Review Article

Prevalence of Iron Deficiency Anemia among Iranian Pregnant Women; a Systematic Review and Meta-analysis

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Abstract

Introduction: Anemia, particularly Iron Deficiency Anemia (IDA), is the most common hematological disorder during pregnancy with considerable complications in both mothers and fetuses. The estimation of anemia prevalence is an important step for health policy makers. Despite being considered a hot topic in epidemiological studies in Iran for the last twenty years, lack of a comprehensive overview on the findings encouraged the authors to carry out this study.

Materials and Methods: All published papers in main national and international databases were systematically searched for some specific keywords to find the related studies between the years 1993 and 2007. All published studies which had reported the prevalence of anemia were included in the study except studies on refugees, patients undergoing hemodialysis, patients with thalassemia or cancer or other selective sub-populations. Two trained reviewers independently assessed the inclusion/exclusion criteria and the quality of the selected papers, summarized them and eventually analyzed the data.

Results: Ten eligible papers including 11,037 participants were entered into the analysis. The maximum and minimum reported prevalence rates of anemia during pregnancy were 4.3% and 21.5%, respectively. The overall estimate of anemia prevalence in Iranian pregnant women was 13.6 (95% CI: 8.3 - 18.9). Excluding the only out-layer from the meta-analysis, the overall estimated prevalence was 12.4% (95% CI: 9.6% - 17.9%).

Conclusion: The prevalence of anemia in Iranian women during pregnancy is considerably lower than that of most EMRO countries or the one reported by WHO for Iran (> 40%) which had been performed on a small group 16 years ago. The lower prevalence rate of anemia in pregnant women versus the regional rates could be due to the improvements of the national health system and prenatal programs in recent years.

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Introduction

Anemia is defined as decreased hemoglobin level, or circulating red blood cells and it is the most common hematological disorder during pregnancy. Inadequate intake or absorption of iron in conjunction with blood loss during pregnancy may contribute to anemia. Iron deficiency and

consequent anemia during pregnancy could be associated with severe complications like increased risks of maternal mortality and morbidity, premature delivery, and low birth weight. Thus, routine screening tests for anemia are recommended in pregnant women (1, 2).

Iron deficiency (IDA) is the most common and primary cause of anemia. IDA prevalence indicates the nutritional status of a community. Considering the effects of IDA on maternal and fetal mortalities, physical function and child growth and development, it is regarded as one of the main health indicators (3).

There were some limited small to intermediate-scale epidemiological studies that have estimated the prevalence of anemia in Iran. The largest survey on the prevalence of maternal anemia in Iran had been performed by Safavi et al. in 11 provinces in 2001. In this study, the researchers reported a 21.5% prevalence rate for anemia in Iranian pregnant women (4). At another study performed in Bandar-Abas in southern parts of Iran, reported the prevalence to be 17.5% in the same year (5). In Zahedan, an eastern province in Iran, the prevalence of anemia among pregnant women was 12.9% (6). While two other studies carried out in Tehran, Iran's capital, in 2002 and 2003 respectively reported 14.9% and 8.6% for anemia prevalence in pregnant women (7, 8). Although the differences among the reported prevalence rates in the studies might be due to variations in the main characteristics of their target population, methodological differences such as laboratory tests and the anemia definitions have to be considered as other important issues (9).

Studies in eastern neighboring countries of Iran, have reported a 90-percent prevalence for anemia during pregnancy (10). Iron deficiency anemia during pregnancy was reported 80% in India where 16% percent of maternal mortalities have been related to anemia (11). On the other hand, the World Health Organization (WHO) has reported the prevalence of anemia in pregnant women of Eastern Mediterranean countries to be 44.2%. In this report, the prevalence of anemia in Iranian pregnant women was surprisingly more than 40% (3).

Employing systematic reviews and meta-analyses for the identification and analysis of findings from observational studies, one will synthesize research results that are needed by health care professionals and policy makers and provide them with important information on epidemiological indicators (e.g. prevalence rates, incidence rates, etc) (9, 12). Additionally, in meta-analysis sample size is increased as the studies are combined, resulting in a better statistical power. Meta-analysis can also explore the observed heterogeneity among the results of individual studies (9, 12, 13).

