



RESEARCH ARTICLE

## Pregnancy Induced Hypertension and associated factors among pregnant women attending antenatal care at Dilla University General Hospital Ethiopia, 2023

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Received: 22 November 2024

Accepted: 16 December 2025

DOI:10.20372/ajhsm.v04i02.04

Published: 20 December 2025



**Suggested Citation:** Demeke M., Molla W., and Gashaw A. Pregnancy Induced Hypertension and associated factors among pregnant women attending antenatal care at Dilla University General Hospital Ethiopia, 2023. *Afri. J. Heal. Sci. Med.* 2025, 04(02).

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### Abstract

**Introduction:** Pregnancy-induced hypertension is a major health concern within the obstetric population and remains one of the leading causes of maternal morbidity and mortality. The increasing prevalence of conditions such as diabetes mellitus, hypertension, and obesity among women further exacerbates pregnancy-induced hypertension, underscoring the need for updated, region-specific data. Thus, this study aimed to assess the prevalence of pregnancy-induced hypertension and its associated factors among pregnant women attending antenatal care at Dilla University General Hospital in Ethiopia in 2023.

**Method:** A hospital-based cross-sectional study was conducted at Dilla University General Hospital from October 1 to November 20, 2023. Participants were selected using a systematic random sampling approach. Data collection employed a pretested, structured questionnaire administered by trained interviewers, supplemented by a review of patient records. Information was entered into EpiData (version 4.6.0.2) and analyzed using SPSS (version 26). Both bivariate and multivariable logistic regression analyses were performed, with statistical significance set at  $p \leq 0.05$ . Results were presented as adjusted odds ratios (AORs) along with 95% confidence intervals (CIs).

**Results:** The study revealed the prevalence of pregnancy-induced hypertension of 15.3% (95% CI: 11.5, 18.9). Significant predictors of pregnancy-induced hypertension included primigravidity (AOR=1.863; 95% CI: 1.147–3.196) and a family history of chronic hypertension (AOR=2.795; 95% CI: 1.120–5.953).

**Conclusions:** This study found a high prevalence of pregnancy-induced hypertension. Notably, factors such as a family history of chronic hypertension and primigravidity were significantly associated with this condition. These findings emphasize the importance of incorporating risk assessments and family history screenings into routine antenatal care to effectively mitigate the risk of pregnancy-induced hypertension.

**Keywords:** Prevalence, Pregnant women, Pregnancy Induced Hypertension, Ethiopia

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## 1 Introduction

Pregnancy-induced hypertension is defined as a systolic blood pressure (BP) of 140 mmHg or higher, and a diastolic BP of 90 mmHg or higher, measured on two occasions 4-6 hours apart, or  $\geq 160/110$  mmHg on a single occasion after 20 weeks of gestation in a previously normotensive woman [1].

According to the World Health Organization (WHO), 295,000 women die annually from complications related to pregnancy or childbirth, with 94% of these deaths occurring in low- and middle-income countries (LMICs) [2]. In Ethiopia, the 2016 Ethiopian Demographic Health Survey (EDHS) reported a maternal mortality rate of 412 per 100,000 live births and a neonatal mortality rate of 29 per 1,000 live births [3]. Pregnancy-induced hypertension is one of the most common causes of maternal mortality and morbidity, affecting 5-10% of all pregnancies globally [4]. During the period from 1990 to 2016, the main direct causes of maternal death in Ethiopia included obstetric complications such as hemorrhages, obstructed labor/ruptured uterus, pregnancy-induced hypertension, puerperal sepsis, and unsafe abortion [5].

Pregnancy-induced hypertension increases the likelihood of adverse maternal and perinatal outcomes, including preterm birth, intrauterine growth restriction (IUGR), perinatal morbidity and mortality, acute renal failure, and acute hepatic failure [6, 7]. It is also associated with bleeding during delivery and postpartum complications, as well as maternal mortality and morbidity due to conditions such as Hemolysis, Elevated Liver Enzyme, Low Platelet Count (HELLP syndrome), disseminated intravascular coagulation (DIC), and seizures [8, 9].

