Prevalence of Preeclampsia and Eclampsia in Iran: An Updated Systematic Review and Meta-Analysis

Abstract

Background: Preeclampsia is a major contributor to maternal morbidity and mortality. A previous systematic review was carried out in Iran in 2014. Due to the importance of this issue, a current evaluation is necessary after ten years. This research was performed to determine the prevalence of preeclampsia and eclampsia in Iran. **Materials and Methods:** Adhering to the PRISMA guideline, we searched English databases including Web of Science, PubMed, Scopus, and Persian databases including SID, Magiran, and IranMedex on August 20, 2023, to identify studies reporting the prevalence of preeclampsia or eclampsia in Iran. Employing a focused term strategy and eligibility criteria, we ultimately included 55 studies in this review. After conducting a thorough evaluation, the CMAV3 software was utilized to analyze the data using the random effects model and calculate pooled results. **Results:** The overall prevalence of preeclampsia among Iranian mothers was 5.3%, while eclampsia accounted for 0.1% of live births. Notably, preeclampsia rates have risen since 2015, whereas eclampsia rates have declined over time. Single-variable meta-regression results indicated a negative correlation between age and preeclampsia. **Conclusions:** Preeclampsia is increasing among Iranian mothers, requiring an investigation into its risk factors, including maternal age, and consequently, high-risk pregnancies. Conversely, the decreasing occurrence of eclampsia indicates an enhancement in the quality of care following a preeclampsia diagnosis.

Keywords: *Eclampsia, Iran, meta-analysis, preeclampsia, systematic review*

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Introduction

Pregnancy and childbirth may occasionally stray from the typical path, exchanging the happiness of motherhood for the hardship of maternal morbidities and potentially life-threatening situations.[1] This situation imposes significant psychological and social burdens on the mother due to the challenging physical conditions.[2] Given that hypertensive disorders are a leading cause of maternal and perinatal morbidity and mortality, it is crucial to explore improvements in care quality, particularly following the 2015 target and the achievement of the Millennium Development Goals.[3,4]

Preeclampsia and eclampsia contribute significantly to these challenges, characterized by high blood pressure after 20 weeks of pregnancy, elevated protein levels in urine, and potential organ damage.[5] Preeclampsia, in particular, is responsible for over 70,000 maternal deaths and 500,000 fetal deaths annually, making it a leading cause of morbidity and mortality.[6]

Globally, the estimated prevalence of preeclampsia is 4.6%,[7] ranging from 1.8% to 16.7% in developing countries.[8] A 2014 systematic review among Iranian pregnant women found an overall prevalence of 5% for preeclampsia and 0.23% for eclampsia, indicating a recent increase in preeclampsia cases.[9] Acknowledging the importance of updating information regarding preeclampsia and its influence on improving the maternal mortality rate, there is a need for a new systematic review and meta-analysis study. Hence, this review aims to evaluate the prevalence of preeclampsia and eclampsia in Iran in 2023.

Materials and Methods

A systematic review and meta-analysis were conducted on articles reporting the prevalence of preeclampsia or eclampsia in Iran. The studies were gathered from English databases such as Web of Science,

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PubMed, and Scopus, as well as Persian databases including SID, Magiran, and IranMedex. Additionally, we searched the Google Scholar database and reference lists of articles to ensure comprehensive coverage. The search utilized the following terms: ((prevalence OR incidence) AND ("hypertensive disorders of pregnancy" OR "gestational hypertension" OR preeclampsia OR eclampsia OR pregnancy complication) AND Iran)). All published articles up to August 20, 2023, were included in this review.

All descriptive, cross-sectional, prospective, or retrospective cohort studies meeting the standard definition or classification of preeclampsia or eclampsia in Iranian pregnancy or deliveries were included. Articles in English or Farsi with outcomes relevant to the study's purpose were considered. Chronic hypertension during pregnancy was excluded. Article characteristics including author, publication year, age, sampling location, study design, and sample size were listed in Table 1. Data extraction was performed using the PRISMA tool.

The protocol for this systematic review and meta-analysis was registered in PROSPERO (CRD42023447823). Additionally, the study received approval from the research council of Mashhad University of Medical Sciences.

