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

Faezeh Ebadi[1], Ahmad Ghashghaee[1], Nicola Luigi Bragazzi[2], Mariano Martini[3], Razieh Sepehrian[4], Mozhgan sadat Ghaemmohamadi[1], Sahar Sadat Saeedi Shahri[1], Meysam Behzadifar[5], Aidin Aryankhesal[4], Masoud Behzadifar*[6]

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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

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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,

Corresponding author: Dr Masoud Behzadifar, masoudbehzadifar@gmail.com

1. Student Research Committee, Department of Health Services Management, School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran.
2. School of Public Health, Department of Health Sciences (DISSAL), University of Genoa, Genoa, Italy.
3. Section of History of Medicine and Ethics, Department of Health Sciences (DISSAL), University of Genoa, Genoa, Italy.
4. Department of Health Services Management, School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran.
5. Department of Epidemiology, Faculty of Health and Nutrition, Lorestan University of Medical Sciences, Khorramabad, Iran.
6. Health Management and Economics Research Center, Iran University of Medical Sciences, Tehran, Iran.

↑What is "already known" in this topic:
Low birth weight (LBW) is a major determinant of neonatal complications as well as of mental and physical development in children. About 18 million infants are affected by LBW annually.

→What this article adds:
This study aimed at determining LBW prevalence rate in Iran by performing a systematic review and meta-analysis. LBW prevalence rate was estimated to be 8% (95%CI: 7-9], 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.

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stroke, hypertension, and dementia (5), among others. Poor diet, age, educatio n 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 I^2 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.

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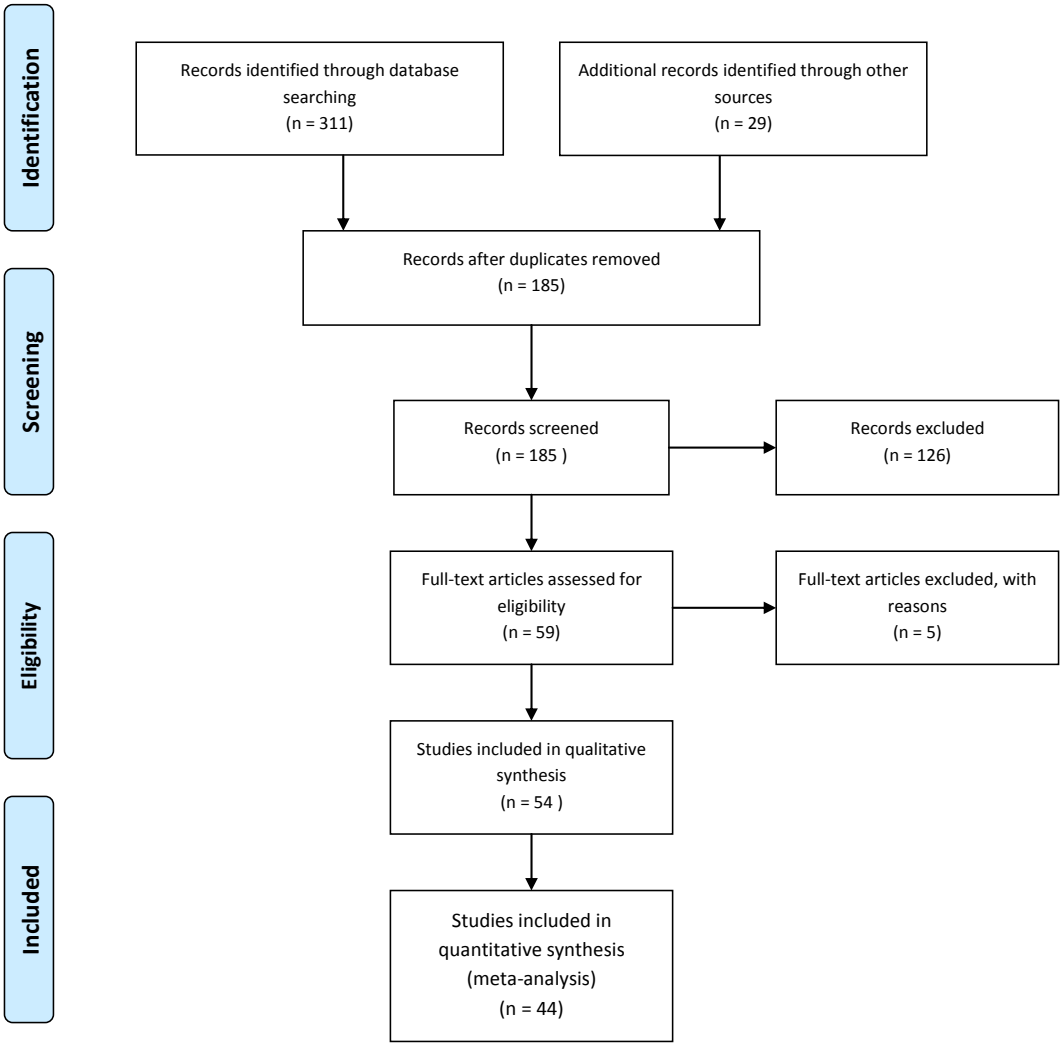

