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Original Article

Magnitude of preeclampsia and associated factors among pregnant women who attend antenatal care service at Shashamane Comprehensive Specialized and Melka Oda General Hospitals, Oromia, Ethiopia

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Abstract

Background: Preeclampsia is the most common medical problem encountered in pregnancy. Despite the high burden of the disease, it remains poorly studied in low- and middle-income countries. Therefore, the study aimed to assess the magnitude of preeclampsia and its associated factors among pregnant women who attended antenatal care (ANC) in two government hospitals in the Oromia region of Ethiopia.

Methods: A facility-based cross-sectional study was employed among 510 randomly selected pregnant women with a gestational age of above 20 weeks attending ANC at Shashamane Comprehensive Specialized and Melka Oda General Hospitals from July 11 to September 9, 2021. Women who had severe illnesses and mental health problems were excluded from the study. A pretested, structured, face-to-face interview questionnaire was used to collect the data. EpiData version 4.6.0.2 and SPSS version 25 were used to enter and analyze the data, respectively. Blood pressure measurements and urinalysis were carried out to identify and diagnose preeclampsia. Bivariable and multivariable binary logistic regressions were done to identify factors associated with preeclampsia. Adjusted odds ratios with 95% confidence intervals and p-values < 0.05 were used to declare statistical significance.

Results: In this study, the magnitude of preeclampsia was found to be 9.02% (95% CI: 6.03%-11.8%). Age <25 years [AOR= 0.49 (95% CI: 0.003, 0.71)], having normal body mass index (BMI) [(AOR=0.07(95% CI: 0.022, 0.22)], and history of previous ANC follows up [AOR=0.26 (95% CI: 0.10, 0.71)] were identified to be negatively

associated with preeclampsia. Having a history of renal disease [AOR = 4.89 (95% CI: 1.78–13.25)], having had preeclampsia before [AOR = 5.03 (95% CI: 1.82–13.93)], or having a family history of preeclampsia [AOR = 7.27 (95% CI: 2.36–22.42)] were all linked to having preeclampsia.

Conclusion: The observed magnitude of preeclampsia in this study is comparable to the global level. Being older, overweight, having no previous ANC follow-up, having a history of renal disease, and having a personal and family history of preeclampsia were found to be significant factors. Therefore, health care providers and other stakeholders should consider the above risk factors for timely identification and management through regular antenatal monitoring and careful follow-up. Moreover, by increasing awareness about the importance of adopting a healthy lifestyle and receiving regular prenatal care, women can be empowered to proactively mitigate their risk.

Keywords: preeclampsia, pregnant women, determinants, Ethiopia

Introduction

Preeclampsia (PE) is when a woman's systolic blood pressure is 140 mmHg or higher and her diastolic blood pressure is 90 mmHg or higher on at least two separate occasions, four hours apart, and she has protein in her urine or signs of end-organ dysfunction, such as liver damage, kidney failure, or neurological symptoms (1). It is a multisystem disorder and a leading cause of maternal and perinatal morbidity and mortality, especially when the condition is of early onset (2).

The global prevalence of PE varies significantly, being seven times more common in low- and middle-income countries than in high-income countries (3). Notably, the prevalence reaches up to 16.7% in developing countries (4). Moreover, because of its unpredictable nature and the unavailability of curative treatment for the disease, it accounts for 40%–60% of maternal deaths in developing countries (4, 5). PE is an age-long obstetric challenge that has been researched for decades yet remains unresolved (6). The disease also has implications for the mother beyond pregnancy and has long-term effects on child health (7). In severe cases, PE can progress to red blood cell breakdown, a low blood platelet count, impaired liver function, swelling, shortness of breath due to fluid in the lungs, visual disturbances, severe epigastric or right upper quadrant pain, impaired renal function, and fetal complications like preterm birth, respiratory distress syndrome, fetal growth restriction, and intrauterine death (8, 9).

In Ethiopia, there were notable variations in the prevalence of PE, with a higher reported magnitude of 9.9% in 2020 from Halaba Kulito General Hospital (10) and 8.4% in 2015 from Dessie Referral Hospital (11). However, a relatively lower prevalence of 4.2% in 2016 was identified in selected governmental hospitals in Addis Ababa City (12). These studies highlight the need for region-specific investigations to determine the exact magnitude of pre-eclampsia in Southern oromia and there seems to be an increase in PE-related deaths, which is a challenge for disease prevention (13).