The study selection process involved excluding duplicated studies after exporting retrieved studies to EndNote software. The retrieved studies were then assessed based on their title and abstract, and their full texts were reviewed to evaluate their quality before being selected for final analysis. The quality of the articles was evaluated using the Ottawa-Newcastle scale for observational studies, which examines sample selection processes (including sample size, non-response, and measurement tools), comparability (investigation of confounders and other influencing factors), and results (evaluation of results and statistical tests).[10] According to the Newcastle-Ottawa scale (NOS), articles are rated on a scale from 0 (weakest study) to 10 (strongest study). A higher score indicates better quality. Scores of 0–3, 4–6, and 7–10 are considered to represent low, moderate, and high quality, respectively. For this systematic review, articles of moderate and good quality were included. Three authors (SA, MSh, and MA) independently selected the studies for inclusion in the analysis, with any discrepancies resolved by TKh. Articles that did not provide data on preeclampsia and/or eclampsia, or had insufficient data to calculate prevalence, were excluded. The number of observed events was used to calculate the proportions.

Heterogeneity was assessed using I^2 and its corresponding p value (more than 50% indicating heterogeneity) and p value (less than one-tenth indicating the presence of heterogeneity). For results with statistically significant heterogeneity, a random effect model of analysis was used. Sensitivity analysis was performed to determine which study (if any) had the most impact on the heterogeneity

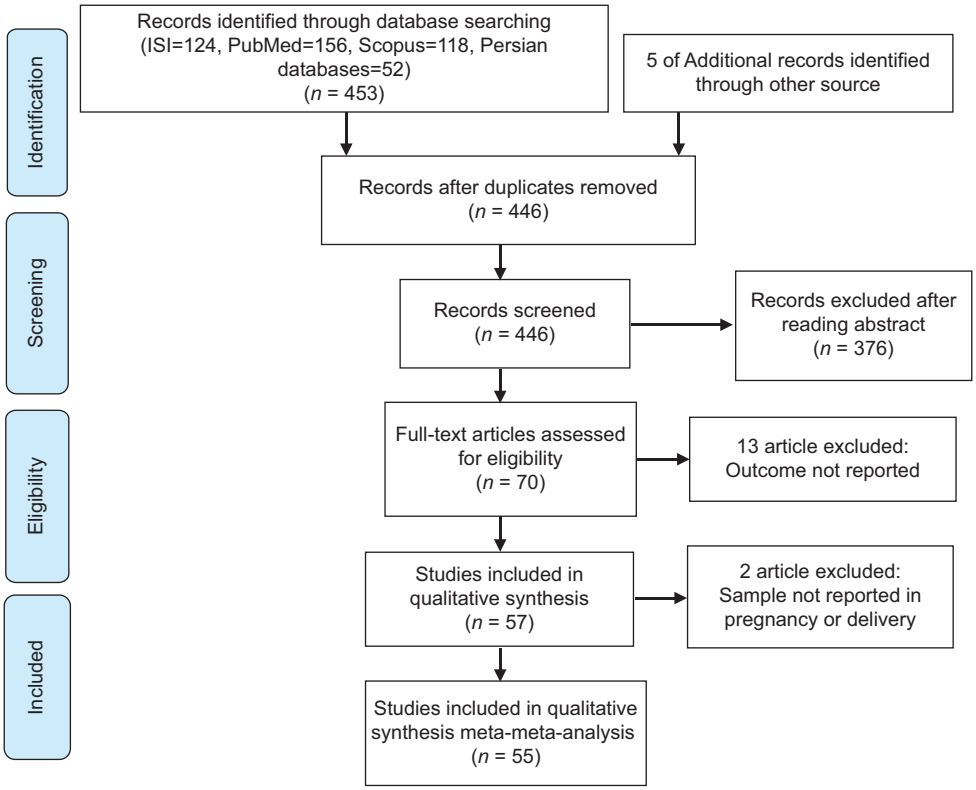

Figure 1: PRISMA flow diagram for study selection for meta-analysis of prevalence of preeclampsia in Iran

