http://www.ijwhr.net

doi 10.15296/ijwhr.2018.40

Open Access Review

IJWHR

International Journal of Women's Health and Reproduction Sciences
Vol. 6, No. 3, July 2018, 233–239
ISSN 2330-4456

Prevalence of Low Birth Weight in Iranian Newborns: A Systematic Review and Meta-analysis

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Abstract

Objectives: Low birth weight (LBW) affects newborns' survival. It is also a credible sign of intra-uterine growth restriction and the most common health indicator for assessing neonates' health conditions. The present study was conducted to determine the prevalence of LBW in Iran.

Materials and Methods: In this meta-analysis, we reviewed studies conducted in Iran through literature search in electronic databases including SID, Magiran, Irandoc, Iranmedex, PubMed [including Medline], Scopus, Web of Science, and Google Scholar. 'Low birth weight' and its synonyms were searched as keywords in English and Farsi languages to retrieve articles published from 2000 to 2016. Lastly, 20 articles were included in this study after appraisal using the tool of Hoy et al. The findings of the included studies were combined using a random model. The heterogeneity of reported prevalence among articles was also evaluated by Q test and I^2 index. The data were analyzed by the STATA software.

Results: Total number of the samples was 43801 individuals. The prevalence of LBW was between 2.6%-18.9% in some Iranian studies. According to the random effects model, total prevalence of LBW in Iran was estimated 9% (95% CI, 7%-10%). Differences in prevalence of LBW in terms of year (b=-2 * 10-3, $P=0.154$) and sample size (b=-4.02 * 10-6, $P=0.317$) were not statistically significant.

Conclusions: Despite differences in the designs of the included studies, LBW had a high prevalence in Iran. Therefore, there is a need to adopt meticulous care policies during pregnancy. Further investigations on the risk factors of LBW are required to be conducted in different areas of Iran.

Keywords: Low birth weight, Prevalence, Iran, Meta-analysis

Introduction

Intrauterine development is a vulnerable period of a human's life. Infant's weight at birth is one of the important factors that affect the growth and development in future (1). Studies have shown that approximately 20 million children are born with LBW each year (2,3). In majority of the studies, definition is the same for LBW, that is, birth weight less than 2500 g (5). LBW is the second leading cause of neonatal death. Infants with LBW are 20 times more at the risk of death than normal weight infants (6). LBW leads to an increased economic burden on the healthcare system and is equal to one-third of the world's medical expenses (7). In addition to health-related issues such as the need for hospital care, infants with LBW are at the risk of chronic diseases and mental-physical disabilities compared with normal weight infants (8,9). Premature birth and intrauterine growth restriction (IUGR) are the important causes of LBW (2,3,10,11). Other factors affecting LBW are inadequate care and hard physical work during pregnancy, deprivation of family from social support, and malnutrition (12). The etiology of LBW is complex and several factors such as demographic factors, mother malnutrition, reproduction and socio-economic factors influence it (13). Moreover, infections, multiple pregnancies and pregnancy complications such as preeclampsia (2,3,10,11), maternal emotional distress, drug abuse, smoking, inadequate prenatal care and infertility are associated with LBW (14). One of the indicators of health in each country is the reduction of infant mortality. In this respect, one of the goals of Healthy People 2020 is the reduction of LBW to less than 5% (11).

LBW is associated with maternal health, prenatal care and socio-economic factors (15). The prevalence of LBW is different across the globe; for instance, in the USA during 13 years this prevalence increased about 0.5% (16). The higher rate of LBW has been reported in Asia and Africa (16% on average) (17,18). The prevalence of LBW in Iran was reported as 6.8% in Zanjan, 11.8% in Zahedan, 4.7% in Tehran, 6.3% in Ardabil and 8.8% in Yazd (19-23). Studies show an increasing trend in the prevalence of LBW from 1991 to 2010 (24). One of the goals of Healthy People 2020 is the reduction of the prevalence of LBW

Received 13 February 2017, **Accepted** 10 June 2017, **Available online** 5 July 2017

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to 5% (16). Given the significance of LBW in infants' morbidity, mortality and healthcare costs and a lack of meta-analysis studies in Iran, the aim of the present study was to determine the prevalence of LBW in Iran. The results of this study can be used for designing screening interventions for the prevention of LBW in community healthcare settings.

Materials and Methods

In this meta-analysis, Iranian studies published in national and international journals were reviewed and analyzed based on the Prisma's standards for reporting systematic reviews.

