HYPERTENSIVE DISORDERS OF PREGNANCY AND ITS EFFECT ON BIRTH OUTCOMES AMONG MOTHERS IN PUBLIC HOSPITALS OF TIGRAY, NORTH ETHIOPIA

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Original Papers

This dissertation is based on the following four papers, which will be referred in the text by their Roman numbers:

I. **Hailemariam Berhe Kahsay, Fikre Enquselassie Gashe and Wubegzier Mekonnen Ayele.** Patterns of hypertensive disorders of pregnancy in Public hospitals of Tigray, Ethiopia. Journal of Advances in Medicine and Medical Research. 2018; 27(12):1-14. DOI: 10.9734/JAMMR/2018/44557

II. **Hailemariam Berhe Kahsay, Fikre Enquselassie Gashe and Wubegzier Mekonnen Ayele.** Risk Factors for Hypertensive Disorders of Pregnancy among Mothers in Public hospitals of Tigray Region, Ethiopia: Matched Case-Control Study. BMC Pregnancy and Childbirth. 2018; 18(482):1-10 https://doi.org/10.1186/s12884-018-2106-5

III. **Hailemariam Berhe Kahsay, Fikre Enquselassie Gashe and Wubegzier Mekonnen Ayele.** The Effect of Hypertensive Disorders in Pregnancy on Maternal and Perinatal Birth Outcomes in Public hospitals of Tigray, Ethiopia: A prospective cohort study. *Submitted to plose one*

IV. **Hailemariam Berhe Kahsay, Fikre Enquselassie Gashe and Wubegzier Mekonnen Ayele.** Why mothers are not early screened and treated for hypertensive disorders of pregnancy in Tigray, Ethiopia: A Qualitative study. *Under review in BMC Nursing*

Acronyms and Abbreviations

ACOG	American College of Obstetricians and Gynaecologists
ANC	Antenatal Care
APGAR	Activity Pulse Grimace Appearance Respiration
BEmONC	Basic Emergency Obstetrics and New-born Care
BMI	Body Mass Index
BP	Blood Pressure
CEmONC	Comprehensive Emergency Obstetrics and New-born Care
CFR	Case Fatality Rate
COC	Combined Oral Contraceptive
CVD	Cardiovascular Disease
DIC	Disseminated Intravascular Coagulation
DM	Diabetes Mellitus
EmONC	Emergency Obstetrics and New-born Care
GA	Gestational Age
GDM	Gestational Diabetes Mellitus
HDP	Hypertensive Disorders of Pregnancy
HELLP	Haemolysis, Elevated Liver Enzymes and Low Platelet count
HIV	Human Immune Deficiency Virus
HMIS	Health Management Information Systems
IRB	Institutional Review Board
IUFD	Intrauterine Fetal Death
IUGR	Intrauterine Growth Restriction
LBW	Low Birth Weight
MgSO4	Magnesium sulphate
MUAC	Mid Upper Arm Circumference
NGOs	Non-Governmental Organizations

OR Odds Ratio

PAH Pregnancy Aggravated Hypertension

PE/E Preeclampsia-Eclampsia

PE Preeclampsia

PIH Pregnancy Induced Hypertension

PNMR Perinatal Mortality Rate

SGA Small for Gestational Age

USA United States of America

WHO World Health Organization

Glossary

Hypertensive Disorders of Pregnancy- any type, including gestational hypertension, chronic hypertension, preeclampsia/eclampsia, or preeclampsia/eclampsia superimposed on chronic hypertension

Gestational hypertension- systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg measured on two occasions at least 4 hours apart after twenty weeks of gestation in the absence of proteinuria or other systemic symptoms.

Chronic hypertension- includes essential hypertension as well as hypertension secondary to a range of conditions which is characterized by a blood pressure greater than or equal to 140 mmHg systolic and/or 90mmHg diastolic confirmed before pregnancy or before 20 completed weeks gestation.

Mild Preeclampsia- blood pressure (BP) ≥ 140/90 mmHg after 20 weeks of pregnancy without severity features.

Severe pre-eclampsia- diastolic blood pressure of 110 mm Hg or higher; proteinuria of 3+ or higher;signs and symptoms, including headache, hyperreflexia, blurred vision, oliguria, epigastric pain, and pulmonary edema.

Eclampsia- convulsions; diastolic blood pressure of 90 mm Hg or higher after 20 weeks of pregnancy; proteinuria of 2+ or higher; signs and symptoms of severe pre-eclampsia may be present.

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Abstract

Background: over half a million women die each year from pregnancy related causes signifying that complications of pregnancy and childbirth are the leading cause of death amongst women of reproductive ages. Hypertensive disorders of pregnancy are the second direct cause of maternal death only next to hemorrhage which accounts 14% of all maternal mortality globally and 16 % in sub-Saharan African countries. In Ethiopia 11% of all maternal deaths and 16% of direct maternal deaths are due to this obstetric complication. There is paucity of study looking into the pattern and distribution, the risk factors and the maternal and perinatal outcomes of hypertensive disorders of pregnancy. Moreover, little is known why hypertensive disorders of pregnancy are not early detected and managed to prevent the serious consequences of the disorders.

Objective: the aim of this study was to assess hypertensive disorders of pregnancy and its effect on birth outcomes

Methods: The study was conducted in public hospitals of Tigray, Ethiopia. Cross-sectional, matched case control, cohort and descriptive qualitative designs were applied for objectives one, two, three and four respectively. For the retrospective record review, all records of women diagnosed with hypotensive disorders of pregnancy from September 2012 to August 2017 (with calculated sample size of 746) were considered while for the case control study a total of 330 (cases=110 and controls=220) matched by parity were included. In addition, a total of 374 (exposed/with hypertensive disorders=187, non-exposed/without hypertensive disorders=187) were included in the follow up study. In the qualitative study, for documenting barriers, health professionals, health care leaders and women with a history of hypertensive disorder of pregnancy were included. Cases were pregnant women attending maternal health services with a diagnosis of hypertensive disorders of pregnancy by an obstetrician while controls were pregnant women attending maternal health services without hypertensive disorders of pregnancy. In the cohort study, exposed group were women diagnosed with any of the hypertensive disorders of pregnancy after 20 weeks of gestation by an obstetrician while non-exposed group were women free from any of the hypertensive disorders of pregnancy. Case-control incidence density sampling was used to identify cases and controls. For the cohort study, women diagnosed with hypertensive disorders of pregnancy with their non-hypertensive pairs were enrolled after 20 weeks of gestation and followed until the first 7 days postpartum. In both designs (case-control and cohort) the sample size was distributed to each selected hospitals according to the case load. For the qualitative study, a total of 22 in-depth interviews were conducted and the sample size was guided by the level of information saturation

Data entry for the quantitative study was done into Epi-Info software and it was analysed using STATA 14 software. Descriptive statistics was computed and data were summarized in frequencies, proportions and means. Binary logistic regression was used to calibrate the association of different variables with the dependent variable for the quantitative study. For the case control study conditional logistic regression model was applied and Odds ratio was generated. Besides, relative risk was generated from a binary logistric regression for the cohort study. P-value less than 0.05 were considered significant in all analysis. For the qualitative study, recorded data were transcribed verbatim and translated to English. The transcript was exported to Atlas ti.7 software for qualitative data analysis which was followed by developing a categorization scheme to reduce the data and make it more manageable. Transcripts were read for several times and the primary codes were extracted. Then, the related codes were put in one group/category. Finally, based on similarity and content, the subcategories were used to make the main categories or themes. Thus, thematic content analysis was used to generate the main themes of the study. The overall findings were presented using figures, tables and texts. Ethical clearance was obtained from Institutional Review Board (IRB) of Addis Ababa University College of Health Sciences. Cooperation letter was written from the Regional Health Bureau and permission was requested from study facilities. Individual written informed consent was also sought from respondents at the time of data collection.

Results: A total of 45,329 mothers were admitted to deliver in the selected public hospitals of Tigray during the five years study period (September 2012 to August 2017). Out of the total deliveries, 1347 (3%) women were diagnosed for one of the hypertensive disorders of pregnancy. The overall magnitude showed an increasing trend over the review period ranging from 1. 4% in 2013 to 4% in 2017 which gives average percentage increase of 31% per annum.The change over the five years period was checked for its significance using chi-square trend analysis and it was found to be significant (X^2= 153, p≤0.001).

Multivariable analysis on the relationship between hypertensive disorders of pregnancy and different covariates revealed that rural residence (AOR = 3.7, 95% CI; 1.9, 7.1), less amount of fruits consumption (OR =5.1, 95% CI;2.4, 11.15), being overweight (pre-pregnancy BMI>25 Kg/m2) (AOR= 5.5 95% CI; 1.12, 27.6), gestational diabetes mellitus (AOR = 5.4, 95%CI; 1.1, 27.0) and multiple pregnancy (AOR= 4.2 95%CI; 1.3, 13.3) were independent predictors of hypertensive disorders of pregnancy.

Moreover, the study showed higher risk of having pregnancies complicated by maternal and perinatal adverse outcomes. Thirty six (20.2%) of hypertensive women and 19(10.7%) of normotensive women undergone cesarean section delivery. Preterm birth (RR=1.8; 95%CI, 1.5, 2.2), stillbirth (RR=1.6; 95%CI, 1.3, 2.02), low birth weight (RR=1.9; 95%CI, 1.6, 2.3), early neonatal death (RR=1.7; 95%CI, 1.3, 2.3), perinatal death (aRR=2.6, 95%CI; 1.2, 5.7) and cesarean section delivery(RR=1.7; 95%CI, 1.02, 2.9) were significantly higher among women with hypertensive disorders of pregnancy

Furthermore, the qualitative study showed that knowledge deficit and traditional believes towards hypertensive disorders of pregnancy, delayed referral and provision of incomplete pre-referral treatments in the lower level health care facilities, failure to implement antenatal follow up as per the recommendation; scarcity and interruption in the supply of resources; and lack of mentorship programs to make professionals competent were claimed for the late detection and management of hypertensive disorders of pregnancy.

Conclusion: Hypertensive disorder of pregnancy in Tigray is found to be 3% and it showed an increasing trend. Rural residence, less fruit consumption, multiple pregnancy, presence of gestational diabetes mellitus and pre-pregnancy overweight were identified as independent risk factors in the current study. Besides, women with hypertensive disorders in pregnancy were at significantly higher risk of having pregnancies complicated by maternal and perinatal adverse outcomes. A significant risk of cesarean section delivery, preterm birth, perinatal death, stillbirth and low birth weight delivery were reported among women with hypertensive disorders of pregnancy.

Moreover, poor awareness of mothers and community misconceptions towards hypertensive disorders of pregnancy, multiple referrals before reaching the final functional health care facility, less focus on the quality of antenatal care, scarcity of resources and limited capacity building programs were reported as barriers for early detection and management of hypertensive disorders of pregnancy.

Therefore, health care managers and administrators at different level of the health care system should give due emphasis to hypertensive disorders of pregnancy as it is one of the top causes of maternal and perinatal mortality and its magnitude is increasing from time to time.

Health institutions should have strong strategies of screening, counselling, follow-up and referral linkage of mothers in the antenatal clinic and maternity wards by availing necessary materials and designing strong supportive supervision/ mentorship programs.

I. Introduction

1. 1 Background

Globally, about half a million women die every year associated with complications in pregnancy and childbirth and most of these deaths are in low income countries[1]. Hypertensive disorders of pregnancy is one of the leading causes of maternal and perinatal mortality and morbidity [2, 3].

According to the American college of obstetricians and gynaecologists (ACOG), Hypertension in pregnancy is defined as: Systolic blood pressure greater than or equal to 140 mmHg and/or diastolic blood pressure greater than or equal to 90 mmHg in two occasions at least 6 hours apart. Hypertensive disorders of pregnancy (HDP) is categorized as Chronic hypertension, Gestational hypertension, Preeclampsia superimposed on chronic hypertension and Preeclampsia –eclampsia. It is characterized by increased blood pressure, protein in urine and sometimes convulsions during pregnancy [4-6].

Chronic hypertension is elevated blood pressure diagnosed before pregnancy or within the first 20 weeks of gestation whereas gestational hypertension refers to elevated blood pressure detected after the 20th week of gestation. Preeclampsia is characterised by increased blood pressure after 20 weeks of gestation in a woman with previously normal blood pressure and proteinuria greater than or equal to 300mg per 24-hours urine collection or a qualitative dipstick reading of above 1+. In addition patients could have decreased platelet count, impaired liver function, progressive renal insufficiency, pulmonary edema and cerebral or visual disturbances. In cases where signs and symptoms of preeclampsia are also accompanied by grand mal/tonic clonic seizures, the term eclampsia is used[5, 7].

These groups of disorders vary in their pathogenesis, clinical features, and clinical courses though hypertension is a common denominator for all [5, 6, 8]. In most cases gestational hypertension and preeclampsia are developed during term or when the women approaches term. Late development of mild hypertension or preeclampsia during pregnancy is associated with reduced maternal and neonatal morbidities[7]. Among the hypertensive disorders of pregnancy, preeclampsia-eclampsia has higher impact on maternal and neonatal health but its pathogenesis is not well established and suspected to be related to placental disturbances and generalized inflammation early in pregnancy which eventually progresses to endothelial damage[9, 10].

Women having the advanced cases of the disorders such as sever preeclampsia demands intensive monitoring during the period of pregnancy, and those with maternal and perinatal complications should be managed in well-equipped health facilities[7].The most serious consequence of preeclampsia is eclampsia, before, during or after birth which can be manifested by convulsions. Termination of pregnancy is the only ideal therapy. Nowadays, it is recommended to terminate pregnancy in a severe preeclampsia once the mother is stable regardless of the gestational age. However, in less severe cases (<32 weeks), termination of pregnancy can be postponed accompanied by strict follow up to assist in fetal lung maturation[11].

So far, many studies have been conducted especially in developed countries but the reported magnitude, risk factors and maternal and perinatal outcomes associated with hypertensive disorders of pregnancy varies widely across countries. In addition studies on HDP are scarce across many developing countries, including Ethiopia.

1.2 Statement of the Problem

In 2009, it was reported that globally 10% of pregnant women have had high blood pressure and 2 to 8% of them complicated with preeclampsia [1]. There is in fact regional variation regarding the magnitude of hypertensive disorders of pregnancy; For instance, the prevalence of Hypertensive disorder of pregnancy was 2.31%in Iran [12]8.49% in Turkey [13]7.5 % in Brazil [14] 5.3% in Ethiopia [15]and 8% in Jordan [16].

