AFRICAN JOURNAL OF HEALTH SCIENCES AND MEDICINE
AJHSM (2026)05:01
http://www.du.edu.et/duj

RESEARCH ARTICLE

Undiagnosed hypertension and associated factors among women in Southern Ethiopia: A community-based cross-sectional study

Moges Mareg[1*], Temesgen Muche[2], Getachew Assefa[3], Getachew Nenko[3], Bahiru Mantefardo[4], Selamawit Dires[1]

Received: 30 September 2025

Accepted: 07 June 2026

Published: 30 June 2026

DOI:10.20372/ajhsm.v05i01.01

Suggested Citation: Mareg M., Muche T., Assefa G., Nenko G., Mantefardo B., & Dires S. Undiagnosed hypertension and associated factors among women in Southern Ethiopia: A community-based cross-sectional study. Afri. J. Heal. Sci. Med; 2026, 05(01).

Copyright: ©2026 Dilla University. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Background: With 7% of all disability-adjusted life years (DALYs) worldwide, hypertension (HTN) is the leading cause of disease burden. It was estimated that about half of the world's population had undetected hypertension in 2007. However, little is known about the prevalence and contributing factors of undetected hypertension in the Gedeo zone. Therefore, this study assessed the prevalence and contributing variables of undiagnosed hypertension among women in southern Ethiopia's Gedeo zone.

Methods: A community-based cross-sectional study was conducted with 414 women. Participants were systematically selected from districts within the Gedeo zone. Data were analyzed using SPSS version 25. Binary logistic regression was used to identify factors associated with undetected hypertension. Statistical significance was determined at a P-value < 0.05. Adjusted odds ratios (AORs) and 95% confidence intervals (CIs) were calculated.

Results: The prevalence (magnitude) of undiagnosed hypertension was 9.4% (95% CI: 6.6% to 12.2%). The following factors were significantly associated with undetected HTN: Age 40–49 years (AOR: 0.25; 95% CI: 0.07, 0.84), Being married (AOR: 0.33; 95% CI: 0.11, 0.96), Contraceptive use (AOR: 0.42; 95% CI: 0.19, 0.91), Lack of knowledge about hypertension (AOR: 2.38; 95% CI: 1.03, 5.52), and Cigarette smoking (AOR: 7.35; 95% CI: 1.21, 44.65).

Conclusion: The magnitude of undiagnosed hypertension was relatively low compared with the national prevalence reported for the general population. Women's age, marital status, contraceptive use, knowledge about hypertension, and cigarette smoking were significantly associated with undiagnosed HTN. The authors recommended screening women for undiagnosed hypertension, improving maternal knowledge about hypertension, and providing counseling to prevent smoking. Community-based interventions to reduce the risk of undiagnosed hypertension were also suggested for future research.

Keywords: Associated factors, Southern Ethiopia, Undiagnosed hypertension, Women

*Correspondence: metanmann@gmail.com
[1]Department of Reproductive Health, College of Health Sciences & Medicine, Dilla University, Dilla, Ethiopia.
Full list of author information is available at the end of the article

1 Background

Hypertension (HTN) is a condition of systemic high blood pressure defined as a systolic blood pressure of at least 140 mmHg and/or a diastolic blood pressure of at least 90 mmHg measured on two or more consecutive readings [1,2].

High blood pressure is classified as primary (essential) hypertension or secondary hypertension [3]. Approximately 90–95% of cases are primary hypertension, which is defined as elevated blood pressure resulting from nonspecific lifestyle and genetic factors [3]. The remaining 5–10% of cases are secondary hypertension, which is high blood pressure caused by a known factor, such as chronic kidney disease, renal artery constriction, endocrine disorders, or the use of contraceptives. Evidence directly linking contraceptive use with undiagnosed hypertension is limited; however, studies have shown that hormonal contraceptive use is associated with increased risks of prehypertension and hypertension, which may contribute to delayed detection in asymptomatic women [4].

Hypertension is the leading contributor to the global burden of disease, accounting for 7% of global disability-adjusted life years (DALYs) [5]. Globally, HTN is a major predisposing risk factor for cardiovascular disease (CVD). It is well established that treatment of elevated blood pressure yields substantial reductions in CVD outcomes [6]. According to World Health Organization (WHO) estimates, elevated blood pressure causes 7.5 million deaths annually and accounts for 57 million DALYs [7]. Over the past few decades, the burden of hypertension has continued to increase in Sub-Saharan Africa (SSA) [5].

The consequences are particularly severe in low-resource settings, where a large proportion of individuals with hypertension may remain undiagnosed, untreated, or inadequately treated, placing them at high risk of illness and death from preventable complications such as stroke and heart disease [8]. Globally, 51% of stroke (bleeding in the brain) and 45% of ischemic heart disease (IHD) mortalities are related to high systolic blood pressure. At any age, the risk of dying from high blood pressure in low- and middle-income countries (LMICs) is more than twice that in developed countries [8].

According to a World Health Organization (WHO) report, more than one-half of cardiovascular diseases (CVD) and about three-fourths of strokes are consequences of high blood pressure (BP) [9]. It was estimated that 62% of CVDs and approximately half of ischemic heart diseases (IHDs) worldwide are attributable to elevated BP [10]. Globally, hypertension (HTN) causes morbidity in about one billion people and results in about 10 million deaths [11]. In 2018, the prevalence of hypertension among adults was 24.0% in rural areas and 32.0% in urban areas. In the early stages, HTN is often asymptomatic, which means many cases remain undiagnosed [12].