The Ethiopian government has made significant strides in improving maternal health services, including training healthcare providers in the identification and management of pre-eclampsia, administration of magnesium sulfate, and providing necessary logistics alongside ongoing supportive supervision [10]. Despite these efforts, maternal mortality in the country has not decreased as intended [11].

The reported prevalence of pregnancy-induced hypertension in Ethiopia varies across different regions: 18.25% in Arba Minch, 16.8% in Gondar, 11.5% in Addis Ababa, 12.4% in Metu, and 15.7% in Debre Tabor [12-16].

While the prevalence of pregnancy-induced hypertension in Ethiopia has been studied, it remains one of the leading causes of maternal mortality and morbidity. Additionally, the rising prevalence of chronic conditions such as diabetes mellitus, chronic hypertension, obesity, and physical inactivity contributes to the development of pregnancy-induced hypertension. This underscores the need for updated, region-specific data. Therefore, this study aimed to assess the prevalence of pregnancy-induced hypertension and associated factors among pregnant women at Dilla University General Hospital in Ethiopia. The findings of this study will provide critical information to guide targeted interventions and improve maternal and neonatal health outcomes in this specific setting.

## 2 Method

### 2.1 Study design and setting

A cross-sectional study was conducted at Dilla University General Hospital in Dilla Town, Gedeo Zone, Southern Ethiopia, from October 1 to November 20, 2023. The hospital is located 359 km from Addis Ababa, the capital of Ethiopia, and 90 km from Hawassa, the capital of the Sidama Region. It serves a catchment population of 2.5 million, providing preventive, curative, and rehabilitative services. The hospital consists of five major wards: medical, surgical, obstetrics/gynecology, pediatrics, and psychiatry. According to data from the hospital's logbook and department heads, 550 pregnant women were expected to attend antenatal care (ANC) follow-up during the data collection period.

### 2.2 Population

#### Source Population

All pregnant women who attended antenatal care service at Dilla University General Hospital.

## Study Population

All pregnant women who attended antenatal care service at Dilla university General Hospital and available during data collection period.

## Inclusion Criteria

All pregnant women who attended antenatal care service at Dilla University General Hospital.

## Exclusion Criteria

Pregnant women who were unable to communicate verbally or severely ill were excluded from the study.

## 2.3 Sample size determination

The sample size was calculated using the single population proportion formula. A prevalence of pregnancy-induced hypertension (PIH) of 21.9%, reported in a previous study from Addis Ababa [17], was taken as the reference proportion.

With a 95% confidence level ( $Z = 1.96$ ) and a 5% margin of error, the computation was:

$$n = (Z_{\alpha/2})^2 p(1 - p) / d^2$$

Where:

- n = required sample size
- $Z_{\frac{\alpha}{2}} = 1.96$  (critical value at 95% CI)
- p = 0.219 (prevalence of PIH)
- d = 0.05 (margin of error)

$$n = (1.96)^2 (0.219) (0.781) / (0.05)^2 = 263.$$

After adding a 10% non-response rate, the final sample size was 289.

## 2.4 Sampling technique

Systematic random sampling technique was employed to select study participants. The total number of pregnant women expected to come for ANC follow up for corresponding data collection period was 550. To calculate skip interval,  $K = N/n$ ,  $N = 550$  (Average total population over 6 weeks),  $n = 289$  (sample size). Thus,  $K = 550/289 = 1.9 \sim 2$ . The first participant was selected using a lottery method, and every subsequent

participant was chosen based on the skip interval (every 2 pregnant women).

## 2.5 Operational definition

**Pregnancy-Induced Hypertension:** This condition is characterized by a rise in blood pressure, defined as systolic blood pressure (SBP)  $\geq 140$  mmHg and/or diastolic blood pressure (DBP)  $\geq 90$  mmHg, measured on two occasions 4-6 hours apart after 20 weeks of gestation, with or without proteinuria in women who were previously normotensive [17, 18].

**Gestational Hypertension:** This refers to an increase in blood pressure (SBP  $\geq 140$  mmHg and/or DBP  $\geq 90$  mmHg) on two occasions 4-6 hours apart after 20 weeks of gestation, without the presence of proteinuria [17, 18].