Multi-country survey on maternal and new-born health by world health organization in 29 countries of Africa, Asia, Latin America and the Middle East revealed that overall 2.7% women suffered from hypertensive disorders and the incidence of pre-eclampsia was 2.16%. The prevalence of eclampsia in low income and high income countries was 0.26% and 0.05% respectively[17]. In general, the prevalence of preeclampsia in developing countries ranges from 1.8% to 16.7%[18].

According to WHO report, direct obstetric causes contributed for about 72.5% of all maternal deaths whereas 27·5% were due to indirect causes between 2003 and 2009. Of the direct obstetric causes, haemorrhage accounted for 27·1%, hypertensive disorders 14·0% and sepsis 10·7% of maternal death. The remaining deaths were due to abortion (7·9%), embolism (3·2%) and all other direct causes of death (9.6%). It was also reported that indirect causes of maternal death include HIV, diabetes mellitus, anaemia, malaria, tuberculosis, cardiac disease and renal disorders which accounted all for 70%[3].

The aforementioned findings revealed that hypertensive disorder of pregnancy is the second direct cause of maternal death only next to hemorrhage which accounts 14% of all maternal mortality, this figure went up to16 % in sub-Saharan African countries[3]; also in some countries like Mexico, hypertensive disorders of pregnancy specially the advanced forms of severe pre-eclampsia and eclampsia is the leading cause of maternal mortality[19]. Overall, 10 to 15% of direct maternal deaths are associated with preeclampsia and eclampsia. Nearly 63,000 pregnant women die every year due to eclampsia and severe pre-eclampsia. In areas where maternal mortality is high, most of deaths are attributable to eclampsia. Not only this but also perinatal mortality is high in preeclampsia and eclampsia cases[2, 19]

The probability of maternal death due to pre-eclampsia/eclampsia in developing country is about 300 times higher compared with a woman from developed country. If a woman develops pre-eclampsia, she is three times more likely to progress to eclampsia and 14 times more likely to die of eclampsia[19].

According to the 2008, emergency obstetrics and new born care (EmONC) study in Ethiopia, 1.2% of pre-eclampsia/eclampsia cases were reported among all institutional deliveries. Besides, it contributed for 11% of all maternal deaths and 16% of direct maternal deaths [20].

Studies in different parts of the globe identified the common risk factors of hypertensive disorders of pregnancy. Some of these risk factors include socio-demographic variables, personal and lifestyle factors, obstetric related factors, familial factors and medical related variables [21-26].

Mothers experiencing hypertensive disorders during pregnancy are prone to many perinatal and maternal adverse outcomes as well as possibly develop chronic diseases in their later life[27]. According to a study by WHO, maternal near-miss cases were eight and sixty times higher in women with pre-eclampsia and eclampsia respectively; compared with women without these conditions[17]. preeclampsia which is characterised by hypertension and proteinuria is the main cause of maternal mortality and also is responsible for 20-25% of perinatal mortality[11].

In an Algerian study, the overall incidence of maternal adverse event due to hypertensive disorders of pregnancy was 28.7%. Prematurity, small for gestational age birth, preterm and fetal death rates were substantially higher[23]. Similarly, in Iran the cesarean section delivery rate was 45.8% among women with hypertensive disorders of pregnancy [12].

WHO has developed a guideline with present evidence-informed recommendations with a view to promoting the best possible clinical practices for the management of pre-eclampsia and eclampsia[9].

But there is variation among countries with respect to the implementation of the guideline. In developing countries, control of preeclampsia depends on the ability of health care systems to identify and manage a high risk women [18]. The number of health facilities with intensive care units are limited in low and middle income countries and have high mortality and morbidity [1].

Even though hypertensive disorders of pregnancy are the leading causes of maternal and perinatal mortality, there is paucity of evidence about it in Ethiopia. Information on magnitude, risk factors, birth outcomes and barriers for screening women with hypertensive disorders of pregnancy in Ethiopia and other sub-Saharan Africa countries is limited.

Therefore, the aim of this research was to assess hypertensive disorders of pregnancy and its effect on birth outcomes among mothers in public hospitals of Tigray.

1.3 Rationale of the study

Hypertensive disorder of pregnancy is a public health important issue both in developed and developing countries[3, 28]. The developed countries have actually investigated the issue extensively and trying to manage it properly[19] but in developing countries, health professionals mainly depend on evidences produced elsewhere to manage the problem. On the other hand, maternal mortality analysis in Ethiopia in the last decade showed that death due to abortion and bleeding is decreasing but death due to hypertensive disorders is rising[29, 30].

Although appropriate prenatal care, with observation of women for signs of preeclampsia and then delivery to terminate the disorder, has reduced the number and extent of poor outcomes, serious maternal-fetal morbidity and mortality is still prevailing[1].

Besides, to date chronic diseases are prevailing and becoming international agenda. In-line with this, some studies are explaining the linkage between hypertensive disorders of pregnancy and chronic diseases such as cardiovascular, liver, kidney and so forth in later life[25]. By 2020 it is projected that cardiovascular diseases (CVD) will surpass infectious disease as the world's leading cause of death and disability; among those at increased risk are women who develop hypertensive disorders in pregnancy[24]. In addition, this is supported by a study in Taiwan which confirmed higher risk of end-stage renal disease in women with hypertensive disorders during pregnancy[25].

Investigating this area of study will inform policy makers to develop appropriate screening and treatment guidelines, design prevention and control mechanisms for hypertensive disorders of pregnancy. Likewise, it will be important to improve the quality of services being given for women with hypertensive disorders in health facilities.

Moreover, it will be a good source of knowledge for clinicians and assist them in diagnosing and monitoring women with hypertensive disorders of pregnancy and eventually improve quality of care. Likewise it may guide them in providing health education on the area which can contribute for better birth preparedness and complication readiness of women. Furthermore, it will help as a baseline resource to conduct more studies in this area

II. Review of related literature

2.1. The Biology of hypertensive disorders of pregnancy

2.1.1. Definition of hypertensive disorders of pregnancy

Systolic blood pressure (BP) greater than or equal to 140 mmHg and/or diastolic BP greater than or equal to 90 mmHg measured in two occasions 6 hours apart defines hypertension[4, 5, 28].

Preeclampsia is defined as hypertension plus significant proteinuria. Preeclampsia superimposed on chronic hypertension is diagnosed when a woman with pre-existing hypertension develops systemic features of preeclampsia after 20 weeks of gestation. Proteinuria is present when 24-hour protein excretion equals or exceeds 300 mg/day or protein: creatinine ratio in the range of 0.15 to 0.3 g protein/g creatinine. Similarly, severe preeclampsia includes severe hypertension (systolic blood pressure ≥160 mm Hg or diastolic blood pressure ≥110 mm Hg, or both), cerebral or visual disturbance, epigastric or right upper quadrant pain, oliguria, pulmonary edema, cyanosis, impaired liver function, thrombocytopenia or intrauterine growth restriction (IUGR). Eclampsia is defined as the onset of convulsions in a woman with preeclampsia that cannot be attributed to other causes. The seizures are generalized and may appear before, during, or after labor [4, 5, 31-33]

2.1.2. Etiology and Pathogenesis of hypertensive disorders of pregnancy

Despite extensive research, the etiology of HDP remains largely unknown[6, 10]. One of the characteristics of normal pregnancy is the change in the circulatory system and the blood pressure. Early in pregnancy vasodilatation results in a decrease in blood pressure. The available hypothesis suggests two stages for the development of hypertensive disorders. The first stage of the disease process is thought to occur due to physiological changes in the spiral arteries of the decidua and myometrium. This may also result in poor placental perfusion, early placental hypoxia and oxidative stress. In the second stage, toxic substances are released as a result of the poor placentation. Thus, the endothelial cells of the maternal circulatory system are damaged that provoke systemic inflammatory response. These changes in turn lead to vasospasm, abnormal coagulation, increased endothelial permeability [2, 6, 34].

2.1.3 Clinical course of hypertensive disorders of pregnancy

In some cases, women who have been diagnosed with gestational hypertension will develop preeclampsia. The likelihood of progression decreases with gestational age at diagnosis. Women

with pre-existing hypertension experience a 10 to 20% risk of developing preeclampsia[35]. Maternal organ systems susceptible to the inflammation and endothelial damage of preeclampsia include the liver, kidneys, lungs and hematological and central nervous systems. Its manifestation includes persistent headache, visual disturbances (blurring, flashing, dark spots in the field of vision), epigastric pain/right upper quadrant pain, nausea and/or vomiting and chest pain/shortness of breath. Maternal and perinatal complications increase with the number of organ systems affected[2].

HELLP syndrome is a sign of severity which is characterized by hemolysis, elevated liver enzymes and low-platelet count. Serious maternal complications of HELLP syndrome include disseminated intravascular coagulation (DIC), placental abruption, and acute renal failure[6].

2.1.4. Diagnosis of hypertensive disorders of pregnancy

A number of factors affect the accurate and consistent assessment of blood pressure (BP). Factors that increase BP include anxiety, excitement, caffeine and physical or emotional stress. As a result clients are allowed to rest at least for 5 minutes before measuring. The client should be in a siting position with the arm at the heart level. In addition, a cuff at least 1.5 times the circumference of the client's arm should be used. A mercury or calibrated aneroid sphygmomanometer can be used to measure the BP[36].

Methods of testing for proteinuria include urinary dipstick, spot urinary protein/creatinine ratio, and 2-hour, 12-hour and 24-hour urinalysis but none of them best predicts adverse birth outcomes. Dipstick testing for urinary protein is common practice in maternity care due to ease of use, low cost and availability of a rapid result. A reading of nil means there is no protein in urine whereas a value of +1 to +4 means there is protein in urine in different degree. Significant proteinuria is diagnosed if the urinary protein:creatinine ratio is greater than 30 mg/mmolurinary creatinine in a spot urine sample or more than 300 mg protein in a 24-hour urine sample[5, 6].

There is no single accepted model to predict preeclampsia due to its heterogeneous nature. As a result researchers suggest tests that combine different information than single biomarkers or clinical factors to predict the disease. prophylactic agents and behavioural modifications are also suggested to reduce the incidence or severity of the disease[6, 35].

2.1.5. Management of hypertensive disorders of pregnancy

Integrated package of care is needed for a woman who developed hypertensive disorders of pregnancy. These include measuring BP, conducting urine and blood tests followed by treatment

[37]. Thus, treatment options for HDP vary according to diagnosis, severity, gestational age Magnesium sulphate is recommended to use as an anticonvulsant for prevention and treatment of eclamptic patients[6, 9].

2.2. The Epidemiology of hypertensive disorders of pregnancy

2.2.1. Magnitude and pattern of hypertensive disorders of pregnancy

Worldwide hypertensive disorder of pregnancy accounts for 14% of maternal mortality. There is regional variations in light of the burden of hypertensive disorders of pregnancy; for instance it accounts for 12.9, 14, 16.9, 16, 10.4, 10.3, 14.5,13.4, 14.7, 22.1 and 13.8% in the developed region, developing regions, Northern Africa, Sub-Saharan Africa, Eastern Asia, Southern Asia, South-eastern Asia, Western Asia, Central Asia, Latin America and Caribbean and Oceania, respectively[3].

In high income countries, the overall incidence of hypertensive disorders of pregnancy is estimated at 5-10% [38-42]. In USA the overall prevalence of hypertensive disorders of pregnancy was estimated at 8.1% in 2006; 3.5% and 2.2% for eclampsia/severe preeclampsia and gestational hypertension, respectively[43].

Approximately 1% of pregnancies in Canada are affected by pre-existing hypertension, 5 to 6% by gestational hypertension without proteinuria, and 1 to 2% by preeclampsia[6]. According to another population-based study in newfoundland Canada; the incidence of preeclampsia in the population was 5.6%, and in primiparous women it was 7.9%whereas gestation hypertension was identified in 5.5% of the mothers[44].

A cross sectional study was done in South Wales to determine rates and outcomes of hypertensive disorders of pregnancy; according to this study overall 9.8% women had hypertensive disorders of pregnancy[41]. In Sweden hypertensive disorder of pregnancy accounts for 7.7% of cases[42]. Another study in Sweden showed 4.4% gestational hypertension, and 5.2% preeclampsia[45].In a study in Britain, Birmingham the prevalence of preeclampsia (PE) in the groups of pregnancy induced hypertension (PIH) and chronic hypertensive women was 11.9 and 16.0% respectively[46].

In addition, the incidence of preeclampsia showed an increasing trend. For instance, in USA preeclampsia complicated 2.9% pregnancies in 2000 and increased significantly to 3.1% in 2008[47]. Likewise, in another study in USA chronic hypertension increased from 0.9% (1995–1996)to 1.5%

of births (2007–2008)[48]. But in New South Wales, Australia the incidence of hypertensive disorders of pregnancy significantly decreased from 4.6% (2000) to 2.4% (2008)[49].

In low and middle income countries large scale studies to estimate incidence are limited but using the available studies the overall incidence of HDP ranges from 1.3 to 17%[50-53]. In a hospital based prospective study conducted in India, the incidence of hypertensive disorders of pregnancy increased from 10.3% of all births (1996–2004) to 11.8% (2005–2010)[54].

A secondary analysis of the World Health Organization multicountry survey in 29 countries from Africa, Asia, Latin America and the Middle East (2010–2012) on maternal and newborn health estimated overall prevalence of hypertensive disorders of pregnancy at 2.7%. Incidences of pre-eclampsia, eclampsia and chronic hypertension were 2.16%, 0.28% and 0.29%, respectively[17].Another WHO global survey (200-2007) reported overall prevalence of pre-eclampsia/eclampsia at 4% but there was much variation between and within countries; 2.32% in Africa, 3.13% in Asia and 6% in Latin America. Across regions pre-eclampsia/eclampsia prevalence at the country level ranged from less than 1% in Angola to 8% in Brazil[55].

HDP accounted for 5.22% of all pregnancies in China. Out of the six subtypes of HDP, severe preeclampsia accounted for 39.9%, gestational hypertension for 31.40%, mild preeclampsia for 15.13%, chronic hypertension in pregnancy for 6.00%, preeclampsia superimposed on chronic hypertension for 3.68% and eclampsia for 0.89%[56].