Hypertension complicates up to 5% of the estimated 4 million pregnancies in developed countries each year [12] and is a major cause of maternal and fetal morbidity [13]. Between 10% and 25% of women with chronic hypertension develop superimposed preeclampsia [14]. The risk of placental abruption has also substantially increased, reaching 2% in some studies. Life-threatening maternal outcomes—including stroke, renal failure, pulmonary edema, and death—are significantly more common in women with chronic hypertension and those with undiagnosed hypertension [15,16]. Adverse fetal outcomes associated with chronic hypertension include preterm birth and intrauterine growth restriction, and the perinatal mortality rate among offspring of women with chronic hypertension is nearly 2–4 times higher [14,17].

Approximately 75% of people with hypertension live in low- and middle-income countries (LMICs). In these settings, awareness of HTN, its management, and control measures is often low [18]. Inadequate health-care seeking contributes to this situation and increases the prevalence of undetected hypertension. It has been reported that 30% of people in Sub-Saharan Africa (SSA) have undetected hypertension. Among individuals with HTN, 73% were unaware of their condition, only 18% received treatment, and just 7% had controlled BP [18].

The estimated prevalence of HTN among women aged 15–49 years is 7.7%. Hypertensive disorders of pregnancy—an umbrella term that includes preexisting and gestational hypertension, preeclampsia, and eclampsia—complicate up to 10% of pregnancies and are an important cause of maternal and perinatal morbidity and mortality [19].

Several factors have been linked to undiagnosed hypertension, including family history of hypertension [20], age-associated changes when combined with Western diet and lifestyle [21], arterial stiffening [22], and obesity [23,24]. More than 85% of cases occur among individuals with a body mass index (BMI) greater than 25. Other contributing factors include high salt (sodium) intake and chat chewing [23,24].

Hypertension is often referred to as a "silent killer" because many people do not develop noticeable signs or symptoms until the disease becomes severe, leading to poorer outcomes and higher health-care costs [24]. In 2007, it was estimated that about 50% of people worldwide had undiagnosed hypertension [25]. Evidence shows that early HTN screening has been particularly effective in reducing mortality over the past three decades [25]. However, there is limited information on the magnitude and associated factors of undiagnosed hypertension in the Gedeo zone in southern Ethiopia. Therefore, this study aims to determine the magnitude and associated factors of undiagnosed hypertension among women in the Gedeo zone, southern Ethiopia.

The findings will provide evidence to support interventions that improve women's health-seeking behavior and promote early identification and treatment before complications arise. The results will also be used to design interventions by zonal and district health offices and nongovernmental organizations (NGOs) to improve the health status of reproductive-age women and reduce hypertension-related complications.

2 Methods

2.1 Study Setting and Period

The current study was conducted in two selected districts—Yirgachefe and Repe—and in the administration of Dilla town in the Gedeo Zone of southern Ethiopia. Dilla, the capital city of the Gedeo Zone, is located about 360 km from Addis Ababa, the capital of Ethiopia.

The total population of the study area was 1,139,429. The Zone includes eight woredas (Bule, Gedeb, Wonago, Kochere, Chorso, Repe, Yirgachefe, and Dillazuria) and three administrative towns (Dilla, Gedeb, and Yirgachefe). According to the Gedeo Zone Health Department, the estimated number of women aged 15–49 years was 256,487. The study was conducted from October 1 to October 30, 2022.

2.2 Study design

A community-based cross-sectional study design was utilized.

2.3 Target population

All women who are residing in the Gedeo Zone are the source population.

2.4 Study population

Women who are residing in selected Districts of Gedeo Zone during the study period.

2.5 Sampling unit

The sampling unit was Households.

2.6 Study units

The study unit for this study was individual Women.

2.7 Variables of the study

Outcome variable

- Undiagnosed hypertension

Independent variables

- Socio-demographic factors of respondents (age, marital status, Religion, educational status, husband education, occupation, husband occupation, residence)

- Socio-economic factors
- Family history of cardiovascular diseases
- Reproductive and obstetric-related factors
- Knowledge about hypertension
- Personal behavior

2.8 Sample size calculation

The sample size was estimated using a single population proportion formula with the following assumptions: a percentage of undiagnosed hypertension (p = 0.21) in Jimma [26], a significance level of 5% ($\alpha = 0.05$), a 95% confidence level ($Z_{\alpha/2} = 1.96$), and an absolute precision or margin of error of 5% (d = 0.05).

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

Where, n = sample size
p = the percentage of undetected hypertension (0.21%)
Z = the value of the standard normal distribution curve for the 95% confidence interval (1.96).
d = the allowed error or accepted margin of error

$$n = \frac{(1.92)^2 * 0.21 * 0.79}{0.052}$$

The overall sample size was 26 + 255 = 281 after accounting for a 10% non-response rate. The final sample size is 422 after a design effect of 1.5 was applied.

2.9 Sampling procedures

A multi-stage simple random sampling method was used to select districts and kebeles. In the first stage, three districts and one town administration were selected by lottery from eight rural districts and three town administrations in the Gedeo Zone. In the second stage, two kebeles were selected from each of the selected districts and one kebele was selected from the Dilla town administration.

The total number of sampled women was then allocated proportionally across the three selected districts and the one town administration. Household lists for the selected areas were obtained from health extension workers. Finally, systematic sampling was employed to select individual women within the households.

2.10 Inclusion and exclusion criteria

Inclusion criteria
Women who are residing in Yirga-chefee, Repe, Bule districts and Dilla town of Gedeo zone were included.

Exclusion criteria
Women who were critically ill and unable to communicate during the data collection period were excluded.

