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Risk factors associated with low birth weight in the Americas: literature review

Factores de riesgo de bajo peso al nacer en las Américas: una revisión de literatura

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| Abstract |

Introduction: Low birth weight (LBW) is one of the main risk factors that affects infant morbidity and mortality worldwide. Approximately one third of neonatal deaths are attributable to this cause.

Objective: To review the most relevant papers related to low birth weight in the Americas between 2010 and 2016.

Materials and methods: Narrative literature review. The information was obtained from the PubMed, SciELO, LILACS and Portal Regional da BVS databases, using DeCS and MeSH descriptors.

Results: Most of the studies were published between 2012 and 2015. Of 29 articles published, 11 (40.7%) dealt with sociodemographic factors, 9 (33.3%) with environmental risks, 3 (11.1%) with behavioral factors, 2 (7.4%) with prenatal or coverage controls and 2 (7.4%) were interrelated with other risk factors.

Conclusion: Most of the studies agree on the association of sociodemographic, biological and behavioral factors. Those studies that refer to the association of LBW with environmental risk factors are growing in strength.

Keywords: Infant Mortality; Risk Factors; Americas (MeSH).

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| Resumen |

Introducción. El bajo peso al nacer (BPN) es uno de los principales factores de riesgo que afecta la morbimortalidad infantil en todo el mundo; cerca de 1/3 de las muertes neonatales son atribuibles a este.

Objetivo. Revisar los artículos más relevantes sobre BPN en las Américas en el periodo de 2010-2016.

Materiales y métodos. Revisión narrativa de literatura. La información se obtuvo de las bases de datos PubMed, SciELO, LILACS, Portal Regional da BVS, con el uso de los descriptores DeCS y MeSH.

Resultados. La mayoría de los estudios fueron publicados entre el 2012 y el 2015. De los 27 artículos publicados, 11 (40.7%) fueron atribuidos a factores sociodemográficos, 9 (33.3%) a riesgos ambientales, 3 (11.1%) a factores conductuales, 2 (7.4%) a controles prenatales o por cobertura y 2 (7.4%) se interrelacionaban con otros factores de riesgo.

Conclusión. La mayoría de los estudios coinciden en la asociación de factores sociodemográficos, biológicos y conductuales. Los estudios que refieren la asociación de BPN con factores de riesgo ambientales están tomando fuerza.

Palabras clave: Mortalidad infantil; Factores de riesgo; Américas (DeCS).

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Introduction

Research on sexual and reproductive health in Latin America is increasingly numerous in topics such as health interventions for the prevention of maternal and neonatal morbidity and mortality, specifically, those that study the increase and decrease of fertility, the use of different birth control methods, the quality of prenatal care and the prevalence of institutional delivery in rural and urban areas in certain populations and samples. All these investigations show that women are vulnerable according to their socioeconomic or educational level, employment conditions and family configuration. (1)

The World Health Organization (WHO) considers that a newborn has low birth weight (LBW) if weight is below 2 500 grams, regardless of gestational age or any other etiology. (2) Children with LBW have 40 to 200 times greater risk of dying than children with adequate weight at birth. (3,4) In the Americas, a comparison can be made between the Latin American countries that have a LBW index of 8.6% and the United States, whose index is 0.5%. (5) Colombia is not the country with the highest LBW rate in Latin America, but it reached an index close to 8.5% in 2008. (1)

It should be noted that the State of the World's Children 2008, published by UNICEF, reported that around 20 million children worldwide are born each year with LBW, a figure that corresponds to 14.5% of all live births. (5,6) Furthermore, UNICEF found that LBW is more prevalent in developing countries because they do not measure the weight of more than half of newborns. (7)

In Colombia, the National Survey of Demography and Health (ENDS by its acronym in Spanish), conducted in 2010, reported that vulnerability to LBW is differential according to the place of occurrence of the births. For example, the risk is greater in departments like La Guajira, which do not achieve the national goal of reducing and meeting the Millennium Development Goals (MDGs). However, an improvement in the living conditions of the population and in social development opportunities was achieved (8), as deliveries took place in health facilities with a higher frequency: 88% in 2000, 92% in 2005 and 95% in 2010. (9,10) In consequence, conducting a narrative literature review on LBW in the Americas region during this decade is highly relevant.

Materials and methods

A narrative review of publications in health sciences about risk factors associated with LBW in the Americas was conducted. The research stages were: bibliographic search, data systematization, selection of articles and primary analysis, evaluation and final analysis.

