neonatal Intensive Care Unit. São Paulo, Brazil.

<sup>II</sup> Universidade Federal de São Paulo, Paulista School of Nursing. São Paulo, Brazil.

### How to cite this article:

Mendes CQS, Cacella BCA, Mandetta MA, Balieiro MMFG. Low birth weight in a municipality in the southeast region of Brazil. Rev Bras Enferm. 2015;68(6):857-63. DOI: <http://dx.doi.org/10.1590/0034-7167.2015680624i>

Submission: 04-03-2015 Approval: 08-16-2015

### ABSTRACT

**Objective:** to identify the prevalence of low birth weight in the city of São Paulo. **Method:** epidemiological cross-sectional study with data collected by means of the Brazilian Live Birth Information System related to births occurred in the city of São Paulo between 2007 and 2013. Maternal, gestational, childbirth, and neonatal variables were analyzed descriptively and by association. **Results:** 9.65% (1,342,655) of live births were underweight (mean of 3234.55 grams in the term group and 2312.17 in the pre-term group) with a mean maternal age of 27.53 years old. The risk factors identified include maternal age, not having a partner, low maternal level of education, other race rather than white, pre-term pregnancy, multiple births, low number of prenatal check-ups, and cesarean delivery. **Conclusion:** knowledge of this evidence favors planning the care provided by defining strategies to reduce it and consequently improve maternal and infant health care.

**Key words:** Epidemiology; Low Birth Weight Infant; Epidemiologic Factors.

### RESUMO

**Objetivo:** identificar a prevalência de baixo peso ao nascer no município de São Paulo. **Método:** estudo epidemiológico do tipo transversal, a partir de dados do Sistema de Informações sobre Nascidos, referentes aos nascimentos ocorridos no município de São Paulo, nos anos entre 2007 - 2013. As variáveis maternas, gestacionais, do parto e neonatais foram analisadas descritivamente e por associação. **Resultados:** do total de nascidos vivos (1.342.655), 9,65% apresentaram baixo peso (média de 3234,55 gramas no grupo a termo e 2312,17 no grupo pré-termo) e média de idade materna de 27,53 anos. Os fatores de riscos identificados incluem idade materna, ausência de companheiro, baixo nível de escolaridade materno, raça não branca; gestação pré-termo, gemelaridade, baixo número de consultas no pré-natal e parto cesáreo. **Conclusão:** o conhecimento destas evidências favorece o planejamento da assistência com a definição de estratégias para sua redução e consequentemente melhoria na atenção à saúde materno infantil.

**Descritores:** Epidemiologia; Recém-Nascido de Baixo Peso; Fatores Epidemiológicos.

### RESUMEN

**Objetivo:** identificar la prevalencia de bajo peso al nacer, en São Paulo. **Método:** estudio transversal epidemiológico. Los datos fueron recolectados a través del Sistema Brasileño de Información Nacido Vivo, relacionados con los nacimientos ocurrieron en São Paulo, entre 2007 - 2013. La madre, la gestación, el parto y las variables neonatales fueron analizados descriptivamente y por asociación. **Resultados:** 9,60% (1.342.655) de nacido vivo tenían bajo peso (media de 3234,55 gramos en el grupo a término y 2.312,17 en el grupo prematuro) y la media de edad de la madre de 27,53 años. Los factores de riesgo identificados incluyen la edad materna, sin compañeros, la educación materna baja, la raza no blanca; el embarazo prematuro, embarazo gemelar, bajo número de consultas en la atención prenatal y el parto por cesárea. con una edad media de 27,59 años materna. **Conclusión:** El conocimiento de esta evidencia favorece la planificación de la atención a la definición de estrategias para reducir y, en consecuencia, mejora en la atención a la salud materna e infantil.

**Palabras clave:** Epidemiología; Bajo Peso al Nacer; Factores Epidemiológicos.

CORRESPONDING AUTHOR

Maria Magda Ferreira Gomes Balieiro

E-mail: [mmfgbalieiro@unifesp.br](mailto:mmfgbalieiro@unifesp.br)

## INTRODUCTION

The weight of newborns is an important indicator of fetal health and a predictor of normal growth during childhood and adolescence, being determinant as a risk in neonatal morbidity and mortality<sup>(1)</sup>. The World Health Organization defines low birth weight (LBW) as being at or below 2,500 g<sup>(2)</sup>.