Inclusion and Exclusion Criteria

Inclusion criteria were observational and cohort studies on the prevalence of LBW. Therefore, review articles, case studies, abstracts, posters and letters to editor, repeated articles, case-control and intervention studies were excluded. Unrelated studies and studies conducted on specific groups such as mothers with chronic diseases, working mothers, specific age groups and the studies with different definition for LBW were also excluded. After selection of the studies based on the above-mentioned criteria, related articles were appraised by a checklist consisting of questions regarding title, year and place of studies, sampling method, sample size, design, and prevalence of LBW.

Search Strategy

Magiran, SID, Iranmedex, MEDLIB, Irandoc, PubMed [including Medline], Google scholar, Web of Science and Scopus were searched using the strategy of BOOLEAN and tag in accordance with each database in the titles, keywords and abstracts of articles. Iran, LBW and its synonyms on the MeSH ("Birth AND Premature", "Premature Births", "Preterm Birth", "Birth AND Preterm", "Preterm Births") were searched as keywords for retrieving articles published in English and Farsi languages from 2000 to 2016 (Table 1).

Selection of Studies

In the first and second steps of the search process, the titles and abstracts of articles were reviewed and irrelevant ones were excluded. In the third step, for choosing the most relevant articles, we selected those, for them full-texts were available. Two independent investigators (NSH and AFK) performed the analysis process described above. In case of any disagreement, the investigators held discussions to reach consensus.

Risk for Assessment Bias

Two independent investigators (NSH and AFK) performed a quality assessment of the eligible articles using the tool of Hoy et al (25) and resolved disagreements by consensus.

Data Extraction

Two independent investigators (RP and MD) selected relevant articles and extracted data regarding the study design, sampling method, research zone, aim and scope and participants (gestational age, sample size, and inclusion and exclusion criteria). Disagreements between the investigators were resolved by consensus.

Data Analysis

Binominal distribution was used for calculating variance of each study. We combined studies based on their sample size and variance. Due to the heterogeneity of the articles, the random effects model was used for combining them. Meta-regression was also used for assessing changes in the prevalence of LBW according to the publication dates of studies and sample size. The heterogeneity of the articles was assessed using the I2 index. The data was analyzed using the STATA 11 software.

The search process resulted in retrieving 2446 articles (Figure 1). After removing unrelated and duplicate articles, 60 articles were selected. The inclusion and exclusion criteria led to the deletion of 40 articles. Lastly, 20 articles were included for the data analysis.

Results

In this study, 17 studies had used a cross-sectional method (descriptive, cross-sectional and correlational) (22,26-39) and design of 3 articles was based on cohort studies (40-42) (Table 2). The total number of samples were 43801 people. Sharifirad et al (35) recruited the smallest sample size (n = 225) in Esfahan. On the other hand, Sobhi et al (37) reported a greater sample size (n = 7763) in Fariman.

The lowest and the highest prevalence of LBW were 2.6% and 18.9% in Zahedan and Tehran, respectively (32,36). The prevalence of LBW in 13 articles was shown as 2%-10%, (28,30-32,35,37-39,43). The prevalence higher than

Table 1. Strategy Used for Search in the PubMed [Including Medline]

Batch Search term
#1 Low Birth Weight on the MeSH
#2 Birth, Premature, "Births, Premature", "Premature Births", "Preterm Birth", "Birth, Preterm", "Births, Preterm", "Preterm Births"
#3 Combination #1 and #2: "Low Birth Weight" OR "Low-Birth-Weight Infant" OR (Infant AND "Low-Birth-Weight") OR "Low Birth Weight Infant" OR "Low-Birth-Weight Infant" OR ("Birth Weight" AND Low)
#4 Iran [tiab] OR Iran [PL] OR Iran [ad]
#5 Combination #3 and #5
("Low Birth Weight" OR "Low-Birth-Weight Infant" OR (Infant AND "Low-Birth-Weight") OR "Low Birth Weight Infant" OR "Low-Birth-Weight Infant" OR ("Birth Weight" AND Low)) AND (iran[tiab] OR iran[PL] OR iran[ad])
#6 Combination #5 AND 2000:2016[dp]