There is still no clear answer to what causes preeclampsia, but there are a number of clinical risk factors that have been identified. These include advanced maternal age, multiple pregnancies, intrauterine foetal growth restriction, a history of PE, short or long pregnancy intervals, use of assisted reproductive technologies, and autoimmune diseases like systemic lupus erythematous (5). Other risk factors associated with PE are family history of PE, diabetes mellitus, pre-existing chronic hypertension, renal disease, and null parity (14-16). While there is no known cure for preeclampsia other than delivery, the majority of

cases of pre-eclampsia will resolve upon delivery of the fetus and placenta (17, 18).

The World Health Organization (WHO) recommends supplementation with 1.5 to 2.0 g of calcium daily from 20 weeks of gestation for the prevention of pre-eclampsia among all pregnant women living in areas with low dietary calcium intake, and for those at higher risky (19). Another study also suggested that a high-risk woman should receive low-dose aspirin or calcium supplementation at 11–14 weeks of gestation to prevent PE, intrauterine growth restriction, preterm birth, and improve outcomes (6, 20). However, effective control of preeclampsia in developing countries is limited by factors such as poor health care systems and household involvement (21).

Despite the significant burden of pre-eclampsia in Ethiopia and its detrimental consequences, there has been a lack of extensive research determining the prevalence and associated factors of this condition in southern Oromia. Likewise, the available data on the prevalence of pre-eclampsia in the region has been inconsistent and diverse. Therefore, it is imperative to gain a thorough understanding of the scale of pre-eclampsia and its contributing factors in order to improve the well-being of both mothers and fetuses in the region. Additionally, this research endeavour aims to equip healthcare providers with valuable insights, allowing them to implement targeted interventions and preventive strategies to minimize the impact of this potentially life-threatening condition.

Methods and materials

Study setting

The study was conducted in Shashemane Comprehensive Specialised Hospital (SCSH) and Melka Oda General Hospital in Shashemane town. Shashemane town was one of the fastest-growing towns in the Oromia region and serves as the capital city of West Arsi Zone. The town is 250 km away south of Addis Ababa and 25 km away from Hawassa, which is the capital city of the Sidama region. The town's surface area is 17.19 square kilometres (6.64 square miles) and has 8 *kebeles* (lowest administrative units in Ethiopia). Based on 2021 data from the town administration office, the town's population is estimated to be 288,216, with 141,225 (49%) males and 146,990 (51%) females. The town has two government hospitals and one private hospital. It also has four health centres and sixteen private clinics.

SCSH is found at a distance of 14 km from the town in the northeast direction. The hospital provides services for around 2.4 million people in the West Arsi Zone and neighbouring regions like the Sidama region and other zones in the Oromia region like Bale, East Arsi, East Shoa, Guji, and others. It has four main wards: surgery, internal medicine, gynaecology and obstetrics, and paediatrics, as well as other departments like psychiatry, ophthalmology, dentistry, and dermatology. The gynaecology and obstetrics ward has four gynaecologists, one general practitioner, one Integrated Emergency Surgical Officer (IESO), and 26 midwives who give services for delivering mothers and attended ANC at SCSH. The obstetrics and gynaecology ward has 37 functional beds. In the past six months, from October 1 to March 30, there were 1779 deliveries in the SCSH Obstetrics ward.

Melka Oda General Hospital (MOGH) is found in Shashemane town, *'zero asir' kebele*. The hospital provides service for around 600,000 people. It has four main wards: surgery, internal medicine, gynaecology and obstetrics, and paediatrics. The gynaecology and obstetrics ward had one gynaecologist, one general practitioner, four IESOs, and 22 midwives who give service for delivering mothers and who attended ANC at MOGH. The obstetrics and gynaecology ward had 24 functional beds. In the past six months,

from October 1 to March 30, there were 1569 deliveries in MOGH.

Study design and period

A facility-based cross-sectional study was conducted among pregnant women who attended ANC at the two government hospitals in Oromia region, Ethiopia, from July 11–September 9, 2021. The study populations were all pregnant women who attended ANC clinics in governmental health facilities in the Oromia region, West Arsi Zone, South Ethiopia. The study populations comprised of pregnant women who attended ANC in the two selected governmental hospitals in the Oromia region, West Arsi Zone, South Ethiopia.