2.11 Operational definition

The American Heart Association's Hypertension Guideline was used to measure hypertension. It was developed in 2017 by the American College of Cardiology and the American Heart Association to prevent, detect, assess, and treat elevated blood pressure in adults [27].

Undiagnosed hypertension was defined as a systolic blood pressure (SBP) of at least 140 mmHg and/or a diastolic blood pressure (DBP) of at least 90 mmHg, with no history of hypertension and no visit to a health facility for a blood pressure check within the previous year [1]. Blood pressure status was determined by averaging three readings taken with a sphygmomanometer. Measurements were taken while the participant was seated, with 10-minute intervals between readings.

Prehypertension was defined as an SBP of 120–139 mmHg and/or a DBP of 80–89 mmHg [1]. Normal blood pressure was defined as an SBP of 90–120 mmHg and a DBP of 60–80 mmHg [1].

Family history of hypertension was defined as a history of hypertension in either the father, the mother, or both.

Low fruit and/or vegetable consumption was defined as eating fruits and/or vegetables fewer than five times per day. One serving was considered to be three tablespoons of cooked vegetables or one apple, one orange, or one banana [1].

Questionnaires modified from earlier research were used to gauge participants' knowledge of hypertension. Knowledge scores of 50% and higher

were classified as "good." Knowledge scores below 50% are considered poor [28,29].

Personal behavior related factors were measured by the WHO Stepwise approach to surveillance (STEPS) procedures on chronic risk factor surveillance questionnaire [30].

2.12 Data collection tools and procedures

The data were collected using a structured, close-ended questionnaire developed based on related published literature [28,29]. The questionnaire had five main sections: socio-demographic characteristics, socio-economic status, knowledge about hypertension, family history of cardiovascular diseases and related factors, and personal behavior.

Socio-demographic section: Age, marital status, religion, educational status, husband's educational status, occupation, and place of residence were used to assess women's socio-demographic characteristics.

Knowledge about hypertension: Questions adapted from previous studies were used to assess women's understanding of hypertension. Knowledge scores of 50% and above were classified as "good," whereas scores below 50% were classified as "poor" [28,29].

Personal behavior: Personal behavior-related variables were measured using items adapted from the Chronic Risk Factor Surveillance Questionnaire and the WHO STEPS-wise approach recommendations [30].

After the interview, the participants' height and weight were measured by the data collectors. Weight was measured using a portable digital scale, and results were recorded to the nearest 0.1 kg. Height was measured using a portable stadiometer, and results were recorded to the nearest 0.1 cm. Participants were instructed to stand with their head, buttocks, heels, and upper back touching the stadiometer, with legs straight, arms at their sides, and their backs against the device. The headpiece was then lowered until it made firm contact with the crown of the head, compressing the hair.

Blood pressure was measured using a standard mercury sphygmomanometer with a cuff size that covered two-thirds of the upper arm. Thirty minutes before the measurement, participants were instructed to avoid coffee, alcohol, smoking, and physical exercise. Measurements were taken with the participant seated, back supported, legs straight, feet flat on the floor, and the bladder emptied. The participant's arm was positioned so that the upper arm was at heart level, resting on a desk with the arm supported. The cuff was placed on the upper arm with the brachial artery aligned correctly. Three blood pressure readings were taken while the participant was seated, with 10-minute intervals between each reading. The average of the three readings was used to determine the participant's blood pressure status.

2.13 Data quality assurance

To ensure consistency of meaning, the tool was translated from English into the Gedeoffa language and then back into English. This process was used to confirm the accuracy and consistency of the questionnaire items.

To determine which interview questions and physical measurements required modification, the questionnaire was pilot-tested on 28 participants living in the Wonago district, who had characteristics similar to those of the study population.

Two days of intensive training were provided to the supervisors and data collectors on how to obtain ethical consent, conduct participant interviews, measure blood pressure, record weight and height, and maintain accurate records.

Finally, the collected data were reviewed daily for completeness, consistency, and overall quality.

2.14 Data processing and statistical analysis

After being input into EpiData version 4.6, the data was transferred to SPSS statistical software version 25. Frequency and percentage were used for categorical data, and mean and standard deviation were computed for continuous

data. To determine the degree of correlation between women undiagnosed hypertension and independent variables, a bivariate logistic regression model was fitted with each independent variable separately. The multivariable logistic regression model comprised variables with a binary logistic regression p-value of less than 0.25 in to assess the connection between independent factors and the outcome variables. The unadjusted (crude) and adjusted odds ratios' 95% confidence intervals were computed. Hosmer and Lemeshow's goodness-of-fit test was used to evaluate the model's fitness (p = 0.85). The odds ratio (OR) with 95% confidence interval (CI) and a P-value ≤0.05 were used to assess statistical significance.

3 Results

3.1 Socio-demographic factors of the participants

From the total of 422 participants, 414 women participated in the study, making the response rate 98.10%. The mean age of the participants with the standard deviation was 28.25 (SD ±5.73) and the minimum and the maximum age of women were 18 and 49 years respectively. About more than half of the respondents, 268 (64.7%) were aged 18-29 years. Regarding participants' marital status, occupational status, and educational status, most of them, 388 (93.7%) were married, 107 (25.8%) were housewives and 63 (15.2%) had attended primary education (Table 1).