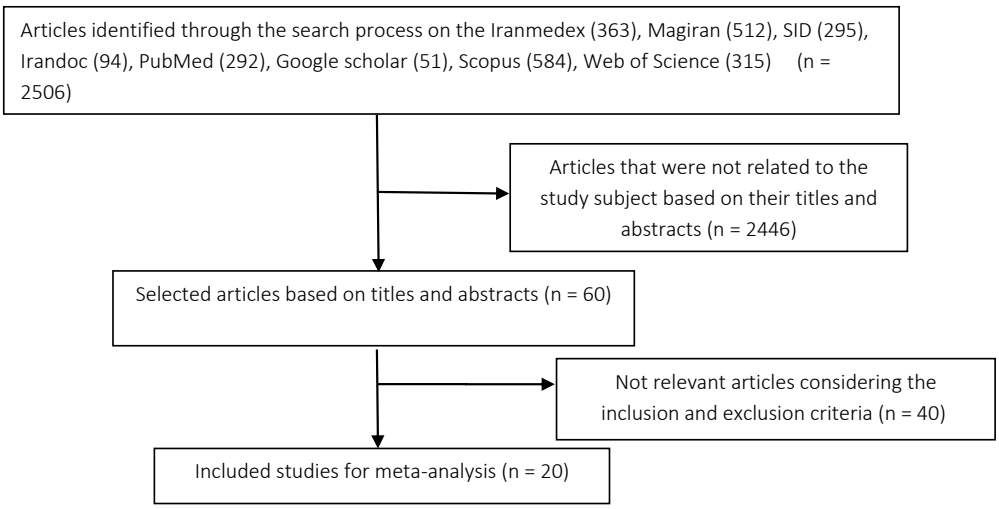

Figure 1. Different Phases of Search and Number of Retrieved Articles for Data Analysis.

10% was reported in 6 articles (22,29,34,36,41,44). The majority of articles (3 articles) were conducted in Tehran and showed the prevalence of 3.5%-18.9% (33,34, 36). Based on the random effects model, the pooled prevalence of this outcome was 9% in Iran (95% CI, 7%-10%).

According to Q test, the results showed a high heterogeneity between the reported prevalence (I^2 = 94%, $P<0.001$). Thus, the random effects model was used for the meta-analysis (Figure 2). Figure 2 shows the prevalence of LBW by year.

Based on the meta-regression figures, the prevalence of LBW decreased by an increase in year and sample size. The difference was not statistically significant ($P>0.05$) (Figures 3 and 4; Table 3).

Discussion

Slow growth and lack of support can increase health risks throughout life and reduce the power of functional perceptions during adulthood (45,46). A healthy lifestyle is considered a functional priority for each child (47). The most important factor which can influence infants' survival is LBW. It is also an important health indicator in each country (48). According to this study, the prevalence of LBW varied from 2.6% to 18.9% in different cities of Iran. The lowest prevalence and the highest prevalence were reported in the study of Khojasteh et al in Zahedan (32) and the study of Sharifzadeh et al in Tehran (36), respectively. The overall prevalence of LBW was about 9% (CI 95%, 7%-10%). In general, LBW occurred in 15%-20% or in 20 million annual births across the world. A

Table 2. Characteristics of Included Articles

Author	Location	Design	Sample Size (n)	Prevalence (%)	CI
Khojaste et al(32)	Zahedan	Cross sectional	227	2.6	0.05-4.7
Bahrami et al(26)	Ghazvin	Cross sectional	3076	6.67	5.8-7.6
Sobhi et al(37)	Fariman	Cross sectional	7763	6.1	5.6-6.6
Gojani et al(30)	Rafsanjan	Cross sectional	5925	7	6.4-7.6
Chaman et al(43)	Shahrood	Cross sectional	1000	7.2	5.6-8.8
Sharifi Rad et al(35)	Esfahan	Cross sectional	205	7.11	3.8-10.5
Sharif Zadeh et al(36)	Tehran	Cross sectional	396	18.9	15-22.8
Moghadam Banaem et al(33)	Tehran	Cross sectional	344	3.5	1.6-5.4
Jafari et al(42)	Zanjan	Cohort	4510	6.8	6.1-7.5
Delaram et al(28)	Hamedan	Cross sectional	5102	8.5	7.7-9.3
Hoseini et al (41)	Shemiran	Cohort	610	11.7	9.1-14.3
Vaghari et al (38)	Gorgan	Cross sectional	2881	9.8	8.7-10.9
Delvarian Zadeh et al (40)	Shahrood	Cohort	424	13	9.8-16.2
Rodbari et al (22)	Zahedan	Cross sectional	1109	11.8	9.9-13.7
Nojomi et al (34)	Tehran	Cross sectional	403	13.6	10.3-16.9
Faramarzi et al(29)	Babol	Cross sectional	3275	11.2	10.1-12.3
Hoseini et al (31)	Tonekabon	Cross sectional	2016	4.2	3.3.5-1
Zahed Pasha et al(39)	Babol	Cross sectional	2228	9.67.7	6.6-8.8
Karimian et al (44)	Ghom	Cross sectional	1927	11.8	10.4-13.2
Dabaghi et al(27)	Sabzevar	Cross sectional	360	8.6	5.7-11.5