Lack of precise and reliable information on the prevalence of anemia among Iranian pregnant women, in conjunction with the considerable differences between results and the published reports from neighboring countries, necessitated a more comprehensive study on the subject to sum up the available findings in the literature.

Materials and Methods

Search Strategy: To find relevant studies, we searched Medline through PubMed and Scopus for publications between the years 1994 and 2008. In addition, Scientific Information Database, (SID) and IranMedex for related Persian keywords with all probable word combinations were searched too. In order to maximize the sensitivity of the search, general keywords such as “anemia” OR “Hemoglobin” AND (“prevalence” OR “frequency”) AND “pregnancy” plus “Iran” were co-searched. Moreover, bibliographies of identified studies were screened for additional relevant studies.

Selection Criteria and Quality Assessment: Two reviewers independently reviewed all the resultant titles and abstracts for the disease. The full-texts of all relevant articles were then assessed by either reviewer. Studies were independently selected for inclusion and were included in the study if they were original and provided estimates of prevalence of “anemia” in pregnant women using World Health Organization (WHO) criterion for anemia (Hb < 11 *g/dl*) in both English and Persian languages.

Studies were excluded if they were not primary studies (such as review articles). We also excluded studies that were not representative of the general population, i.e., studies conducted on specific subgroups, for example in medically ill patients, refugees or prisoners. In addition, studies

with non-random sampling or with small samples (less than 200 individuals) were excluded. Discrepancies between reviewers were resolved by consensus.

In the next step, reviewers used a standard quality assessment checklist which had 11 questions about the main methodological aspects of descriptive studies, such as the sampling method, measurement of variables, objectives and statistical analysis. Only papers with a minimum score of eight out of eleven were selected. Any disagreement between two reviewers was assessed by a third reviewer.

Data Extraction: The bibliographic data, methodological information, including the age of the pregnant women, the prevalence of anemia and concentration of Hb and Ferritin were extracted from the papers. In one of the papers that the prevalence of anemia had not been reported, we estimated the prevalence based on the reported mean and standard deviation of Hb by normal distribution assumptions.

Statistical Analysis: The variance of anemia prevalence in each study was computed based on the binomial distribution formula. Having used heterogeneity test (Cochran Q), we found significant variations between the study findings. Hence, we used a random effect model for the estimations. In addition, in order to minimize the random variation between point estimations of the studies, we adjusted all findings of the studies using Bayesian analysis.

Having described the findings in forest plots, the point estimations and their 95% confidence intervals (CIs) were computed accordingly. In the aforesaid graph, the size of squares presents the weight of each study which had positive association with the sample size; lines in both sides of the squares reflect the 95% confidence interval of the reported prevalence risks. In the next step, we used meta-regression to check the effect of the study dates as a probable source of heterogeneity. All the statistical calculations were computed using STATA, ver.10, software.

Results

Having assessed the quality of the full-texts of potentially relevant studies, 19 studies with a total of 11,037 individuals were included in the present systematic review. The detailed information of the included studies has been shown in Table 1.

The minimum prevalence rates of anemia had been reported in two studies: Hamedan (4.8%), situated in western parts of Iran and with a sample size of 378 and Fars (4.1%), a province in central Iran with a sample size of 3371. The highest prevalence rates of anemia in pregnant women had been reported in Varamin (26%), a city near Tehran, and Bandar-Abbas (17.5%), a major city in southern Iran.

The overall estimation for prevalence of anemia in Iranian pregnant women was 13.59% (95% CI: 8.3 – 19.0). The findings in this category also had substantial heterogeneity ($\tau^2 = 98.7$).

