Low birth weight in Iran: Implications from a systematic review of the literature and meta-analysis in the period 1999-2017

Faezeh Ebadi1, Ahmad Ghashghaei1, Nicola Luigi Bragazzi2, Mariano Martini3, Razieh Sepehrian4, Mozghan sadat Ghaemmohamadi5, Sahar Sadat Saeedi Shahri1, Meysam Behzadifar5, Aidin Aryankhesal6, Masoud Behzadifar**

Abstract

Background: Low birth weight (LBW), a crucial determinant of neonatal complications, represents a major public health concern worldwide. Epidemiological research is of crucial importance for designing and implementing ad hoc interventions for this issue, helping and guiding decision- and policy-makers in each country to prevent the increased prevalence of LBW in infants through estimating the prevalence rate, identifying and controlling major risk factors. The present investigation aimed to systematically assess LBW prevalence rate in Iran and its determinants.

Methods: PubMed/Medline via Ovid, Embase, Web of Science and Scopus as well as Magiran, SID and Irandoc were searched from inception until November 2016. Also, the grey literature (via Google Scholar) was mined. The DerSimonian-Laird model was exploited. The I2 and Q-test tests were used to investigate heterogeneity between the studies. Sensitivity and subgroup analyses were performed to ensure the robustness and validity of our findings. Different cumulative meta-analyses were conducted stratifying according to the year of publication and sample size. Any potential bias in publication was assessed carrying out the Egger’s test.

Results: LBW prevalence rate was estimated to be 8% (95%CI: 7-9) in Iran. Sensitivity analysis confirmed the stability of finding. Studies were cumulated by the year of publication, and the results did not change pre- and post-cumulative meta-analysis. No publication bias could be observed.

Conclusion: LBW prevalence rate in Iran is well comparable with the prevalence figures of both developed and developing countries. This could be due to the health reforms implemented in Iran throughout the years.

Keywords: Low birth weight, Systematic review and meta-analysis, Iran


Introduction

Low birth weight (LBW), a major determinant of neonatal complications, is a crucial public health concern worldwide (1). About 18 million infants are affected by LBW annually (2). The World Health Organization (WHO) defines LBW when the weight of the newborn is less than 2.5 kg (3).

Further, LBW is among the important factors affecting long-term mental and physical development in children and represents a major determinant of infant mortality (4). LBW can be caused by maternal disorders, including endocrinological impairments, like metabolic syndrome and diabetes, malignancies, arthritis, chronic heart diseases,
stroke, hypertension, and dementia (5), among others. Poor diet, age, education level, lack of proper prenatal care, gravidity and parity, as well as economic and social status of pregnant women are among the foremost factors predicting a higher risk of LBW (6, 7).

Numerous researches have been carried out worldwide in order to assess the LBW prevalence rate, which has been computed to be 5-7% and 19% in economically developed and developing countries, respectively (8). Thus, significant differences can be observed in the prevalence rate of low LBW between these countries. Areas across the world with low socio-economic status and poor diet seem to have higher prevalence rate of LBW and, as a result, greater complications when compared to developed countries (9).

Epidemiological and clinical research is of crucial importance for designing and implementing ad hoc interventions for this issue, helping and guiding decision- and policy-makers in each country to prevent increased prevalence of LBW in infants through estimating the prevalence rate, identifying and controlling major risk factors. These mainly concern the social and economic status of the households (10).

In recent years, different researches have been performed to investigate LBW prevalence rate in various provinces in Iran. It is of utmost importance to examine LBW trend so that risk factors associated with it could be identified and possible ways to intervene to reduce it could be suggested. In addition, LBW is a crucial predictor of neonatal survival and development. For these reasons, we aimed at investigating LBW prevalence rate in Iran and its predictors and determinants.

Methods

Search methods

The results of the current investigation were reported according to the PRISMA items (11). Different databases/bibliographical thesauri (namely, PubMed/Medline via Ovid, Scopus, Embase, and Web of Science, as well as Magiran, SID and Irandoc) were searched from inception until April 2017. Also, the grey literature (via Google Scholar) was mined.

The search strategy included a proper string of keywords connected by adequate Boolean connectors, such as (“prevalence” OR “epidemiology” OR “frequency”) AND (“low birth weight” OR “LBW”) AND “Iran”. Wildcard option and medical subject headings (MeSH) terms where used when appropriate. Moreover, reference lists of national and international articles written in Persian and English and conferences related to the topic were examined.

Study selection

Inclusion criteria were: i) observational studies, and ii) studies reporting the prevalence rate of LBW in Iran. Exclusion criteria were: i) case-reports, case-series, letters to the editor, editorials, commentaries and review studies and ii) studies with poor quality data.