During the first stage, information was collected from metasearch engines and digital databases including PubMed, SciELO, LILACS, VHL Regional Portal using DeCS (Descriptors in Health Sciences), MeSH (Medical Subject Headings) and Tripdatabase descriptors. Connectors "and" and "or", among others, were used. Likewise, a direct bibliographical search was carried out in multiple chapters of specialized texts as a complementary activity. The search was delimited as follows:

Time frame: 2010-2016.
Languages: English, Spanish and Portuguese.
Type of design: empirical studies without design limitations.
Document type: articles derived from research and review; therefore, gray literature, editorials, papers, communications and opinion articles were excluded.

Upon searching the databases, potentially selected studies were obtained and a total of 82 were retrieved. Titles, abstracts and full texts were independently examined, using the eligibility criteria specified, excluding 44 that did not have any relation to the subject of interest. Also, 11 articles were excluded because they did not deal with risk factors associated with LBW. Finally, 27 article type documents (11) were obtained as shown in Figure 1.

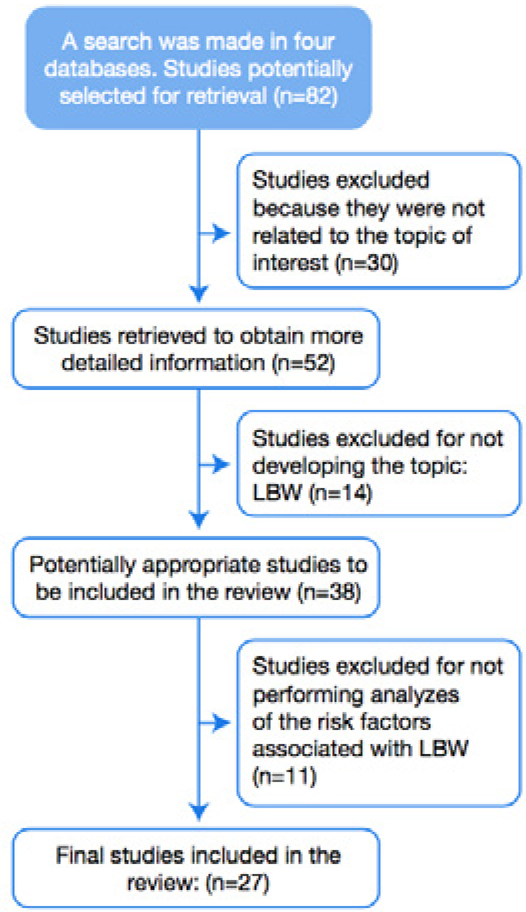

Figure 1. Flow diagram of the study. Selection process of the studies.
Source: Own elaboration based on the data obtained in the study.

Once the search was completed, the second stage of information systematization was carried out, during which matrices that contained objectives, author, country, methodology and results were elaborated. These matrices would facilitate the third phase: bibliometric and methodological extraction and analysis of geographical location, year, language, designs used, service evaluated, selection of the sample and statistical analysis of the information. The fourth stage consisted of defining the articles to be included considering full-text retrieval and their consistency with the objective of the review.

Results

Of the selected studies (Tables 1 and 2), 88% were published between 2012 and 2015 (Table 3). The country with the highest number of publications is the United States with 12 (44.4%), followed by Brazil with eight (29.6%). Regarding language, most articles were published in English with 15 (51.72%), followed by Portuguese with eight (29.6%).

Table 1. Methodology used by the studies found.

Author, year	Design	Instrument	Sample	Source population and country	Statistical analysis
Da Fonseca *et al.* (12) 2014	Cases and controls	Medical records and live birth certificates	1 720 newborns	Two groups of 860 newborns each in São Paulo, Brazil	Modified Kessner Index
Pinzón *et al.* (13) 2015	Cross-sectional	Demographic survey	10 692 children	Children born to women (aged 13 to 49) included in the National Demographic and Health Survey in Bogotá, Colombia	Binomial regression

Continues.

