

Preeclampsia Among Pregnant Women Admitted to a Tertiary Care Hospital in Taiz City: Insights from a Conflict-Stricken Setting in Southwest Yemen

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Background: Preeclampsia (PE) contributes substantially to morbidity and mortality among mothers and newborns, especially in conflict-stricken settings like Yemen, where data are limited. This study investigated the prevalence and factors associated with PE among pregnant women at a tertiary care hospital in Taiz, southwest of Yemen.

Methods: From January to December 2024, a retrospective cross-sectional study was conducted among 205 pregnant women admitted to the Republican General Teaching Hospital in Taiz. Women's demographics, obstetric characteristics and medical history were extracted from medical records using a data collection sheet. Descriptive statistics were used to summarize data, and chi-square or Fisher's exact tests were used to assess associations with PE, with P -values <0.05 being considered statistically significant.

Results: PE prevalence was 10.7% (22/205; 95% CI: 6.9–15.8). Gestational age (GA) at admission was significantly associated with PE, where the likelihood of PE was more than 10-fold higher among women admitted at <37 weeks compared to those admitted at ≥ 37 weeks (OR 10.6; 95% CI: 4.05–27.60; $P < 0.001$). Although a higher risk of PE was observed among women who were nulliparous, had twin pregnancies, chronic hypertension or a history of PE, these associations were not statistically significant. No significant associations were also found with maternal age, place of residence, gravidity, antenatal care follow-up, abortion history, gestational diabetes, or renal disease.

Conclusion: PE affects approximately one in ten pregnant women admitted for delivery in Taiz, exceeding regional and global estimates. Its significant association with GA <37 weeks indicates the need to improve antenatal screening, early detection, and high-risk pregnancy management to reduce preventable maternal and neonatal complications.

Keywords: preeclampsia, pregnant women, prevalence, associated factors, Yemen

Introduction

Preeclampsia (PE) is a gestational hypertensive disorder that substantially contributes to maternal and perinatal morbidity and mortality worldwide.¹ According to the International Society for the Study of Hypertension in Pregnancy (ISSHP), PE is hypertension (HTN) occurring at or beyond 20 weeks of gestation with one or more new-onset conditions, such as proteinuria, end-organ dysfunction (brain, kidney, liver, or hematological), pulmonary edema, or utero-placental dysfunction.² Likewise, the American College of Obstetricians and Gynecologists (ACOG) defines PE as HTN (systolic ≥ 140 mmHg or diastolic ≥ 90 mmHg) with or without proteinuria, in association with features such as thrombocytopenia, renal impairment, liver dysfunction, pulmonary edema, or unexplained headache, typically occurring at or after 20 weeks of gestation.³

The World Health Organization (WHO) estimates that PE affects 2–8% of pregnancies globally.⁴ According to a recent meta-analysis, the global prevalence of PE was estimated at 4.4% with significant regional variations and a higher prevalence in low-income countries.⁵ According to recent Global Burden of Disease (GBD) data, the global age-standardized incidence rate of maternal hypertensive disorders has decreased from 554.35 per 100,000 in 1990 to

461.94 per 100,000 in 2021, while the age-standardized death rate declined from 1.94 per 100,000 to 0.97 per 100,000 during the same period.⁶ Despite these improvements, the burden of disease remains disproportionately high in low-resource settings with limited access to timely and adequate maternal healthcare.⁶ The WHO estimates that the incidence of PE is seven times greater in developing nations compared to developed nations.⁷

The prevalence of PE in the Middle East varies substantially both within and across countries, ranging from 0.17% to 5%.⁸ Regional data about PE from Arab countries remain limited, but published studies report rates of 1% in Lebanon, 1.2–2.3% in Qatar, 1.3–4.7% in Jordan, 1.1–4.2% in Saudi Arabia, 1.9–2.7% in Bahrain, 2.4% in Occupied Palestinian Territory (OPT), Iraq (4.4%).^{9–19} However, PE was found as a frequent pregnancy complication among 26.1% of renal transplant recipients in five Middle Eastern countries (Lebanon, Saudi Arabia, Syria, Oman, and Turkey).²⁰ The limited availability of epidemiological studies emphasizes the necessity of further research to better characterize the true burden of PE across Arab nations, including Yemen.