Fig. 1. Flow-chart of the present meta-analysis, carried out according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines.

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.

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

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Table 1. Cntd

Vahdaninia	2008	3734	5.20%	Tehran	NA	NA	25.7±5.3
Golestsn	2008	6016	8.40%	Yazd	NA	NA	NA
Delaram	2008	5102	8.50%	Shahrekord	187	247	NA
Veghari	2008	704	11.10%	Gorgan	NA	NA	26.1
Rafiei	2008	10211	9%	Arak	456	465	NA
Mirzarahimi	2009	7353	6.40%	Ardabil	226	244	NA
Moghaddam	2010	344	3.50%	Tehran	NA	NA	27.02±5.3
Talebian	2010	910	9.50%	Esfahan	NA	NA	NA
Tabatabaei	2010	2050	7.70%	Tehran	61	64	NA
Mohammadi	2011	400	2%	Noor	NA	NA	26.2±5.5
Golestsn	2011	5897	8.80%	Yazd	269	249	NA
Fadakar	2012	1177	7.10%	Rasht	30	53	NA
Mirzarahimi	2013	6832	6.30%	Ardabil	NA	NA	NA
Khorshidi	2013	3792	2.90%	NA	53	55	NA
Chaman	2013	1000	7.20%	Shahrood	NA	NA	NA
Alizadeh	2014	560	4.10%	Rasht	NA	NA	NA
Esmaeili	2014	800	14.90%	Mashhad	NA	NA	26.32±5.21
Rezaeian	2014	5532	7.10%	Rafsanjan	172	194	27.84±5.31
Ranjbaran	2015	461	6.70%	Arak	12	19	27.38± 5.55
Saberi	2015	504	25.80%	Mashhad	NA	NA	27.8±5.3
Judipour	2015	1712	9.30%	Zabol-Zahak-Hirmand	94	65	NA
Safari	2016	683	4.70%	Garmsar	15	17	27.8 ±1.3
Fallah	2016	8456	6.80%	Zanjan	NA	NA	27.1±5.4
Momeni	2017	60273	9.4%	Kerman	2370	2844	NA