Inclusion and exclusion criteria

Woman whose gestational age was above 20 weeks were included in this study. Pregnant women with a gestational age of more than 20 weeks but who were in labour or were not willing to participate; pregnant women with a gestational age of below 20 weeks of gestation, and pregnant women who had severe illnesses and mental health problems were excluded from the study.

Sample size determination and procedure

The sample size for the first objective (prevalence of pre-eclampsia) was determined using the single population proportion formula in Epi Info version 7.2.5.0 statistical software. The required sample size was generated by the software based on the following information: the proportion of preeclampsia, which is 12.4% in Metu Karl referral hospital (22); a 95% confidence interval (z = 1.96); a 3% margin of error (d); and a 10% non-respondent rate. As a result, the calculated final sample size was 510. Similarly, the sample size for the second objective, which aims to identify risk factors, was computed using the double population proportion formula in EpiInfo software. Taking into account the factor parity found in a previous study, a 95% confidence interval (CI), a power of 80%, proportion of the outcome in the unexposed 85.2% an adjusted odds ratio (AOR) of 2.55, a ratio of 1 for unexposed to exposed individuals, and a 10% nonresponse rate, the final sample size was 510, which was the same as the sample size for the first objective. Thus, the final sample size for the study was considered to be 510.

Shashamane Comprehensive Specialised and MelkaOda General Hospitals were purposely selected because these two hospitals are the largest public hospitals with maternal health services, specifically ANC services. After obtaining the total number of ANC visits in the past 6 months (October 1, 2020, to March 30, 2021) in each hospital (2012 in SCSH and 1210 in MOGH), the calculated sample size was allocated proportionally to the population size of each hospital. A systematic random sampling technique was used to select pregnant women from both hospitals, and only pregnant women who were above 20 weeks of gestation were interviewed.

Data collection procedures and quality assurance

The data were collected using a pretested, structured face-to-face interview and a standard check list. The questionnaires were adapted from previous peer-reviewed literature (22-24). The questionnaire was first prepared in English and then translated to the local language, *Afaan Oromo*, by fluent speakers of both languages, and then translated back to English to maintain the consistency of the questionnaire. The socio-demographic characteristics and behavioural and nutritional characteristics of pregnant women were collected using a face-to-face interview whereas, the obstetric and gynecologic history, and medical history of pregnant women were

extracted from the maternal medical record using a standard check list.

Four data collectors and one supervisor were recruited, and the data collectors were trained on the significance of the research, the importance of privacy, and the confidentiality of the study. The questionnaire was pretested on 5% of the expected sample size (n = 26) at Arsi Negelle Hospital prior to data collection to check whether the questionnaire was accurate. No adjustment was made. The overall supervision was carried out by investigators during the data collection period on a daily basis, and the data were cleaned and checked daily for completeness and consistency before processing and analysis. All the study participants were encouraged to participate in the study voluntarily, and at the same time, they were also told that they had the right not to participate in the study.

Study variables and operational definition

The dependent variable of the study was pre-eclampsia, and the independent variables were socio-demographic characteristics (age, place of residence, marital status, occupational status, and income), obstetric and gynecologic factors (age of menarche, multiple pregnancies, null parity, ANC follow-up, interpregnancy interval, gravidity, self-history of preeclampsia, family history of preeclampsia), behavioural and nutritional characteristics (drinking alcohol, cigarette smoking, stress, and obesity), and medically related history (maternal chronic hypertension, maternal DM, renal disease, family history of hypertension, family history of DM, cardiac disease, and anaemia).