Studies<sup>(3-8)</sup> point out smoking, low maternal level of education, younger maternal age, marital status, small weight gain during pregnancy, high blood pressure, infections of the genitourinary tract during pregnancy, twins, and fewer prenatal doctor check-ups as factors related to low birth weight. Consequently, LBW can be associated with a higher risk of infections, increased hospitalization, and a greater propensity to post-natal neuropsychological deficits<sup>(9)</sup>.

For this reason, knowledge of the characteristics of live births in a region can improve health services, making them more resolute and qualified in maternal-infant health care.

In Brazil, due to the precariousness of technological access and inadequate records in less developed regions, recent studies highlight a higher LBW index in better economic regions, thus creating a paradox<sup>(8)</sup>.

The rate of low birth weight increased from 8.5% in 1996 to 9.1% in 2010 in all Brazilian capitals ( $p < 0.001$ ) with a general increase until 2003 and 2004 followed by a stabilization of rates from 2003 and 2004 to 2010<sup>(7)</sup>.

Although previously associated with lower socioeconomic levels, a growth in low birth weight rates followed by their stabilization has occurred in recent years in developed countries. This aspect may be related to the technological advances in perinatal care that allows the survival of premature infants with low birth weight<sup>(8)</sup>. In 2011, the total fertility rate in Brazil was 1.95 children per woman. This decline in fertility rates is a reflection of changes in Brazilian society in recent decades such as increasing urbanization, greater participation of women in the labor market, higher education levels, increasing dissemination of contraceptive methods<sup>(9)</sup>.

Despite the significant drop in child mortality over the past decade, the rates are still high, especially in neonatal mortality (0 to 27 days) in economically disadvantaged regions and populations, reflecting social inequalities. This situation becomes even more serious when it is recognized that most of these early deaths could be considered preventable if health services were more responsive and qualified.

Studies indicate that low birth weight and prematurity are predictors of relevant morbidities such as cerebral palsy, perinatal asphyxia, sepsis, peri-intraventricular hemorrhage, bronchopulmonary dysplasia, acute respiratory syndrome, jaundice, meningitis, and pneumonia. Such complications and morbidities can generate numerous impacts on neuropsychic-motor development of infants throughout their life<sup>(10)</sup>.

Studies<sup>(11-12)</sup> aimed at understanding the association of low birth weight with maternal and fetal demographic characteristics identified adolescent pregnancy as a determining factor because of the risk of exposure to sexually transmitted diseases and the increase in LBW rate among premature infants and newborns with intrauterine growth restriction. This

association is aggravated in the presence of poverty, social deprivation, along with biological and nutritional factors during pregnancy<sup>(11)</sup>.

Maternal education has often been used to assess pregnancy outcomes. Better-educated women are more aware of the precautions to be taken during pregnancy and have better socioeconomic status, which facilitates access to care and information<sup>(7)</sup>.

In this context, the present study had the objective to identify the prevalence of low birth weight based on live birth records.

## METHOD

An epidemiological cross-sectional study was conducted based on data from Statements of Live Births (SLB) from the Brazilian Live Birth Information System (SINASC, as per its acronym in Portuguese), available on the website of the Department of the Unified Health System (DATASUS. <http://www.datasus.gov.br>) in June 2015 relating to births from women living in São Paulo that occurred in the same municipality in the years between 2007 and 2013.

The sample consisted of all live births in the city of São Paulo from 2007 to 2013, totaling 1,342,655 live births.

The inclusion criterion adopted was newborns weighing over 500 grams and less than 2,500 grams. The exclusion criterion on the other hand was applied to newborns whose record in the SLB ignored weight or failed to fill out a variable of the study.