A study was conducted on the epidemiology of hypertensive disorders of pregnancy and childbirth in Thailand and hypertension with edema or proteinuria was observed in about 6% of pregnancies[57].

In Iran 2.32% mothers were hypertensive and the prevalence of chronic hypertension, preeclampsia and eclampsia were 2.13, 0.17, 0.03%, respectively[12]. Similarly, in Saudi Arabia the prevalence of HDP was 3%. Preeclampsia and eclampsia occurred in 60%, gestational hypertension in 23.6%, chronic hypertension in 8.7%, and preeclampsia-complicating chronic hypertension in 7.7%. Eclampsia accounted for1.9% of the HDP and 0.06% of all pregnancies[58].

A retrospective chart review study in Malawi, showed 1.3% prevalence of HDP in which 34% were eclamptic[50]. Likewise in Sudan the prevalence of hypertensive disorder in pregnancy was 2.17%[59]. In Nigeria the overall prevalence of hypertensive disorder of pregnancy was 17%and it was 6% for preeclampsia[51]. Another study in the same country reported 16% severe

preeclampsia/eclampsia among pregnant mothers[60].Moreover, studies in Algeria and Mongolia estimatedprevalence of pre-eclampsia at 8%[23] and 4%[61] respectively

Single hospital based studies in Ethiopia documented the prevalence of hypertensive disorders of pregnany less than 9%. It was 2.4% in Mettu[62],5.3% in Tikur Anbess[15]3.9% in Debre Berhan[63] and 8.5%[21] in Jimma University Hospital.

In low income countries including Ethiopia there are limited numbers of studies showing the magnitude and pattern of hypertensive disorders of pregnancy over time. Overall there are few pocket studies conducted in Ethiopia and there is no published study in Tigray region regarding hypertensive disorders of pregnancy. Even some of the studies were conducted a decade ago which might not represent the current situation as it can vary from time to time which has been reported in studies of high income countries. Therefore, this study was a multicentre study which covered many hospitals in the region and showed the current patterns of each type of hypertensive disorders of pregnancy in a way that policy makers and implementers may make use of it.

2.2.2. Risk factors of hypertensive disorders of pregnancy

As hypertensive disorders of pregnancy are progressive and multiple cause disorders, there are different predisposing factors suspected to facilitate the development of the disorders. These include socio-demographic, obstetric, nutritional and lifestyle, familial and medical related variables.

Different studies showed that age is associated with the development of hypertensive disorders of pregnancy. A maternal age ≥ 40 was associated with a twice increased risk of hypertensive disorders of pregnancy, specifically preeclampsia [23, 64].World Health Organization multicountry survey and WHO global survey as well as other studies reported maternal age of more than 35 years as a risk factor for preeclampsia/eclampsia [17, 44, 55, 65]. In China age of >35 years was a risk factors for HDP and Pregnant women aged 25–29 years had the lowest risk of HDP[56].

On the other hand, in Iraq maternal age of 20-29 years was identified to be the significant age group for induced hypertension in pregnancy[66]. Similarly, a case control study in India identified age of less than 20 years as significant risk factor for pre eclampsia[67]. Early teenage status was reported as risk factors for hypertensive diseases in pregnancy in Maroua, Cameroon[68]. Epidemiological study conducted in Cairo, Egypt showed maternal age group of 26-30 years to be significant risk factor for preeclampsia[69]. On the contrary, maternal age was not associated with higher risk of having preeclampsia/hypertensive disorders of pregnancy in other studies [46, 70, 71].

Epidemiological studies showed that rural residence was a significant risk factor for preeclampsia and found to have statistically significant association with severity of the hypertensive disorder of pregnancy [21, 69]. Geographical region where the women live was also a risk factor for hypertensive disorders of pregnancy. In a population-based study in Canada and China there were significant differences in the prevalence of HDP between geographical regions [44, 56].

Studies documented that mothers married more than once and inter pregnancies' interval <3 years were at a higher risk of developing preeclampsia[69].On the other hand, studies published that risk of preeclampsia increased with an interval of 10 years or more since a previous pregnancy[64]Similarly, in another study being unmarried was found to be associated with preeclampsia[65].Moreover, women who had their first conception within one year of their marriage were at risk of developing pre-eclampsia more than 10 times compared to those who had their first conception after one year of marriage[67].Besides, housewife status was mentioned as risk factor for hypertensive disorders in pregnancy in different studies [60, 66, 68].

As per the secondary analysis of the World Health Organization multicountry survey; pre-eclampsia and eclampsia were associated with poor socioeconomic conditions and poor education[17].Lower socioeconomic class was also mentioned as a risk factor for preeclampsia/eclampsia elsewhere[67, 72]. Another WHO global survey and various studies identified lower than secondary education attainment such as primary level or no education with higher odds of having hypertensive disorders in pregnancy [16, 55, 68].

Studies suggested raised body mass index (BMI)before pregnancy or at booking as a risk factor for preeclampsia [6, 16, 51, 55, 64, 71].WHO global survey on maternal and perinatal health identified high BMI (>26 kg/ m2) as a risk factors of pre-eclampsia/eclampsia[55]. In other studies overweight and obesity were also risk factors for HDP[23, 56, 72]. However, high body mass index was not associated with higher risk of having preeclampsiain Pakistan[70]

Study in Norway suggested that high intakes of energy, sucrose, and polyunsaturated fatty acids independently increase the risk for preeclampsia[73]. In addition, systematic review showed that higher calcium intake was associated with lower odds for HDP and studies on dietary patterns mentioned beneficial effect of fruit and vegetables on pre-eclampsia, although not all the results were statistically significant[74]. In Cairo, Egypt much salty diet intake, no adequate fresh fruits/vegetables and much fat were significant dietary risk factors for pre-eclampsia[69]. Similarly a study in Bahr Dar, Ethiopia revealed consumption of fruits or vegetables at least three times a week

and folate intake during pregnancy to be protective against pre-eclampsia. It was also reported that for every 1-cm increase of MUAC, there was an increase in the incidence rate of pre-eclampsia by a factor of 1.35[75].

In Iraq a study demonstrated that current smokers were 3.5 times more prone to develop hypertension in pregnancy than other group[66]. Likewise, case-control study conducted in North India identified exposure to passive smoking as a risk factor for preeclampsia/eclampsia[72]. On the contrary, other studies failed to report significant relation between hypertensive disorders of pregnancy and smoking [16, 46]

A higher incidence of pre-eclampsia was found in women who reported to have consumed coffee daily during pregnancy in a study in Bahr Dar, Ethiopia[75]. Another study in Iran failed to get association between consumption of different types of caffeine (tea, coffee, or soft drinks) and hypertensive disorders in pregnancy [76].

Antenatal care non-attendance and inadequate antenatal supervision were reported as a significant risk factor of pre-eclampsia/eclampsia[55, 72]. In Jordan women who had not received prenatal care had a four-fold increased risk of developing hypertensive disorders in pregnancy[16]. In Nigeria fewer than four antenatal care visit was a risk for severe preeclampsia/eclampsia[60]. Another study did not report statistically significant relationship between hypertensive disorders of pregnancy and antenatal visits[21].

A range of studies revealed that parity is associated with the development of hypertensive disorders of pregnancy. Nulliparity was reported as a risk factor for hypertensive disorders of pregnancy in majority of the studies [16, 17, 23, 44, 55, 56, 60, 64, 66, 68, 69, 77, 78]. In Nigeria nulliparous and grand multiparous women had the highest incidence of HDP [51]. Despite this, there were studies that reported no significant differences in parity with regard to the development of hypertensive disorders of pregnancy [21, 46, 71]..

Studies and reviews from different parts of the world reported multiple pregnancy as a common risk factor for hypertensive disorders of pregnancy/preeclampsia [17, 45, 56, 64, 69, 79]. According to a study in southern India multiple pregnancy significantly increased the risk of pre-eclampsia by 5.7 times[71]. Furthermore, in Nigeria, study reported that women with multiple pregnancy had a fourfold risk of developing HDP[51]. But a study in Jordan failed to get significant relation between multifetal gestation and PE[16]

Studies suggested presence of previous HDP/preeclampsia as a risk factor for HDP/preeclampsia in the subsequent pregnancy [6, 16, 23, 56, 60, 64, 72, 78]. In Nigeria, women with previous history of preeclampsia had a fourfold risk of developing preeclampsia in their subsequent pregnancy[51].

Gestational diabetes was reported as a risk factor for HDP/preeclampsia in different studies[44, 55, 70].In Nigeria women with gestational diabetes had a fivefold risk of developing HDP[51].

Study in India identified age of menarche as significant risk factors of pre eclampsia. Women who had menarche at age of less than 12years were at greater odds of having pre-eclampsia compared to those who had menarche after 12years of age [67].

Studies reported that pre-gestational diabetes was a risk factor for hypertensive disorders of pregnancy/preeclampsia [44, 64, 70, 79].Study in southern India, demonstrated that pre-existing diabetes increased the likelihood of pre-eclampsia nearly by 8.7 times [71].

WHO Global survey on maternal and perinatal health identified severe anaemia as a significantly risk factor associated with higher pre-eclampsia/ eclampsia[55]. According to study in Bahir Dar City, Ethiopia women who had anaemia during the first trimester had pre-eclampsia 2.5 times higher than their counterparts[75]. However, a case control study in Tehran, Iran reported anemia as protective for pre-eclampsia[78].

Different studies identified chronic hypertension as a risk factor for pre-eclampsa/eclampsia [16, 55, 65, 71, 79].In another study in Nigeria the risk factor for severe preeclampsia/eclampsia was personal history of preexisting hypertension[60].

Studies suggested the presence of family history of preeclampsia as risk factor for HDP /preeclampsia [6, 16, 56, 64-66, 68, 70, 79]. A case control study in India identified, family history of pre eclampsia and family history of hypertension as a significant risk factors of pre eclampsia[67]. Another study in the same area showed an increased risk for those family history of hypertension in one or more first-degree relative [72].

Generally the studies conducted in different parts of the globe reported different types of risk factors which also showed controversies among studies. Majority of the studies used a hospital based record reviews. The current study assessed risk factors by using matched case control study design from a primary data source to identify risk factors in the study area.

2.2.3 Effect of hypertensive disorders

Pregnancies complicated with hypertensive disorders are associated with maternal and perinatal adverse outcomes. The commonly reported outcomes include, cesarean birth, increased induction of labour, maternal death, perinatal death, neonatal death, preterm birth, low birth weight, low apgar scare and small for gestational age birth among others.

According to WHO global survey on maternal and perinatal health, the overall prevalence for maternal death associated with pre-eclampsia/eclampsia was 1% and it was found to be a significant risk factor for maternal death. The prevalence was 1.4%, 0.7% and 0.05% in Africa, Asia and Latin America respectively. The highest maternal mortality was observed in Nigeria at 3%[55].In a study in Wales, women with hypertensions were more likely to suffer death or major morbidity than those without hypertension [41]. Another study in Nigeria which assessed adverse outcomes associated with pregnancy reported case fatality rate of 8.5%[80]. Similarly, in Algeria the incidence of maternal adverse events was 28.7% [23].

In Britain, it was reported that there was a trend towards higher rates of caesarean section in pregnancies with hypertensive complications[46]. In Chin and Iran, caesarean delivery rate was significantly higher among women with HDP than those without it[56, 78].In Nigeria women with hypertensive disorder were more likely to have a caesarean section than normotensive women, caesarean section rate among women that developed HDP in the study was 5 times higher than that of normotensive women [51].

Women with hypertensive disorder were more likely to have induction than normotensive women in Nigeria; induction of labour among women with HDP was 5 times higher than that of normotensive women[51]. Besides in China the prevalence of placental abruption and postpartum hemorrhage were significantly higher among women with HDP than those without HDP[56].

Small for gestational age (SGA) birth was higher among women with hypertension in pregnancy in Canada. Hypertensive women were 1.6 times more likely to have a live birth with SGA[81].Likewise, in other European countries, mothers with hypertension were more likely to deliver small for gestational age babies [41, 46].In Algeria the rate of small for gestational age was 49.7%[23]. Similarly, in Sudan, the rate of small for gestational age was higher in pre eclampsia (53%) compared to other hypertensive groups[59].

According to WHO global survey, the overall prevalence for perinatal death associated with pre-eclampsia/eclampsia was 3% and it was found to be a significant risk factor for perinatal death. It was 16.4%, 9.5% and 3.3% in Africa, Asia and Latin America respectively. The highest perinatal mortality was reported from the Democratic Republic of Congo and it was 22%[55].However, in Sweden no significant difference was observed with regard to perinatal mortality rates between hypertensive and normotensive pregnancies[42]. In addition, hypertensive disorders of pregnancy did not produce a significant increase in perinatal deaths in the Thailand study[57].

Stillbirth in Canada was higher among women with pre-existing hypertension as compared with normotensive women[81].Similarly in Britain, pregnancies with hypertensive complications had higher rates of stillbirth [46].In Algeria, the rate of fetal death was 6.7%[23].There was increased risk of IUFD in the severe preeclampsia group as compare with the gestational hypertensive mothers in another Indian study [82].Besides, the rate of prematurity was reported to be 58.2% in Algeria[23].But in Sweden no significant difference was observed in terms of fetal death, between hypertensive and normotensive pregnancies[42].

According to WHO global survey, the overall prevalence for preterm birth associated with preeclampsia/ eclampsia was 10% and it was significantly affected by pre-eclampsia/eclampsi. It was 26.7%, 27.3% and 20.9% in Africa, Asia and Latin America respectively. The highest prevalence of preterm birth associated with preeclampsia/ eclampsia was found in Angola and it was 76%[55].In addition, the prevalence of pre-term birth rate was significantly higher among women with HDP than those without HDP in other studies [41, 46, 56]. An epidemiological study conducted in Cairo, Egypt reported that preterm labor was more common in pre-eclamptic mothers compared to controls with statistically significant differences[69].

Globally, the overall prevalence for low birth weight associated with preeclampsia/ eclampsia was 10% and it was significantly affected by pre-eclampsia/eclampsia. It was 23.9%, 34.5% and 23.5% in Africa, Asia and Latin America respectively. The highest rate of low birth weight was in Sri Lankaand it was estimated at 40% [55]. Hypertensive disorders of pregnancy were associated with a significant increase of low birth weight babies elsewhere [46, 50, 51, 57, 59, 69, 82].