Operational definitions

- **Hypertension** is when the systolic blood pressure exceeds 140 mmHg and/or the diastolic blood pressure exceeds 90 mmHg (5).
- **Hypertensive disorders of pregnancy** are a group of diseases that include preeclampsia, eclampsia, gestational hypertension, and chronic hypertension (1).
- **Preeclampsia** is a pregnancy-related hypertension disorder, diagnosed after the 20th week of gestation, affecting the liver, kidneys, or brain (25).
- **Severe preeclampsia** is characterized by high blood pressure >160/110 and urine proteinuria of 3+ or higher on a urine dipstick (26).
- **Proteinuria** is the presence of excess serum proteins in the urine (> 0.3g) in 24 hours (27).
- **Eclampsia** is the onset of seizures (convulsions) in a woman with preeclampsia (28).
- **Gravidity** indicates the number of times the woman has been pregnant (14).
- **Parity** is the number of babies delivered by a woman either alive or dead after 28 weeks of gestation (14).
- **Body Mass Index (BMI)** is the product of weight (kg) and height (m2), divided by the square of the weight. It is classified as underweight (<18.5 kg/m2), normal (18.5 to 24.9 kg/m2), overweight (25 to 29.9 kg/m2), and obese (>30 kg/m2) (29).
- **Renal disease** includes acute and long-standing chronic diseases like; acute renal failure, pyelonephritis, and chronic kidney disease (30).

Data processing and analysis

EpiData version 4.6.0.2 cleaned, coded, and entered the collected data before exporting it to the statistical package for social science (SPSS) version 25 for analysis. Continuous variables were summarised using mean (±SD) and median (IQR) according to the normality of the data and presented using frequency tables and texts. Binary logistic regression analysis was done to examine the statistical association between preeclampsia and independent variables. Variables with a p-value <0.2 on bivariable analysis were further entered into a multivariable binary logistic regression to control the potential confounding variables. Utilising the variation inflation factor (VIF) and the tolerance test, it was possible to determine whether there was multicollinearity between independent variables. The Hosmer-Lemeshow test was done to check the model's fitness for analysis. Adjusted odds ratios (AORs) with 95% confidence interval (CI) were used to estimate the strength of associations, and statistical significance was declared at a p-value < 0.05. The study applied the Strengthening the Reporting of Observational Studies in Epidemiology *(*STROBE) statement in reporting the study

Results

Socio-demographic characteristics of study participants

All 510 sampled study participants responded to the face-to-face interview questions, giving a response rate of 100%. The median (IQR) age of the participants was 28.0 (8.5) years, and nearly five in six mothers (82%) were found in the age group of 18–34 years. Five hundred (98%) were married, and more than half (56.5%) were urban residents. Concerning educational status, 74 (14.5%) and 23 (4.5%) of the study participants and their partners, respectively, have no formal education. The median (IQR) monthly income of the women was 89.32 (62.53) birr (Table 1).

Obstetric and gynecologic history of the study participants

The mean (±SD) age of the women at first pregnancy was 20.91 (3.5) years. Out of 370 respondents who had a previous pregnancy history, about 310 (83.8%) of the participants had a history of at least ANC follow-up during the previous pregnancy. From the women who came for regular ANC follow-up, 418 (82%) of the pregnant women) knew that they have a singleton intrauterine pregnancy. The mean (±SD) age at menarche was 13.17 years. Concerning gravidity, 140 (27.5%) of the respondents were primigravida, 9.0% of the responding pregnant women had been pregnant more than five times, and 52 (10.2%) have a previous history of preeclampsia (Table 2).

Behavioral and nutritional characteristics of participants

Cereals and legumes were the most commonly consumed foods among 277(54.3%) of the study participants. The majority (82.7%) eat three times per day, whereas only 52 (10.2%) consume four or more meals per day. Out of 510 respondents, 4.51% drink alcohol and 7.84% reported having stress. Encouragingly, only a very small percentage 2 (0.4%) of pregnant women attending ANC follow-up during the study period smoked cigarettes (Table 3).

Medical history of the respondents

Among all pregnant women who were interviewed, 39 (7.6%) had reported a history of chronic hypertension, and 43 (8.3%) had a family history of DM (Table 4).