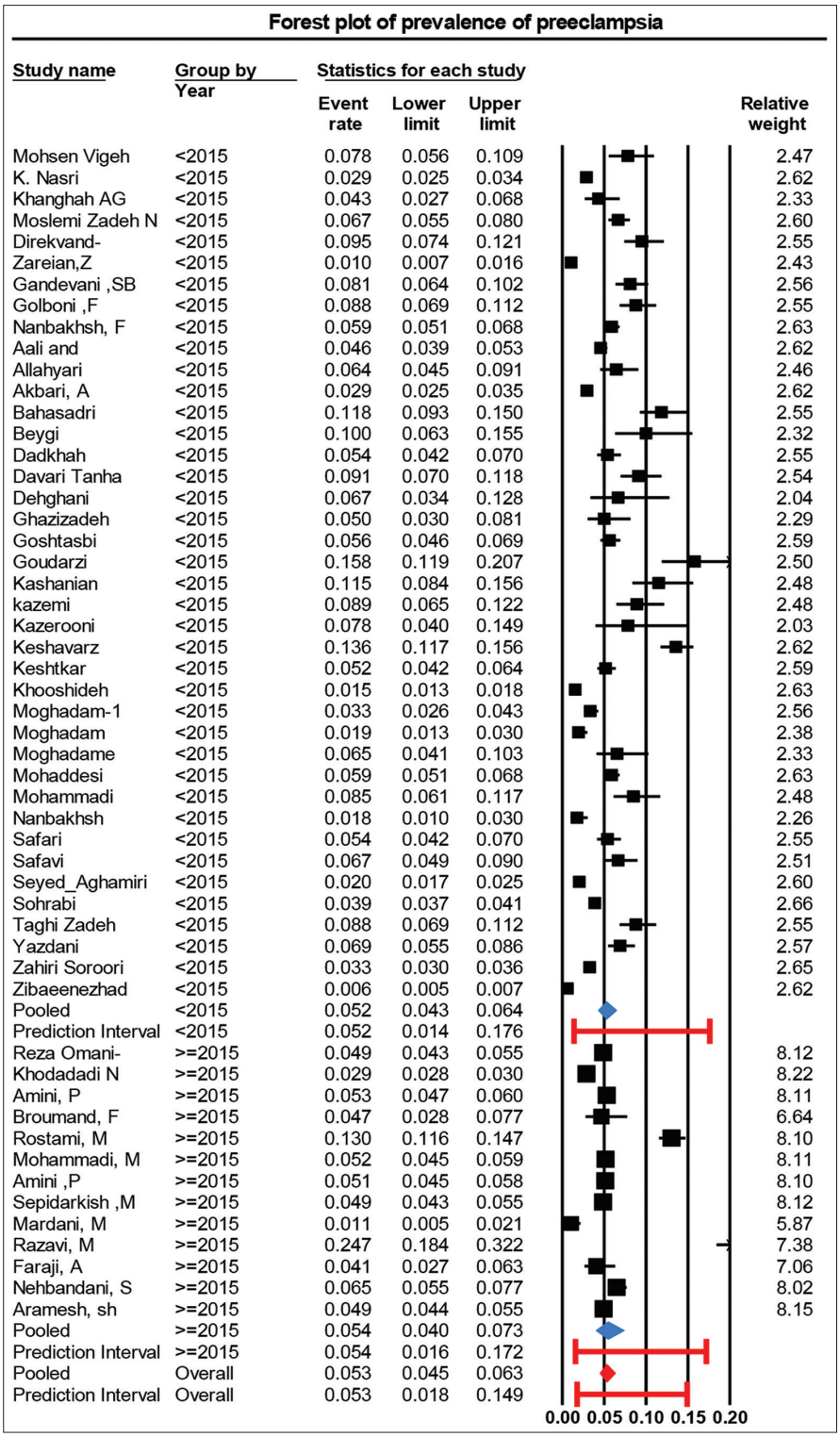

Figure 2: Forest plot for overall prevalence of preeclampsia in Iran

and the Egger regression asymmetry test was used to assess the statistical significance of publication bias.[11]

The study data was inputted using Microsoft Excel. The free version of Comprehensive Meta-Analysis (CMA) software was utilized for conducting the meta-analysis. Forest plots were employed to display the combined estimate along with the 95% confidence interval (CI), presenting both the individual study results and the overall meta-analysis outcome. The estimated pooled prevalence was calculated with a 95% CI. Python, along with the folium, pandas,