In Iran study the one minute Apgar score of neonates less than 8 was more common in women with hypertensive disorder [78].More so, an epidemiological study conducted in Cairo, Egypt reported significantly lower mean of 1- and 5-minutes Apgar scores in newborns of pre-eclamptic mothers compared to controls[69].

An epidemiological study conducted in Cairo, Egypt reported that fetal growth restriction and neonate intensive care admission were more common in pre-eclamptic mothers compared to controls with statistically significant differences[69].

In general, studies regarding the effect of hypertensive disorders of pregnancy are limited in Ethiopia and other African countries. Furthermore, almost all of the studies reviewed employed either cross sectional study or case control study designs to assess the effect of hypertensive disorders on maternal and perinatal birth outcomes and mainly data were obtained retrospectively. In contrast, this study applied cohort study design to obtain robust evidence on the real variation regarding maternal as well as perinatal birth outcomes among mothers with hypertensive and without hypertensive disorders in the study area.

2.3 Barriers for early detection and management of hypertensive disorders of pregnancy

Many challenges exist in the prediction, prevention, and management of hypertensive disorders of pregnancy. Currently, there is no a single reliable and cost-effective method of screening for preeclampsia and other hypertensive disorders in pregnancy which can be recommended for use in developing countries[5, 6].

Treatment of hypertensive disorders of pregnancy remain prenatal care, timely diagnosis, proper management, timely delivery and follow up in the early postpartum period. Hence, prenatal, delivery, and postnatal care services can serve as opportunities for the detection of hypertensive disorders as it can only be prevented through early detection and prompt treatment of the conditions at all levels. However, in the vast majority of developing countries health care access is limited due to delay in the decision to seek care, in reaching the health facility and in health service provision [18, 83-86].

Delay in the decision to seek care- includes delayed responses at the household level to obstetric emergencies which usually results from inadequate information on when and where to seek care. This depends on the quality of antenatal care given in the health facilities and the information dissemination and communication at the community level. Even though the focused antenatal care approach encompasses birth preparedness and complication readiness of mothers as a key component, most health professionals do not focus on the counseling aspect that leads to less awareness about the disease among mothers and what to do in case of complication. In addition,

there are cultural barriers in the community that hinders early health care seeking when the sign and symptoms of advance complication start to manifest [86-88].

Delay in reaching the health facility- includes lack of access to quality care due to the location, distance, and lack of transport to health facilities [83, 86, 87].

Delay in health service provision- refers to the delays which arise in health facilities due to attitudes of health service providers, lack of trained personnel, lack of equipment and supplies. Since hypertensive disorders can occur during pregnancy, labor or postpartum, it is important that detection efforts begin in pregnancy and continue through labor and the postpartum period. It demands also the presence of skilled health care professionals at antenatal clinics and during births, with ready access to emergency obstetric and newborn care. Not only this but also facilities should be able to fulfill necessary materials such as BP apparatus and urine protein testing kits for diagnosis; magnesium sulfate and other medical supply and drugs should also be readily available for management of the complicated cases of hypertensive disorders of pregnancy[86-88]

A study in India suggested, the need for improved inventory control practices to ensure sustained availability of supplies and building confidence of care providers in using MgSO4 treatment for severe pre-eclampsia and eclampsia in public facilities, in addition to teaching expectant mothers how to recognize symptoms of these conditions[89].

Another study in Afghanistan revealed that lack of service delivery guidelines, refresher training, and reinforcement on best practices with supervision were common barriers to detection and management of hypertensive disorders[90]. Similarly, according to mixed method study in Nigeria, barriers to management of PE/E were inadequate numbers of skilled providers, frequent shortages of MgSO4, lack of essential equipment and supplies, irregular supply of electricity and water, non-availability of guidelines and clinical protocols at the health facilities and inadequate technical support to providers[91].

Studies showed that availability of basic instruments at all levels of care together with competent health care workers play key role in managing patients with hypertensive disorders but many public health facilities are challenged by lack of essential supplies for screening and managing patients with hypertensive disorders. According to a study conducted in Tanzania, less than half of the health facilities had dipsticks for detection of protein in urine. Availability of drugs for treating preeclampsia and eclampsia in the health facilities was low, less than half of them had magnesium sulfate for controlling and prevention of seizures. Availability of antihypertensive was generally low

only 40% of health facilities had methyldopa, 37% nifedipine and 17% hydrallazine. Guidelines for managing patients with preeclampsia/eclampsia were available in 70% of all the health facilities[92].

Different studies reported the possible reasons for delay in diagnosis and management of mothers with hypertensive disorders of pregnancy. These studies are not conclusive showing variations in the findings across countries. Besides, there is paucity of evidence regarding the barriers for early detection and management of hypertensive disorders of pregnancy in Ethiopia. As it is believed that many of the reasons are not easily studied quantitatively this study employed qualitative method to shed light on the possible reasons why mothers with hypertensive disorders during pregnancy are not early detected and managed without delay before they develop life threatening complication. Furthermore, this will be approached from different perspectives such as from the health professionals' point of view, the health care managers and patients' perspectives to generate powerful evidence on the proposed problem.

2.4 Conceptual framework

Conceptual frame work was developed to easily understand the concepts and show how the different factors affect the development of hypertensive disorders of pregnancy and eventually affect the maternal and perinatal birth outcomes. Different research articles, books and guidelines were reviewed to come up with the possible risk factors of hypertensive disorders and the maternal and perinatal adverse outcomes. In this research it has been hypothesized that maternal and perinatal adverse outcomes are higher among mothers having hypertensive disorders as compared with those mothers who have no any type of hypertensive disorders. Some factors directly affect both the development of hypertensive disorders and the possible adverse birth outcomes but others only affect one of the outcomes.

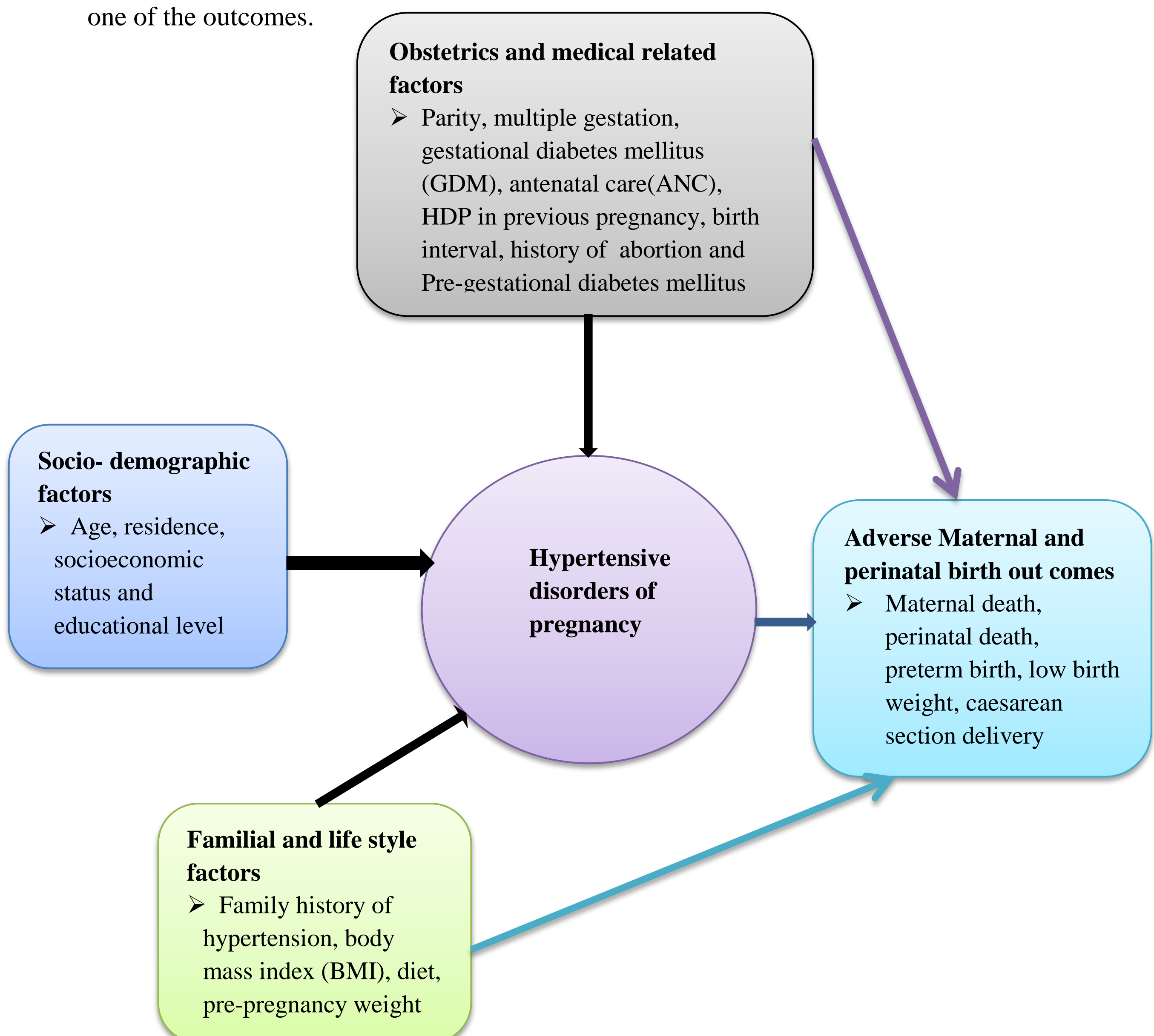


Figure 1: Conceptual framework of risk factors of hypertensive disorders of pregnancy and birth outcomes

Research questions

1. What is the magnitude of hypertensive disorders of pregnancy over the last five years in public hospitals of Tigray?
2. What are the facilitators or preventive factors for and against hypertensive disorders of pregnancy among mothers in public hospitals of Tigray?
3. What is the level of difference in adverse birth outcomes among mothers with hypertensive disorders and without hypertensive disorders?
4. What are the reasons for late detection and management of hypertensive disorders of pregnancy among mothers in Tigray region, Ethiopia?

III. Objectives

3.1 General objective

To assess hypertensive disorders of pregnancy and its effect on maternal and perinatal birth outcomes among mothers in selected hospitals of Tigray, North Ethiopia

3.2 Specific objectives

1. To describe the pattern of hypertensive disorders of pregnancy among mothers in public hospitals of Tigray, North Ethiopia
2. To assess risk factors for hypertensive disorders of pregnancy among mothers in public hospitals of Tigray, North Ethiopia
3. To assess maternal and perinatal outcomes of hypertensive disorders of pregnancy among mothers in public hospitals of Tigray, North Ethiopia
4. To explore barriers for early detection and management of hypertensive disorders of pregnancy in Tigray, North Ethiopia

IV. Methodology

4.1 Study Area

The study was conducted in Tigray region, northern Ethiopia. The total projected population of the region was 5,247,005 in 2017 of which 2,587,003 males and 2,660,002 females. Reproductive age group females (15-49years) comprised 23.5% of the population. The annual population growth rate and total fertility rate of the region are 2.3% and 4.6 children per woman respectively. There were 178, 398 total expected pregnancies for the year 2017 which resulted in a pregnancy rate of 3.4%. In the region there are 22 primary hospitals, 18 general hospitals and 2 referral hospitals, 211 health centers and 712 health posts which are run and owned by the government[93]. There are 28 functional health facilities providing basic emergency obstetrics and newborn care (BEmONC) and 16 facilities providing comprehensive emergency obstetrics and newborn care (CEmONC) in Tigray region[94].

This study was conducted in seven public hospitals of Tigray region namely; Ayder referral, Mekelle, Lemlem Carl, Adigrat, St.Marry, Suhul and Kahsay Abera hospitals. A package of comprehensive care and management is given in hospitals where there are materials and equipments to diagnose and treat the problem and there are senior professionals (obstetricians) who can provide comprehensive care whereas the lower health facilities such as health centers provide only the primary care, so a mother with severe form of the hypertensive disorder is supposed to be referred to the higher level which makes the follow up interrupted. Therefore, the presence of obstetrician and capacity of health facilities to provide comprehensive care were taken as criteria to include in the study. The study was conducted from June to December, 2017.

4.2 Study Design

For objective one: Cross-sectional study design was employed to describe the patterns of hypertensive disorders of pregnancy for five years.

For objective two: Hospital based matched case control study was used to identify predictors of hypertensive disorders of pregnancy in public hospitals of Tigray.

For objective three: Prospective cohort study was applied to assess the effect of hypertensive disorders of pregnancy on maternal and perinatal outcomes

For objective four: Descriptive qualitative approach was used to explore barriers for early detection and management of women with hypertensive disorders of pregnancy

4.3 Population

4.3.1 Source population

Objective1: All women who delivered in the five successive years (September 1, 2012 to August 31, 2017) in Tigray.

Objective 2: All pregnant mothers attending prenatal health care services in public hospitals of Tigray region

Cases: were pregnant women diagnosed with hypertensive disorders of pregnancy (gestational hypertension, preeclampsia, eclampsia and peeclampsia superimposed with chronic hypertension) attending maternal health services during the study period. Cases were identified after clinical examination by obstetrician and lab investigations which are relevant during pregnancy. Elevation of blood pressure beyond 140/90 mmHg (either of them or both) measured at two occasions more than 6 hours apart, dipstick urine protein >1+ and clinical features of preeclampsia/eclampsia were considered.

Controls: were pregnant women without hypertensive disorders of pregnancy attending maternal health services at the selected hospitals during the same period as cases.

Matching- cases and controls were matched by parity as it was found to be associated with hypertensive disorders of pregnancy in majority of the studies reviewed.

Objective 3: All pregnant mothers attending prenatal health care services in public hospitals of Tigray region

Exposed group: were mothers diagnosed with any one of the hypertensive disorders of pregnancy after 20 weeks gestation and followed until 7 days postpartum.

Non-exposed group: were mothers free from any of the hypertensive disorders of pregnancy during the follow up period, after 20 weeks gestation and followed until 7 days postpartum. Maternal and perinatal outcomes were compared between the two groups at the end of the follow up period. Maternal outcomes include maternal death, maternal complications (cesarean section birth, induction, postpartum haemorrhage, abruption placenta, Antepartum haemorrhage) and preterm

birth. Likewise, perinatal outcomes include perinatal death (still birth and early neonatal death), low birth weight, low Apgar score and ICU admission.