Table 1: Socio-demographic characteristics of pregnant women who attended ANC at Shashemane Comprehensive Specialized Hospital and Melka Oda General Hospital, September 2021

Variable	Frequency	Percentage (%)
Age of respondents		
<18	14	2.2
18-24	128	25.1
25-29	159	31.2
30-34	131	25.7
≥35	78	15.3
Mean ± SD	28.18 ± 6.01	
Marital status		
Married	500	98
Single	6	1.2
Divorced	4	0.8
Place of residence		
Urban	288	56.5
Rural	222	43.5
Educational status of women		
No education	74	14.5
Primary	229	44.9
Secondary	149	29.2
More than secondary	58	11.4
Respondent husbands' educational status		
No education	23	4.5
Primary	134	26.3
Secondary	147	28.8
More than secondary	206	40.4
Respondent's family size		
≤5	416	81.76
≥6	93	18.24
Household Monthly income (birr)		
>5000	263	51.6
5000 – 10,000	201	39.4
>10,000	46	9.0
Ever change, husband		
Yes	40	7.8
No	470	92.2

Table 2: Obstetrics and Gynecologic History of pregnant women who attended ANC at Shashemane Comprehensive Specialized Hospital and Melka Oda General Hospital, September 2021

Variable	Frequency	Percentage (%)
Age at first pregnancy (N=370)		
< 20	248	67.0
20 – 24	101	27.3
≥25	21	5.7
ANC during previous pregnancy		
Yes	310	83.8
No	60	16.2
Number of fetus		
One	418	82.0
Two	52	10.2
Unknown	40	7.8
Gravidity		
Primigravidae	140	27.45
Multigravidae	370	72.55
Parity		
Nulliparous	8	2.2
2 – 4	335	90.5
≥5	27	7.3
Inter pregnancy interval (years)		
2≤	136	36.8
2-5	179	48.3
≥5	55	14.9
Previous history of preeclampsia		
Yes	52	10.2
No	458	89.8
Family history of preeclampsia		
Yes	41	8.0
No	469	92.0

Magnitude of preeclampsia

Generally, of the 510 women interviewed, 46 (9.02%) were found to be pre-eclamptic. Out of 46 pre-eclamptic women with the diagnosis of preeclampsia, 41 (89%) had at least one severity sign. Out of women with PE, 6 (13%) had a derranged liver function test, and 5 (10.9%) had an abnormal renal function test. Of the 46 pre-eclamptic women, 7 (17.9%) had haemoglobin values less than 11 g/dl. Eleven (23.9%) of women with PE had thrombocytopenia and a

platelet value <150,000. Most women with preeclampsia—41 (89.2%)—had one or more severity signs. Around half (43.5%) of pregnant women developed preeclampsia at gestational age less than 28 weeks (Table 5).

Table 3: Behavioral and nutritional characteristics of pregnant women who attended ANC at Shashemane Comprehensive Specialized Hospital and Melka Oda General Hospital, September 2021

Variable	Frequency	Percent
Food most frequently consumed		
Fruits and vegetables	129	25.3
Legumes and Cereals	277	54.3
Meat and Fish	21	4.1
Cheese and Butter	32	6.3
Unspecified	51	10.0
How many times you eat per day		
Twice	36	7.1
Three	422	82.7
Four and above	52	10.2
Alcohol consumption history		
Yes	23	4.5
No	487	95.5
Cigarette Smoking history		
Yes	2	0.4
No	508	99.6
BMI		
<18.5	20	3.9
18.5 -24.99	345	67.6
≥25	145	28.4
Mean (±SD) 23.46 kg/m^2 (±3.2)		

Factors associated with preeclampsia

On bi-variable analysis, age of women, level of education, body mass index, place of residence, age of menarche, number of pregnancies, previous history of AN visits, history of alcohol consumption, having hypertension, cardiac disease, self-reported history of preeclampsia, and preeclampsia in the patient's family were eligible for the final model. In the multivariate logistic regression analysis, age of women, body mass index, previous history of preeclampsia, family history of preeclampsia, and having a previous history of ANC were found to be associated factors of preeclampsia.

Accordingly, pregnant women less than 25 years of age have a 51% reduced chance of being preeclamptic as compared to those women with an age greater than 30 years [AOR = 0.49; 95% CI: 0.003, 0.71]. Similarly, women who had previous ANC follow-up during the previous pregnancy were 74% less likely to be preeclamptic as compared to those who had no ANC follow-up history [AOR = 0.26; 95% CI 0.10, 0.71].