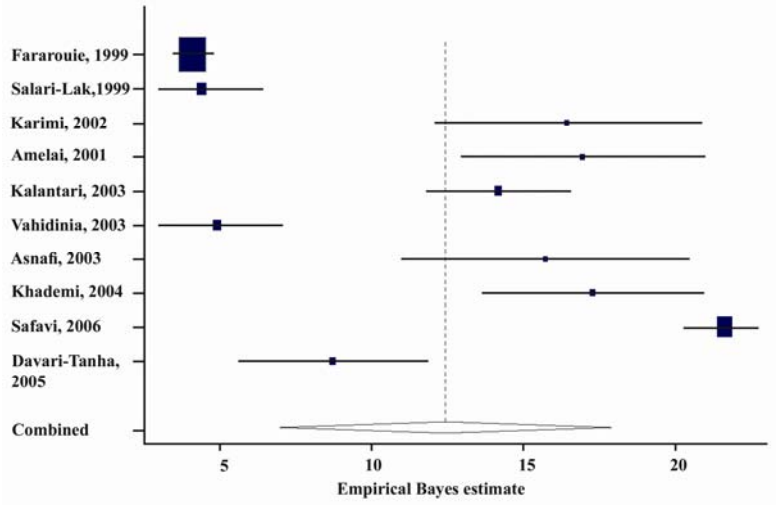

Figure 1. The reported prevalence of anemia in different studies, and the overall estimated prevalence in Iran. The horizontal lines define the reported 95% confidence interval for the prevalence in each study, and the diamond below the graph shows the pooled prevalence.

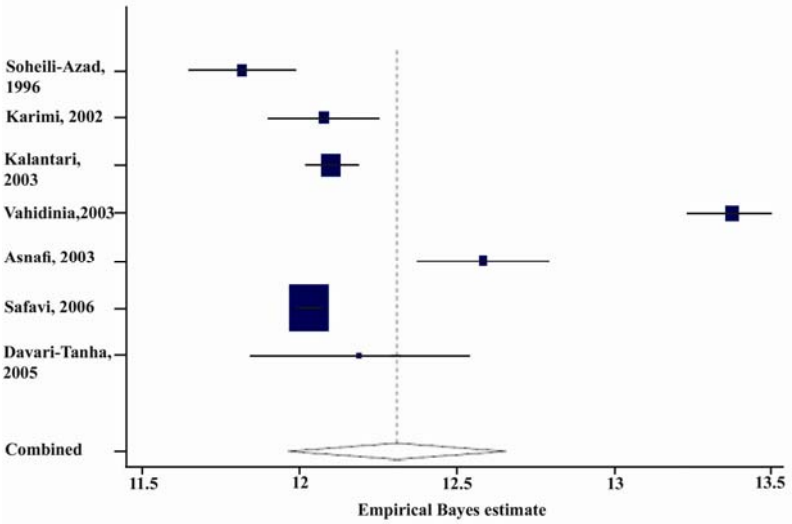

Figure 2. The average hemoglobin concentration in Iranian pregnant women. The horizontal lines define the reported 95% confidence interval in each study, and the diamond below the graph shows the pooled average.

Reviewing the findings, the only out-layer data (the one with more than two standard deviation difference from the overall estimated prevalence (14)), that of Varamin, was excluded and the findings of the remaining studies were re-analyzed. The estimated prevalence of anemia in pregnant women excluding the out-layer data was 12.4% (95% CI: 6.9 – 17.9; $\tau^2 = 98.7$); Figure 1.

The estimated prevalence of anemia during pregnancy in urban areas using random effect model was 10.75% (95% CI: 6.2 – 15.3) and in mixed urban/ rural samples the estimated prevalence was 14.74% (95% CI: 3.2 – 26.3). The findings of both categories had considerable heterogeneity and the difference was not statistically significant (τ^2 = 93.7, and 99.5, respectively).

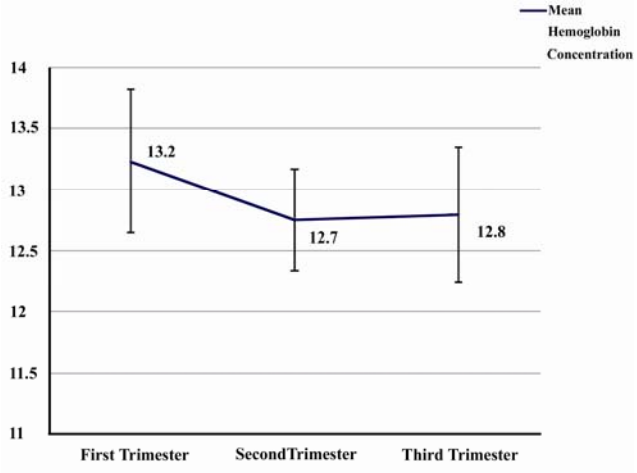

Figure 3. Mean hemoglobin concentration in pregnancy period. Error bar shows the 95% confidence interval.