4.3.2 Study population

Objective1- all women who delivered in the selected public hospitals over the previous five successive years (September 1, 2012 to August 31, 2017).

Objective 2 and 3: All pregnant mothers attending prenatal health care services in selected public hospitals of Tigray region

Objective 4: Health professionals working in maternity units (obstetricians and midwives), health care leaders working in different positions of the health care delivery system (maternal and child health (MCH) department heads in hospitals and health centers as well as MCH experts in district health office and regional health bureau were included. In addition, women with a history of hypertensive disorders of pregnancy in the previous one year were participants of the study.

4.3.2 Eligibility criteria

4.3.2.1 Inclusion criteria

Women who delivered in the selected hospitals in the five years review period (September 1, 2012 to August 31, 2017); women who were attending antenatal clinics in the selected health facilities whose gestational age was 20 weeks and above were included. Moreover, Professionals who were working in maternal health care services were targeted.

4.3.2.2 Exclusion criteria

Severely sick women and those having difficulty in communication were excluded. Besides, women with the history of hypertensive disorders of pregnancy were excluded from the control.

4.3.3 Sample size determination

Objective1: To assess the pattern and distribution of hypertensive disorders of pregnancy, all mothers who delivered in the selected hospitals in the last 5 years period were included in the study. All client cards were retrieved and reviewed given that the number is beyond the calculated maximum sample size.

Table 1: Sample size calculation using single population proportion formula

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

Category	Proportion (%) (previous study)	Margin of error (%)	Sample size
HDP[21]	8.5	2	746
preeclampsia[65]	8.4	2	738
HDP[62]	2.4	2	225

The minimum sample size estimated was 746(by taking the maximum size) and adding 10% for missing, the require sample was 821. However, all eligible women in the study hospitals were included.

Objective 2: To assess the risk factors, number of cases and controls were determined using Epi-Info StatCalc comparison of proportions for case-control study using the following assumptions: Considering 95% CI, 80% power and taking different risk factor for hypertensive disorders of pregnancy as shown in the table below

$$n_1 = \frac{\left[Z\alpha/2\sqrt{\left(1+\frac{1}{r}\right)P(1-P)} + Z\beta\sqrt{P1(1-P1)+\frac{P2(1-P2)}{r}}\right]^2}{(P1-P2)^2}, \qquad n_2 = n_1 r$$

Table 2: Sample size calculation for matched case control study

Exposure variable	Proportion among cases (P1)	Proportion among controls (P2)	Ration of cases to controls (r)	Total sample size (n1+n2)
History of hypertension in previous pregnancy [68]	14.5%	2.2 %	1:2	194
History of Paternal hypertension [68]	17.4%	6%	1:2	300
Inadequate fruit intake[75]	39.1%	18.2	1:2	173

The final total sample size is 300, 100cases and 200 controls, taking the maximum among the three.

Objective 3: To compare maternal and perinatal outcomes among hypertensive and non-hypertensive mothers, the number of exposed and non-exposed mothers was calculated using Epi Info 7 StatCalc as follows:

Two sided confidence level=95%

Power=80%

Ratio (unexposed: exposed) =1

Proportion of outcome in the unexposed group and proportion of outcome in the exposed group as in the table below.

Table 3: Sample size calculation for cohort study

Exposure variable	Proportion among exposed (P1)	Proportion among unexposed (P2)	Ratio of exposed to unexposed (r)	Total sample size (n1+n2)
Low Birth[95] weight	16.1%	6 %	1:1	340
Preterm birth	31.4%[62]	14.3%[96]	1:1	210

Adding 10 % non- response rate the final total sample size is 374, 187 exposed and 187 non-exposed, taking the maximum among the two.

Objective 4: To assess barriers for early screening and treatment of hypertensive disorders of pregnancy descriptive qualitative method was employed. Sample size was guided by the level of information saturation

4.3.4 Sampling procedures

Objective 1(pattern): the number of mothers delivered in the five consecutive years was found from the HMIS record. Information of all mothers with hypertensive disorders of pregnancy who delivered in the five years was retrieved from logbooks, and client cards.

Objective 2 (risk factors): Case-control incidence density sampling was used; in incidence density sampling the selection of controls is governed by the diagnoses of cases. Every time a case is diagnosed two controls were selected from other members of the cohort who, at that time, did not have the diagnosis. Since the case is rare each case was included in the study and controls were selected at the day of case identification in line with the matching. Sample size was proportionally allocated to the selected hospitals according to the respective hospitals' client flow from the previous year's record.

Objective 3 (outcomes): Mothers who were diagnosed with hypertensive disorders of pregnancy with their non-hypertensive pairs were enrolled in the antenatal clinic as well as maternity wards. Then, they were followed until delivery and the first 7 days postpartum. The sample size of these cohorts was distributed to each selected hospital according to the case load. All exposed cases were included whereas the controls were randomly selected from the available controls.

Objective 4 (barriers): Study participants were selected through purposive sampling which is appropriate for qualitative studies. Health professional closely working with maternal health services in general and basic emergency obstetrics in particular were included in the study; those who work in different management and administrative positions were also part of the study. In addition women with history of the disorders were purposively selected. Maximum variation sampling was employed by approaching from different perspectives and this helped to have thick information about the issue.

4.4 Data collection

4.4.1 Design of data collection tools

For the pattern study, standard checklist was developed by reviewing the national basic emergency obstetrics and new-born care[97] and WHO guideline[9] to extract relevant data from the client's

medical record. The checklist consisted of variables related to socio-demographic, obstetrics and medical characteristics as well as laboratory investigation results

For the risk factors study, structured questionnaire was developed by reviewing different relevant sources [5, 9, 98, 99]. The questionnaire included socio-demographic, medical, obstetric, personal and familial variables.

For the outcome study, structured questionnaire and checklist [5, 9, 98]was developed to assess the socio-demographic, obstetrics, medical, personal and familial variables as well as the maternal and perinatal outcomes at the end of the follow up period.

For the barriers study, in-depth interview guide was developed for key informants and clients to investigate major gaps from the respondent's point of view.

4.4.2 Data collection procedures

To assess the pattern of hypertensive disorders, data were retrieved from patient records using data extraction checklist. On the other hand, interviewer administered face to face interview was applied to assess the risk factors. For the outcome study, follow up based face to face interview and retrieval of patient record was employed. For the qualitative method, tape recorded in-depth interview techniques was applied.

A total of 20 data collectors and 6 supervisors participated in this study (17 for the quantitative data and 3 for qualitative data). Quantitative data were extracted and/or collected by bachelor's degree holder nurses/midwives. Data collectors interviewed pregnant women coming for maternity services to identify risk factors. In addition, women were followed until seven days postpartum through close contact with the health extension workers at the specific kebelle of the mother's residence. The data collection was supervised by masters degree holder health professionals.

For the qualitative data, health care leaders, women with history of hypertensive disorder and health care professionals were approached in their respective usual settings to investigate barriers for early detection and management of hypertensive disorders of pregnancy. Data collectors were masters degree holders in nursing with a previous experience on qualitative study and closely supervised by the prinicipal investigator. In both cases the data collection process was commenced after providing adequate training on the tools and its procedures.

4.4.3 Variables of the study

I. Record review design

Dependent variable- the dependent variable was hypertensive disorders of pregnancy which constitutes chronic hypertension, gestational hypertension, preeclampsia-eclampsia and preeclampsia superimposed on chronic hypertension

Independent variables-the independent variables for the pattern of hypertensive disorders of pregnancy include socio-demographic, obstetrics and medical related variables

II. Matched case control study

Dependent variable- the dependent variable for the matched case control study was hypertensive disorders of pregnancy

Independent variables- the independent variables for the matched case control study include socio-demographic, obstetrics, medical, personal and familial variables.

III. Cohort study

Dependent variables

The dependent variables for the cohort study were maternal adverse outcomes and perinatal adverse outcomes

Perinatal adverse outcomes- perinatal adverse outcomes include preterm birth, still birth, perinatal death, low birth weight and early neonatal death

Maternal adverse outcomes- maternal adverse outcomes include maternal death, induction, caesarean delivery, admission to intensive care unit and pregnancy complications

Independent variables

The independent variables for the cohort study design include socio-demographic, obstetrics, medical, personal and familial variables

4.5 Data processing and management

Data collection process was checked on daily basis for inconsistencies and errors. Collected data was carefully handled with maximum security, questionnaires and audios were kept in a locked cabinet; the principal investigator closely followed the supervisors and data collectors. Quantitative data were coded and entered in EPI-Info software. Missing values and outliers were checked by using SPSS version 20 software and data cleaning was done for errors. Outliers were either deleted or transformed based on its nature. For the qualitative data interviews were transcribed verbatim on daily basis and translated in to English

4.6 Data analysis

For the record review, data was analysed using SPSS version 21. Descriptive statistics was computed and data were summarized in frequencies, proportions and means. Chi-square trend analysis was run to see the change across the years. The overall findings were presented using figures, tables and texts

Data were analysed using STATA version14 software for the case control and cohort studies. Descriptive statistics was computed and frequencies as well as percentages were used to summarize categorical variables. Similarly, mean was used to summarize quantitative variables. For the case control study, conditional binary logistic regression model was used to show the association of different variables with the dependent variable by generating the matched odds ratio with its 95%CI. Similary, crude and adjuster relative risk was generated from the binary logistic regression. Variables with P-value less than 0.2in the bivariate analysis were taken to the multivariable analysis. Multi colinearity diagnostics and interaction of variables was tested by the use of logistic regression model. Multi-collinearity was checked among the independent variables by running the *regress* and *vif* syntaxes in the *stata* software. Accordingly, the variance inflation factor (*VIF*) was close to one and the tolerance which is the reciprocal of the variance inflation factor was also far above 0 which showed minimal collinearity. Post estimation command (Hosmer and Lemeshow test) in the logistic regression was run by using the *estat gof*to check the model fitness. Thus, the p-value for the Hosmer and Lemeshow chi-square was greater than 0.05 which indicated the fitness of the model. Multivariable logistic regression was used to control the possible confounding effect of variables and to determine the independent predictors. Adjusted odds ratio and their 95% confidenceintervals were reported and P-value of less than 0.05, (95 % CI) two sided in the final model were considered as independent predictors.

For the qualitative study, the transcript was taken to Atlas ti.7 software for qualitative data analysis. This was followed by developing a categorization scheme which is helpful to reduce the data and make it more manageable. Transcripts were read for several times and the primary codes were extracted. Then, the related codes were put in one group/category. Finally, based on similarity and content, the subcategories were used to make the main categories or themes. Thus, thematic qualitative technique of analysis was used to generate the main themes of the study.

4.7 Data quality assurance

The questionnaire was prepared in English version and translated in to Tigrigna (local language) by experts. Data collectors with a similar previous experience were recruited and trained for 3 days on

the purpose and procedure of the study as well as on the meaning and essence of the study tools. In addition it was pre-tested on 10% of the calculated sample size in institutions not selected in the study two weeks preceding the actual data collection period. Additional adjustment was made in terminologies, sequence of questions, meaning and so on accordingly. Five percent of the collected data were checked by the supervisors for completeness and finally the principal investigator monitored the overall quality of data collection.

To assure the trustworthiness of the qualitative data, data collectors with previous experience on doing qualitative research were included and further training was given to them. Data was collected from different group of participants to triangulate the finding and to have thick description of findings. Furthermore, data was transcribed as soon as it was collected and this was accompanied by daily debriefings.

4.8 Ethical issues

Ethical clearance was sought from research ethics committee of the school of public health (REC/SPH) and Institutional Review Board (IRB) of Addis Ababa University, College of Health Sciences. Support letter was obtained from Addis Ababa University to Tigray Regional Health Bureau and from Tigray Regional Health Bureau to respective health institutions.

Permission was obtained from the administrators of respective health facilities to extract data from client's card. Willingness of study participants was confirmed and they were told that withdrawal or decline to participate in the study would not result in any loss to which they are otherwise entitled including denial of any health care service. Participants were not exposed to any risks apart from the time spent during interview for participating in the study. The study was anonymous in which any client information was not revealed; the name of participants was not written in the form and all information given by the study participants kept confidentially including the audio records for the qualitative study. It was also explained that there was no direct benefit to them for their participation in the study but the output of the study would benefit mothers, health facilities, researchers, policy makers and the community. Finally informed consent was obtained from study participant.

V. Tabular Summary of the Methods Applied in the Dissertation

Table 4: Summary of methods based on objectives of the study

S. N	Research objectives	Study design	Study subjects	Sample size utilized	Data collection tools	Data analysis
1	To describe the pattern of hypertensive disorders of pregnancy among women in hospitals of Tigray	Cross-sectional study design	Medical records of women diagnosed with Hypertensive disorders of pregnancy in the years 2013-2017 in 5 general/zonal hospitals and one referral hospital	All mothers chart having HDP from 2013-2017 (1347)	Checklist Adapted from EmONC and WHO guidelines	Descriptive analysis (frequency distributions, proportions and summary measures) Chi-square for trend
2	To identify risk factors for hypertensive disorders of pregnancy among women in hospitals of Tigray	Matched Case-control study design	Pregnant women with/without hypertensive disorders of pregnancy who had got medical care in 6 general/zonal hospitals and one referral hospital in Tigrai region	330 (110 cases and 220controls), matched for parity	Structured interviewer administered questionnaire (adopted from different literatures)	Descriptive analysis and conditional logistic regression analysis for matched data (Bivariate and multi variable) Estimated using odds ratio (OR)
3	To assess maternal and perinatal outcomes of hypertensive disorders of pregnancy among women in hospitals of Tigray	Prospective cohort study design	Pregnant women with/without hypertensive disorders of pregnancy enrolled after 20 weeks of gestation and followed to the first 7 days postpartum in 6 general/zonal hospitals and one referral hospital	374 (172 exposed women and 172 controls)	Checklist Structured interviewer administered questionnaire (adopted from different literatures)	Descriptive analysis and logistic regression analysis (Bivariate and multi variable) Estimated using Relative risk (RR)
4	To assess barriers for early detection and management of hypertensive disorders of pregnancy in Tigray	Descriptive qualitative study design	Pregnant women with an experience of hypertensive disorders of pregnancy in the last tone year, health professionals (obstetricians and midwives) and health care leaders in Tigray.	A total of 22 in-depth interviews 7 health care managers and administrator, 10 health professionals and 5 women	Interview guide Audio recorder	Descriptive analysis (thematic content analysis)

VI. Results

6.1 Patterns of hypertensive disorders of pregnancy

A total of 45,329 women were admitted for delivery in 5 general hospitals and 1 referral hospital from September 2012 to August 2017. Among all deliveries, 1404 women were with hypertensive disorders of pregnancy. However, only 1347 cases were used for analysis after excluding 57 patient cards due to either incompleteness or failure to identify. Thus, out of the total deliveries, 1347 (3%) were found to have hypertensive disorders of pregnancy and 887 (2%) were diagnosed as severe preeclampsia/eclampsia in the review period **(Table 5)**.