The study's dependent variable was birth weight (< 2,500 g) and the independent ones were maternal sociodemographic characteristics related to pregnancy, childbirth, and the newborn. Maternal and pregnancy characteristics were obtained from the following variables: age (in years); education (years), marital status, number of prenatal check-ups, type of delivery; length of gestation, type of pregnancy, and place of occurrence. The neonatal variables selected were gender, Apgar at 1 and 5 minutes, and the presence of congenital anomalies. The categorization of the variables followed those defined by the SLB and made available by SINASC.

Analysis was performed using absolute and relative frequency and measures of central tendency and dispersion as continuous variables. Later, prevalence rates, odds ratio, and associations between the independent variables for the development of LBW were investigated according to two distinct groups: the term and pre-term. Live births with a gestational age equal to or greater than 37 weeks were selected for the term group. As for the pre-term group, live births with a gestational age less than 37 weeks were selected.

The candidate variables to the final multivariate model were those with a type I error probability in the association test (likelihood ratio) of less than 20%. After this, multivariate logistic regression models were drawn according to the stepwise method in both population groups in order to obtain adjusted odd ratios for LBW. They were considered statistically significant when  $p < 0.05$ .

The data used are public domain and correspond to the DATASUS system database, which exempts the assessment of the project by a Research Ethics Committee.

**RESULTS**

During the period analyzed, the highest number of live births occurred in 2012, totaling 194,911, with variations in other years between 188,923 and 194,021 live births.

Of the 1,342,655 live births, 129,610 (9.65%) were underweight and 1,213,045 (90.3%) were adequate birth weight. By analyzing the weight distribution of the newborns by year, it can be seen that the proportion of LBW remains in the range of 9.56% to 9.79% during the period studied (Figure 1).

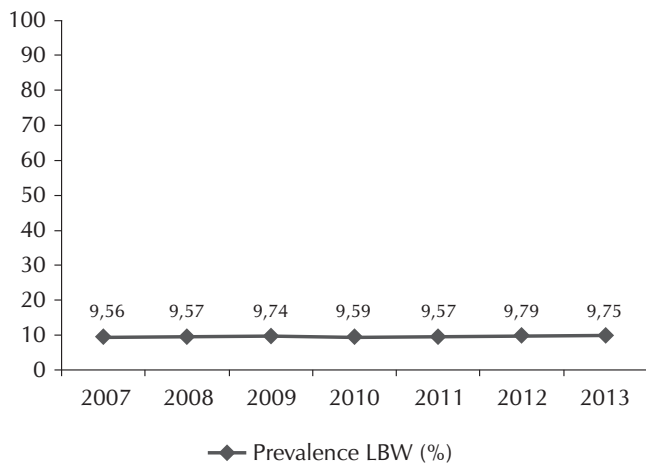
In the descriptive analysis of the SLB as to maternal characteristics, it was found that the mean age of the mothers was 27.53 years old ( $\pm 6.56$ ), with the highest frequency of schooling from 8 to 11 years of education (56.50%), single (52.90%), and who had seven (7) or more prenatal check-ups (76.20%).

Most mothers had single pregnancies in 97.30% of all live births, appropriate gestational age, pregnancies to term in 88.90% (1,193,226) of the cases, and 56.50% (758,882) had a cesarean section. Twin and triplet pregnancies or more were determining factors in the prevalence of LBW in 62.90% and 96.90% of the cases, respectively.