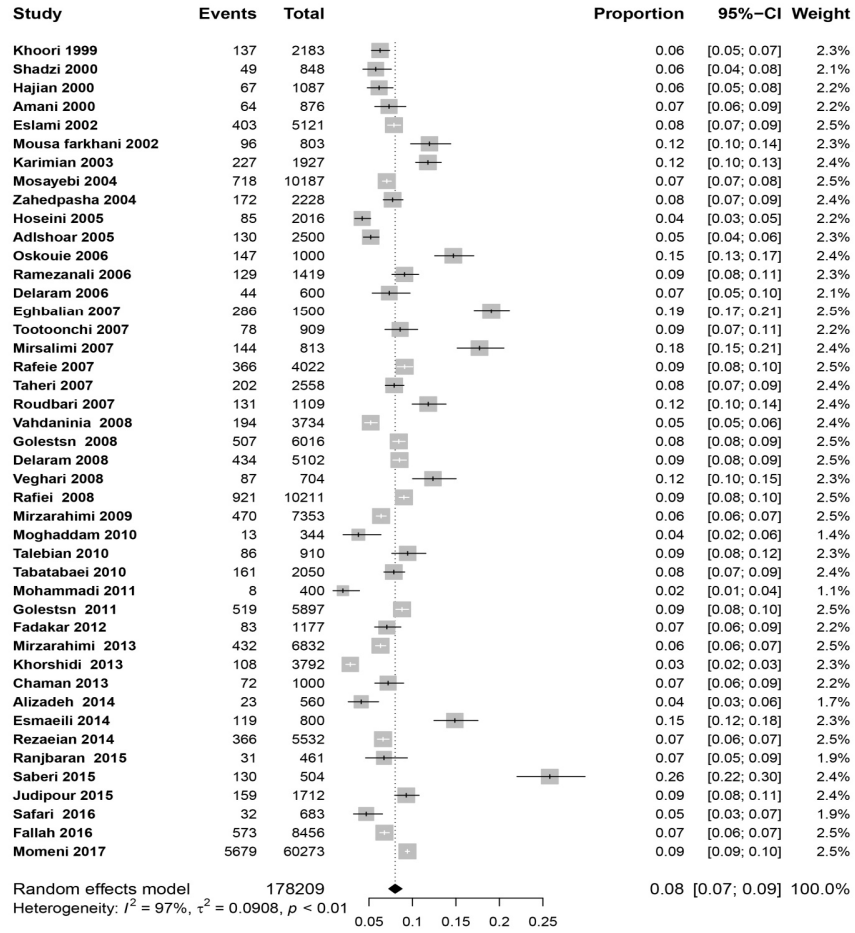

Fig. 2. The overall prevalence rate of low birth weight in Iran.

analysis (Fig. 4).

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.

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

Variables	Number of studies	Number of participants	Prevalence rate (%) [95%CI]	I^2	
Publication year					
≤2008	25	58558	8% [7-10]	96%	0.01
>2008	19	119651	7% [7-9]	97%	0.01
Geographical location					
Center	18	61401	8% [8-10]	94%	0.01
East	9	69442	10% [8-13]	97%	0.01
North	10	16647	5% [4-7]	94%	0.01
West	6	29843	8% [6-12]	99%	0.01
South	1	876	7% [6-9]	-	-
Quality of included studies					
Good	25	137187	9% [8-9]	96%	0.01
Medium	10	34676	6% [7-10]	98%	0.01
Low	9	6346	6% [4-9]	98%	0.01
Sample size					
≤2000	19	15311	9% [7-11]	96%	0.01
>2000	25	162898	7% [7-8]	96%	0.01

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

Socio-demographic variables of the mother
Age, ethnicity, education level, socioeconomic level of the household, job, place of living (urban versus rural)
Gynecological/obstetric variables of the mother
Gravidity and parity, rank of pregnancy, type of delivery, a history of abortion, preeclampsia, previous LBW newborns, previous episodes of bleeding or spotting, unwanted pregnancies, twining 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.

Variables	Estimate	Standard error	Z-val	p-value	Lower 95%CI	Upper 95%CI
Year of publication	-0.0025	0.0109	-0.2264	0.8209	-0.0239	0.0190
Sample size	0.000	0.000	0.1231	0.9020	-0.000	0.000

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).