Table 4: Medical history of pregnant women who attended ANC at Shashemane Comprehensive Specialized Hospital and Melka Oda General Hospital, September 2021

Variable	Frequency	Percent
History of chronic hypertension		
Yes	39	7.6
No	471	92.4
History of DM		
Yes	26	5.1
No	484	94.9
Family History of DM		
Yes	43	8.4
No	467	91.6
History of renal disease		
Yes	69	13.5
No	441	86.5
Cardiac History		
Yes	26	5.1
No	484	94.9
Woman's BP measurement at time of diagnosis		
< 140/90	464	90.98
≥ 140/90	46	9.02

Women who had a normal BMI had a 93% reduced odds of contracting preeclampsia when compared to women with an abnormal BMI [AOR = 0.07; 95% CI: 0.022, 0.22]. Likewise,

women with a history of preeclampsia were five times more likely to be preeclamptic as compared to their counterparts [AOR: 5.03; 95% CI: 1.82–13.93].

In addition, women with a family history of preeclampsia were seven times more likely to be preeclamptic as compared to those who had no family history of PE [AOR: 7.27, 95% CI: 2.36, 22.42]. Moreover, women with a history of renal disease were nearly five times more likely to be preeclamptic as compared to their counter parts [AOR: 4.89; 95% CI: 1.78–13.23] (Table 6).

Discussion

In this study, the magnitude of PE was found to be 9%. This is similar to previous studies done in Ethiopia (10, 12, 23) and also with an estimated prevalence of the condition in Africa (17). Similarly, other studies done in the USA (5) and Iran (31) also reported results consistent with this study. The similarities might be due to the fact that studies have implemented similar inclusion and exclusion criteria when selecting study participants. By having consistent criteria, such as age range, gestational period, and pre-existing medical conditions, the researchers ensure that they are studying a homogeneous sample, which enhances the comparability of the findings. However, this study's preeclampsia prevalence is higher than that of studies carried out in government hospitals in Addis Abeba, Ethiopia (12) and sizable studies in Sweden and China (32). The difference might be due to the scope of study settings. On the other hand, the result is lower than a study conducted in Bangladesh (33), Zanzibar (34), and Harare City, Zimbabwe (35). These discrepancies may be attributed to differences in study design, geographical location, sample size, and diagnostic criteria used. Despite potential variations in study designs and populations, the prevalence rate of preeclampsia reported in our study falls within the range observed in existing literature. This consistent evidence further supports the significance of preeclampsia as a global health concern.

Table 5: Clinical and laboratory features of pregnant women with preeclampsia who attended ANC at Shashemane Comprehensive Specialized Hospital and Melka Oda General Hospital, September 2021

Variable	Frequency	Percentage
Preeclampsia		
Yes	46	9.02
No	464	90.98
Protein by dipstick (n=46)		
+1	4	8.7
+2	27	58.7
+3	15	32.6
Gestational age when developing preeclampsia (n=46)		
≤28 weeks	20	43.5
>28 weeks	26	56.5
Liver function test (n=46)		
Normal	40	87.0
Abnormal	6	13.0
Renal function test (n=46)		
Normal	41	89.1
Abnormal	5	10.9
Hemoglobin Value(n=46)		
< 11 md/dl	7	17.9
≥ 11 mg/dl	39	82.1
Platelet value(n=46)		
< 150,000/uL	11	23.9
≥150,000/uL	35	76.1
Number of severity signs (n=46)		
1	13	28.2
≥2	28	61.0
No sign	5	10.8

Table 6: Factors associated with preeclampsia among pregnant women who attended ANC at Shashemane Comprehensive Specialized Hospital and Melka Oda General Hospital, September 2021