Several studies have identified a number of factors that predispose pregnant women to PE, including gestational diabetes mellitus (GDM), chronic HTN, obesity, metabolic syndrome, antiphospholipid syndrome, advanced maternal age, a previous history of PE, nulliparity, chronic kidney disease, multiple gestation, donor-oocyte pregnancies, and the utilization of assisted reproductive technologies.^{21–25} Understanding these factors is crucial for early detection and management to reduce maternal and neonatal complications. PE is associated with a number of adverse maternal outcomes, including higher rates of cesarean sections, mortality and serious complications such as liver dysfunction/HELLP syndrome, pulmonary edema, stroke, acute kidney injury, postpartum hemorrhage, and intensive care unit admission.¹² Additionally, it is associated with several adverse neonatal outcomes such as stillbirth, preterm birth, low birth weight, low Apgar scores, intrauterine growth restriction, and higher rates of neonatal intensive care unit admission.²⁶ These adverse outcomes can be reduced with improved antenatal care (ANC) and early detection, highlighting the need for health education and accessible services for populations at high risk.

High-risk pregnancies, including those with PE, are complex medical conditions affecting approximately 12% of pregnancies, requiring specialized medical supervision and interventions to reduce the likelihood of adverse maternal and perinatal outcomes.²⁷ These pregnancies involve medical conditions that potentially compromise maternal or fetal health, with risk factors including advanced maternal age, pre-existing medical conditions like diabetes, and pregnancy-specific complications.²⁸ The prognosis of high-risk pregnancies is generally good when identified early and appropriately managed.²⁹ However, challenges remain, particularly in resource-limited and conflict-stricken settings like Yemen. Factors such as socioeconomic status, access to healthcare, and maternal health conditions can impact the effectiveness of management strategies. Management of high-risk pregnancies typically involves early risk stratification, multidisciplinary care, and enhanced maternal-fetal surveillance, with growing evidence supporting structured outpatient monitoring programs in tertiary obstetric centers as a safe, cost-effective alternative to prolonged inpatient care for selected conditions.³⁰

The burden of PE in Yemen is exacerbated by poor access to antenatal services, a lack of qualified healthcare providers, delays in seeking and receiving care, and disrupted health systems, particularly in conflict-affected governorates like Taiz. Nevertheless, there are only a few studies on PE in the country. For instance, 10.1% (174/1728) of pregnant women who delivered from May 2012 to the end of April in 2013 in the Saudi Hospital in Hajjah governorate, north of Yemen, were found to have PE/eclampsia.³¹ A case-control study of 206 mothers at Al-Sabeen Hospital in Sana'a identified maternal age (both young and advanced), rural residence, history of HTN or anemia, multiple pregnancies, and prior cesarean delivery as risk factors for PE.³² Two other recent hospital-based studies in Sana'a city and Al-Dhalea governorate have focused on platelet indices as early markers of PE.^{33,34} The ongoing conflict, deterioration of health infrastructure, and disparities in ANC coverage have likely increased the risk of PE among Yemeni women, yet current epidemiological data are limited. This lack of local evidence makes it harder for clinicians, hospital managers, and policymakers to detect high-risk pregnancies early, allocate resources effectively, and design targeted interventions.

The Republican General Teaching Hospital is one of the largest referral maternity hospitals in Taiz, with a large number of obstetric admissions. However, no studies have investigated the prevalence of PE or its associated factors among women delivering in this hospital. Therefore, the current study aimed to bridge this gap by investigating the prevalence of PE and its associated factors among pregnant women admitted for delivery at the Republican General Teaching Hospital.

Methods

Study Design, Population and Setting

A retrospective cross-sectional study was conducted to investigate PE and its associated factors at the Republican General Teaching Hospital in Taiz, which is the second largest hospital in the governorate. PE was defined as systolic blood pressure (BP) ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg after 20 weeks of gestation in the presence of proteinuria or other organ dysfunction. The study analyzed the medical records of a selected sample of women admitted for delivery at the Gynecology and Obstetrics Department from January to December 2024. Records with missing or incomplete data for key variables were excluded during data extraction.

Sample Size and Sampling Strategy

A sample size of 139 records was calculated using OpenEpi, version 3.01 (<https://www.openepi.com>), assuming an expected prevalence of PE of 10%,³¹ a 95% confidence level, and a 5% margin of error. To account for missing data, the sample size was increased to 205. A convenience sampling method was utilized, where eligible medical records were consecutively reviewed until the sample size was achieved.