Data collection

Two authors independently extracted the data including first author, publication year, sample size, number of LBW cases (based on gender), maternal age, geographic area of study, type of study and prevalence rate reported. Any controversy was resolved by discussion or through consultation of a third person as a judge.

Quality assessment of studies

Methodology quality of the studies included in the current review was evaluated using the STROBE items (12). Based on the scores obtained from the checklist, the studies were scored between 1-8 (low quality), 9-16 (medium quality) and 16-24 (good quality). Any disagreement among the two reviewers of the studies was resolved with discussion until consensus was reached.

Statistical analysis

In this study, the DerSimonian-Laird (13) random model was exploited to determine the LBW prevalence rate. Results were reported with a confidence interval of 95% (95%CI). The I² and Q-test tests were used to investigate heterogeneity between the studies (14). In addition, in order to examine the source of heterogeneity, meta-regression analyses were carried out based on the publication year and sample size of included studies (15). Sensitivity and subgroup analyses were performed in order to ensure the robustness and validity of our findings (16). In particular, the subgroup analysis was performed based on the sample size, research geographic location, publication year, gender, study type, and study quality. Different cumulative meta-analyses were conducted based on the year of publication and sample size (17). Any potential bias in publication was assessed using the Egger’s test (18).

Data were analyzed using the open source R software (version 3.4.0). In this study, p<0.05 was considered as statistically significant.

Results

A total of 44 studies was finally selected for the present meta-analysis (19-62), as shown in the flow-chart in Fig. 1.

The main features of the selected researches are shown in Table 1. The total number of recruited participants was 178,209.

The overall prevalence of LBW

The overall prevalence rate of LBW was computed to be 8% (95%CI 7-9) in Iran. For further details, the reader is referred to Fig. 2.

The main findings of the subgroup analysis are reported in Table 2. Publication year, geographical location, quality of included studies and sample size resulted statistically significant (p=0.01).

Predictors and determinants of LBW in Iran

Table 3 highlights the main determinants and predictors/variables of LBW, on the basis of the findings of the present meta-analysis.
**Sensitivity analysis**

A sensitivity analysis was performed and the results did not change pre- and post-analysis (Fig. 3).

**Cumulative meta-analysis**

Studies were cumulated by the year of publication and the results did not change pre- and post-cumulative meta-

**Table 1.** The main features of studies selected in the present systematic review and meta-analysis.

<table>
<thead>
<tr>
<th>First author</th>
<th>Year</th>
<th>Sample size</th>
<th>Prevalence rate (%)</th>
<th>City</th>
<th>Male</th>
<th>Female</th>
<th>Age of mother (year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khoori</td>
<td>1999</td>
<td>2183</td>
<td>6.30%</td>
<td>Gorgan</td>
<td>63</td>
<td>74</td>
<td>NA</td>
</tr>
<tr>
<td>Shadzi</td>
<td>2000</td>
<td>848</td>
<td>5.90%</td>
<td>Esfahan</td>
<td>21</td>
<td>28</td>
<td>NA</td>
</tr>
<tr>
<td>Hajian</td>
<td>2000</td>
<td>1087</td>
<td>6.20%</td>
<td>Babol</td>
<td>25</td>
<td>42</td>
<td>NA</td>
</tr>
<tr>
<td>Amani</td>
<td>2000</td>
<td>876</td>
<td>7.30%</td>
<td>Ahvaz</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Esfani</td>
<td>2002</td>
<td>5121</td>
<td>7.97%</td>
<td>Yazd</td>
<td>186</td>
<td>271</td>
<td>NA</td>
</tr>
<tr>
<td>Moussafirani</td>
<td>2002</td>
<td>803</td>
<td>12%</td>
<td>Ghoochan</td>
<td>59</td>
<td>37</td>
<td>NA</td>
</tr>
<tr>
<td>Karimian</td>
<td>2003</td>
<td>1927</td>
<td>11.80%</td>
<td>Qom</td>
<td>105</td>
<td>110</td>
<td>NA</td>
</tr>
<tr>
<td>Mosayebi</td>
<td>2004</td>
<td>10187</td>
<td>7.05%</td>
<td>Tehran</td>
<td>344</td>
<td>371</td>
<td>NA</td>
</tr>
<tr>
<td>Zahedpasha</td>
<td>2004</td>
<td>2228</td>
<td>7.70%</td>
<td>Babol</td>
<td>66</td>
<td>104</td>
<td>NA</td>
</tr>
<tr>
<td>Hoseini</td>
<td>2005</td>
<td>2016</td>
<td>4.20%</td>
<td>Tonekabon</td>
<td>41</td>
<td>44</td>
<td>NA</td>
</tr>
<tr>
<td>Oskouie</td>
<td>2005</td>
<td>1000</td>
<td>14.70%</td>
<td>Tehran</td>
<td>NA</td>
<td>NA</td>
<td>20-24</td>
</tr>
<tr>
<td>Adlshoar</td>
<td>2005</td>
<td>2500</td>
<td>5.20%</td>
<td>Rasht</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Ramezanali</td>
<td>2006</td>
<td>1419</td>
<td>9.09%</td>
<td>Tehran</td>
<td>NA</td>
<td>NA</td>
<td>26.08±4.96</td>
</tr>
<tr>
<td>Delaram</td>
<td>2006</td>
<td>600</td>
<td>7.30%</td>
<td>Shahrekord</td>
<td>NA</td>
<td>NA</td>
<td>24.7±4.6</td>
</tr>
<tr>
<td>Eghbalian</td>
<td>2007</td>
<td>1500</td>
<td>19.10%</td>
<td>Hamedan</td>
<td>148</td>
<td>138</td>
<td>24.15±5.91</td>
</tr>
<tr>
<td>Toootoonchi</td>
<td>2007</td>
<td>909</td>
<td>8.60%</td>
<td>Tehran</td>
<td>39</td>
<td>37</td>
<td>20-35</td>
</tr>
<tr>
<td>Minalimi</td>
<td>2007</td>
<td>813</td>
<td>17.70%</td>
<td>Tehran</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Rafiee</td>
<td>2007</td>
<td>4022</td>
<td>9.10%</td>
<td>Arak</td>
<td>161</td>
<td>205</td>
<td>NA</td>
</tr>
<tr>
<td>Taheri</td>
<td>2007</td>
<td>2558</td>
<td>7.90%</td>
<td>Birjand</td>
<td>88</td>
<td>114</td>
<td>26.09±5.6</td>
</tr>
<tr>
<td>Roudbari</td>
<td>2007</td>
<td>1109</td>
<td>11.81%</td>
<td>Zahedan</td>
<td>65</td>
<td>66</td>
<td>NA</td>
</tr>
</tbody>
</table>
The main findings of the meta-regressions