Table 1: Socio-demographic factors of women in Gedeo zone, south Ethiopia 2022 (n = 414)

Variables	Responses	Frequency	Percent (%)
Age group	18-29 years	268	64.7
	30-39 years	126	30.4
	40-49 years	20	4.8
Ethnicity	Gedeo	176	42.5
	Amhara	78	18.8
	Oromo	51	12.3
	Guragae	77	18.6
	Others*	32	7.7
Occupational status	Government employee	51	12.3
	Private work	121	29.2
	Housewife	107	25.8
	Merchant	73	17.6
	Farmer	51	12.3
	Others**	11	2.7
Educational status	Unable to read and write/illiterate	33	8
	Able to read and write/literate	85	20.5
	Primary education	63	15.2
	Secondary education	171	41.3
	College and above education	62	15
Marital status of respondents	Not married	9	2.2
	Married	388	93.7
	Divorced	9	2.2
	Widowed	8	1.9

Variables	Responses	Frequency	Percent (%)
Husband Educational status	Cannot read and write/illiterate	9	2.2
	Can read and write/literate	74	17.9
	Primary education	70	16.9
	Secondary education	169	40.8
	College and above	92	22.2
Husband Occupational status	Government employee	71	17.1
	Private work	103	24.9
	Merchant	184	44.4
	Farmer	41	9.9
	Others***	71	17.1
Monthly household Income	Less than 2000	145	35
	Greater than 20001	269	65
Residence	Rural	119	28.7
	Urban	295	71.3

Note: others*= silte, Tigririe; others**= student, day laborer, bank worker; others***=banker, laborer

3.2 Reproductive and obstetric-related factors

Among the total, 414 respondents, 35 (8.5%) had history of abortion. More than half of the study participants, 221 (53.4%) were primi-gravid (experienced pregnancy once). Almost two thirds of the participants, 292 (70.5%), used contraceptive methods, of those who used contraceptive, the Depo-Provera (injectable) users were 127 (30.7%) (Table 2).

Table 2 Reproductive health and related factors of women in Gedeo zone, south Ethiopia 2022 (n = 414)

Variables	Responses	Frequency	Percent (%)
Gravidity	Primi gravid	221	53.4
	Multi gravid	193	46.6
Number of children	Less than or equal to three	302	72.9
	More than three	112	27.1
Abortion	Yes	35	8.5
	No	379	91.5
Contraceptive use	Yes	292	70.5
	No	122	29.5
Type of contraceptive method used	Injection (Depo-Provera)	127	30.7
	Pills	106	25.6
	Implants	47	11.4
	Others*	14	3.4

Note: others*= IUCDs, Lactational-amenorrhea

3.3 Knowledge about hypertension

Approximately 325 mothers (78.5%) who participated in the study stated that they seek treatment for the symptoms of hypertension. About 144 (34.7%) of the respondents said that hypertension (HTN) can be prevented, while 342

(82.6%) were aware that difficulties or complications could arise from HTN. Furthermore, 155 research participants (37.4%) thought they were susceptible to HTN. Three hundred forty-five participants, or 83.3%, said that stressful living situations are a known cause of hypertension (Table 3). Majority, 348 (84.1%) of the respondents who answered the question had some knowledge of hypertension, while 66 (15.9%) did not (Figure 1).

Table 3 Knowledge of women about hypertension in Gedeo zone, south Ethiopia 2022 (n = 414)

Variables		Frequency	Percent (%)
Know the risk of hypertension	Yes	404	97.6
	No	10	2.4
Is curse a risk factor for hypertension	Yes	31	7.5
	No	383	92.5
Know the sign of hypertension	Yes	216	52.2
	No	198	47.8
Know that hypertension is preventable	Yes	339	81.9
	No	75	18.1
Knowing hypertension leads to complication	Yes	342	82.6
	No	72	17.4
Know the importance of frequent checkups of Blood Pressure	Yes	364	87.9
	No	50	12.1
Know that hypertensive people need to attend health facilities	Yes	379	91.5
	No	35	8.5
know the problem of not checking Blood Pressure	Yes	357	86.2
	No	57	13.8
Knowing one susceptibility to hypertension	Yes	155	37.4
	No	259	62.6
Knowledge on Hypertension	Good	348	84.1
	Poor	66	15.9

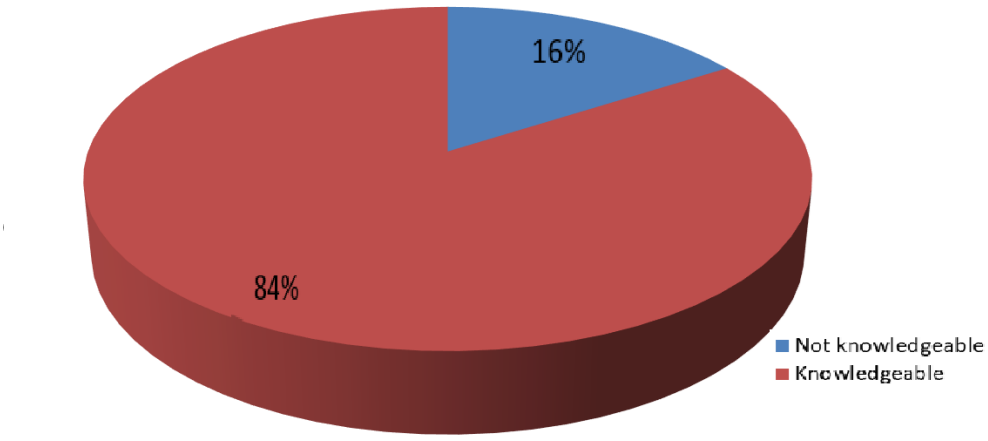


Figure 1 Knowledge of women about hypertension in Gedeo zone, south Ethiopia 2022 (n = 414)

3.4 Participant's history of previous illness

This current study showed that, of the total participants, 316 (76.3%) had a family history of hypertension. Twenty-five (6%) of the total respondents had a history of chronic diseases; of these, 11 (2.7%) had diabetes mellitus, 10 (2.4%) had kidney diseases, and the remaining 4 (1.0%) had cardiac diseases. Regarding the family history of chronic illnesses, 70 participants (16.9%) had a family history of chronic illnesses, whereas 344 (83.1%) had no family history of chronic illnesses. Fifty-one (12.3%) of participants with a history of chronic illnesses in their families had diabetes mellitus, 10 (2.4%) had kidney disease, and 8 (1.9%) suffered from cardiovascular problems. Regarding the lifestyles of the participants, 44 participants (10.6%) lead a sedentary lifestyle, whereas the majority of them, 370 (89.4%), have non-sedentary lives.