Author, year	Design	Instrument	Sample	Source population and country	Statistical analysis
McDermott, *et al.* (14) 2014	Cohort	Medicaid and newborn's record	9 920 women	Pregnant women and their newborns, low-income families from South Carolina, USA.	Multivariate analysis
Ebisu & Bell (15) 2012	Descriptive	Birth certificates	7 098 417 births in 419 counties	Birth certificate. National Center for Health Statistics in counties with data on PM components in Atlanta, Georgia. USA	Logistic regression
Laurent *et al.* (16) 2013	Cohort	Obstetric database of the hospital network	70 000 births	Births, hospital obstetric database of Los Angeles and Orange County, Southern California, USA.	Multivariate analysis
Ghosh *et al.*(17) 2012	Cohort	Digital birth certificates	1 745 754 registered births	Digital birth certificates issued in California to identify women who gave birth between January 1, 1995 and December 31, 2006	Logistic regression
Padula *et al.* (18) 2012	Cohort	California Department of Health Services in Sacramento	All live births	Live births from the four most populated counties in the San Joaquin Valley of California, USA	Attributable risk
Cândido *et al.* (19). 2014	Cohort	Information System on Live Births (SINASC by its acronym in Portuguese)	6 147 births	Single full-term live births from the cities of the State of Mato Grosso in the Brazilian Amazon	Logistic regression
Coker *et al.* (20) 2015	Cohort	Certificates provided by the Department of Health	1 356 304 births	Births in Los Angeles County, USA	Multivariate logistic regressions
Habermann & Gouveia (8) 2014	Cases and controls		11 589 live births	Newborns with LBW and 5 814 controls matched by sex and month of birth in São Paulo. Brazil.	Multiple logistic regression adjusted for birth
Lin & Scott. (21) 2012.	Cohort	Birth certificates, databases of the National Center for Health Statistics. Vital statistics for public use	1 374 875 term births	Term births among the seven states considered, New Jersey and New York, USA	Logistic regression to estimate the association
Guimarães *et al.* (22) 2013	Cross-sectional	Interview questionnaire	4 746 pairs of mothers and their babies	Mothers and their newborns from a birth cohort in Aracaju, northeastern Brazil	Multiple logistic regression
Ferreira-Veloso *et al.* (23) 2014	Cohort	SINASC	7 466 births	Newborns: 2 426 included in 1997/98 and 5 040 in 2010. In São Luís, northeastern Brazil.	Multiple logistic regression
Neggers &Crowe. (24) 2013.	Ecological	Medical records and literature	Pregnant women and newborns	Pregnant women and newborns in the USA and Cuba	Multivariate analysis
Pinzón-Villate *et al.* (1) 2013	Retrospective descriptive	Certificates of live birth available at the DANE database	Newborns in the DANE database	Live births in Colombia in 2005-2009	Logistic regression to determine associated predictors
Britto *et al.*(25) 2013	Cross-sectional	Structured questionnaire	2 972 children	2 226 mother-child pairs from 23 neighborhoods of Chabolas, Brazil were included	Logistic regression
Bragança *et al.* (26) 2012	Ecological	SINASC	149 165 live births	Children born in Rio Grande do Sul, Brazil	Multilevel logistic regression
Silva da Oliveira *et al.* (27) 2010	Ecological	SINASC, IPEA and IBGE	Live births	Live births in the 27 Brazilian States in 2009	Bivariate analysis
Herd *et al.* (28) 2015	Descriptive	Census data files	Live births	Single live births in 2000 to women residing in 805 zip codes of California. USA	Binomial regression
Wehby *et al.* (29) 2016	Descriptive	ECLAMC (Latin American Collaborative Study of Congenital Malformations) Website, epidemiological research and surveillance program for birth defects in South America	60 480 single live births	Newborns from 71 cities in eight South American countries: Brazil, Ecuador, Uruguay, Venezuela, Argentina, Bolivia, Chile and Colombia	Logistic regression
Nascimento *et al.* (30) 2013	Ecological exploratory	Database of the Municipal Health Secretariat of Taubaté. Declaration of live births	1 817 live births with LBW.	18 915 live births in Taubaté, São Paulo, Brazil.	Data were analyzed using the TerraView program (available in https://goo.gl/aqjUMU)
Von Ehrenstein *et al.* (31) 2014	Cases and controls	U.S. Census Bureau	Newborns	(n=1 498) nested within the birth cohort in 2003 (n=58 316) in the Los Angeles County, USA	Logistic regression analysis of single and multiple variables
Fulda *et al.* (32) 2014	Cross-sectional	Birth certificates, clinical records of the Texas Department of State Health Services Vital Statistics Bureau	145 054 births	Mothers from 145 054 births recorded in Tarrant County, USA	Simple and multiple logistic regression
Loggins-Clay & Andrade. (33) 2015	Descriptive	Reference surveys, study data: Fragile Family and Child Wellbeing	3 869 births	Mother and children with LBW in black and white women in the USA	Logistic regression
Sanches-Ranzani-da Silva. (34) 2012	Systematic review	PubMed, Lilacs, SciELO, institutional repositories	64 studies	Studies on LBW in Latin America	Qualitative through systematization and analysis
Xaverius *et al.* (35) 2014	Cohort	Fetal death and birth certificates	160 913 certificates	159 547 records of live births and 1 366 death records in St. Louis, USA.	Multivariate logistic regression
Dennis &.Mollborn. (36) 2013	Cohort	Survey	10 700 live births	Live births in the USA	Bivariate analysis