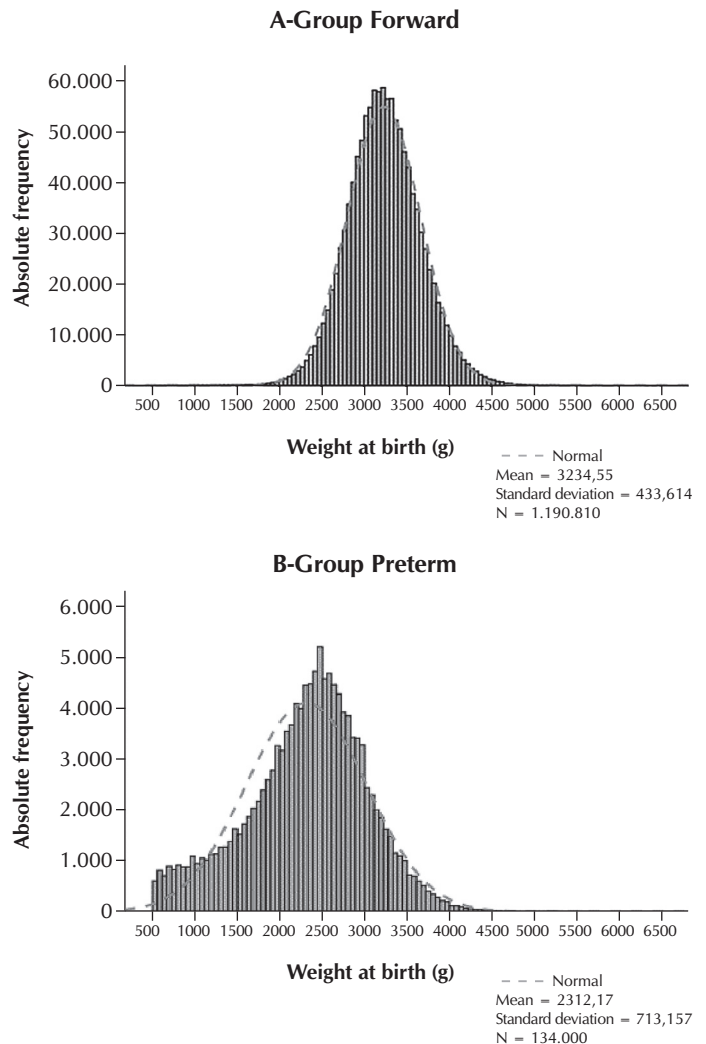
As for neonatal characteristics, it was found that most newborns were female (51.20%); white (62.00%), with a mean Apgar of 8.36 in the first minute and 9.41 in the fifth minute, and 1.40% had congenital anomalies.

The mean weight at birth was 3,234.55 ( $\pm 433.614$ ) grams in the term group and 2,312.17 ( $\pm 713.156$ ) in the pre-term group (Figure 2).

The prevalence of LBW in the population studied was 9.65%, but when broken down into the term and pre-term groups it was found that the term group represented 3.85% and pre-term 57.35%.



**Figure 1 -** Prevalence of low birth weight, São Paulo, Brazil, 2007 - 2013



**Figure 2 -** Weight distribution of live births (A) forward and (B) preterm, São Paulo, Brazil, 2007-2013

The risk of LBW (Table 1) was associated in the term group with maternal age below 20 years old (OR = 1.323) and above 35 years old (OR = 1.155), marital status without a partner (OR = 11.265), no maternal education (OR = 1.407), fewer prenatal care check-ups, and higher in the absence of check-ups (OR = 3.305), female newborn (OR = 1.472), and having other race rather than white (OR = 1.184).

The prevalence of LBW in newborns with congenital anomalies was 25.60%, representing an odds ratio of 3.32, broken down as 10.70% (OR = 3.060) in the term group and 70.50% (OR = 1.813) in the pre-term group.

In the pre-term group, however, the risk of LBW was also associated with maternal age, under 20 years old (OR = 1.082) and over 35 years old (OR = 1.078), marital status without a partner (OR = 1.126), no education (OR = 1.284), no prenatal care check-ups (OR = 2.408), female newborn (OR = 1.281), and to a lesser extent with non-white race (OR = 0.975).

**Table 1 -** Prevalence and odds ratio for low birth weight according to demographic, pregnancy, and pre-natal characteristics among live births in São Paulo, Brazil, 2007-2013