Variables	Preeclampsia		COR (95%CI)	AOR (95%CI)
	Yes	No		
Age of Women				
<25	7	135	0.40(0.16,0.95)	0.49(0.003,0.71)*
25-29	15	144	0.80(0.40,1.58)	0.58(0.23,1.348)
≥ 30	24	185	1	1
Educational Status				
No formal education	15	59	3.43(1.07,10.98)	
Primary	20	209	1.29(0.42,3.93)	
Secondary	7	142	0.66(0.18,2.36)	
Above secondary	4	54	1.00	
Husband**'s** educational Status				
No formal education	5	18	4.49(1.42,14.17)	
Primary	16	118	2.19(1.01,4.79)	
Secondary	13	134	1.56(0.69,3.54)	
Above secondary	12	194	1.00	
Body mass index				
Underweight	8	12	2.91(1.08,7.82)	0.88(0.14,5.39)
Normal	11	334	0.14(0.06,0.29)	0.07(0.022,0.22)***
Overweight/obese	27	118	1	1
Number of Fetuses				
Singleton	30	388	1.00	
Twin	13	39	4.31(2.07,8.94)	
Unknown	3	37	1.05(0.30,3.60)	
Place of residence				
Urban	20	228	1.00	
Rural	26	196	1.77(0.96,3.27)	
Previous history of ANC (n=370)				
Yes	22	288	0.22 (0.11,0.47)	0.26 (0.10,0.71)**
No	15	45	1.00	1.00
Alcohol History				
Yes	8	15	6.30 (2.51,15.80)	2.56 (0.57,11.45)
No	38	449	1.00	1.00
Self-history of preeclampsia				
Yes	21	31	11.73(5.91, 23.27)	5.03(1.82, 13.93)**
No	25	433	1.00	1.00
Self-history of HTN				
Yes	13	26	6.63(3.12 14.10)	2.10(0.67 6.58)
No	33	438	1.00	1.00

Table 6 continued

Variable	Preeclampsia		COR (95%CI)	AOR (95%CI)
	Yes	No		
History of DM				
Yes	5	21	2.57(0.92 7.18)	1.37(0.26 7.20)
No	41	443	1.00	1.00
History of renal disease				
Yes	20	49	6.51(3.38 12.52)	4.89(1.78 13.25)**
No	26	415	1.00	1.00
Cardiac disease history				
Yes	11	15	9.40(4.01,22.02)	3.29(0.75,14.39)
No	35	449	1.00	1.00
Family history of preeclampsia				
Yes	20	21	16.23(7.82, 33.63)	7.27(2.36, 22.42)***
No	26	443	1.00	1.00
Birth interval (in years)(n=370)				
≤ 2	13	123	0.86(0.31, 2.39)	
3-4	18	161	0.91(0.34, 2.42)	
≥ 5	6	49	1.00	
Gravidity				
Primigravidia	9	131	0.61(0.29, 1.31)	
Multigravidia	37	333	1.00	
Parity				
Nulliparous	9	131	0.55(0.25, 1.20)	
Primiparous	9	108	0.67(0.30, 1.46)	
Multiparous	28	225	1.00	

AOR, adjusted odds ratio; COR, crude odds ratio; * $p < 0.05$); ** $p < 0.01$); *** $p < 0.001$

Among pregnant women who were diagnosed with preeclampsia, 89% of them had at least one severity (headaches, blurring of vision, epigastric pain, and right upper quadrant pain), which was lower than a study done in Jimma University Specialised Hospital with 97% of pregnant women having severity signs (7) and higher than the study done in Iran with 82% of women having severity signs (31). This result indicates that we should have to screen for preeclampsia as early as possible in a mild case or before the occurrence of any severity sign.

In this study, pregnant women whose ages were younger were less likely to develop pre-eclampsia. The finding is supported by studies done in Ethiopia (11, 36) and differs from the study done by the International Federation of Gynaecology and Obstetrics (9). This could be due to the fact that during pregnancy, younger women experience extensive changes in their maternal blood vessels, exhibiting better elasticity and adaptability, reducing the risk of pre-eclampsia. Additionally, their balanced immune response and healthier placental function further decrease the chances of preeclampsia development. Apart from this, older women are more likely to have cardiovascular diseases, renal disease, diabetes mellitus, and obesity, which is probably reflected in an increase in hypertension and also preeclampsia (37, 38).

Having a normal BMI was found to be a protective factor for preeclampsia in this study. This finding is consistent with different studies (39-41). This might be due to the fact that a higher BMI is often linked to insulin resistance, which can lead to metabolic dysfunction (42) and also because the adipose tissue in individuals with an increased BMI produces pro-inflammatory substances such as cytokines and adipokines which can contribute to inflammation and endothelial dysfunction, which are involved in the development of preeclampsia (43). Moreover, increased BMI is often associated with hormonal imbalances that can disrupt the normal regulation of blood pressure and vascular function, which is a risk factor for pre-eclampsia (17, 31). On top of all, obesity during pregnancy increases the likelihood of developing gestational diabetes, a condition that can lead to complications for both the mother and the baby (44). This result implies that maintaining a normal BMI during pregnancy helps minimise the risk of developing PE.