SINASC: Information System on Live Births; ECLAMC: Latin-American collaborative study of congenital malformations; PM: Particulate Matter; IPEA: Institute of Applied Economic Research; IBGE: Brazilian Institute of Geography and Statistics.
Source: Own elaboration based on the data obtained in the study.

Table 2. Institutions represented and number of authors.

Institution	No. Author	Institution	No. Author
Medical School of São Paulo State University, Botucatu Campus	1	School of Medicine and Health Sciences, Universidad del Rosario, Bogotá, Colombia	1
Department of Epidemiology and Biostatistics, School of Public Health, University of South Carolina, USA.	1	Yale School of Forestry and Environmental Studies, New Haven, Connecticut, USA	1
Public Health Program, University of California, Irvine, California, USA	1	National Institute of Environmental Health Sciences, California, USA	2
National School of Public Health of Brazil.	1	California Department of Public Health, USA	4
Department of Preventive Medicine, Faculty of Medicine, University of São Paulo, São Paulo, Brazil	1	Environmental Public Health Monitoring Program of the Centers for Disease Control and Prevention, Atlanta, USA	1
Department of Public Health of the Federal University of Maranhão, Rua	1	Department of Human Nutrition, Universidad Nacional de Colombia, Bogotá, Colombia	1
Federal University of Alagoas, Maceió, Brazil	2	Federal University of Santa Maria, Santa Maria, Brazil	1
Federal University of Rio Grande do Sul, Porto Alegre, Brazil	2	School of Public Health, University of California, California, USA UU	2
National Institute of Population Medical Genetics (INAGEMP), Rio de Janeiro, Brazil	1	Latin American Collaborative Study of Congenital Malformations (ECLAMC)	2
University of Iowa College of Public Health, USA	1	University of Taubaté (UNITAU), Taubaté, São Paulo, Brazil	3
UCLA Fielding School of Public Health, University of California, Los Angeles, USA	3	Department of Family Medicine, North Texas Primary Care Practice-Based Research Network (NorTex), Texas Prevention Institute, USA	1
Department of Sociology, Institute of Behavioral Sciences, Health and Society Program, University of Colorado Boulder, Colorado, USA	1	UNT Health Sciences Center, University of North Texas, Fort Worth, Texas, USA	3
University do Vale do Rio dos Sinos (UNISINOS), Sao Leopoldo, Brazil	1	Saint Louis University, College for Public Health and Social Justice, San Luis, USA	3
Lindenwood University, St. Charles, USA	1	School of Social Sciences, University of Texas of the Permian Basin, USA	1
Department of Sociology, Institute of Behavioral Sciences, Health and Society Program, University of Colorado Boulder, Colorado, USA	1		
Total authors	54		

Source: Own elaboration based on the data obtained in the study.

Table 3. Number of studies published per year included in the review.

Year	2010	2011	2012	2013	2014	2015	2016	Total
Articles	1	0	7	6	7	4	2	27

Source: Own elaboration based on the data obtained in the study.

Regarding the results, Table 4 shows that 11 of the 27 published articles (40.7%) dealt with sociodemographic factors, 9 (33.3%) with environmental risks, 3 (11.1%) with behavioral factors, 2 (7.4 %) with prenatal or coverage controls and 2 (7.4%) correlated to other risk factors.

Table 4. Classification of articles by risk factors.

Risk factor	Number of articles	Weight %
Coverage	2	7.4%
Environmental risk	9	33.3%
Behavioral factor	3	11.1%
Sociodemographic	11	40.7%
Mixed	2	7.4%

Source: Own elaboration based on the data obtained in the study.