3.5 Behavioral factors

Regarding the behavioral factors, almost all of the respondents, 407 (98.3%), did not practice smoking, whereas 7 (1.7%) of the respondents have practiced smoking. These participants practiced smoking cigarettes daily. Regarding alcohol consumption, most 350 (84.5%) of the respondents consumed alcohol within the last one month (Table 4).

Table 4 Behavioral characteristics of women in Gedeo Zone, south Ethiopia 2022 (n = 414)

Variables		Frequency	Percent (%)
Salt intake	Yes	406	98.1
	No	8	1.9
Smoked cigarettes, cigarette products	Yes	7	1.7
	No	407	98.3
Smoked cigarettes daily	Yes	7	1.7
	No	407	98.3
Drink alcohol within the past 30 days	Yes	49	11.8
	No	350	84.5
Consumed alcoholic drinks like beer, wine, spirits	Yes	124	30
	No	290	70
Consumed an alcoholic drink within the past month	Yes	81	19.6
	No	329	79.5
Does your work involve vigorous-intensity activity	Yes	29	7
	No	385	93

3.6 Magnitude of Undiagnosed Hypertension

The status of respondents about their blood pressure was assessed using a sphygmomanometer by averaging three readings of measurement while the patient was seated and ten minutes apart. The magnitude of undiagnosed hypertension of the study area was 9.4%.

3.7 Undiagnosed hypertension and associated factors

On bivariate logistic regression analysis, the variables like maternal age, maternal occupational status, husband educational status, educational status, history of abortion, household monthly income, history of family planning use, knowledge of hypertension, and cigarette smoking were eligible for the final multivariable logistic regression analysis. Finally, the variables like maternal

age, marital status, contraceptive use, maternal knowledge about hypertension, and cigarette smoking were significantly associated with undiagnosed HTN.

Women between the ages of 40 and 49 had a 75% lower chance of having undetected hypertension than women between the ages of 18 and 29 (AOR = 0.25, 95% CI (0.07, 0.84)). Compared to single woman, married mothers had a 67% lower risk of undetected hypertension (AOR = 0.33, 95% CI (0.11, 0.96)). Compared to women who used modern contraceptive techniques, mothers who did not utilize family planning were 58% less likely to have undetected hypertension (AOR = 0.42, 95% CI (0.19, 0.91)). The likelihood of undiagnosed hypertension was twice as high for mothers who were unaware of the condition (AOR = 2.38, 95% CI (1.03, 5.52)). Compared to women who did not smoke, those who smoked were seven times more likely to have undetected hypertension (AOR = 7.35, 95% CI (1.21, 44.65)) (Table 5).

Table 5 Bivariate and Multivariable analysis on undiagnosed hypertension of reproductive age women assessed for undiagnosed hypertension in Gedeo zone, south Ethiopia 2022 (n = 414)

Variables Category	Undiagnosed hypertension		COR (95% CI)	AOR (95% CI)
	Yes	No		
Age group				
18-29 years	21 (7.83%)	247 (92.17%)	1	1
30-39 years	13 (10.32%)	113 (89.68%)	0.74 (0.36, 1.52)	0.93 (0.42, 2.04)
40-49 years	5 (25.00%)	15 (75.00%)	0.25 (0.08, 0.77)*	0.25 (0.07, 0.84)*
Marital status of respondents				
Single	7 (26.92%)	19 (73.08%)	1	1
Married	32 (8.25%)	356 (91.75%)	0.24 (0.09, 0.62)*	0.33 (0.11, 0.96)*
History of abortion				
Yes	3 (8.57%)	32 (91.43%)	1	1
No	36 (9.50%)	343 (90.50%)	0.89 (0.26, 3.06)	0.70 (0.18, 2.86
Contraceptive use				
Yes	23 (7.88%)	269 (92.12%)	1	1
No	16 (13.11%)	106 (86.89%)	0.56 (0.28, 1.11)	0.42 (0.19, 0.91)*
Sedentary lifestyle				
Yes	7 (15.91%)	37 (84.09%)	1	1
No	32 (8.65%)	338 (91.35%)	1.99 (0.82, 4.84)	0.83 (0.25, 2.82)
Knowledge on HTN				
Not knowledgeable	11 (16.67%)	55 (83.33%)	2.28 (1.08, 4.85)*	2.38 (1.03, 5.52)*
Knowledgeable	28 (8.05%)	320 (91.95%)	1	1
Alcohol intake				
Yes	12 (9.68%)	112 (90.32%)	1	1
No	27 (9.31%)	263 (90.69%)	1.04 (0.51, 2.13)	0.21 (0.02, 1.96)
Cigarette smoking				
Yes	3 (42.86%)	4 (57.14%)	7.73 (1.66, 35.89)	7.35 (1.21, 44.65)*
No	36 (8.85%)	371 (91.15%)	1	1

Note: * = significantly associated factors

4 Discussions

A community-based cross-sectional research was conducted to calculate the magnitude of undiagnosed HTN and related factors among women in the Gedeo zone, southern Ethiopia. The magnitude of undiagnosed HTN in the study setting was 9.4%. The factors like maternal age between 40 and 49 years, being married, contraceptive use, have knowledge about hypertension, and practicing cigarette smoking are variables associated with undiagnosed HTN.