**Pre-eclampsia:** This condition involves the development of gestational hypertension along with proteinuria (as indicated by urine dipstick) after 20 weeks of gestation in an individual who previously had normal blood pressure and no proteinuria [17, 18].

**Alcohol –intake:** If the mother drinks any amount of alcohol during this pregnancy [19].

## 2.6 Data collection tool and Procedure

Data was collected using a pre-tested, structured, interviewer-administered questionnaire, supplemented by a review of patient cards. The questionnaire was adapted from various literature and contextualized to fit the specific situation [17, 18, 20]. The tool included sections on socio-demographic factors, obstetric history, medical conditions, and behavioral factors. Participants were allowed to rest for ten minutes before blood pressure measurement. Blood pressure was assessed while the women were seated in an upright position, using a mercury sphygmomanometer. Pregnant women with abnormal readings had their blood pressure measured again after 4-6 hours to confirm the diagnosis. Data regarding proteinuria and other clinical results were obtained from the women's medical records. Data collection was conducted by three graduating nursing students from Dilla University.

## 2.7 Data quality assurance

To ensure data quality, the English version of the tool was translated into Amharic and subsequently back translated into English by three different individuals to confirm consistency and accuracy. A one-day training session was provided for data collectors by the principal investigators, covering the study's purpose, aspects related to the questionnaire, and the methods and steps involved in the data collection procedure. The questionnaire was pre-tested on 5% of the sample at Yirgacheffe Primary Hospital to evaluate clarity, response accuracy, and the time required for interviews. Modifications were made based on the pretest findings to enhance the tool before the actual data collection began. The data collection process was closely supervised throughout.

## 2.8 Data processing and analysis

After data collection, each questionnaire was manually checked for completeness. The collected data were entered into EpiData version 4.6.0.2 and then exported to SPSS version 26 for data verification, cleaning, and regression analysis. Descriptive statistics, including frequencies, percentages, means, medians, and standard deviations, were used to summarize and describe the data. The results were presented in tables, graphs, and narrative descriptions.

Binary logistic regression was performed to assess the associations between the dependent and independent variables. Variables with a p-value of 0.2 or less were included in the final model. Multivariable logistic regression analysis was conducted to identify factors independently associated with the dependent variable, applying a significance level of  $p < 0.05$  and a 95% confidence interval (CI). Both crude and adjusted odds ratios (OR) were calculated to quantify the strength of the associations.

## 3 Results

### 3.1 Socio-demographic characteristics of respondents

Out of the 289 respondents required for the study, 287 pregnant women participated, resulting in a response rate of 99.3%. The mean age of the participants was 27.53 years, with a standard deviation of  $\pm 5.989$  years. Most respondents, 236 (82.3%), resided in urban areas. Among the 287 mothers, 258 (89.9%) were married, and 78 (27.2%) completed up to primary school. More than half of the mothers, 156 (54.4%), were housewives. The mean family income was 3729.15 ETB ( $\pm 4094.835$ ). Regarding family size, over half of the respondents, 158 (55.1%), reported having a family size of three to five members (see Table 1).

**Table 1** Socio-demographic characteristics of pregnant women attending antenatal care at Dilla University General Hospital Ethiopia, 2023

Variable		Frequency (N)	Percent (%)
Age of the mother	18-27	147	51.2
	28-35	105	36.6
	≥36	35	12.2
Residence	Urban	236	82.3
	Rural	51	17.7
Marital status	Single	14	4.2
	Married	258	89.9
	Divorced	15	4.5
Maternal education	No formal education	58	20.2
	primary school	141	49.1
	secondary school	29	10.1
	college and above	59	20.6
Husband education (N=258)	No formal education	42	16.4
	primary school	144	55.7
	secondary school	38	14.6
	college and above	34	13.2
Occupation of the mother	government employee	25	8.7
	private employee	25	8.7
	daily laborer	18	6.3
	house wife	156	54.4
	Merchant	34	11.8
	Others	29	10.1
Occupation of the father (N=258)	government employee	74	28.9
	private employee	48	18.5
	daily laborer	39	15
	merchant	73	28.2
	others	24	9.4
Family income	500-2499	82	28.6
	2500-4499	88	30.7
	4500-6499	77	26.8
	≥6500	40	13.9
Family size	<3	74	25.8
	3-5	158	55.1
	>5	55	19.2

### 3.2 Obstetric factors

Among all respondents, 171 (59.6%) were multi-gravida, and the majority, 243 (84.7%), reported having planned pregnancies. Additionally, 22

(7.7%) had a prior history of pregnancy-induced hypertension. Among the pregnant women diagnosed with preeclampsia, 11 (25%) exhibited features of severe disease (see Table 2).