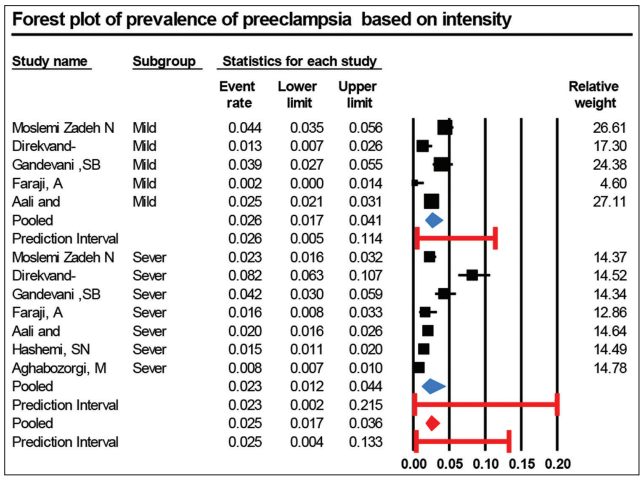

Figure 3: Forest plot for prevalence of preeclampsia according to severity

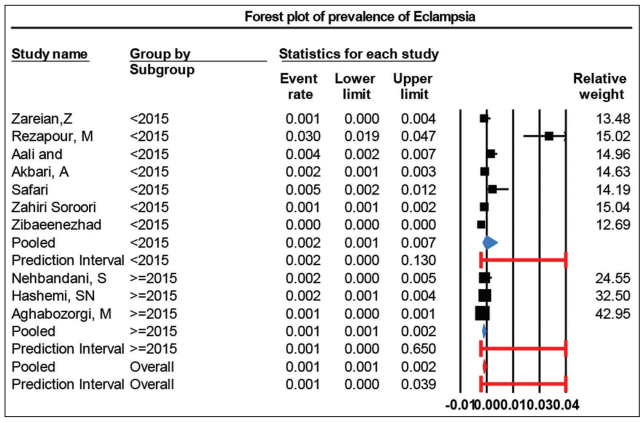

Figure 4: Forest plot for the prevalence of eclampsia

geopy, and seaborn libraries, was employed for creating the map. Subgroup analysis was performed based on the year of sampling, city, and severity of preeclampsia. Additionally, a meta-regression analysis was conducted to explore the relationships between the prevalence of preeclampsia and the year of publication (before and after 2015) as well as age.

Ethical considerations

This study was approved by the Research Ethics Committee of Mashhad University of Medical Sciences (IR.MUMS.NURSE.REC.1402.075). This manuscript has no plagiarism. The results of the analysis were completely honest. Any data fabrication has been avoided.

Results

Studies identified

After removing duplicates, 446 out of 458 articles were retained for full-text review. Following the exclusion of 376 ineligible studies, 70 full-text articles were assessed for eligibility. Of these, 13 studies were excluded, leaving 57 for critical appraisal. None of the studies were excluded due to poor quality. Ultimately, 57 studies were included in the review. Additionally, 55 articles were included in the meta-analysis, with two being excluded due to the target population not being live birth/pregnancy. The PRISMA flow diagram in Figure 1 illustrates the studies included in and excluded from the meta-analysis.

Overall prevalence of preeclampsia

Based on the findings of 42 studies, the mean (SD) of mothers with preeclampsia was 27.27 (2.9). The studies were conducted between 1994 and 2021, and most of them demonstrated moderate-to-good quality. Specifics for each study can be found in Table 1.

Based on 55 articles, there were 326,053 births and 11,111 cases of preeclampsia. The prevalence of preeclampsia among Iranian mothers was 5.30% (95% CI: 0.045–0.063; df = 52; I-Squared = 98; Egger test = 0.06). Figure 2 illustrates that 43 articles were categorized before and after 2015. In articles from 2015 onwards, there were 186,769 births and 6,332 cases of preeclampsia, resulting in a 5.40% prevalence. For articles before 2015, there were 139,284 births and 4,779 cases of preeclampsia, with a 5.20% prevalence. We also categorized preeclampsia by severity. Table 2 shows that mild preeclampsia had a prevalence of 2.60%, severe preeclampsia 2.30%, and eclampsia 0.10%. The table includes details such as Lower limit, Upper limit, CI = 95%, df, I-Squared, and Egger test for each subgroup.