It is noteworthy that nine articles (33.3%) conducted between 2011 and 2015 study the environmental risk related to LBW (21), for example, the association of water soluble metals such as copper and LBW. (37) An important finding in the United States is found in four counties of Connecticut and Massachusetts that reported the association of LBW with levels higher than 2.5PM of components such as aluminum, coal, nickel, silicon, vanadium and zinc. (38) These findings on risk factors in water reported that the probability of LBW is higher in Afro-descendant infants and mothers compared to white women. (15,20)

The increase of LBW and air pollution are associated, (16,19) as is the case of benzene in contaminated air which, in addition to contributing to LBW, can cause fetal growth restriction and complications during pregnancy. (17) Prenatal exposure to air pollution is related to habitats or workplaces near high traffic congestion areas such as highways, whose traffic increases pollutants. (18,39) Finally, the presence of arsenic in the soil near housing areas is associated with LBW as well (14).

Several studies report relevant information regarding sociodemographic risk factors. An ecological study carried out in the state of Rio Grande do Sul in Brazil established that mothers who have had less than seven prenatal checkups have 3.8 times the risk of LBW. (34) This finding has been reported in the medical literature for decades, where sociodemographic, ethnic, maternal, fetal and environmental conditions were already correlated to LBW. (40)

In this way, sociodemographic aspects and the health system itself are part of the specificities of prenatal care as a prevention strategy against LBW. However, in developing countries, it is often underestimated to such an extent that guidelines and strategies established in industrialized countries are used without hesitation. (13,12) Another sociodemographic risk factor refers to maternal age as a predisposing factor, since LBW as an outcome is higher in mothers older than 35 and under 20 years of age. (34,41) Likewise, mothers with low levels of education have a higher risk of LBW. (26)

Studies that seek statistical significance between ethnic groups in the Americas and LBW (42,28) show an association with LBW prevalence in women of African descent. (29) According to a study in Caucasian and Hispanic couples with African American parents, paternal origin is an important predictor of LBW. (33) Although LBW is etiologically multifactorial, race is taken as a causal variable. (31,32,35)

Similarly, low socioeconomic status and poverty take on greater relevance in research in South American countries. (22,43) Many of them consider health as the most precarious socioeconomic condition. (44) LBW is a condition influenced by many factors: He *et al.* (45) report that its incidence depends on the pregnant woman's occupation during pregnancy; Camacho (46) states that medical risks in pregnancy such as cesarean delivery increase its probability; Rodríguez-Dominguez *et al.* (41) point that congenital anomalies increase the risk of LBW more than three times; Neggers & Crowe (24) express that anemia increases its occurrence, and Britto *et al.* (25) state that the mother's gain or loss of weight may also have an influence.

Modifiable lifestyles, such as smoking during pregnancy, have been reported as behavioral risks that trigger a series of complications that lead to LBW. (23) However, abstinence syndrome leads to sudden infant death or fetal growth restriction. (37,47)

Finally, Silva de Oliveira *et al.* (27) state that regional inequalities in living conditions, especially in access to maternal and child health, contribute to the unequal distribution of neonatal mortality.

Conclusion

The aim of this review was to summarize the most relevant findings on risk factors associated with LBW in the Americas, despite the fact that eight "best-match" publications on LBW since 2012 (48-55) were not developed in this region. Although many of these countries met the goal of reducing the LBW by more than 95%, risk factors continue to be studied. The truth is that in Latin America there are countries that continue to maintain the incidence of LBW within the regional average due to deficient maternal nutrition, low socioeconomic status and associated maternal diseases. (56)

It is worth mentioning that one of the limitations to this study was the restriction to access to all indicators and databases. Therefore, selection and systematization depended on access to the database of the Fundación Universitaria del Area Andina (Andean Region University Foundation).

Regarding the multifactorial etiology of LBW, it has been reported that most of the selected studies have agreed, for years, in the association of sociodemographic, biological and behavioral factors. In addition, the studies that refer association of LBW with environmental risk factors, particularly during maternity, carried out between 2012 and 2016, are increasingly gaining importance. The most intriguing findings in the United States include exposure to microparticles in water and soil near the oil zones of California and Texas, and exposure to air pollutants in cities like New York.

In Latin America, it is striking to see that the Amazon region has been under research, since this area is subject to enormous extractive and polluting activities. This changes the target of public policies to reduce LBW and improve the conditions of pregnant women and children in the Americas region, especially in less developed countries and territories where abandonment, social inequalities and environmental exploitation activities are becoming more frequent.

Conflicts of interest

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