Table 4 reports the findings of the meta-regression analyses, which are pictorially shown in Fig. 5 based on the sample size (Fig. 5A) and on the year of publication (Fig. 5B).

Publication bias

The results of the Egger’s test (p=0.1927) are shown in Fig. 6. No publication bias could be observed.
Discussion

LBW significantly affects the physical and mental development of children, as well as their survival. LBW can, indeed, cause serious infant morbidity and mortality.

We aimed to investigate LBW prevalence rate in Iran, which was computed to be 8% (95%CI 7-9). This figure is well comparable with the prevalence rates of LBW in other countries, reported in Table 5 (2, 63-72). This could be due to the advancements and progresses achieved by the Iranian National Health System.

In the investigations selected in the present systematic review and meta-analysis, several risk factors have been highlighted, the most important of which were maternal age, education level, occupation, smoking status, gravidity and parity, birth rank, and type of delivery. The risk factors observed in these studies were consistent with those reported in the studies carried out worldwide (64, 68, 70, 72).

As previously mentioned, maternal age is among the most critical risk factors for LBW. Several studies showed that infants born from younger women (10-19 years) compared to older women were more likely to suffer from LBW (73-75).

Another critical risk factor is given by a low maternal education level (76-78). Mahmoodi et al. found that LBW in pregnant women with low literacy levels was three times higher than in women with higher education (79).

Other studies have underlined the role of birth rank, showing a higher risk of LBW during the first pregnancy, when compared to subsequent pregnancies. Factors such as economic status, education level and weight during pregnancy could play a role (80). Also, the type of delivery could influence the prevalence rate of LBW, with studies revealing higher LBW rates in women undergoing cesarean delivery. However, this finding is controversial, in that in other studies, the risk for LBW was reported to be higher among women undergoing cesarean delivery (67).

Employment of pregnant women in hard, tiring and stressful jobs is among the factors affecting LBW, preterm delivery and fetal death (81). Workplace condition is also an important predictor of pregnancy- and delivery-related outcomes. Various studies indicated that the type of job, as well as working conditions, might lead to LBW (82-85).

In addition, smoking has dangerous side effects for pregnant women. Any type of smoking during pregnancy could lead to LBW, respiratory problems, mental and learning impairment, birth defects, premature births and even infant death (86-89).