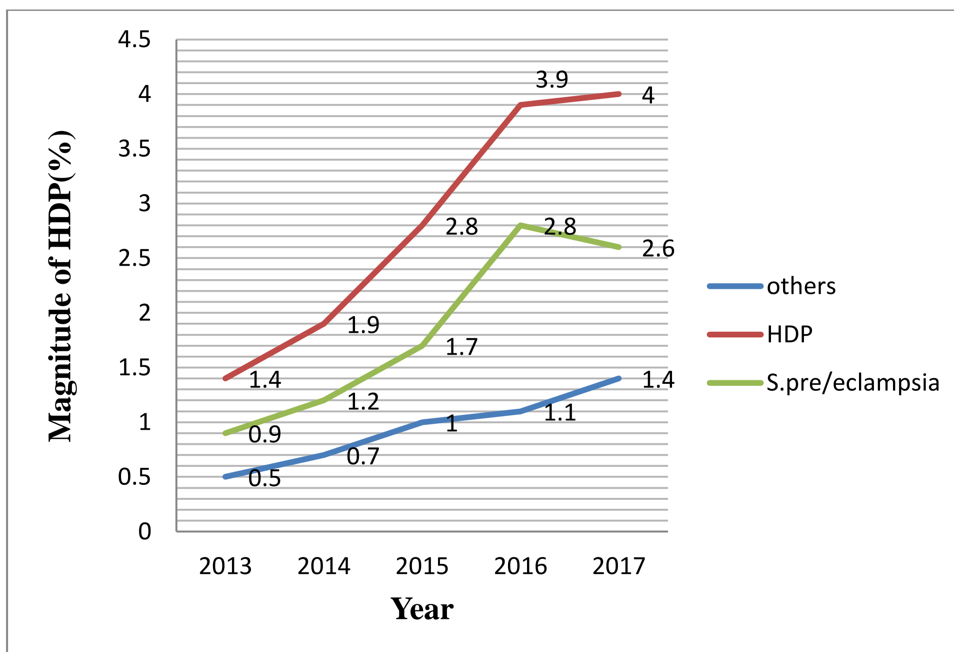
The majority of cases were diagnosed either during pregnancy or labor/delivery; only in 28 (2.07%) pregnant women, hypertensive disorder was diagnosed in the postpartum period. Three (0.22%) mothers had developed preeclampsia superimposed on chronic hypertension and 16 (1.18%) mother developed atypical preeclampsia/eclampsia.

Table 5: Distribution of proportionate cause specific morbidity for hypertensive disorders of pregnancy (HDP) cases in public hospitals of Tigray, Ethiopia. 2013-2017

Year	Total births	Overall HDP			S. pre/eclampsia		
		Frequency	%	95%CI	Frequency	%	95%CI
2013	6909	98	1.41	1.16, 1.74	61	0.88	0.68,1.14
2014	7785	148	1.90	1.61, 2.23	95	1.22	0.99,1.5
2015	9670	269	2.78	2.47, 3.13	169	1.74	1.5, 2.0
2016	10281	404	3.92	3.57, 4.33	287	2.79	2.48,3.13
2017	10684	428	4.00	3.65, 4.40	275	2.57	2.28,2.89
Total/average	45329	1347	3	2.82, 3.13	887	1.95	1.84,2.09

S. pre=severe preeclampsia

The overall magnitude of hypertensive disorders of pregnancy showed an increasing trend over the review period (5 years) ranging from 1.4% in 2013 to 4% 2017 and this gives 31% increase per annum on average. The change over the five years period was checked wether it is significant using chi-square trend analysis and it was found that the trend was significant (X^2= 153, p≤0.001. Similarly, severe preeclampsia/eclampsia ranged from 0.9 in 2013 to 2.8 in 2016 and the estimated annual rate of change is 13.7%. The hypertensive disorders of pregnancy and severe preeclampsia/eclampsia showed a sharp rise in the first four years and maintained in the last 1 year and even slight decline for severe preeclampsia/eclampsia (**Fig 2**).



Others=chronic hypertension, gestational hypertension

Figure 2: Trends of hypertensive disorders of pregnancy in public hospitals of Tigray, 2013-2017

More than half of the cases (56.1%) were rural residents. The mean± SD age of the mothers was 26.43±5.88; the minimum and maximum ages were 15 and 48 respectively. Besides, majority of the mothers (83.7) were between 18 and 33 years old and only 1.3% of mothers were less than 18 years. Of the total maternal records reviewed around 60 % were primiparas. The mean value for gravidity and parity were 2.61 and 1.97 respectively. Among the cases 92.3% of them had a history of ANC follow up and 72 % of them attended less than four visits **(Table 6)**.

Table 6: Background and obstetrics characteristics of mothers with hypertensive disorders of pregnancy delivered in public hospitals of Tigray, 2013-2017.

Variable (**N=1347**)	Frequency	Percent
Hospital		
Ayder referal hospital	215	16.0
Adigrat Hospital	327	24.3
Axum Hospital	199	14.8
Lemlem Carl Hospital	178	13.2
Kahsay Abera Hospital	230	17.1
Suhul Hospital	198	14.7
Residence		
Urban	592	43.9
Rural	755	56.1
Year		
2013	98	7.3
2014	148	11.0
2015	269	20.0
2016	404	30.0
2017	428	31.8
Age category		
<=18	18	1.3
19-33	1127	83.7
34-48	202	15.0
ANC follow up		
Yes	1243	92.3
No	104	7.7
Number of ANC(**N=1243**)		
Once	69	5.6
Twice	356	28.6
3 times	470	37.8
4 times	303	24.4
More than 4 times	45	3.6
Gravidity		
1	519	38.5
2	296	22.0
3	193	14.3
>=4	339	25.2
Parity		
1	804	59.7
2	222	16.5
3	128	9.5
>=4	193	14.3

Distribution of cases by type of hypertensive disorders of pregnancy was assessed. Accordingly, preeclampsia was the most frequent disorder estimated at 724 (75.1%) followed by eclampsia 143 (12.1) while chronic hypertension 40(3%) was the least frequent disorders (**Figure 3**).

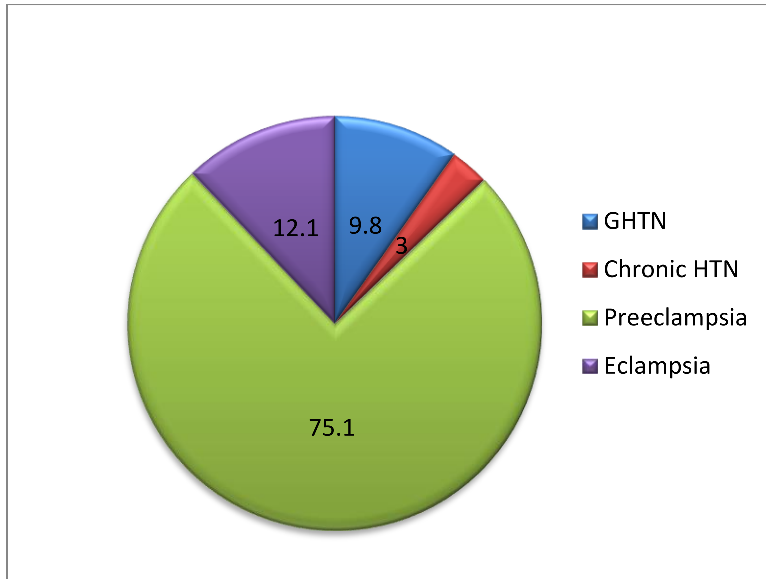


Figure 3: Distribution of cases by HDP types in public hospitals of Tigray 2013-2017(N=1347)

In all the study sites (hospitals) included in the study severe pre-eclampsia predominated except in Humera hospital where it is surpassed by mild pre-eclampsia. The magnitude of eclampsia is similar and comparable across the hospitals.

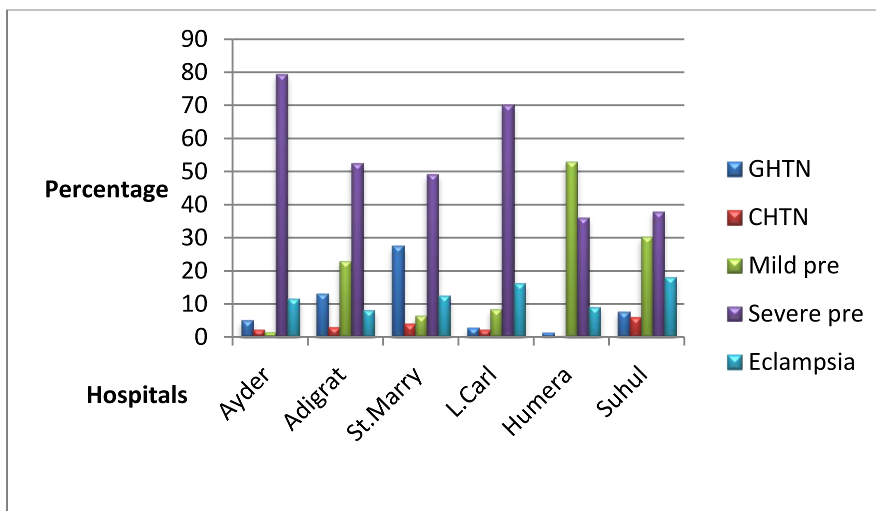


Figure 4: Distribution of types of hypertensive disorders of pregnancy in public hospitals of Tigray, 2013-2017

The mean $\pm$ SD gestational age at diagnosis of the cases was 36.4weeks. Likewise, the mean value for newborn's weight, Apgar score at 1 minute and Apgar score at 5 minutes were 2.61Kg, 6.48, and 7.43 respectively. Out of the total birth, 13.2% of newborns to cases were dead and out of them 80.3% accounted for fetal death (born dead). Over the review period a total of 50 (3.7%) mothers with hypertensive disorders were died. Among the HDP cases admitted to the hospitals 40.1% of them were preterm deliveries and a fifth of deliveries were confirmed to have intrauterine growth restriction. Two hundred eighty eight (21.4%) of mothers with hypertensive disorders of pregnancy ended up in caesarean section delivery, whereas 94(7.0%) of them were instrumentally delivered **(Table 7).**

Table 7: Obstetrics complications and delivery outcomes of mothers with HDP delivered in public hospitals of Tigray, 2013-2017.

Variable	Frequency	Percent
Mode of delivery		
Spontaneous vaginal delivery (SVD)	965	71.6
Caesarean section (CS)	288	21.4
Instrumental Delivery	94	7.0
Delivery initiation		
Spontaneous	841	62.4
Induced	506	37.6
Complication		
Abruption placenta	53	3.9
Placenta previe	37	2.7
Postpartum hemorrhage (PPH)	50	3.7
Maternal outcome		
Alive	1297	96.3
Dead	50	3.7
Intrauterine growth restriction (IUGR)		
	272	20.2
Yes	942	69.9
No	133	9.9
Unknown		
New-born outcome		
Alive	1169	86.8
Death	178	13.2
Time of death (N=178)		
Born Dead	143	80.3
Immediately After birth	24	13.5
Within the first 24 hours	5	2.8
Within the first 7 days	6	3.4
A measure taken at delivery		
Nothing done	1051	78.0
Admitted to ICU	126	9.4
Resuscitation done	170	12.6

A higher proportion of mild preeclampsia was observed in Humera hospital. Similarly, the proportion of gestational hypertension is comparable with the proportion of HELLP syndrome in St. Marry hospital Aksum. A similar proportion of gestational and chronic hypertension cases were observed in both rural and urban areas.