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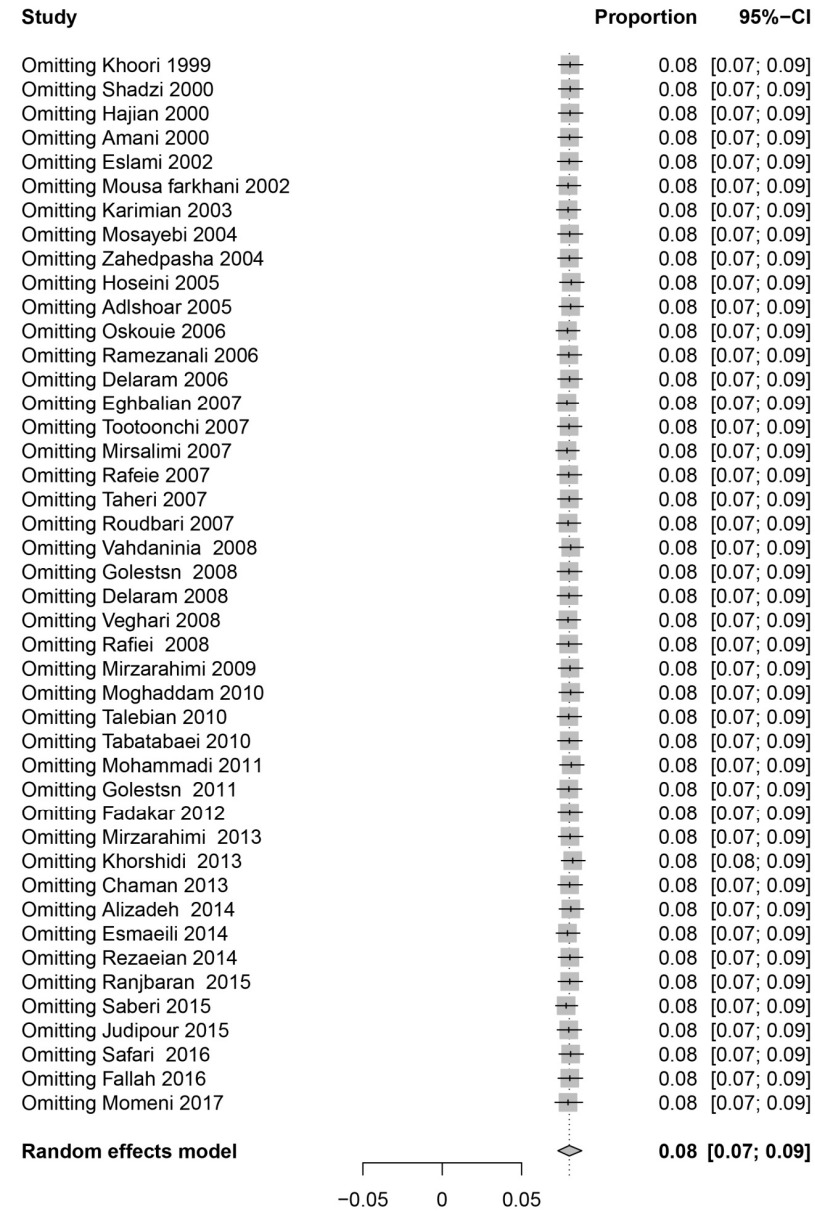

Fig. 3. Sensitivity analysis

Table 5. Prevalence rate of low birth weight reported in other countries

Author	Country	Prevalence rate (%)
Badshah	Pakistan	9.9%
Suzuki	Japan	7.4%
Takai	Nigeria	16.9%
Assefa	Ethiopia	28.3%
Akin	Turkey	10.61%
Nobile	Italy	11.8%
Daring	USA	8.2%
Bell	England	7.8%
Chen	China	6.1%
Bharati	India	19.3%
Islam	Oman	9%