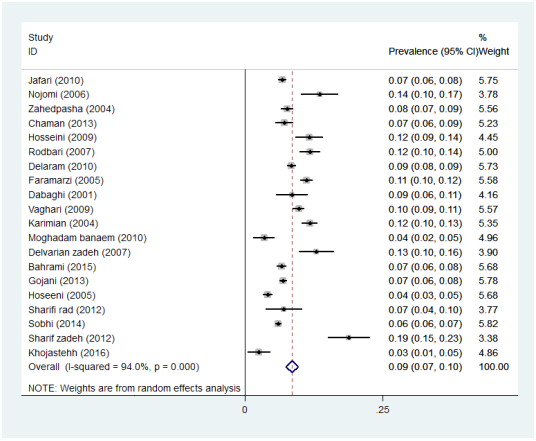

Figure 2. Prevalence of LBW Based on Author's Name, Year of Publication, OR and 95% CI.

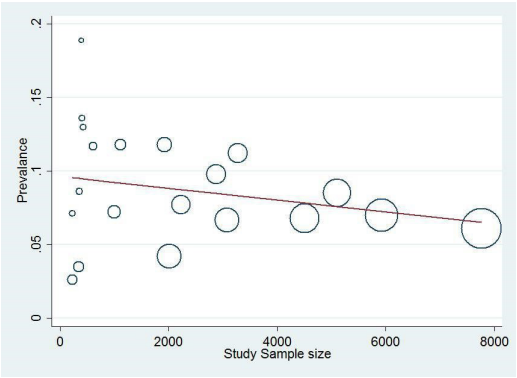

Figure 3. Meta-regression Graph for the Prevalence of LBW Based on the Study Sample Size.

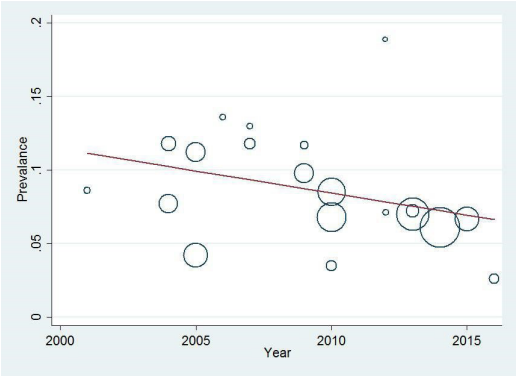

Figure 4. Meta-regression Graph of the Prevalence of LBW Based on the Study Year.

and that few databases were searched (52). As mentioned earlier, premature birth and IUGR or a combination of them were mentioned as the primary causes for LBW (2,3,,10,,11). As a result, problems such as hypoglycemia, respiratory distress syndrome (RDS), instable body temperature, hyperbilirubinemia, apnea, intraventricular hemorrhage (IVH), long-term stay in the nursing ward and the need for care in the NICU threaten infants' health

Table 3. Meta-regression Coefficient Between the Prevalence of LBW and the Sample Size and Year of Publication

Variable	Meta-regression Coefficient	SE	*P*
Sample size of the study	-4.02 * 10 -6	3.91 * 10-6	0.317
Year of publication	-2 * 10 -3	-2 * 10-3	0.154

30% decrease in the incidence of LBW until 2025 is an international aim of healthcare systems. This rate shows 3% of decrease in LBW per year from 2012 to 2025 indicating an actual reduction of 14 to 20 million cases of LBW (49). According to studies, the prevalence of LBW was reported differently (50). It was also 5.7% in Spain, 6.6% in Syria, 6.2% in Thailand, and 2.8% in the United Kingdom (51). The prevalence of this outcome in the study of Karimiyan et al was 11.8%, but in the results of the present study, the correct prevalence ranged from 10.4% to 13.3%. A low maternal age (under 18 years) affected the incidence of LBW. This prevalence is interpreted as high compared to other countries and even different regions of Iran and need attention by healthcare policy-makers (44). The prevalence of LBW varies in different regions due to the quality of healthcare, various sample sizes, and the influential socio-economic and cultural conditions in different regions of Iran. The results of similar studies confirm the findings of this study. Unlike many studies conducted regarding LBW in some provinces including Tehran, Khorasan Razavi, Semnan, Isfahan, Chaharmahal and Bakhtiari, West Azarbaijan, Gilan and Yazd, a correct image of the prevalence of LBW is unavailable in other provinces. Therefore, there is a need for similar studies with similar designs to draw a comprehensive image of LBW.