Variables	Term				Pre-Term					
	Total n = 1.190.810	Prevalence of low weight (%)	Odds ratio	CI 95%	P value	Total n = 134.000	Prevalence of low weight (%)	Odds ratio	CI 95%	P value
Mother's age		3.80					57.30			
< 20 years old		4.80	1.323	(1.289; 1.357)	<0.001		14.10	1.082	(1.049; 1.117)	<0.001
20 - 35 years old		3.60	1	-	-		56.70	1	-	-
> 35 years old		4.30	1.155	(1.124; 1.187)	<0.001		16.30	1.078	(1.047; 1.111)	<0.001
Marital status										
With a partner		3.40	1	-	-		55.80	1	-	-
No partner		4.20	1.265	(1.241; 1.289)	<0.001		58.70	1.126	(1.101; 1.150)	<0.001
Education										
None		5.30	1.407	(1.200; 1.651)	<0.001		63.30	1.284	(1.041; 1.584)	0.019
1 - 3 years		5.10	1.342	(1.262; 1.427)	<0.001		59.30	1.084	(0.997; 1.180)	0.059
4 - 7 years		4.80	1.328	(1.296; 1.360)	<0.001		58.90	1.077	(1.044; 1.111)	<0.001
8 - 11 years		3.80	1.002	(0.983; 1.021)	0.87		57.20	1.002	(0.983; 1.021)	0.315
12 or more		3.40	1	-	-		56.60	1	-	-
Delivery										
Vaginal		4.00	1	-	-		52.70	1	-	-
Cesarean		3.80	0.947	(0.929; 0.965)	<0.001		60.20	1.36	(1.330; 1.391)	<0.001
Prenatal check-ups										
None		11.40	3.305	(3.119; 3.502)	<0.001		75.90	2.408	(2.232; 2.598)	<0.001
1 - 3		6.70	1.864	(1.792; 1.940)	<0.001		69.20	1.768	(1.700; 1.839)	<0.001
4 - 6		4.90	1.382	(1.351; 1.414)	<0.001		63.50	1.442	(1.407; 1.477)	<0.001
7 or more		7.40	1	-	-		51.20	1	-	-
Gender of the newborn										
Female		4.60	1.472	(1.450; 1.506)	<0.001		60.50	1.281	(1.253; 1.309)	<0.001
Male		3.10	1	-	-		54.50	1	-	-
Race										
White		3.60	1	-	-		57.60	1	-	-
Non-white		4.30	1.184	(1.161; 1.207)	<0.001		56.90	0.975	(0.952; 0.997)	0.029

**Table 2** - Results of the multivariate logistic regression for low birth weight among live births in the city of São Paulo between 2007-2013, São Paulo, Brazil, 2015

Variables	Term			Pre-Term		
	OR adjusted	CI 95%	P value	OR adjusted	CI 95%	P value
Female	1.489	(1.460; 1.518)	<0.001	1.294	(1.265; 1.323)	<0.001
Maternal age > 35 years old	1.237	(1.203; 1.273)	<0.001	1.16	(1.125; 1.197)	<0.001
Non-white race	1.117	(1.095; 1.139)	<0.001	0.887	(0.866; 0.909)	<0.001
7 or more prenatal check-ups	0.618	(0.605; 0.631)	<0.001	0.53	(0.518; 0.543)	<0.001
No companion	1.166	(1.142; 1.189)	<0.001	-	-	-

Different values were found between the two strata of live births in relation to the type of delivery, and in the pre-term group cesarean delivery was significantly associated with LBW, with an odds ratio of 1.36.

Multivariate logistic regression for low birth weight among live births in São Paulo showed an increase in risk among those born at term compared to pre-term, according to the independent variables studied.

## DISCUSSION

Birth weight is considered an important indicator of the conditions of maternal and child health. This study showed that pre-term birth, cesarean delivery, and multiple gestations had higher percentages in the group of live births with low birth weight.

There was a stability of the LBW percentage from 2007 to 2013 in São Paulo, which ranged from 9.56 to 9.75%. Even so, this rate is considered high when compared to other countries with the same economic level, such as in Chile, which has a 5% rate<sup>(12)</sup>.

A similar rate was found in a study in Thailand<sup>(13)</sup> with the incidence of low birth weight of 9.2% strongly related to a maternal body mass index lower than 18.5 kg/m<sup>2</sup> and weight gain in the second trimester of less than 300 grams per week.

In the city of New York, on the other hand, the rate of low birth weight in 2009 was 8.2%, being related to adolescent pregnancy. This fact calls for public policies and support programs for this age group<sup>(14)</sup>.