Data Collection

A structured data collection sheet was developed following a thorough review of the relevant literature and in alignment with the study objectives. The collected data included demographic characteristics (age and place of residence), obstetric characteristics (parity, gravidity, gestational age (GA), multiplicity of gestation, and ANC follow-up), and medical history (chronic HTN, history of HTN, GDM, previous PE, history of abortion, and history of renal disease).

Data Analysis

Data analysis was performed using the IBM SPSS Statistics, version 24 (IBM Corp., Armonk, NY, USA). Frequencies and percentages were used to describe categorical data, while the mean and standard deviation (SD) were used for normally distributed continuous data. Pearson's chi-square or Fisher's exact test was used to assess the associations between PE and study variables. The odds ratios (ORs) and 95% confidence intervals (CIs) of associations were reported. A *P*-value of <0.05 was considered statistically significant.

Ethical Considerations

This study adhered to the Declaration of Helsinki and was approved by the Research Ethics Committee of the University of Science and Technology (USTY) in Sana'a, Yemen (Ethical clearance No.: 1447/0077/UREC/UST). Informed consent was waived due to the retrospective design of the study. Anonymity and confidentiality of all women's data were strictly maintained, and no information was used outside the scope of this research.

Results

Demographic Obstetric Characteristics of the Study Population

The mean age of the pregnant women included in the study was 27.9 ± 6.7 years, with the majority being younger than 30 years (59.5%) and residing in urban areas (63.4%). Regarding parity, 41.5% of women were multiparous, followed by 24.4% primiparous, 21.5% nulliparous, and 12.7% grand multiparous. For gravidity, 48.3% were multigravida, 31.7% grand multigravida, and 20% primigravida. The mean GA at admission was 38.0 ± 3.4 weeks, with most pregnancies being below 40 weeks of gestation (82.9%). Almost all pregnancies were singleton (97.6%), with only 2.4% being twin gestations. Regarding ANC, 63.4% of women reported no ANC follow-up, whereas 36.6% had attended at least one ANC visit (Table 1).

Table 1 Demographic and Obstetric Characteristics of the Study Population (N = 205)

Characteristics	n (%)
Maternal age (years)	
Mean $\pm$ SD: 27.9 $\pm$ 6.7	
<30	122 (59.5)
$\geq$ 30	83 (40.5)
Place of residence	
Urban	130 (63.4)
Rural	75 (36.6)
Parity	
Nulliparous	44 (21.5)
Primiparous	50 (24.4)
Multiparous	85 (41.5)
Grand multiparous	26 (12.7)
Gravidity	
Primigravida	41 (20.0)
Multigravida	99 (48.3)
Grand multigravida	65 (31.7)
GA at admission (weeks)	
Mean $\pm$ SD: 38.0 $\pm$ 3.4	
<37	35 (17.1)
$\geq$ 37	170 (82.9)
Multiplicity of gestation	
Singleton	200 (97.6)
Twin	5 (2.4)
Self-reported ANC follow-up	
No	130 (63.4)
Yes	75 (36.6)

Abbreviations: SD, standard deviation; GA, gestational age; ANC, antenatal care.

Medical History of the Study Population

Table 2 shows that about one-quarter of women had a history of abortion. In addition, a small proportion had chronic HTN (2.9%) or a history of HTN (2.4%). PE in previous pregnancies was observed in 1.5% of women, while a history of GDM and renal disease was each present in 0.5% of the participants.

Prevalence of Preeclampsia

The overall prevalence of PE among pregnant women admitted to the Gynecology and Obstetrics Department at the Republican General Teaching Hospital was 10.7% (22/205; 95% CI: 6.9–15.8).

Table 2 Medical History of Women Included in the Study (N = 205)

Medical History	n (%)
History of abortion	51 (24.9)
Chronic HTN	6 (2.9)
History of HTN	5 (2.4)
Previous PE	3 (1.5)
History of GDM	1 (0.5)
History of renal disease	1 (0.5)

Abbreviations: HTN, hypertension; PE, preeclampsia; GDM, gestational diabetes mellitus.