Table 8: Distribution of background and obstetrics variables by types of hypertensive disorders of pregnancy in public hospitals of Tigray, 2013-2017

Variables	Types of HDP (**Fre /%**)					
	Gestational Hypertension	Chronic Hypertension	Mild preeclampsia	Sever Preeclampsia	Eclampsia	HELLP syndrome
Year						
2013	27 (20.5)	3 (7.5)	7 (2.4)	46 (6.4)	14 (9.9)	1 (4.8)
2014	23 (17.4)	2 (5.0)	28 (9.7)	80 (11.0)	14 (9.9)	1 (4.8)
2015	26 (19.7)	6 (15.0)	68 (23.6)	141 (19.5)	26 (18.3)	2 (9.5)
2016	30 (22.7)	8 (20.0)	79 (27.4)	239 (33.0)	41 (28.9)	7 (33.3)
2017	26 (19.7)	21 (52.5)	106 (36.8)	218 (30.1)	47 (33.1)	10 (47.6)
Residence						
Urban	64 (48.5)	20 (50.0)	115 (39.9)	337 (46.5)	47 (32.9)	9 (45.0)
Rural	68 (51.5)	20 (50.0)	173 (60.1)	387 (53.5)	95 (66.9)	12(57.1)
Age						
<=18	2 (1.5)	0 (0.0)	5 (1.7)	6 (0.8)	5 (3.5)	0 (0.0)
19-33	104 (78.8)	29 (72.5)	251 (87.2)	604 (83.4)	118 (83.1)	21 (100)
34-48	26 (19.7)	11 (27.5)	32 (11.1)	114 (15.7)	19 (13.4)	0 (0.0)
ANC follows up						
Yes	102 (77.3)	36 (90.0)	280 (97.2)	677 (93.5)	130 (91.5)	18 (85.7)
No	30 (22.7)	4 (10.0)	8 (2.8)	47 (6.5)	12 (8.5)	3 (14.3)
ANC visit						
Once	1 (1.0)	1 (2.8)	19 (6.8)	38 (5.6)	7 (5.4)	3 (16.7)
Twice	25 (24.5)	7 (19.4)	99 (35.4)	178 (26.3)	42 (32.3)	5 (27.8)
3 times	52 (51.0)	19 (52.8)	110 (39.3)	240 (35.5)	41 (31.5)	8 (44.4)
4 times	22 (21.6)	9 (25.0)	49 (17.5)	189 (27.9)	33 (25.4)	1 (5.6)
more than 4	2 (2.0)	0 (0.0)	3 (1.1)	32 (4.7)	7 (5.4)	1 (5.6)
Gravidity						
1	41 (31.1)	6 (15.0)	117 (40.6)	263 (36.3)	80 (56.3)	12 (57.1)
2	30 (22.7)	11 (27.5)	73 (25.3)	159 (22.0)	19 (13.4)	4 (19.0)
3	23 (17.4)	8 (20.0)	41 (14.2)	102 (14.1)	16 (11.3)	3 (14.3)
>=4	38 (28.8)	15 (37.5)	57 (19.8)	200 (27.6)	27 (19.0)	2 (9.5)
Parity						
1	63 (47.7)	18 (45.0)	194 (67.4)	418 (57.7)	96 (67.6)	15 (71.4)
2	30 (22.7)	9 (22.5)	48 (16.7)	114 (15.7)	18 (12.7)	3 (14.3)
3	17 (12.9)	6 (15.0)	20 (6.9)	73 (10.1)	10 (7.0)	2 (9.5)
>=4	22 (16.7)	7 (17.5)	26 (9.0)	119 (16.4)	18 (12.7)	1 (4.8)

Out of the total 506 induced delivery cases, 391 (73.7 %) were due to severe pre-eclampsia/eclampsia. Regarding to the measure of delivery 46.7% of newborns born from mothers of sever preeclampsia/eclampsia were resuscitated or admitted to ICU; whereas in the mild cases such as gestational hypertension and mild preeclampsia nothing was done in more than 80% of deliveries. The majority of the fetal deaths (87.4%) occurred among the sever preeclampsia/eclampsia cases.

Table 9: Distribution of delivery outcomes by types of hypertensive disorders of pregnancy in public hospitals of Tigray, 2013-2017

	Types of HDP (**Fre/%**)					
Variables	Gestational Hypertension	Chronic Hypertension	Mild preeclampsia	Severe Preeclampsia	Eclampsia	HELLP syndrome
Mode of delivery						
SVD	102 (77.3)	34 (85.0)	210 (72.9)	508 (70.2)	95 (66.9)	16 (76.2)
CS	24 (18.2)	4 (10.0)	44 (15.3)	174 (24.0)	38 (26.8)	4 (19.0)
Instrumental	6 (4.5)	2 (5.0)	34 (11.8)	42 (5.8)	9 (6.3)	1 (4.8)
Delivery initiation						
Spontaneous	105 (79.5)	28 (70.0)	218 (75.7)	381 (52.6)	95 (66.9)	14 (66.7)
Induced	27 (20.5)	12 (30.0)	70 (24.3)	343 (47.4)	47 (33.1)	7 (33.3)
Maternal outcome						
Alive	127 (96.2)	38 (95.0)	285 (99.0)	695 (96.0)	132 (93.0)	20 (95.2)
Dead	5 (3.8)	2 (5.0)	3 (1.0)	29 (4.0)	10 (7.0)	1 (4.8)
IUGR						
Yes	53 (40.2)	8 (20.0)	29 (10.1)	149 (20.6)	24 (16.9)	9 (42.9)
No	79 (59.8)	31 (77.5)	238 (82.6)	489 (67.5)	95 (66.9)	10 (47.6)
Unknown	0 (0.0)	1 (2.5)	21 (7.3)	86 (11.9)	23 (16.2	2 (9.5)
Newborn outcome						
Alive	124 (93.9)	36 (90.0)	280 (97.2)	606 (83.7)	109 (76.8)	14 (66.7)
Death	8 (6.1)	4 (10.0)	8 (2.8)	118 (16.3)	33 (23.2)	7 (33.3)
Time of death						
Born Dead	3 (37.5)	3 (75.0)	7 (77.8)	94 (81.0)	30 (88.2)	6 (85.7)
Immediately After birth	4 (50.0)	1 (25.0)	2 (22.2)	13 (11.2)	4 (11.8)	0 (0.0)
Within the first 24h	1 (12.5)	0 (0.0)	0 (0.0)	4 (3.4)	0 (0.0)	0 (0.0)
Within the first 7d	0 (0.0)	0 (0.0)	0 (0.0)	5 (4.3)	0 (0.0)	1 (14.3)
A measure taken at delivery						
	107 (81.1)	35 (87.5)	243 (84.4)	538 (74.3)	112 (78.9)	16 (76.2)
Nothing done	3 (2.3)	2 (5.0)	22 (7.6)	83 (11.5)	14 (9.9)	2 (9.5)
Admitted to ICU	22 (16.7)	3 (7.5)	23 (8.0)	103 (14.2)	16 (11.3)	3 (14.3)
Resuscitation done						
Gestational age						
<=34 weeks	8 (6.1)	5 (12.5)	24 (8.3)	165 (22.8)	34 (23.9)	7 (33.3)
34.1-36.6	26 (19.7)	5 (12.5)	65 (22.6)	175 (24.2)	26 (18.3)	1 (4.8)
>=37	98 (74.2)	30 (75.0)	199 (69.1)	384 (53.0)	82 (57.7)	13 (61.9)
Weight						
Low birth weight	23 (17.4)	11 (28.2)	58 (20.1)	276 (38.8)	53 (37.6)	7 (35.0)
Normal	109 (82.6)	28 (71.8)	230 (79.9)	436 (61.2)	88 (62.4)	13 (65.0)
APGAR score at 1 minute						
Low	19 (14.4)	13 (32.5)	75 (26.0)	239 (33.0)	58 (40.8)	8 (38.1)
Normal	113 (85.6)	27 (67.5)	213 (74.0)	485 (67.0)	84 (59.2)	13 (61.9)
APGAR score at 5 minutes						
Low	8 (6.1)	4 (10.0)	27 (9.4)	154 (21.3)	38 (26.8)	7 (33.3)
Normal	124 (93.9)	36 (90.0)	261 (90.6)	570 (78.7)	104 (73.2)	14 (66.7)

6.2 Risk factors for hypertensive disorders of pregnancy

Socio-demographic characteristics

A total of 330 mothers were interviewed in the data collection period that was held from June to November, 2018. Overall 110 cases matched on parity, day of interviews and study site/hospital with 220 controls taken part in the study to identify risk factors of hypertensive disorders of pregnancy. Of the total cases, gestational hypertension, preeclampsia, eclampsia and preeclampsia/eclampsia superimposed on chronic hypertension comprised of 36(32.7%), 55(50%), 14(12.7%), and 5(4.5%) respectively. Respondents were predominantly married, Orthodox Christianity followers and Tegaru by ethnicity in both cases and controls (90% and above in all cases). Majority of the mothers were housewives and comparable proportions were reported among cases and controls (64.5% Vs 68.2%). The Mean ±(SD) age of cases and controls were 27.6±5.6 and 26.7 ±5.8 years respectively. The proportion of older age mothers (age≥35) was found to be higher among cases as compared to controls (23.6% Vs 11.8%)(**P=.006**). Besides, rural residents were higher among cases 71(64.5%) as compared with controls 76 (34.5%) (**P<.001**)(**Table 10**).

Table 10: Socio-demographic characteristics of mothers with and without hypertensive disorders of pregnancy in public hospitals of Tigray, 2018.

variable	HDP/Cases N=110, N (%)	No HDP/Controls N= 220, N (%)	COR (95% CI)	P-value
Age group				
≤18	7(6.4)	10(4.6)	1.5(0.58, 4.1)	0.378
19-34	77(70.0)	184(83.6)	1.0	
≥35	26(23.6)	26(11.8)	2.3(1.3, 4.2)	0.006
Residence				
rural	71(64.5)	76(34.5)	3.1 (1.9, 5.0)	<0.001
urban	39(35.4)	144(65.4)	1.0	
Marital status				
married	104(94.5)	199(90.5)	1.0	
unmarried	6(5.4)	21(9.5)	0.5 (0.2, 1.4)	0.2
Partner change				
Yes	14(12.7)	26(11.8)	1.09 (0.5, 2.2)	0.8
No	96(87.2)	194(88.2)	1.0	
Religion				
Orthodox	103(93.6)	199(90.5)	1.4 (0.5, 3.6)	0.49
Muslim	6(5.5)	16(7.3)	1.0	
Maternal education				
literate	74(67.3)	153(69.5)	1.0	
illiterate	36(32.7)	67(30.5)	1.12(0.7, 1.9)	0.65
Ethnicity				
Tigrian	105(95.5)	200(90.9)	1.0	
Amhara	4(3.6)	17(7.7)	0.4 (0.14, 1.36)	0.15
Occupation				
Housewife	71 (64.5)	150(68.2)	1.0	
Government employee	22(20.0)	33(15)	1.4(0.7, 2.7)	0.26
NGO employee	8(7.3)	7(3.2)	2.5(0.8, 7.7)	0.08
Private employee	7(6.4)	28(12.7)	0.5(0.2,1.3)	0.17
Husband education				
Illiterate	14(12.7)	31(14.1)	1.2 (0.6, 2.5)	0.6
Read and write	14(12.7)	26(11.8)	1.2(0.6, 2.5)	0.7
Primary	23(20.9)	42(19.1)	1.1(0.5, 2.0)	0.8
Secondary and above	59(53.6)	122(55)	1.0	
Income category				
≤2500	37 (33.64)	62 (28.18)	0.8(0.4,1.5)	0.5
2501-4999	48 (43.64)	106 (48.18)	0.9 (0.5, 1.7)	0.8
≥5000	25 (22.73)	52 (23.64)	1.0	

Dietary, familial and lifestyle factors

Twenty two (20%) of pregnant mother had family history of hypertension among cases while only 14(6.4 %) pregnant women had family history of hypertension among controls. The mean pre-pregnancy weight of cases and controls were 53.6±8.4 and 51.3±6.8 Kg, respectively. The maximum BMI recorded was 29.9kg/m^2; 65 (59.1%) and 147 (66.8%) of the respondents had BMI ranging from 18.5 to 25 kg/m^2 in cases and controls respectively. The mid-upper arm circumference of mothers was categorized below the mean and above the mean (≥22. 1 and >22.1) centimeters and more than 60% of the cases and controls were measured less than or equal to the mean. On average, the pre-pregnancy BMI was higher in women with hypertensive disorders than in those with normal pregnancies (20.36±3.0Vs 19.8±2.6) (**P=.05**). Vegetable and fruit use were found to be less frequent in hypertensive disorders of pregnancy as compared with the normotensive women (42.7% Vs 60.4% and 54.5% Vs 87.7%). Likewise, frequency and volume of coffee use was demonstrated to be higher among cases when compared with controls (**P=. 01, P=. 03**) (**Table 11**).

Table 11: Dietary, familial and lifestyle characteristics of mothers with/without hypertensive disorders of pregnancy in public hospitals of Tigray, 2018.

variable	HDP/Cases N=110, N (%)	No HDP/Controls N= 220, N (%)	COR (95% CI)	P-value
Family history of hypertension				
Yes	22(20)	14(6.4)	3.6(1.7,7.6)	0.001
No	88(80)	206 (93.6)	1.0	
Mean weight ±(SD)	63.2 (8.7)	60.8 (7.3)		0.01
Mean Height ±(SD)	1.61(.06)	1.62(.05)		0.09
MAUC				
≤22.1	69 (62.7)	140(63.6)	1.0	
>22.1	41(37.3)	80 (36.4)	1.0(0.6, 2.0)	0.82
Pre-pregnancy mean weight ±(SD)	53.6 (8.4)	51.3 (6.8)		0.006
Pre-pregnancy mean BMI ±(SD	20.36(3.0)	19.8 (2.6)		0.05
Fruit use				
Yes	60(54.5)	193(87.7)	1.0	
No	50 (45.5)	27 (12.3)	5.3 (3.0, 9.4)	<0.001
Vegetable use				
Yes	47(42.7)	133(60.4)	1.0	0.002
No	63(57.3)	87(39.6)	2.1(1.3, 3.3)	
BMI of mothers				
<18.5	33 (30.0)	67 (30.5)	1.0	
18.5-24.9	65 (59.1)	147 (66.8)	0.9(0.6,1.6)	0.8
≥25	12 (10.9)	6 (2.7)	4.3(1.4,13.6)	0.01
Coffee use				
Yes	93(84.5)	149(67.7)	3.0(1.6, 5.9)	0.001
No	17(15.5)	71(32.3)	1.0	
Frequency of coffee use (N= 242)				
≥ once a day	76 (81.7)	104 (69.8)	3.2 (1.3, 8.3)	0.01
<once a day	17 (18.3)	45 (30.2)	1.0	
volume of coffee use (N= 242)				
<3 cups	28(30.1)	69(46.3)	1.0	
≥3 cups	65(69.9)	80(53.7)	2.1(1.0, 4.1)	0.03

Obstetrics and medical factors

The proportion of multiple pregnancy was 16.4% among cases, while it was 4.5% among controls (p=0.001). On the other hand, average age at menarche was reported to be 15 years, which were similar among cases and controls. About 3% of study participants had gestational diabetes mellitus and the proportion was different between cases and controls. It was 3.63% in cases while in controls it was 1.4% (P=0.02) (**Table 12).**

Table 12: Obstetrics and medical characteristics of mothers with/without hypertensive disorders of pregnancy in public hospitals of Tigray, 2018.