Table 2. Subgroup analyses carried out in the present meta-analysis.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Number of studies</th>
<th>Number of participants</th>
<th>Prevalence rate (%) [95%CI]</th>
<th>I²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publication year</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤2008</td>
<td>25</td>
<td>58558</td>
<td>8% [7-10]</td>
<td>96%</td>
</tr>
<tr>
<td>&gt;2008</td>
<td>19</td>
<td>119651</td>
<td>7% [7-9]</td>
<td>97%</td>
</tr>
<tr>
<td>Geographical location</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Center</td>
<td>18</td>
<td>61401</td>
<td>8% [8-10]</td>
<td>94%</td>
</tr>
<tr>
<td>East</td>
<td>9</td>
<td>69442</td>
<td>10% [8-13]</td>
<td>97%</td>
</tr>
<tr>
<td>North</td>
<td>10</td>
<td>16647</td>
<td>5% [4-7]</td>
<td>94%</td>
</tr>
<tr>
<td>West</td>
<td>6</td>
<td>29843</td>
<td>8% [6-12]</td>
<td>99%</td>
</tr>
<tr>
<td>South</td>
<td>1</td>
<td>876</td>
<td>7% [6-9]</td>
<td>-</td>
</tr>
<tr>
<td>Quality of included studies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>25</td>
<td>137187</td>
<td>9% [8-9]</td>
<td>96%</td>
</tr>
<tr>
<td>Medium</td>
<td>10</td>
<td>34676</td>
<td>6% [7-10]</td>
<td>98%</td>
</tr>
<tr>
<td>Low</td>
<td>9</td>
<td>6346</td>
<td>6% [4-9]</td>
<td>98%</td>
</tr>
<tr>
<td>Sample size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤2000</td>
<td>19</td>
<td>15311</td>
<td>9% [7-11]</td>
<td>96%</td>
</tr>
<tr>
<td>&gt;2000</td>
<td>25</td>
<td>162898</td>
<td>7% [7-8]</td>
<td>96%</td>
</tr>
</tbody>
</table>

Table 3. Risk factors for low birth weight highlighted in the studies included in the present meta-analysis.

| Socio-demographic variables of the mother | Gynecological/obstetric variables of the mother | Gravidity and parity, rank of delivery, a history of abortion, preeclampsia, previous LBW newborns, previous episodes of bleeding or spotting, unwanted pregnancies, twinning or multiple births | Clinical variables of the mother | Nutritional status, smoking status, insufficient care during pregnancy, underlying disease (including diabetes and metabolic syndrome, hypertension, cardiovascular disease, urinary tract infections, pulmonary disease, kidney disease, anemia), use of ferrous sulfate and other supplements during pregnancy, history of drug use | Socio-demographic variables of newborns | Gender | Other variables | Air pollution |

Table 4. Meta-regressions based on the sample size and publication year.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Estimate</th>
<th>Standard error</th>
<th>Z-val</th>
<th>p-value</th>
<th>Lower 95%CI</th>
<th>Upper 95%CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year of publication</td>
<td>-0.0025</td>
<td>0.0109</td>
<td>-0.2264</td>
<td>0.8209</td>
<td>-0.0239</td>
<td>0.0190</td>
</tr>
<tr>
<td>Sample size</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.1231</td>
<td>0.9020</td>
<td>-0.0000</td>
<td>0.0000</td>
</tr>
</tbody>
</table>
Comparative studies on LBW carried out in different provinces of Iran revealed that different climatic conditions, cultural variation, and socioeconomic conditions can have a great impact on increased LBW rate. Iran is, indeed, a vast country and living conditions may vary in different regions of the nation (72, 90). LBW prevalence rate was higher in large provinces of Iran including Tehran, Razavi Khorasan, South Khorasan, Sistan-Baluchestan, and Qom. With high population density in these areas, pregnant women may face difficulties in receiving adequate prenatal care. Such prevalence may be increased due to urban-related issues, such as air pollution.
and stress, among others. The impact of air pollutants such as SO₂, NO₂, PM2.5, and PM10 on pregnant women is remarkable (87, 91, 92).

Concerning the gender of newborns, the results of our investigation failed to reveal any gender-based differences in LBW prevalence rate. The findings are in line with in-
investigations performed in countries such as Turkey and China (66, 93).

We could not detect any significant association between LBW rate in Iran and sample size as well as between LBW prevalence and year of publication.

Our meta-analysis is not free from limitations, and several shortcomings should be recognized. First, there is a dearth of studies focusing on LBW rate for some provinces of Iran. In addition, the heterogeneity rate (97%) was high and statistically significant. Another limitation was that 11.4% of studies were of low quality.

Conclusion

The prevalence of LBW was estimated to be 8% in Iran, a rate comparable with other countries, both developed and developing. This could be due to the health reforms implemented in Iran throughout the years. Also, risk factors for LBW are in line with the extant literature. However, due to the limitations of the current meta-analysis further research is warranted.

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Conflict of Interests

The authors declare that they have no competing interests.

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