Factors Associated with Preeclampsia

Table 3 shows that GA was significantly associated with PE among pregnant women, where the likelihood of PE was more than 10-fold higher among women who were admitted at GA <37 weeks compared to those admitted at GA

Table 3 Factors Associated with PE Among Women Admitted to the Gynecology and Obstetrics Department at the Republican General Teaching Hospital in Taiz City, Yemen (2024)

Factor	N	Presence of PE		P-value
		n (%)	OR (95% CI)	
Maternal age (years)				
<30	122	15 (12.3)	Reference	
≥30	83	7 (8.4)	0.7 (0.26–1.69)	0.381
Place of residence				
Urban	130	11 (8.5)	Reference	
Rural	75	11 (14.7)	1.9 (0.76–4.52)	0.167
Parity				
Nulliparous	44	7 (15.9)	2.3 (0.44–11.86)	0.331
Primiparous	50	2 (4.0)	0.5 (0.07–3.77)	0.501
Multiparous	85	11 (12.9)	1.8 (0.37–8.62)	0.472
Grand multiparous	26	2 (7.7)	Reference	
Gravidity				
Primigravida	41	6 (14.6)	1.1 (0.35–3.26)	0.910
Multigravida	99	7 (7.1)	0.5 (0.17–1.34)	0.160
Grand multigravida	65	9 (13.8)	Reference	
GA at admission (weeks)				
<37	35	13 (37.1)	10.6 (4.05–27.60)	<0.001
≥37	170	9 (5.3)	Reference	
Multiplicity of gestation				
Singleton	200	21 (10.5)	Reference	
Twin	5	1 (20.0)	2.1 (0.23–19.97)	0.436
ANC follow-up				
Yes	75	8 (10.7)	Reference	
No	130	14 (10.8)	1.0 (0.40–2.48)	0.982
History of abortion				
No	154	19 (12.3)	Reference	
Yes	51	3 (5.9)	0.4 (0.13–1.57)	0.197
Chronic HTN				
No	199	20 (10.1)	Reference	
Yes	6	2 (33.3)	4.5 (0.77–25.99)	0.127
History of HTN				
No	200	21 (10.5)	Reference	
Yes	5	1 (20.0)	2.1 (0.23–19.67)	0.436
Previous PE				
No	202	21 (10.4)	Reference	
Yes	3	1 (33.3)	4.3 (0.38–49.57)	0.290
History of GDM				
No	204	21 (10.3)	NA	0.107
Yes	1	1 (100.0)		
History of renal disease				
No	204	22 (10.8)	NA	1.000
Yes	1	0 (0.0)		

Abbreviations: PE, preeclampsia; OR, odds ratio; CI, confidence interval; GA, gestational age; ANC, antenatal care; HTN, hypertension; GDM, gestational diabetes mellitus; NA, not applicable.

≥ 37 weeks (OR = 10.6; 95% CI: 4.05–27.60; $P < 0.001$). Although women with nulliparity (OR = 2.3, 95% CI: 0.44–11.86), twin pregnancies (OR = 2.1, 95% CI: 0.23–19.97), chronic HTN (OR = 4.5, 95% CI: 0.77–25.99), a history of HTN (OR = 2.1, 95% CI: 0.23–19.67), and previous PE (OR = 4.3, 95% CI: 0.38–49.57) had higher odds of PE compared to their counterparts, the differences were not statistically significant. In addition, PE was not significantly associated with maternal age, place of residence, gravidity, self-reported ANC follow-up, history of abortion, a history of GDM, or a history of renal disease.

Discussion

To the best of our knowledge, this study is the first to investigate the prevalence and determinants of PE in Taiz City, one of Yemen's most heavily conflict-stricken settings. It revealed a PE prevalence of 10.7% among pregnant women admitted for delivery at the Republican General Teaching Hospital in the city, which is comparable to the 10.1% reported from Hajjah Governorate in 2012–2013,³¹ indicating a persistently elevated burden of pre-eclampsia across diverse Yemeni settings despite geographical and temporal differences. This consistency may reflect shared underlying determinants, such as widespread poverty, limited ANC coverage, and health system fragility.

The prevalence of PE in the present study exceeds pooled global estimates of 4.4%.⁵ In addition, it is higher than PE prevalence reported from other Arab countries, including Lebanon (1%),¹² Saudi Arabia (1.1–4.2%),^{9,10,13,14,16} Qatar (1.3–2.3%),^{12,18} Jordan (1.3–4.7%),^{12,15} Bahrain (1.9–2.7%),^{11,19} OPT (2.4%),¹² and Iraq (4.4%).¹⁷ Lower rates were also reported from low- and middle-income countries, including Angola (0.9%), Niger (1.1%), China (2.2%), Mexico (7.3%), Brazil (8.2%), and northeastern Ethiopia (8.4%).^{35–37} However, a slightly higher PE prevalence of 12.4% was reported for pregnant women in southeastern Ethiopia.³⁸ Differences in sample size, study design and settings, diagnostic criteria, population characteristics, and the quality of ANC services may account for these variations. The relatively higher prevalence of PE in Yemen compared to other countries may reflect disparities in maternal health infrastructure and socioeconomic conditions, such as poor nutrition, early marriage, and limited ANC follow-up.