In this study, the total sample size was 43 801 people with 94% heterogeneity in the prevalence of LBW. The random effects model was used to analyze the collected data. In this model, it was assumed that variations in the observed differences were related to sampling methods. In the reviewed studies, the weight less than 2500 grams was considered LBW and maternal chronic diseases led to the exclusion of studies. The lowest prevalence for LBW was 2.6% and belonged to the study of Khojasteh et al in Zahedan (32). However, the study by Roudbari et al in Zahedan showed the prevalence of LBW as 11.8% due to variations in sample sizes (22). Additionally, such differences in the results of other studies were related to heterogeneity in sample sizes and some other factors affecting LBW which were not assessed in the present study. In general, the overall prevalence of this outcome was reported 9% which showed high prevalence of this major pregnancy outcome in Iran. Moreover, the study of Nazari et al reported the prevalence of LBW as 7% (95%CI, 6.7%-7.10%). The statistical analysis revealed a high heterogeneity and stability (Q = 2505.12, $P < 0.001$ and $I^2 = 99.5\%$). However, inclusion criteria and definition of the target population for LBW were not determined

compared to full-term infants or those with appropriate gestational age (AGA) (53-55). In addition, LBW infants may also be exposed to growth failure and the increased risk of morbidity and mortality at early ages (56). LBW is responsible for 2.8%-8% of neonatal mortality rates especially among infants with weight between 1500 and 1999 g (17). Furthermore, the risk of chronic diseases in the LBW infants will increase in adulthood (56).

The goal of Healthy People 2020 is the decrease of the incidence of LBW to less than 5% (16) and the prevention and management of LBW in the society, which requires a coordination between different sectors of reproductive healthcare services from family planning to postnatal care for pregnant women by skilled healthcare staff (57, 58). For example, the relationship between the pregnancy interval and LBW was shown in many studies as the interval between two pregnancies was reduced and the probability of LBW was increased (59-61). Conde-Agudelo et al conducted a meta-analysis and reported if the interval between pregnancies would be shorter than 6 months, it could increase the risk of LBW compared with those births with 18-23 months interval. Those women who used family planning services were less at the risk of LBW infants compared to the women without access to such services (61).

Maternal folic acid blood level is associated with LBW in such a way that folic acid supplements reduce the incidence of LBW (62). A balance between the consumption of protein-energy supplements is one of the most important interventions that prevent perinatal complications such as LBW and IUGR (63). Disorders related to blood pressure increase maternal mortality and enhance the risk of IUGR about 2.7 times (64). Calcium supplements during pregnancy reduce the risk of blood pressure disorders followed by its related complications (65-67). Despite limitations and gaps in the studies, adequate knowledge is available to recommend strategies for reducing LBW especially in developing countries. Preventable factors are appropriate reproductive healthcare interventions such as the time-interval between pregnancies, self-care education, prenatal care, education on the healthy lifestyle with an emphasis on healthy nutrition and the use of essential supplements, prevention of diseases, taking necessary and timely actions and childbirth in appropriate labor centers and postpartum care. A relatively high prevalence of LBW in Iran calls for complementary studies with more sample sizes and evaluation of all influential confounding factors for an accurate estimate of LBW. Prospective studies from the beginning of pregnancy until the end of childbirth are required to collect more accurate information on LBW. Appropriate interventions are required to achieve a prevalence of LBW less than 5% based on the aim of Healthy People 2020.

Conclusions

Data of the present study revealed that LBW is widespread and prevalent in Iran. It is a maternal and child health problem, and is seen more often in large cities like Tehran. However, publication bias cannot be overlooked. Furthermore, various factors can affect the prevalence of the problem. Well-designed studies are required to investigate the predisposing factors to LBW in different parts of Iran. The results of the present study can also be used to encourage people to increase prenatal care and balance lifestyle through the education of healthcare providers and mothers. It is also required to adopt meticulous care policies during pregnancy.

Conflict of Interests

Authors declare that they have no conflict of interests.

Ethical Issues

This paper was derived from a research project approved by Research Council of Shahid Beheshti University of Medical Sciences under the code of ethics IR.SBMU.PHNM.1395.524, on October 24, 2016.

Financial Support

Shahid Beheshti University of Medical Sciences supported the study.

Acknowledgments

The cooperation and technical assistance of research staff in Shahid Beheshti University of Medical Sciences are appreciated.

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