Out of 19 studies, only seven papers had reported a mean for hemoglobin concentration. Based on these studies, the overall estimation for hemoglobin level was 12.31 *g/dl* (95% CI: 12.0 – 12.7); Figure 2. The mean hemoglobin concentration in the first, second and third trimesters were 13.23, 12.75 and 12.79 *g/dl*, respectively with no statistically significant differences (Figure 3).

The prevalence of iron deficiency anemia and low ferritin concentration in pregnant women is shown in Table 1. Since the definitions of iron deficiency differed in the aforementioned studies, meta-analysis techniques were not performed to estimate the prevalence of the disease.

The highest prevalence rate of iron deficiency anemia in pregnant women had been reported (50.9% and a ferritin threshold level more than 15 *ng/dl*) in a survey carried out in Isfahan and the lowest (12% with a normal ferritin level above 12 *ng/dl*) in a study in Hamedan. Combining the results of only four studies, the pooled mean for serum ferritin level in Iranian pregnant women was 32.23 *ng/dl* (95% CI: 18.9 – 45.6).

The meta-regression model showed that neither the study date nor the publication date of the included studies could explain the significant variations in the findings (p = 0.614); although the highest prevalence rate had been reported in the oldest study (29).

Table 1. Detailed characteristics of 19 articles included in the systematic review on the prevalence of anemia during pregnancy in Iran

Place of study (source)	Time of study	Place of sampling	Sample size	Hb cut-off point *(gr/dl)*	prevalence of anemia	Ferritin cut-off point for IDA *(ng/dl)*	Prevalence of iron deficiency	Mean serum ferritin
Orumie (27)•	1998	Urban	400	11	4.3	--	13.8	--
Eslam-shahr (28)•	2004	Urban	266	11	--	--	--	--
Isfahan (29)•	1999	Urban	799	11	14.2	15	50.9	19.9
Babol (30)•	2000	--	214	10.5 ••	9.4	--	--	--
Babol (31)	2004	--	871	10.5	6.4	--	--	--
Bandar-abbas (5)•	2001	Both	401	11	17.5	10	37.3	--
Tehran (32)	1995	--	417	--	--	--	34.8	--
Tehran (7)	2002	Urban	970	12	14.9	--	--	--
Tehran (8)	2003	Urban	302	--	8.6	--	--	--
Tehran (33)	2004	Urban	308	--	--	--	--	--
Zahedan (6)	2003	Urban	287	10.5	12.9	12	42.2	--
Semnan (34)	1999	Urban	691	--	16.9	--	--	--
Shiraz (35)•	1999	Urban	263	11	16.7	--	28.5	24.9
Shiraz (36)	2002	Urban	2000	10.5	9	--	--	--
Fars province (37)•	1996	Both	3371	11	4.1	--	--	--
Kermanshah (38)•	1999	Urban	326	11	17.2	12	25.8	--
Varamin (39)•	1993	--	251	11	26.1	--	--	--
Hamedan (40)•	2000	Urban	378	11	4.8	--	--	--
Several regions of Iran (4)•	2001	Both	4368	11	21.5	12	11.2	41.7

- If the date of a study had not been mentioned, it was calculated by reducing the average difference between the date of the performed research and the date of publication.

∗ included studies into meta-analysis

∗∗ The prevalence of Hb < 11 *gr/dl* is calculated by means of mean hemoglobin concentration and its standard deviation.

Discussion

In this study, we tried to estimate the overall prevalence of iron deficiency anemia in Iranian pregnant women by reviewing the findings of available studies. The overall prevalence of anemia in Iranian pregnant women was 12.4%, which has a substantial difference with the reported estimation published by WHO based on a report with a small sample size (79 individuals) in 1994 – 1995 (3). Therefore, one should regard the WHO estimate with caution.