**Table 2** Obstetric characteristics of pregnant women attending antenatal care at Dilla University General Hospital Ethiopia, 2023

Variable		Frequency	Percent
Pregnancy planned	No	44	15.3
	Yes	243	84.7
Gravidity	prim gravid	68	23.7
	multi gravid	219	76.3
Gestational age of current pregnancy	<28 week	164	57.1
	>28 week	123	42.9
History of PIH	No	265	92.3
	Yes	22	7.7
Multiple pregnancy	No	269	93.8
	Yes	18	6.2
PIH for this pregnancy	No	243	84.7
	Yes	44	15.3
Current systolic blood pressure	<120mmHg	174	60.6
	120-139mmHg	78	27.2
	140-160mmHg	28	9.8
	>160mmHg	7	2.4
Current diastolic blood pressure	<90mmHg	222	77.4
	≥90mmHg	44	15.3
Proteinuria	No	242	84.3
	Yes	45	15.7
Preeclampsia with severity feature (N=44)	Yes	11	25
	No	33	75

### 3.3 Medical and behavioral factors

Out of the 287 respondents, 48 (16.7%) reported a family history of hypertension. Additionally, 54 (18.8%) had a family history of kidney disease, and 142 (49.5%) of the mothers had a Body Mass Index (BMI) in the range of 18-25 (see Table 3). Regarding behavioral factors, none of the respondents smoked cigarettes, while 42 (14.6%) reported a history of alcohol consumption during this pregnancy.

### 3.4 Prevalence of pregnancy induced hypertension

Among all respondents, 60 (20.9%) had heard of pregnancy-induced hypertension. The prevalence of pregnancy-induced hypertension was 44 (15.3%) [95% CI: 11.5, 18.9]. Of these cases, 33 (75%) were classified as gestational hypertension or mild pre-eclampsia, while 11 (25%) exhibited

features of severe preeclampsia.

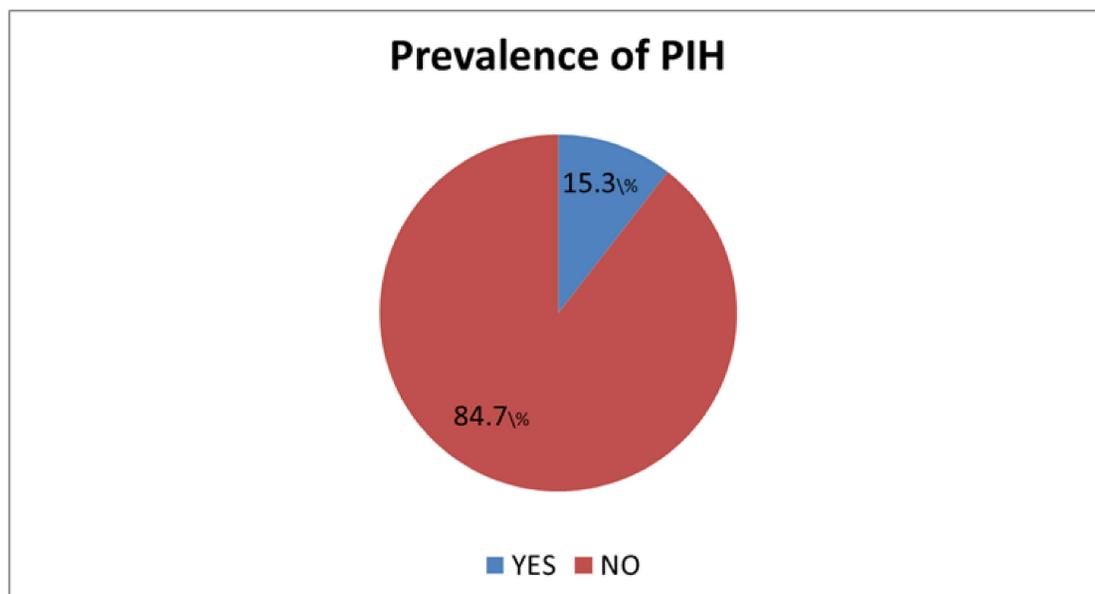
### 3.5 Predictors of Pregnancy induced hypertension