Figure 3 depicts the forest plot illustrating the prevalence of pre-eclampsia. Figure 4 displays the forest plot for the prevalence of eclampsia, both overall and grouped by year. The overall prevalence of eclampsia is 0.10% (Lower limit = 0.001; Upper limit = 0.007; CI = 95%; df = 9; I-Squared = 94; Egger test = 0.08), with rates of 0.20% before 2015 and 0.10% after 2015. Results from single-variable meta-regression on 39 studies revealed a negative correlation between average age and the prevalence of preeclampsia ($\beta = -0.054$, p value <0.001), indicating a decrease in preeclampsia prevalence with increasing age. This is depicted in Figure 5.

Discussion

The systematic review and meta-analysis found that the prevalence of preeclampsia and eclampsia among Iranian mothers was 5.3% and 0.1% of live births, respectively. In comparison, the global estimates show a wide variation across regions, with preeclampsia and eclampsia at 4.6% and 1.4% of all deliveries,[7] and 6.7% in adolescent pregnancy.[12] Iran's maternal health seems to be in good condition, possibly attributed to the quality of care provided during pregnancy and childbirth. It is worth noting that Iran was one of the nine countries that effectively lowered maternal mortality rates to meet the Millennium Development Goals.[13]

The prevalence of preeclampsia in Brazil until 2021 was 6.7%, and eclampsia ranged from 1.7% to 6.2%,

Table 1: Specifications of studies about the prevalence of preeclampsia in Iran

ID	Author	Year	Province/ city	Age	Sample size	Preeclampsia_ Total	Preeclampsia_ Mild	Preeclampsia_ Sever	Eclampsia	Quality score	Study design
1	Mohsen Vigeh	2004	Tehran	27	396	31				6	case-control study
2	Aali BS	2002	Kerman		200			6	2	5	prospective study
3	Reza Omani-	2015	Tehran	30.26	5166	252				6	cross-sectional study
4	K. Nasri	2014	Tehran	28	4994	144				7	Retrospective study
5	Khanghah AG	2010	Guilan	30	394	17				7	cohort study
6	Khodadadi N	2018	Ahvaz		150766	4357				8	Longitudinal cross-sectional study
7	Moslemi Zadeh N	2011	Sari	25.9	1500	100	66	34		6	prospective nested case-control study
8	Direkvand-	2010	Ilam	28	610	58	8	50		5	Cross-sectional
9	Amini, P	2016	Tehran	29.18	4415	234				8	cross-sectional study
10	Broumand, F	2015	Urmia		300	14				7	cross-sectional study
11	Rostami, M	2020	Khuzestan	30	1763	230				8	cross-sectional study
12	Mohammadi, M	2015	Tehran	29.2	4397	227				6	cross-sectional study
13	Zareian, Z	2003	Jahrom	30	2300	24			3	6	retrospective survey
14	Amini, P	2015	Tehran	29.14	4308	221				7	cross-sectional study
15	Sepidarkish, M	2016	Tehran	30.26	5170	252				7	cross-sectional study
16	Gandevani, SB	2009	Noor	26	778	63	30	33		5	cohort study
17	Golboni, F	2007	Tehran	25.7	660	58				5	cross-sectional study
18	Mardani, M	2017	khorramabad		740	8				7	cross-sectional study
19	Nanbakhsh, F	2008	Urmia		2824	166				6	cross-sectional study
20	Razavi, M	2018	Zahedan	25.4	150	37				6	analytic study
21	Faraji, A	2020	Shiraz		486	20	1	8		7	prospective cohort study
22	Rezapour, M	2013	Golestan	30	572	43			17	7	Cross-sectional
23	Nehbandani, S	2015	Zabol	30	2000	130			3	6	Retrospective cohort
24	Aramesh, sh	2016	Yasuj	30	7108	350				7	Cross-sectional
25	Hashemi, SN	2016	Ahvaz	35/5	3002			44	5	7	Cross-sectional
26	Aghabozorgi, M	2019	Tehran	30	16527			134	10	6	Retrospective cohort
27	Aali and	1994	Kerman	27.1	3339	153	85	68	14	5	Cross-sectional
28	Allahyari	2008	Tehran	24.7	466	30				5	Prospective
29	Akbari, A	2004	Tehran	25.9	4856	143			8	5	Cross-sectional
30	Bahasadri	2011	Tehran	24.8	490	58				6	Prospective cohort
31	Beygi	2008	Tehran		170	17				6	Prospective cohort
32	Dadkhah	2010	Tehran	25.5	1000	54				5	Prospective cohort
33	Davari Tanha	2008	Tehran	26.2	549	50				5	Prospective cohort
34	Dehghani	2007	Yazd	21	120	8				5	Prospective cohort
35	Ghazizadeh	2000	Tehran	23.0	300	15				6	Prospective cohort
36	Goshtasbi	2012	Tehran		1513	85				5	Retrospective cohort
37	Goudarzi	2008	Esfahan		266	42				6	Prospective cohort
38	Kashanian	2012	Tehran	26.9	304	35				6	Prospective cohort