This study showed that the magnitude of undiagnosed HTN was 9.4%. This finding is lower than a study done in Addis Ababa and Gondar town [31,32]. This variance might be the difference in sample size and service availability, access and delivery related factors. However, this study is higher than a study done in Bedele town [33] and India [34]. This may be due to the dissimilarities in socio-economic and demographic factors and differences in the study area.

The factor, maternal age is associated with undiagnosed hypertension. Women who are in the age group of 40-49 years were 75% less likely to have undiagnosed hypertension as compared to women who are in the age group of 18-29 years old. This might be due to older women may have reduced physiologic function (*i.e.* reduced elasticity of blood vessels, increased accumulation of fats), which increased the risk of undiagnosed hypertension. This finding was supported by a study done in sub-Saharan Africa [35], Sudan [36], and North India, which showed that age (45–69-year age group) was a risk factor that predicted having undiagnosed HTN [37]. The higher the risk makes them to diagnose their blood pressure status early.

The odds of married women were 67% less likely to have undiagnosed hypertension in the study area than their counterparts. This might be that women who are married may have access to services like pre-pregnancy, pregnancy, and postnatal care. This finding is supported by a study done in southwest Ethiopia [38] and North India, which stated that marital status is associated with undiagnosed hypertension [37].

Women who are nonuser of contraceptive method were 58% less likely to have undiagnosed HTN than users. This may be that women who did not use the contraceptive method may not check their blood pressure status more frequently than their counterparts. Hormonal contraception use and being age over 35 years are known to be higher risk factors for contributing to the development of hypertension [39[40].The main cause of contraceptive's effect on blood pressure rise is estrogen, which works by activating on the renin-angiotensin-aldosterone system, possibly causing sodium and water retention through interaction with mineral corticoid receptors and, more recently, by decreasing nitric oxide-mediated endothelium-dependent vasodilatation [39].

Women who have low knowledge about HTN were 2.38 times more likely to have undiagnosed HTN than their counterparts. This may be because participants who are knowledgeable about hypertension are more likely to seek medical attention and have their hypertension diagnosed than those who have low knowledge about hypertension. This finding is supported by the study done in central Ethiopia, participants with an inadequate understanding of the causes, risk factors, and methods for prevention of hypertension had a 2.65-fold greater chance of going undiagnosed [41].

The odds of women who are cigarette smokers were 7.73 times more likely to have undiagnosed hypertension than those women who did not smoke. This finding is supported by the finding in southern Ethiopia, those respondents who did not smoke were 0.45 times less likely to have undiagnosed hypertension than respondents who smoke [42] and in the central Africa Republic, the likelihood of undiagnosed hypertension among men and/or women increased with current cigarette usage [**??**]. Women who use cigarettes may not be as aware of the negative effects of tobacco use as they should be, as well as other health issues like hypertension, which prevents them from getting a blood pressure checkup.

This study showed that alcohol consumption was not related with undiagnosed HTN. This finding is different from the study conducted in North West Ethiopia found that alcohol intake was associated with undiagnosed hypertension [42] and central Africa Republic, women who consume alcohol may be less aware of the negative impacts of alcohol use and other health issues, such as hypertension, which prevents them from getting a blood pressure checkup [**??**]. High alcohol consumption was a risk factor and significantly associated with undiagnosed hypertension in northern India [37].

As strength, it is a community-based study and used as a source of data to assess the magnitude of undiagnosed hypertension and factors associated with it in the Gedeo Zone and to develop prevention strategies. On the other hand, it is not free from limitations. In this regard, it does not show a cause-effect relationship due to its cross-sectional nature.

5 Conclusion

According to the results of the current community-based cross-sectional investigation, 9.4% of women in the study setting had undiagnosed hypertension. Among women undiagnosed hypertension was substantially associated with maternal age, marital status, use of contraceptives, knowledge of hypertension, and cigarette smoking.

6 Recommendation

In collaboration with the district health facilities zone health department, promoting screening of women for hypertension, increase maternal knowledge about hypertension, improving maternal health education and counseling to avoid smoking, active participation of women in counseling and health education and screening of hypertension and hypertensive prevention activities were recommended. Finally, the authors encourage conducting implementation study to reduce the risk of undiagnosed hypertension in the Gedeo zone.

Declaration

Ethical approval

The College of Health Science and Medicine at Dilla University's IRB (institutional review board) provided ethical approval and clearance. The Gedeo Zone Health Department, as well as the Health Offices of each district and city government, provided a letter of support.

Permission to publish

Not relevant

Statement of data availability

Upon reasonable request, the corresponding author will provide the datasets used in this study.

Conflict of interest

There is no conflict of interest disclosed by the writers.

Funding statement

The research was funded by a Dilla University grant obtained from the research and dissemination office.

Acknowledgment

We would like to sincerely thank Dilla University College of Health Science and Medicine for providing funding for this study. We are grateful to the Gedeo Zone Health Bureau workers for their cooperative and beneficial assistance in providing their time and important information. We sincerely thank the respondents, supervisors, and data collectors for their assistance in completing this study.