Regarding LBW percentages in other cities of Brazil, its incidence in Maceio was 8.4% in 2010<sup>(15)</sup>. In Niterói, Rio de Janeiro, on the other hand, the LBW rate was 8.8% in 2000 and 8.4% in 2009<sup>(16)</sup>.

The LBW rate may be related not only to social conditions, but also to the availability of perinatal care<sup>(17)</sup>. This finding reinforces the importance of prenatal care coverage and access to health services<sup>(5)</sup>.

In Brazil, the highest low birth weight rates are concentrated in the South and Southeast regions. Municipalities with higher socioeconomic levels such as São Paulo have higher LBW rates than the least developed ones. This is because

of better reproductive health care resulting in lower rates of neonatal death and increased number of live births with low birth weight, as well as better access to human reproduction technologies<sup>(18)</sup>.

One factor that hampers the assessment of the prevalence of the underweight indicator at birth is underreporting. In the city of São Paulo there is good coverage of the SINASC and a good filling out of the birth weight form<sup>(19)</sup>. Thus, the use of the information from the registration system has a good quality when compared to other less developed areas.

The association between low birth weight and prematurity is described in several studies<sup>(1,3-7)</sup>, however there is one study that identifies that this association is inadequate. The authors<sup>(12)</sup> report that prematurity may be related to incorrect calculation of the probable date of delivery and to the increased occurrence of cesarean deliveries.

In this study, cesarean deliveries were present in 3.80% of live births of low weight in the term group and 60.20% in the pre-term group, a fact commonly found in the population of a better economic index, and which represents an incidence factor of premature births due to errors estimating the probable delivery date<sup>(12)</sup>.

A national study<sup>(20)</sup> conducted in northeastern Brazil found that pre-term birth is associated with a prior history of prematurity (OR = 2.00), maternal age (OR = 2.15), inadequate maternal weight gain (OR = 2.33), maternal disease (OR = 2.10), high blood pressure without preeclampsia (OR = 6.42), and with eclampsia (OR = 8.17), hospitalization (OR = 5.64), change in the amniotic fluid (OR = 2.28), vaginal bleeding (OR = 1.54), and multiple pregnancy (OR = 22.65).

As highlighted in the literature, prematurity is a risk factor for low birth weight and contributes to high infant mortality causing injury and harm to the newborns who manage to overcome the neonatal period of risk, but they are difficult to measure. In this study, the frequency of premature infants was 10.10% of the cases.

In São Paulo, low maternal education was not associated with low birth weight because 83.00% of the mothers had eight years of education or more. However, another study on risk factors for low birth weight in Brazil revealed that the South and Southeast regions have high levels of maternal

education, which is different from what is seen in the North and Northeast regions<sup>(18)</sup>. This may be related to the low socioeconomic standard of these mothers, who may receive prenatal check-ups later and fewer times<sup>(3)</sup>.

The number of prenatal check-ups is considered a key factor in the occurrence of various complications, including low birth weight<sup>(12)</sup>. In this study, only 76.20% had seven or more check-ups in the total of live births and the rest did not meet the number recommended by the Ministry of Health for the prevention of adverse events. In the stratum of live births at term, the prevalence of low birth weight was 11.40% in those without prenatal check-ups (OR = 3.305).

In Brazil, we have witnessed an increase in the number of pre-natal check-ups, but the behavior of maternal and neonatal mortality has not reflected this improvement. As a result, even the Ministry of Health and researchers of this topic recognize the need to invest in the quality of prenatal care in the country, thus bringing an impact on infant survival.

The present study found a prevalence of low birth weight in 79.90% of the cases of double pregnancy, a relatively higher rate than that found with normal weight. A study conducted in Campinas, São Paulo, also found that multiple pregnancies have higher risks of low birth weight<sup>(6)</sup>.

The identification of risk factors related to low birth weight along with neonatal mortality may help planning actions for

restructuring and improving the care provided to pregnant women and their newborns. One of the actions implemented by the Ministry of Health, the "Rede Cegonha" (Stork Network), is a strategy that ensures access and resoluteness during the prenatal, childbirth, and neonatal period. An epidemiological study<sup>(21)</sup> demonstrated the benefits, applicability, and effectiveness of the program in the regions where it was implemented.