A bivariate logistic regression analysis was conducted, identifying variables such as age, maternal education, family history of chronic hypertension, planned pregnancy, family history of pregnancy-induced hypertension (PIH), history of asthma, and gravidity, all of which had a p-value of less than 0.25. These variables were subsequently included in the final model.

In the multivariable logistic regression analysis, two variables were found to be significantly associated with PIH. Primigravid women were 1.9 times more likely to develop PIH compared to multigravid women. Additionally, women with a family history of chronic hypertension had 2.8 times higher odds of developing PIH.

**Table 3** Medical related characteristics of pregnant women attending antenatal care at Dilla University General Hospital Ethiopia, 2023

Variable		Frequency	Percent
Family history of chronic hypertension	No	239	83.3
	Yes	48	16.7
Family history PIH	No	243	84.7
	Yes	44	15.3
Family History of Diabetes Mellitus	No	261	90.6
	Yes	26	9.4
Self-history of Diabetes Mellitus	No	280	97.6
	Yes	7	2.4
History of kidney disease	No	276	96.2
	Yes	11	3.8
Family history of kidney disease	No	233	81.2
	Yes	54	18.8
History of asthma	No	256	89.1
	Yes	31	10.8
BMI	<18	63	22
	18-25	142	49.5
	>25	82	28.6
Platelet count	$\leq 100000/m^3$	7	2.4
	$100000-150000/m^3$	83	28.9
	$>150000m^3$	197	68.7

**Figure 1** Prevalence of Pregnancy induced hypertension among pregnant women attending antenatal care at Dilla University General Hospital Ethiopia, 2023

**Table 4** Bivariate and multivariable logistic regression analysis of factors associated with pregnancy induced hypertension among pregnant women attending Antenatal care at Dilla University General Hospital, Ethiopia, 2023

Variables		Frequency		COR	AOR
		Yes	No		
Age of the participant	18-27	17	130	1	1
	28-35	20	85	1.79(1.360, 3.460)	.9(0.823, 2.965)
	≥36	7	28	1.91 (1.023, 2.942)	1.056(0.134, 4.1253)
Women's education	No formal education	9	49	1	1
	Primary school	24	117	1.11(0.682,2.821)	0.626(0.146, 2.693)
	Secondary school	1	28	0.19(0.021,1.440)	0.150(0.13, 1.863)
	College and above	10	49	1.11((0.683,2.821)	.721(0.452, 2.132)
Residence	Urban	113	123	1.21( 0.523, 1.923)	.98(0.214, 1.343)
	Rural	22	29	1	1
Planned Pregnancy	Yes	210	33	1	1
	No	33	11	0.47(0.103, 3.603)	.232(0.142, 1.810)
Gravidity	Primigravida	23	45	2.28 (1.323, 3.940)	1.863(1.147,3.196)*
	Multigravida	40	179	1	1
Family history of chronic HTN	No	40	199	1	1
	Yes	15	33	2.26(1.080, 5.585)	2.795(1.120-5.953)*
Family history PIH	No	22	221	1	1
	Yes	10	34	2.95(1.080, 5.585)	1.32(0.985-1.702)
History of asthma	No	82	174	1	1
	Yes	7	24	0.618(0.270, 1.483)	0.863(0.298, 2.498)