Contd...

Table 1: Contd...

ID	Author	Year	Province/ city	Age	Sample size	Preeclampsia_ Total	Preeclampsia_ Mild	Preeclampsia_ Sever	Eclampsia	Quality score	Study design
39	kazemi	2008	Esfahan	22.6	393	35				5	Prospective cohort
40	Kazerooni	2003	Shiraz	22.8	102	8				5	Prospective cohort
41	Keshavarz	2008	Shahroud	25.0	1194	162				5	Prospective cohort
42	Keshtkar	2006	Tehran-Rasht		1643	85				6	Cross-sectional
43	Khooshideh	2008	Zahedan	22.4	10352	160				5	Retrospective cohort
44	Moghadam	2008	Tehran		1800	60				5	Prospective cohort
45	Moghadam	2013	Tehran	26.7	1033	20				6	Prospective cohort
46	Moghadame	2001	Tehran	26.1	260	17				6	Prospective cohort
47	Mohaddesi	2012	Urmia	31.3	2824	166				6	Cross-sectional
48	Mohammadi	2010	Noor city	26.2	400	34				5	Prospective cohort
49	Nanbakhsh	2006	Urmia	31.7	738	13				5	Cross-sectional
50	Safari	2001	Yasuj		1000	54			5	5	Cross-sectional
51	Safavi	2011	Tehran	27.2	600	40				6	Prospective cohort
52	Seyed_Aghamiri	2008	Tehran	25.9	4490	91				6	Cross-sectional
53	Sohrabi	2009	Tehran	27.2	46628	1811				6	Cross-sectional
54	Taghi Zadeh	2009	Tehran	25.7	660	58				6	Prospective cohort
55	Yazdani	2012	Babol		1000	69				5	Retrospective cohort
56	Zahiri Soroori	2007	Gilan		12142	397			17	5	Cross-sectional
57	Zibaeenezhad	2010	Shiraz		24196	148			2	5	Cross-sectional

indicating a higher reported rate of pre-eclampsia and eclampsia in Brazil compared to Iran.[14] Comparatively, in some Asian/African countries, these rates increase significantly.[12,15] For example, there is a comparatively high prevalence of preeclampsia (10%) among pregnant women in Bangladesh,[16] exceeding the reported rates in Asia, which range from 0.2% to 6.7%.[17] This higher prevalence is attributed to the lack of awareness and lower levels of antenatal care in rural areas.[16] In Canada, a developed country, the rates were 2.35 and 0.43 per 1,000 pregnancies for preeclampsia and eclampsia, respectively.[18]

One of the study's findings indicated a rise in the rate of preeclampsia among Iranian mothers since 2015, while the prevalence of eclampsia has decreased over time. This aligns with the last meta-analysis study in Iran conducted by Kharaghani until 2013, which demonstrated increasing preeclampsia and declining eclampsia between 1996 and 2013.[9] Additionally, Guide's study results also demonstrate a recent increase in the frequency of preeclampsia in Brazil.[14] This finding strongly suggests that the uptick in high-risk pregnancies in recent times has led to a higher incidence of preeclampsia. At the same time, enhanced healthcare quality has averted the progression from pre-eclampsia to eclampsia. Additionally, the research highlights that severe preeclampsia is less frequent when compared to milder instances. However, new diagnostic criteria for preeclampsia have been set up and are readily available in healthcare facilities now.[19] However, this contrasts with Sole's study in Norway, where the overall prevalence of preeclampsia decreased from 4.3% to 2.7% between 1999 and 2018,[20] indicating that clinical interventions have contributed to the reduction in preeclampsia prevalence in this country.