Our results indicate that pregnant women who have a previous history of ANC were less likely to be preeclamptic compared to women who had not received regular ANC follow-up. A similar finding was reported from a study done in Sub-Saharan Africa (15) and Nekemte Referral Hospital (36). This might be due to the fact that having regular ANC during pregnancy is vital for preventing and detecting complications like preeclampsia by identifying hypertension and proteinuria early, allowing for timely management and prevention strategies. Additionally, these visits provide an opportunity for healthcare providers to educate pregnant women about preeclampsia symptoms and emphasise the importance of seeking medical attention promptly for any warning signs (26, 45).

This study revealed that women with a previous history of preeclampsia were five times more likely to be preeclamptic. This finding is consistent with studies conducted in Iran (31), Thailand (41) and Ethiopia (10, 36, 46). This might be due to the fact that women with a previous history of pre-eclampsia are at an increased risk for adverse pregnancy outcomes in subsequent pregnancies (36). Similarly, the odds of developing preeclampsia among women who had a family history of preeclampsia were 8.5 times higher as compared to their counterparts. This finding is consistent with previous studies done in Ethiopia (11, 24, 46). A systematic review and meta-analysis found a significant association between a family history of pre-eclampsia and an increased risk of developing the condition in women with a first-degree relative (mother or sister) who had experienced preeclampsia (47). This might be due to the fact that the family might have shared lifestyle habits, such as a high-salt diet, sedentary behaviour, or obesity, which often run in families and can increase the likelihood of developing hypertension and related disorders (48).Moreover, a family history of hypertensive disorders increases the risk of preeclampsia, and hemolysis, elevated liver enzymes, and low platelet (HELLP) syndrome (49). This implies that healthcare providers should be aware of this association to identify women who may be at a higher risk and provide appropriate prenatal care.

This hospital-based cross-sectional study has contributed to the existing knowledge regarding the magnitude and factors associated with preeclampsia, which can be used by health program planners policy makers and public health practitioners who are working in the maternal and child health area. However, due to the nature of the cross-sectional study design, it could not establish cause-and-effect relationships between exposure and outcome variables. Moreover, there might be a recall bias when women were asked to recall their last menstrual period (LMP), and they might have encountered challenges in accurately remembering the precise date or specific details associated with their last period. This could consequently lead to misreporting or approximations, thereby

introducing recall bias. Additionally, the presence of social desirability bias was a possibility, as in certain societal or cultural contexts, women may feel compelled to provide responses that align with societal expectations or the perceived ideal. Such pressures can potentially influence their recollection of the LMP, consequently leading to biased reporting.

Conclusion

The observed magnitude of preeclampsia in this study was found to be consistent with the global level, suggesting that the findings can be generalized to broader populations. Several key risk factors for preeclampsia were identified in this study. Obesity and advanced age were also revealed to be important risks, suggesting that pregnant women in these categories should be more watchful of their health. Significant risk factors also included a history of renal disease, a personal or family history of preeclampsia, and the lack of prior antenatal care (ANC) follow-up. The ramifications of these findings for healthcare providers and other stakeholders in maternity care are significant. It is imperative that they consider the risk factors that have been identified when offering antenatal care and follow-up to expectant mothers. By identifying these variables, medical professionals can prevent the difficulties that may arise from preeclampsia through early detection of high-risk cases and the implementation of suitable management techniques. Additionally, it is crucial to educate expectant mothers about the importance of leading a healthy lifestyle and getting regular prenatal care. Women who are informed about these risk factors may be able to lower their personal risk of preeclampsia by taking preventative action. This can involve eating a healthy, balanced diet, exercising frequently, and going to prenatal appointments on time.

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Ethical considerations

All the methods were performed in accordance with the relevant ethical guidelines and principles outlined in the Declaration of Helsinki. Accordingly, primarily an ethical approval letter was obtained from the Institutional Review Board of Pharma College (Reference Number: P/C/H/C/230/13). Informed written consent was obtained from all respondents after an explanation of the purpose of the study. Confidentiality of the participants' response was maintained by excluding personal information like the patient's name or card number throughout the study**.**

Data Availability statement

For those who are interested, the datasets of this study could be accessed from the corresponding author on reasonable request.

Conflicts of Interest

The authors declare that they have no competing interests.

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