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

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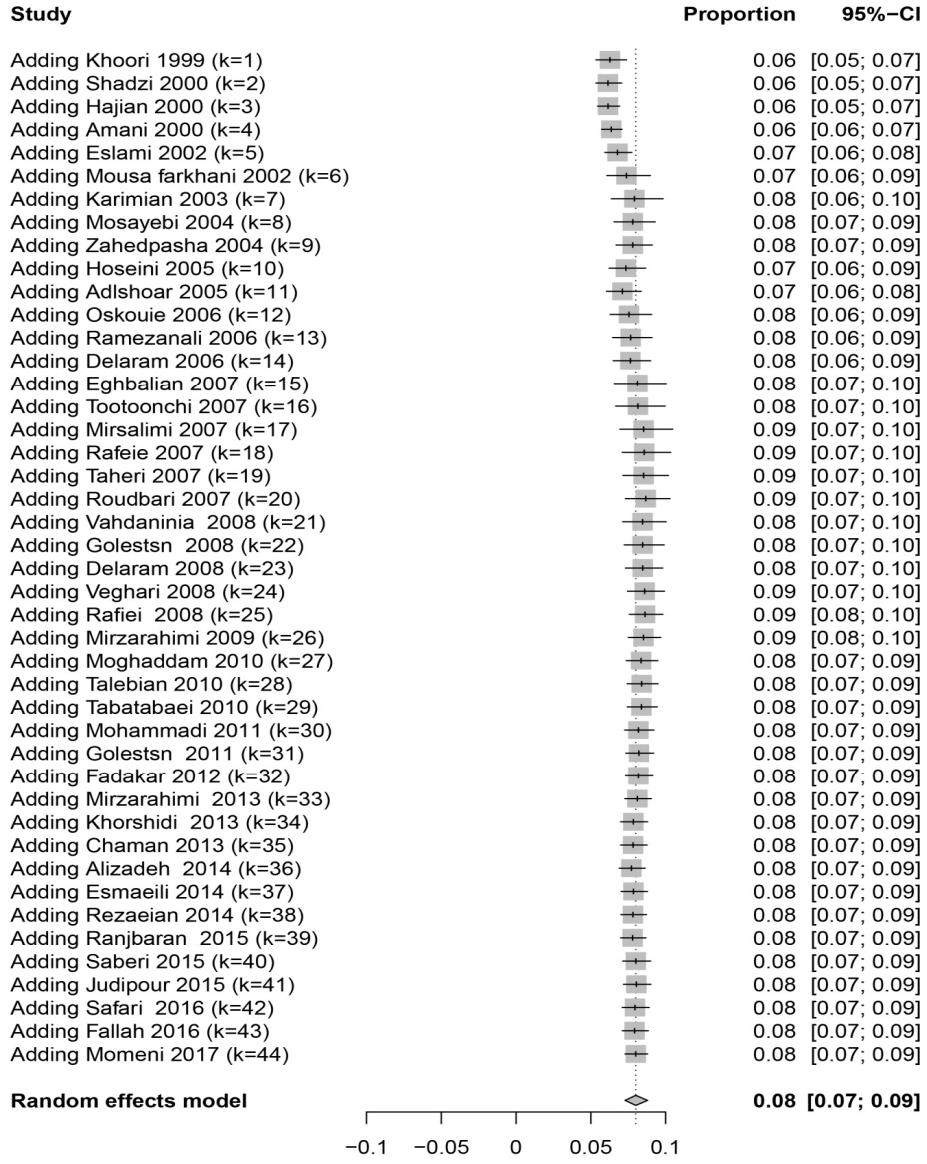

Fig. 4. Cumulative meta-analysis

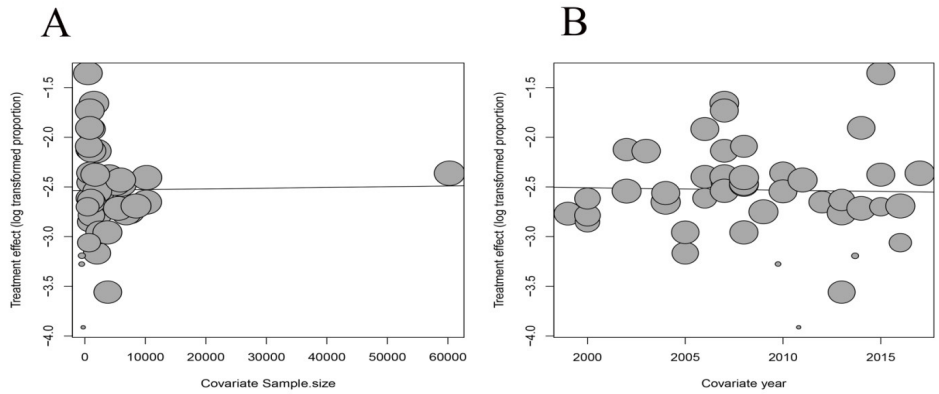

Fig. 5. Association between LBW by sample size (A) and year of publication (B)

and stress, among others. The impact of air pollutants such as SO_2, NO_2, 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-

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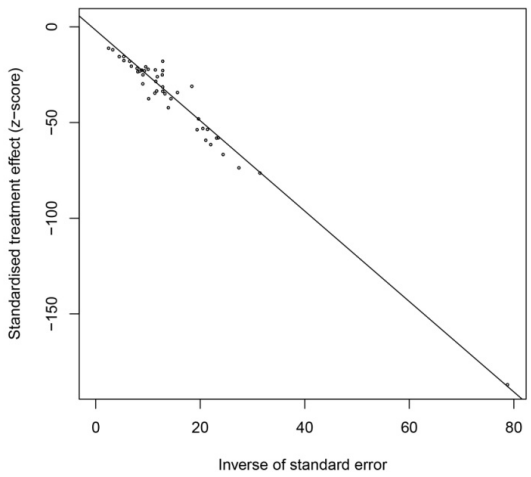

Fig. 6. Egger's test of publication bias

vestigations 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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