In this study, GA < 37 weeks was the only factor significantly associated with PE, being associated with more than a 10-fold increase in the likelihood of PE. This finding may be explained by the fact that early-onset PE is generally more severe and strongly linked to placental dysfunction,³⁹ making it more likely to be detected during the earlier stages of pregnancy. Furthermore, Yemen's limited ANC services and delayed initiation of routine visits hinder the identification of mild or late-onset cases. In line with the present finding, a large population-based case-control study in Scotland found that PE is strongly associated with preterm birth, with affected women having more than a fourfold higher likelihood of preterm deliveries.⁴⁰

In this study, maternal age, place of residence, parity, gravidity, chronic HTN, history of HTN, previous PE, history of GDM, history of renal disease, and lack of ANC were not significantly associated with PE. These findings are consistent with results from Bangladesh, where no significant association was reported between classical risk factors, such as maternal age, parity, or family history of HTN, and the occurrence of PE.⁴¹ However, they contrast with findings from Ethiopia, where maternal age, parity, and history of diabetes or HTN were identified as significant predictors.³⁶ Unlike the present study, PE was found to be significantly associated with HTN and first pregnancies among pregnant women in Jordan,¹⁵ as well as with maternal age between 26–35 years, nulliparity, previous abortion, chronic HTN, renal disease, GDM, and singleton pregnancy among women in Najaf, Iraq.¹⁷ In contrast to the present study, a large systematic review and meta-analysis of 51 studies from sub-Saharan Africa demonstrated that several maternal factors, including primiparity, prior history of PE/eclampsia, chronic HTN and absence of ANC, were significantly associated with increased risk of PE.⁴² Several contextual and methodological explanations may account for the lack of association between classical factors commonly cited in the literature and PE among women in the present study. In this context, the relatively small sample size and the extremely low prevalence of chronic comorbidities, such as HTN, GDM and renal disease, may reduce the statistical power to detect associations that are well-established in the literature.

The findings of this study have important policy and practice implications for maternal health in Yemen. Priority should be given to strengthening ANC, particularly early blood pressure screening and risk stratification. In settings with limited specialist care, task shifting to trained midwives and primary healthcare workers may enhance the early detection

and referral of high-risk pregnancies. Establishing clear referral pathways, ensuring the availability of essential medications, and implementing standardized management protocols are feasible interventions. In conflict-affected areas such as Taiz, targeted support for referral hospitals and community-based health education may help reduce preventable maternal and neonatal complications related to PE.

This study from a major referral hospital provides valuable insights into the burden of PE in a conflict-affected setting where maternal health data are extremely limited. Its findings underline the need to strengthen ANC services and early identify pregnant women at risk of hypertensive disorders. However, we acknowledge a few limitations. First, selection bias and limited generalizability to pregnant women in the city may result from the retrospective design and convenience sampling of records. Second, the cross-sectional design of this study limits the ability to infer causal relationships between PE and the identified associated factors, and the findings therefore represent statistical associations rather than evidence of causality and should be interpreted with caution. Furthermore, underreporting and incorrect exposure classification may have been caused by inconsistent documentation in health systems impacted by conflict. On the other hand, data analysis was limited to univariate associations, as multi-variable logistic regression analysis was not performed due to the relatively small number of PE cases and the very low prevalence of several key exposure variables, which could compromise the reliability of regression estimates. The lack of standardized assessments for proteinuria, laboratory indicators, and ANC quality further limited the ability to fully characterize disease severity and related risk factors. Future research is recommended using larger sample sizes and prospective multicenter designs to increase statistical power and account for population variations. Despite these limitations, the study provides preliminary data to guide national health programs and future studies on PE.

Conclusion

PE affects approximately one in ten pregnant women admitted for delivery in Taiz City, exceeding regional and global estimates. GA <37 weeks shows a significant association with PE, underscoring the need to strengthen antenatal screening, improve early detection, and enhance the management of high-risk pregnancies to reduce preventable adverse maternal and neonatal outcomes.

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Disclosure

The authors have no conflicts of interest associated with this study.

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