Although the findings of the included studies were heterogeneous, they could relatively cover all geographical areas of Iran. In this study, the estimated prevalence of anemia in urban pregnant women (10.8%) was less than that of the mixed urban and rural populations (14.7%).

Despite the fact that the above difference was

not statistically significant, we may conclude that lifestyle modifications and health care interventions in rural area have been of good results. Similarly, the overall prevalence of anemia in pregnant women was 58% with no significant differences between rural and urban populations in a study carried out in China (19).

In WHO categorization, the prevalence of anemia in ranges between 5% and 19.9% is considered as a minor health problem (3).

In our research, the highest research quality belonged to the study by Safavi et al. who had assessed the prevalence of anemia and iron deficiency in 11 different geographical areas of Iran in 2001. They had reported the prevalence of anemia and iron deficiency in Iran to be 21.5% and 42.7%, respectively. Based on that study, the highest (44%) prevalence rates had been seen in southern Kerman, southern Khorasan, and Sistan-Baluchestan, the three eastern provinces of Iran; and the lowest (9%) prevalence had been reported to be in Isfahan, Yazd, Kohkilooye-and-Boyerahmad, and northern Kerman, mostly central provinces of Iran (4). However, in the present review, we found some academic thesis and congress abstracts which estimated the prevalence of anemia as high as 40% (20), but they were excluded from our systematic review because of their low research quality or study in some target subgroups.

It seems that the differences in geographical areas, life style, and diet in different parts of Iran, to be the main reason for the wide spectrum of the reported results in various studies.

The prevalence of anemia in a region depends on numerous factors such as socio-economic status, iron intake, and prevalence of parasitic and infectious diseases (21-23). Moreover, the prevalence of anemia is higher in women in fertile years, due to menstrual bleeding and pregnancy. IDA is more challenging in developing countries, because of inadequate intake of iron and folic acid supplements and unhealthier diets (10, 24). However, it must be kept in mind that the populations in the included studies had been mostly the medical care seeking pregnant women who had attended health care centers, which routinely provide pregnant women with iron and folic acid supplements and the coverage of this program is very high in Iran. In addition, national nutritional programs for the fortification of flour with iron and folic acid may also help reduce the prevalence of anemia.

Based on our findings, it seems that Iranian pregnant women are in a better situation compared to the prevalence of anemia in pregnant women in the Eastern Mediterranean Region (EMRO). The prevalence of anemia in pregnant women in some of these countries are reported as follows: Bahrain 33%, Egypt 26%, Jordan 35%, and the United Arab Emirates 14% (25). Studies in India and Pakistan have reported the prevalence of anemia as high as 80% to 90% (10, 24). Lack of standard frameworks for evaluating anemia and poor reporting characteristics in published studies in this region seem to be another important issue. Therefore, use of a unified methodology and publishing format for these types of studies are recommended.

There were a few studies employing standard methods and criteria in Iran, but the absence of a national health care strategy for surveys on these subjects, create numerous challenges for planning and intervening in this field.

Promoting national health standards and reducing the rate of diseases and their mortality rates are some of the most important goals of health systems. Improvement of health indices in a community need interventions that are based on accurate analysis of risk factors and efficient markers (26).

Conclusion

Maternal anemia is an important public health problem, not only in the East Mediterranean Region but also in many other countries worldwide. The results of the present systematic review suggest that prevalence of anemia during pregnancy in Iran is less than what has been reported by WHO; however, there seems to be the need to implement programmes to reach an ideal state of the disease.

Regarding the increasing rate of research on different health issues and the varieties in their methods and results, it would be impossible to evaluate the present status or forecast the future prospects of any disease if directed and defined efforts such as secondary studies, amongst them systematic reviews, meta-analysis, and modeling studies, are not carried out. However, like primary

studies, these kinds of studies also have inevitable limits, biases, and misdirections. In order to get more accurate and reliable figures, uniform and standard methods and study designs are also recommended for primary studies at the national level.

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