Author contribution

Each of the authors: MB, TM, GA, GN, BM, and SD contributed significantly to the work presented; they were involved in the conception, design, implementation, and data collection of the study. MM, TM, GA, GN, BM, and SD agreed to be responsible for all parts of the work, approved the final version to be published, and took part in the article's drafting, revision, or critical review. They also agreed on the journal to which the paper was submitted. They also made contributions to the interpretation, analysis, and other fields.

Authors' Information

[1]Department of Reproductive Health, College of Health Sciences & Medicine, Dilla University, Dilla Ethiopia.

[2]Department of Human Nutrition, College of Health Sciences & Medicine, Dilla University, Dilla, Ethiopia.

[3]School of Public Health, College of Health Sciences & Medicine, Dilla University, Dilla, Ethiopia.

[4]School of Medicine, College of Health Sciences & Medicine, Dilla University, Dilla, Ethiopia.

References

1. World Health Organization, Geneva W. Global health estimates: deaths by cause, age, sex and country, 2000-2012. 2014;9.
2. Organization WH. Global status report on noncommunicable diseases 2014: World Health Organization; 2014.
3. Carretero OA, Oparil S. Essential hypertension: part I: definition and etiology. *Circulation*. 2000 Jan 25; 101(3):329-35.
4. Adler AJ, Prabhakaran D, Bovet P, Kazi DS, Mancia G, Mungal-Singh V, Poulter N. Reducing cardiovascular mortality through prevention and management of raised blood pressure: a World Heart Federation roadmap. *Global heart*. 2015 Jun 1;10(2).
5. Gudmundsdottir H, Høieggen A, Stenehjem A, Waldum B, Os I. Hypertension in women: latest findings and clinical implications. *Therapeutic advances in chronic disease*. 2012 May; 3(3):137-46.
6. Twagirumukiza M, De Bacquer D, Kips JG, de Backer G, Vander Stichele R, Van Bortel LM. Current and projected prevalence of arterial hypertension in sub-Saharan Africa by sex, age and habitat: an estimate from population studies. *Journal of hypertension*. 2011 Jul 1; 29(7):1243-52.
7. Alwan A. Global status report on noncommunicable diseases 2010: World Health Organization; 2011.
8. Berni A, Ciani E, Cecioni I, Poggesi L, Abbate R, Boddi M. Adherence to antihypertensive therapy affects ambulatory arterial stiffness index. *European journal of internal medicine*. 2011 Feb 1; 22(1):93-8.
9. Ha SK. Dietary salt intake and hypertension. Electrolytes & Blood Pressure: E & BP. 2014 Jun 30; 12(1):7.
10. Forouzanfar MH, Liu P, Roth GA, Ng M, Biryukov S, Marczak L, Alexander L, Estep K, Hassen Abate K, Akinyemiju TF, Ali R. Global burden of hypertension and systolic blood pressure of at least 110 to 115 mm Hg, 1990-2015. *Jama*. 2017 Jan 10; 317(2):165-82.
11. Williams B, Mancia G, Spiering W, Agabiti Rosei E, Azizi M, Burnier M, Clement DL, Coca A, De Simone G, Dominiczak A, Kahan T. ESC/ESH Guidelines for the management of arterial hypertension: The Task Force for the management of arterial hypertension of the European Society of Cardiology (ESC) and the European Society of Hypertension (ESH). *European heart journal*. 2018 Sep 1; 39(33):3021-104.
12. Naghavi M, Abajobir AA, Abbafati C, Abbas KM, Abd-Allah F, Abera SF, Aboyans V, Adetokunboh O, Afshin A, Agrawal A, Ahmadi A. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980–2016: a systematic analysis for the Global Burden of Disease Study 2016. *The lancet*. 2017 Sep 16; 390(10100):1151-210.
13. Sibai BM. Chronic hypertension in pregnancy. *Obstetrics & Gynecology*. 2002 Aug 1; 100(2):369-77.
14. Kuklina EV, Ayala C, Callaghan WM. Hypertensive disorders and severe obstetric morbidity in the United States. *Obstetrics & Gynecology*. 2009 Jun 1; 113(6):1299-306.
15. Bateman BT, Schumacher HC, Bushnell CD, Pile-Spellman J, Simpson LL, Sacco RL, Berman MF. Intracerebral hemorrhage in pregnancy: frequency, risk factors, and outcome. *Neurology*. 2006 Aug 8; 67(3):424-9.
16. Gilbert WM, Young AL, Danielsen B. Pregnancy outcomes in women with chronic hypertension: a population-based study. *The Journal of reproductive medicine*. 2007 Nov 1; 52(11):1046-51.
17. Wang X, Carcel C, Woodward M, Schutte AE. Blood pressure and stroke: a review of sex-and ethnic/racial-specific attributes to the epidemiology, pathophysiology, and management of raised blood pressure. *Stroke*. 2022 Apr; 53(4):1114-33.
18. Ataklte F, Erqou S, Kaptoge S, Taye B, Echouffo-Tcheugui JB, Kengne AP. Burden of undiagnosed hypertension in sub-saharan Africa: a systematic review and meta-analysis. *Hypertension*. 2015 Feb; 65(2):291-8.
19. American College of Obstetricians and Gynecologists. Hypertension in pregnancy. Report of the American College of Obstetricians and Gynecologists' task force on hypertension in pregnancy. *Obstet. Gynecol*. 2013; 122:1122.
20. Carrera-Bastos P, Fontes-Villalba M, O'Keefe JH, Lindeberg S, Cordain L. The western diet and lifestyle and diseases of civilization. *Research Reports in Clinical Cardiology*. 2011 Mar 9:15-35.
21. Kosugi T, Nakagawa T, Kamath D, Johnson RJ. Uric acid and hypertension: an age-related relationship?. *Journal of human hypertension*. 2009 Feb; 23(2):75-6.
22. Romero-Corral A, Somers VK, Sierra-Johnson J, Thomas RJ, Collazo-Clavell ML, Korinek JE, Allison TG, Batsis JA, Sert-Kuniyoshi FH, Lopez-Jimenez F. Accuracy of body mass index in diagnosing obesity in the adult general population. *International journal of obesity*. 2008 Jun; 32(6):959-66.
23. Geleta GT, Cheme MC, Roro EM. Physical, behavioral and sociodemographic determinants of hypertension among the adult population in Nekemte town, western Ethiopia: community based study. *BMC Research Notes*. 2019 Nov 21; 12(1):764.
24. Organization WH. Global action plan for the prevention and control of noncommunicable diseases 2013-2020: *World Health Organization*; 2013.