## CONCLUSION

In São Paulo, between 2007 and 2013, the mean prevalence of LBW was 9.65%, which is high when compared to developed countries, but with lower rates than other regions.

Of the variables analyzed, low maternal education, non-white race, multiple gestation, maternal age greater than 35 years old, cesarean delivery, and live female births were considered risk factors for the occurrence of low birth weight both in the term and pre-term groups. The variable marital status was significantly associated with LBW in the term group in the absence of a partner.

Studies in this area contribute significantly to building good perinatal practices and better planning of maternal and infant care by defining quality improvement strategies and access to care in the prenatal period and consequently the decrease of LBW rates in the municipality assessed.

## REFERENCES

- Nascimento LF, Costa TM, Zöllner SAC. Spatial distribution of low birthweight infants in Taubaté, São Paulo, Brazil. *Rev Paul Pediatr* [internet]. 2013[cited 2015 Apr 02];31(4):466-72. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4183040/pdf/0103-0582-rpp-31-04-00466.pdf>
- World Health Organization. Preterm birth. Fact sheet N°363 [updated 2013 Nov 01; cited 2015 Apr 24]. Available from: <http://www.who.int/mediacentre/factsheets/fs363/en/>.
- Franciotti DL, Mayer GN, Cancelier ACL. Risk factors for low birth weight: a case-control study. *Arq Catarin Med* [internet]. 2010[cited 2015 Apr 02];39(3):63-9. Available from: <http://www.acm.org.br/revista/pdf/artigos/818.pdf>
- Nazari M, Zainiyah SYS, Lye MS, Zalilah MS, Heidarzadeh M. Comparison of maternal characteristics in low birth weight and normal birth weight infants. *East Mediterr Health J* [internet]. 2013[cited 2015 Apr 02];19(9):775-81. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/24313038>
- Maia RRP; Souza JMP. Factors associated with the low birth weight in municipality in northern Brazil. *Rev Bras Crescimento Desenv Hum* [internet]. 2010[cited 2015 Apr 02];20(3):735-44. Available from: <http://pepsic.bvsalud.org/pdf/rbcdh/v20n3/08.pdf>
- Carniel EF, Zanolli ML, Antonio MARGM, Morcillo AM. [Low birth weight determinants present in the statement of live birth]. *Rev Bras Epidemiol* [internet]. 2008[cited 2015 Apr 02];11(1):169-79. Available from: [http://www.scielo.cl/pdf/cienf/v20n3/art\\_03.pdf](http://www.scielo.cl/pdf/cienf/v20n3/art_03.pdf) Portuguese.
- Veloso HJF, Silva AAM, Barbieri MA, Goldani MZ, Lamy Filho F, Simões VMF, et al. Secular trends in the rate of low birth weight in Brazilian state capitals in the period 1996 to 2010. *Cad Saúde Pública* [internet]. 2013[cited 2015 Apr 02];29(1):91-101. Available from: <http://www.scielo.br/pdf/csp/v29n1/11.pdf>
- Viana KJ, Taddei JAAC, Cocetti M, Warkentin S. [Birth weight in Brazilian children under two years of age]. *Cad Saúde Pública* [internet]. 2013[cited 2015 Apr 02];29(2):349-56. Available from: <http://www.scielosp.org/pdf/csp/v29n2/21.pdf> Portuguese.
- Silvestrin S, Silva CH, Hirakata VN, Goldani AAS, Silveira PP, Goldani MZ. Maternal education level and low birth weight: a meta-analysis. *J Pediatr* [internet]. 2013[cited 2015 Apr 02];89(4):339-45. Available from: <http://www.science-direct.com/science/article/pii/S0021755713000971>
- Lemos RA, Frônio JS, Neves LAT, Ribeiro LC. Estudo da prevalência de morbidades e complicações neonatais segundo o peso ao nascimento e a idade gestacional em lactentes de um serviço follow-up. *Rev APS* [internet]. 2010[cited 2015 Apr 02];13(3):277-90 Available from: <http://aps.ujf.emnuvens.com.br/aps/article/view/603/339>
- Surita FGC, Suarez MBB, Siani S, Silva JLP. [Factors associated with low birth weight among adolescents in the Brazil Southeast region]. *Rev Bras Ginecol Obstet* [internet]. 2011[cited 2015 Apr 02];33(10):286-91. Available from: <http://www.scielo.br/pdf/rbgo/v33n10/03.pdf>
- Silva TRSR. Nonbiological maternal risk factor for low birth