This study also found that preeclampsia is more common in younger mothers, decreasing as mothers age, which could serve as a warning sign for teen pregnancies. Consistent with other research, this study regards primiparous birth as a key factor in preeclampsia,[21] and nulliparity as a risk factor for preeclampsia.[18] In this regard, Lisonkova's study shows that younger mothers have a higher risk of severe preeclampsia at term and eclampsia at all gestational ages, while older mothers face increased risks for HELLP syndrome.[18]

Finally, the rising prevalence of preeclampsia, a major direct cause of maternal mortality, could lead to increased long-term disability among women, thereby affecting maternal health cumulatively. One limitation of this study was the lack of data retrieval in some Iranian cities, potentially introducing bias. Furthermore, more attention from researchers is needed to update statistics related to maternal health indicators, especially considering the larger number of studies conducted before 2015.

Table 2: The prevalence of preeclampsia according to severity

Variable	Number studies	Point estimate	Lower limit	Upper limit	df	I^2	Egger test
Total prevalence preeclampsia	53	0.053	0.045	0.063	52	98	0.06
Total prevalence preeclampsia ≥2015	13	0.054	0.040	0.07	12	98	
Total prevalence preeclampsia <2015	40	0.52	0.043	0.063	39	97	
Mild prevalence of preeclampsia	5	0.026	0.017	0.041	4	85	0.55
Severe prevalence of preeclampsia	7	0.023	0.012	0.044	6	97	
Total prevalence eclampsia	10	0.001	0.001	0.007	9	94	0.08
Total prevalence eclampsia ≥2015	3	0.001	0.001	0.002	2	52	
Total prevalence eclampsia <2015	7	0.002	0.001	0.002	6	95	

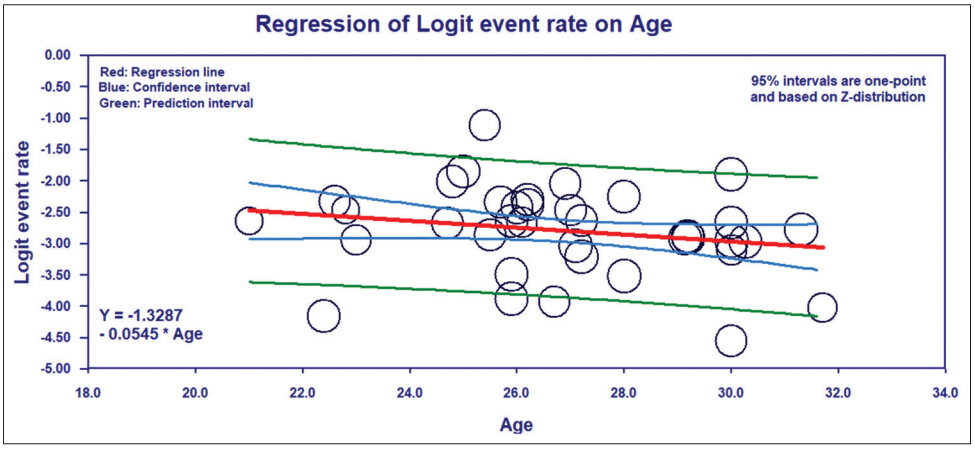

Figure 5: Meta-regression bubble plot for the effects of increases in mean of age on the Prevalence of preeclampsia

Conclusion

The prevalence of preeclampsia, a significant cause of maternal and perinatal morbidity, is currently at 5.3% in Iran. The increasing prevalence of preeclampsia in Iranian mothers underscores the need to investigate related risk factors such as maternal age and subsequent high-risk pregnancies. In contrast, the frequency of eclampsia is decreasing, suggesting the enhanced quality of care post-preeclampsia detection. Utilizing innovative methods like machine learning for predicting preeclampsia in pregnant women is recommended.

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Conflicts of interest

Nothing to declare.

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