25. Arrieta A, Woods JR, Qiao N, Jay SJ. Cost–benefit analysis of home blood pressure monitoring in hypertension diagnosis and treatment: an insurer perspective. *Hypertension*. 2014 Oct; 64(4):891-6.

26. Mogas SB, Tesfaye T, Zewde B, Tesfaye Y, Kebede A, Tadesse M, Gudina EK, Tamiru D, Dadi LS. Burden of undiagnosed hypertension among adults in urban communities of Southwest Ethiopia. *Integrated Blood Pressure Control*. 2021 May 21:69-76.

27. Carey RM, Whelton PK, 2017 ACC/AHA Hypertension Guideline Writing Committee*. Prevention, detection, evaluation, and management of high blood pressure in adults: synopsis of the 2017 American College of Cardiology/American Heart Association Hypertension Guideline. *Annals of internal medicine*. 2018 Mar 6; 168(5):351-8.

28. Mazimpaka C, Nsanzimana S, Logan J, Binagwaho A, Wong R. Assessing the magnitude and risk factors Associated with undiagnosed hypertension in rural Rwanda. Assessing the magnitude and risk factors Associated with undiagnosed hypertension in Rural Rwanda. 2019 Mar 3.

29. Kanj H, Khalil A, Kossaify M, Kossaify A. Predictors of undiagnosed and uncontrolled hypertension in the local community of Byblos, Lebanon. *Health services insights*. 2018 Aug; 11:1178632918791576.

30. World Health Organization. WHO STEPS surveillance manual: the WHO STEPwise approach to chronic disease risk factor surveillance. *World Health Organization*; 2005.

31. Getachew F, Dirar A, Solomon D. Prevalence of undiagnosed hypertension and associated factors among residents in Gulele Sub-City, Addis Ababa, Ethiopia. *J Community Med Health Educ*. 2018; 8(590):2161-0711.

32. Abebe SM, Berhane Y, Worku A, Getachew A. Prevalence and associated factors of hypertension: a crossectional community based study in Northwest Ethiopia. *PloS one*. 2015 Apr 24; 10(4):e0125210.

33. Bonsa F, Gudina EK, Hajito KW. Prevalence of hypertension and associated factors in Bedele Town, Southwest Ethiopia. *Ethiopian journal of health sciences*. 2014 Apr 15; 24(1):21-6.

34. Essa E, Shitie D, Yirsaw MT, Wale MZ. Undiagnosed hypertension and associated factors among adults in Debre Markos town, North-West Ethiopia: a community-based cross-sectional study. *SAGE Open Medicine*. 2022 Apr; 10:20503121221094223.

35. Sookram C, Munodawafa D, Phori PM, Varenne B, Alisalad A. WHO's supported interventions on salt intake reduction in the sub-Saharan Africa region. *Cardiovascular diagnosis and therapy*. 2015 Jun;5(3):186.

36. Bushara SO, Noor SK, Elmadhoun WM, Sulaiman AA, Ahmed MH. Undiagnosed hypertension in a rural community in Sudan and association with some features of the metabolic syndrome: how serious is the situation?. *Renal failure*. 2015 Jul 3; 37(6):1022-6.

37. Tripathy JP, Thakur JS, Jeet G, Chawla S, Jain S. Alarmingly high prevalence of hypertension and pre-hypertension in North India-results from a large cross-sectional STEPS survey. *PLoS ONE*, 2017 12(12): e0188619.

38. Canto, C. and Vogt-Ferrier, N. Hypertension Led by Medicine. *Revue Médicale Suisse*, 2006; 2, 2463-2467.

39. Zamané H, Millogo G. Hormonal Contraception and Hypertension at the Department of Obstetrics and Gynecology, Yalgado Ouédraogo Teaching Hospital: Epidemiological. Clinical and Therapeutic Patterns. *Open Journal of Obstetrics and Gynecology*. 2016 May 10; 6(06):379-84.

40. Gelassa FR, Birhanu A, Shibiru A, Nagari SL, Jabena DE Undiagnosed status and associated factors of hypertension among adults living in rural central, Ethiopia, 2020: Uncovering the hidden magnitude of hypertension. *PLoS ONE*. 2022; 17(12): e0277709. https://doi.org/10.1371/journal.pone.0277709.

41. Haligamo D, Ayalew A, Genemo H, Yiriga N Undiagnosed Hypertension and Its Associated Factors among Adult People Living in Southern Ethiopia: Evidence from Gunchire Woreda of Gurage Zone. *J Hypertens Manag*. 2021; 7:063. doi.org/10.23937/2474-3690/1510063.

42. Pengpid, S., Peltzer, K. Magnitude and associated factors of undiagnosed hypertension among adults in the Central African Republic. *Sci Rep*. 12, 19007 (2022). https://doi.org/10.1038/s41598-022-23868-5.