- weight on Latin America: a systematic review of literature with meta-analysis. *Einstein* [internet]. 2012[cited 2015 Apr 02];10(3):380-5. Available from: [http://www.scielo.br/pdf/eins/v10n3/en\\_v10n3a23.pdf](http://www.scielo.br/pdf/eins/v10n3/en_v10n3a23.pdf)
13. Chiang Mai Low Birth Weight Study Group, Mangklabruks A, Rerkasem A, Wongthanee A, Rerkasem K, Chiowanich P, et al. The risk factors of low birth weight infants in the northern part of Thailand. *J Med Assoc Thai* [internet]. 2012[cited 2015 Apr 02];95(3):358-65. Available from: <http://www.pubfacts.com/fulltext/22550834/The-risk-factors-of-low-birth-weight-infants-in-the-northern-part-of-Thailand>
  14. Darling RD, Atav AS. Risk factors for low birth weight in New York state counties. *Policy Polit Nurs Pract* [internet]. 2012[cited 2015 Apr 02];13(1):17-26. Available from: <http://ppn.sagepub.com/content/13/1/17.long>
  15. Melo AMC, Kassar SB, Lira PLC, Coutinho SB, Eickmann SH, Lima MC. Characteristics and factors associated with health care in children younger than 1 year with very low birth weight. *J Pediatr* [internet]. 2013[cited 2015 Apr 02];89(1):75 – 82. Available from: <http://www.sciencedirect.com/science/article/pii/S0021755713000132>
  16. Rozario S, Brito AS, Kale PL, Fonseca SC. [Time serie of characteristics of mothers and live newborns in Niterói, RJ]. *Rev. Bras. Saúde Matern Infant* [internet]. 2013[cited 2015 Apr 02];13(2):137-146. Available from: <http://www.scielo.br/pdf/rbsmi/v13n2/a07v13n2.pdf> Portuguese.
  17. Silva AAM, Silva LM, Barbieri MA, Bettioli H, Carvalho LM, Ribeiro VS, et al. The epidemiologic paradox of low birth weight in Brazil. *Rev Saúde Pública* [internet]. 2010[cited 2015 Apr 02];44(5):767-75. Available from: <http://www.scielo.br/pdf/rsp/v44n5/1613.pdf>
  18. Lima MCBM, Oliveira GS, Lyra CO, Roncalli AG, Ferreira MAF. [The spatial inequality of low birth weight in Brazil]. *Ciênc Saúde Colet* [internet]. 2013[cited 2015 Apr 02];18(8):2443-52. Available from: <http://www.scielo.br/pdf/csc/v18n8/29.pdf> Portuguese.
  19. Minuci EG, Almeida MF. [Birth weight intra-urban differentials in the city of São Paulo]. *Rev Saúde Pública* [internet]. 2009[cited 2015 Apr 02];43(2):256-66. Available from: <http://www.scielo.br/pdf/rsp/v43n2/7298.pdf> Portuguese.
  20. Assunção PL, Novaes HM, Alencar GP, Melo AS, Almeida MF. Factors associated with preterm birth in Campina Grande, Paraíba State, Brazil: A case-control study. *Cad Saúde Pública* [internet]. 2012[cited 2015 Apr 02];28(6):1078-90. Available from: <http://www.scielo.br/pdf/csp/v28n6/07.pdf>
  21. Kassar SB, Melo AMC, Coutinho SB, Lima MC, Lira PIC. Determinants of neonatal death with emphasis on health care during pregnancy, childbirth and reproductive history. *J Pediatr* [internet]. 2013[cited 2015 Apr 02];89(3):269 – 77. Available from: <http://www.sciencedirect.com/science/article/pii/S0021755713000533>