Note: COR, Crude Odd ratio, AOR: Adjusted Odd ratio

## 4 Discussion

This study aimed to determine the prevalence of pregnancy-induced hypertension (PIH) and associated factors among pregnant women attending antenatal care at Dilla University General Hospital, Ethiopia, in 2023. The findings revealed a PIH prevalence of 15.3% (95% CI: 11.5, 18.9). This result is consistent with the pooled prevalence of pre-eclampsia in Ethiopia, reported at 11.51% [21]. Similarly, this finding aligns with studies conducted in various regions of Ethiopia, including Arba Minch (18.25%), Gondar (16.8%), Addis Ababa (11.5%), Metu (12.4%), Debre Tabor (15.7%), and the Hadiya zone (13.4%) [12-16, 22]. However, the prevalence identified in this study is lower than findings from Jijiga (19%) [23], Addis Ababa (21.9%) [17], the overall pooled prevalence of PIH in Ethiopia (21.81%) [24], and Zimbabwe (21%) [25]. These variations may stem from differences in the timing of studies, as antenatal care

follow-up has increased over time, as well as variations in study designs, healthcare access, and the demographic characteristics of the populations studied.

The prevalence found in this study was higher than that observed in Mizan-Tepi (7.9%) [18], Dessie (8.4%) [26], Nigeria (4.51%) [20], and India (11%) [27]. These differences may be attributed to temporal variations, as the prevalence of chronic diseases and obesity—both significant risk factors for PIH—are on the rise. Additionally, disparities in maternal health service coverage and utilization, which are crucial for the early diagnosis of PIH, may also contribute to these variations.

The study identified a family history of chronic hypertension as a significant predictor of PIH. This finding is supported by studies conducted in Debre Tabor, Wolaita, Dessie, Hadiya zone, and systematic reviews conducted in Ethiopia [21,

22, 24, 26]. This relationship can be explained by the fact that chronic hypertension predisposes women to vascular dysfunction, which can exacerbate the physiological changes in blood pressure regulation during pregnancy, ultimately contributing to the development of PIH.

Furthermore, the study demonstrated that primigravidity was significantly associated with PIH. This finding is supported by research from central Tigray, Chiro in Oromia, Nekemte, and Addis Ababa [28-31]. This association may be explained by the limited sperm exposure of primigravid women, which can trigger immunologic responses that play a crucial role in the pathogenesis of PIH.

### Limitation of the study

The cross-sectional nature of this study precludes the establishment of causal relationships between the independent and outcome variables. Additionally, there is a possibility of recall bias, as some information depended on the participants' memory. Furthermore, since the study was conducted in a general hospital, the prevalence of pregnancy-induced hypertension (PIH) may be overestimated due to a higher likelihood of including complicated or referred cases.

## 5 Conclusion

This study found a high prevalence of pregnancy-induced hypertension (PIH), which remains a significant concern in the obstetric population. Factors such as the family history of chronic hypertension and primigravidity were significantly associated with PIH. These findings underscore the importance of incorporating risk assessment and family history screening into routine antenatal care to effectively mitigate the risk of PIH.

### List of Abbreviations

PIH      Pregnancy Induced Hypertension

### Declarations

#### Ethics approval and consent to participate

Ethical approval was obtained from the Institutional Review Board of Dilla University, College of Medicine and Health Sciences. A formal letter of cooperation was sent

to the Maternal and Neonatal Health (MNCH) Unit from the Department of Midwifery at Dilla University. After securing all necessary permissions, participants were informed about the study's purpose and objectives, and written informed consent was obtained. For those unable to read or write, consent was secured from a companion after the form was read aloud. Data collection was conducted anonymously to ensure confidentiality, accessible only to the investigators. Participants were informed of their right to decline or withdraw from the study at any time. All procedures adhered to institutional regulations and the principles of the Declaration of Helsinki.

**Consent for publication:** Not applicable

### Availability of data and materials

The full dataset supporting the findings of this study is available from the corresponding author upon reasonable request.

### Competing interests

The authors declare that they have no competing interests

**Funding:** The study has no funding source

### Authors' contributions

MD designed the study, participated in data collection, analysis, and interpretation of the results, drafted the manuscript, and contributed to the preparation of all versions of the paper. AG and WM assisted with study design and proposal development, supervised data collection, supported data analysis, and revised subsequent drafts of the manuscript. All authors read and approved the final version of the manuscript.

### Acknowledgments

We extend our heartfelt gratitude to the study participants for their willingness to take part in this research. We also sincerely appreciate the data collectors and supervisors for their cooperative support and assistance.

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