Variable	HDP/Cases N=110, N (%)	No HDP/Controls N= 220, N (%)	COR (95% CI)	P-value
Pregnancy type				
Multiple	18 (16.4)	10 (4.5)	4.1(1.8, 9.6)	0.001
Single	92 (83.6)	210 (95.5)	1.0	
Gestational diabetes mellitus				
Yes	7 (6.36)	3 (1.4)	4.7(1.2,18.0)	0.02
No	103 (93.6)	217 (98.6)	1.0	
Pre-pregnancy oral contraceptive use				
Yes	42(38.2)	63 (28.6)	1.5 (0.9, 2.4)	0.08
No	68 (61.8)	157 (71.4)	1.0	
Presence of anemia at first visit				
Yes	94(85.5)	194(88.2)	1.3(0.6, 2.9)	0.43
No	16(14.5)	26(11.8)	1.0	
Age at menarche				
≤15 years	72(65.4)	148 (67.3)	0.9(0.6, 1.5)	0.73
>15 years	38 (34.6)	72 (32.7)	1.0	
Pre-pregnancy interval (N=216)				
<5 years	54 (83.08)	117 (77.5)	1.0	
≥5 years	11 (16.92)	34 (22.5)	0.6(0.3, 1.5)	0.34
History of abortion				
Yes	25 (22.7)	39 (17.7)	1.0	
No	85 (77.3)	181 (82.3)	0.7(0.4,1.2)	0.26

Predictors of hypertensive disorders of pregnancy

Bivariate analysis was run in the conductional logistic regression considering the discordant pairs between cases and controls to check the association between dependent and independent variables. Accordingly, rural residence, age >=35 years, family history of hypertension, infrequent use of vegetables/fruits, higher pre-pregnancy weight, body mass index, coffee use, gestational diabetes mellitus and pre-pregnancy oral contraceptive use were identified as risk factors. In contrast, There was no difference among cases and controls with regard to average age, marital status, religion, ethnicity, occupation, maternal educational level, husband's educational level, income, history of abortion, history of smoking, pre-pregnancy interval and age at menarche (**Table 13**).

Variables which were found to be associated with the outcome variable in the bivariate analysis (P<=0.2) were taken to the multivariable analysis. This is basically to compensate for the power of

the test since negative findings (that is, $p>0.05$) may be just because of inadequate power. After adjusting for possible confounding factors in the matched pair conditional logistic regression only residence, fruit use, pre-pregnancy BMI of mothers, types of pregnancy and gestational diabetes mellitus were found to be independent predictors of hypertensive disorders of pregnancy. Mothers who live in a rural area were at greater odds of having hypertensive disorders as compared with mothers who reside in urban area (AOR = 3.7, 95%CI; 1.9, 7.1). Similarly, mothers who do not consume at all or consume less amount of fruits in their diet had 5 times higher odds of developing hypertensive disorders than those who consume fruits regularly (AOR =5.1 95%CI;2.4, 11.15). Overweight (BMI>25 Kg/m^2) mothers were also at risk of developing hypertensive disorders of pregnancy as compared with the normal and underweight mothers (AOR= 5.5 95% CI;1.12, 27.6). In addition, multiple pregnancy and presence of diabetes mellitus were independent risk factors for the development of hypertensive disorders of pregnancy; the risk of developing hypertensive disorders of pregnancy was 5.4times higher among diabetic mothers compared with those who are free of the disease (AOR = 5.4, 95%CI; 1.1, 27.0). On the other hand, the effect of age, family history of hypertension, use of vegetables, and drinking coffee disappeared in the multivariable analysis when adjusted for possible confounders.

Table 13: Bivariate and multivariable analysis for the predictors of hypertensive disorders of pregnancy in public hospitals of Tigray, 2018.

Variables	Unadjusted OR(95% CI)	Adjusted OR(95% CI)
Residence		
Rural	3.1 (1.9, 5.0)*	3.7(1.9, 7.1)**
Urban	1.0	1.0
Age		
Mean ±(SD)	1.02(0.9, 1.06)	0.96 (0.9, 1.02)
Marital status		
Married	1.0	1.0
Unmarried	0.5(0.2, 1.4)	0.44(0.12, 1.5)
Family History of hypertension		
Yes	3.6 (1.7, 7.6)*	2.1 (0.7, 6.4)
No	1.0	1.0
Fruit use		
Yes	1.0	1.0
No	5.3 (3.0, 9.4)*	5.1 (2.4, 11.15)**
Vegetable use		1.0
Yes	1.0	1.2(0.6, 2.3)
No	2.08 (1.3, 3.3)*	
History of smoking		
Yes	1.0	1.0
No	0.3 (0.07, 1.2)	0.6(0.07, 5.2)
BMI of mothers (pre-pregnancy)		
<18.5	1.0	1.0
18.5-24.9	0.95 (0.56, 1.6)	1.7(0.8, 3.4)
25-29.9	4.3 (1.4, 13.6)*	5.5 (1.12, 27.6)*
Coffee use		
Yes	3.08 (1.6, 5.9)*	1.9 (0.8, 4.4)
No	1.0	1.0
Pregnancy type		
multiple	4.1 (1.8, 9.6)*	4.2(1.3, 13.3)*
single	1.0	1.0
Presence of gestational diabetes mellitus		
Yes	4.6 (1.2, 18.0)*	5.4(1.1, 27.0)*
No	1.0	1.0
Oral contraceptive use		
Yes	1.5 (0.9, 2.4)	1.2(0.6, 2.4)
No	1.0	1.0

6.3 Maternal and perinatal outcomes of hypertensive disorders of pregnancy

Socio-demographic characteristics

A total of 374 mothers (187 normotensive and 187 with hypertensive disorders) were planned to be included in the study and finally 356 mothers (178 each) were included giving the response rate of 95%. Among the mothers with hypertensive disorders, 50 (28.1%) had gestational hypertension, 10(5.6%) chronic hypertension, 26 (14.6%) mild preeclampsia, 75(42.1%) severe preeclampsia, 12 (6.7%) eclampsia and 5(2.8%) chronic hypertension superimposed with preeclampsia. The mean age (SD) for the overall respondents was 26.8(5.4%); (26.5 (5.6) for women with hypertensive disorders and27.0 (5.1) for women without hypertensive disorders. The minimum and maximum ages were 15 and 46 respectively. Majority of the respondent in both groups were between 20-34 years old. More than 92% of the respondents were married and orthodox Christianity followers (**Table 14**).

Table 14: Frequency distribution of hypertensive and normotensive pregnant women in public hospitals of Tigray, 2017 (N=356)

Variables	Normotensive N (%)	HDP N (%)
Residence		
Urban	77(43.3)	54(30.3)
Rural	101(56.7)	124(69.7)
Age category		
<20	23(12.9)	25(14.0)
20-34	140(78.7)	134(75.3)
>34	15(8.4)	19(10.7)
Mean age (SD) in years	27(5.1)	26.5(5.6)
Mean pre-pregnancy weight(SD)	51(6.6)	53.8(8.3)
Parity		
Primipara	45(25.3)	68(38.2)
Multipara	133(74.7)	110(61.8)
Marital status		
Married	167 (93.8)	168(94.4)
Unmarried	11(6.2)	10(5.6)
Religion		
Orthodox	166(93.3)	163(91.6)
Muslim	12(6.7)	15(8.4)
Ethnicity		
Tigray	166(93.3)	167(93.8)
Amhara	12(6.7)	11(6.2)
Woman's educational status		
No education	45(25.3)	53(29.8)
Read and write	27(15.2)	21(11.8)
Primary	45(25.3)	45(25.3)
Secondary and higher	61(34.3)	59(33.1)
Occupation		
Housewife	130(73)	125(70.2)
Gov't employee	31(17.4)	31(17.4)
Nongovernmental employee		
Private Organization	3(1.7)	7(3.9)
	14(7.8)	15(8.4)
Husband's educational status(N=335)		
No education		
Read and write	24(14.3)	28(16.8)
Primary	45(26.8)	38(22.7)
Secondary and higher	28(16.7)	29(17.4)
	71(42.2)	72(43.1)

Pregnancy characteristic and birth outcomes

Preterm birth, cesarean section delivery, antepartum hemorrhage and postpartum hemorrhage were found to be higher in women with hypertensive disorder. On the other hand, spontaneous vaginal delivery was higher among the women without hypertensive disorders (**Figure 5**).

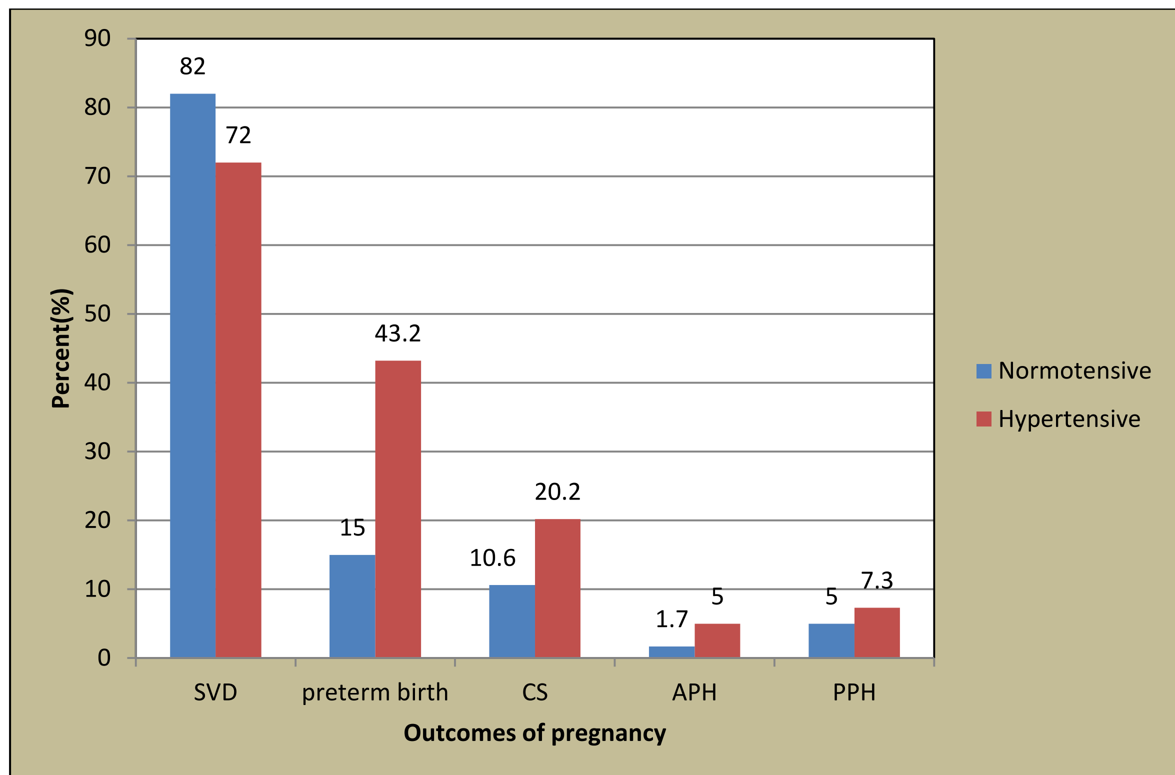


Figure 5: Pregnancy outcomes among hypertensive and normotensive women in public hospitals of Tigray, 2017.

The average (mean (SD)) gestational age at birth for the hypertensive mothers was 36.6(3.3) weeks and it was 38.4(2.1) (**P <.001**) among the women without hypertensive disorders. On average, women with hypertensive disorders deliver 1.5 weeks earlier than the normotensive women. Maternal pregnancy or birth complications were assessed among the two groups and it was found that 12(6.7%) and 24(13.5%) women were found to have abruptio placenta, placenta previea or postpartum hemorrhage in the normotensive and hypertensive groups respectively (**P=.023**). In this study, two women were died and both of them were among the hypertensive disorder cases, particularly in the severe preeclampsia category. Cesarean section rate was found to be almost twice

higher among the exposed group compared with the unexposed mothers (20.2%Vs10.7%, **P=.004).** Similarly,39(21.9%) women in the hypertensive category had undergone induction of labour whereas only 9(5.1%) normotensive women had induction of labour (**Table 15**).

Early neonatal death was significantly higher among mothers with hypertensive disorders compared with the normotensive mothers (6.4% Vs 1.2%, **P<.001**). Term delivery rate was 151(84.8%) among the unexposed groups but it was 101(56.7%) in the exposed group. Women in the hypertensive group were 4 and 4.8 times higher to experience preterm birth at 34-37 and less than 34 weeks respectively. Similarly, significant difference was observed on the birth weight of newborns between the normotensive and hypertensive mothers; the mean birth weight was 3.1(0.5) Kg in the normotensive mothers and 2.7(0.6) Kg in the hypertensive mothers (**Table 15**).

Table 15: Pregnancy characteristics and birth outcomes of normotensive and hypertensive women in public hospitals of Tigray, 2017

Pregnancy characteristics and birth outcomes	Normotensive N (%)	HDP N (%)	RR (95% CI)	P-value
Maternal complications				
Yes	12(6.7)	23(13.5)	1.9 (1.0, 3.7)	0.05
No	166(93.3)	155(86.5)	1.0	
GA at birth in weeks				
<34	8 (4.5)	26(14.6)	1.9(1.5, 2.4)	<0.001
34-37	19(10.7)	51(28.7)	1.8(1.4, 2.2)	<0.001
≥37	151(84.8)	101(56.7)	1.0	
Onset of labour				
Spontaneous	169(94.9)	139(78.1)	1.0	
Induced	9(5.1)	39(21.9)	1.8 (1.5, 2.16)	<0.001
Delivery				
Spontaneous vaginal delivery (SVD)	146(82.0)	128(71.9)	1.0	
Cesarean section (CS)	19(10.7)	36(20.2)	1.4(1.1, 1.7)	0.004
Instrumental	13(7.3)	14(7.9)	1.1(0.7, 1.6)	0.59
Mean GA(SD) at birth in weeks	38.4(2.0)	36.6(3.3)	0.9(0.9, 1.01)	0.275
Mean birth weight (SD)	3.1(0.5)	2.7(0.6)	0.7(0.6, 0.8)	<0.001
Preterm birth				
Yes	27 (15.2)	77(43.3)	1.8(1.5, 2.2)	<0.001
No	151 (84.8)	101(56.7)	1.0	
Apgar score (<7) at 1 minute				
Yes	18(10.1)	51(28.6)	1.6(1.4, 2.0)	<0.001
No	160(89.9)	127(71.4)	1.0	
Apgar score (<7) at 5 minute				
Yes	12(6.7)	39(21.9)	1.6(1.4, 2.0)	<0.001
No	166(93.3)	139(78.1)	1.0	
Birth weight in gms				
< 2500	11(6.4)	44(28.0)	1.9 (1.6, 2.3)	<0.001
≥2500	161(93.6)	113(72.0)	1.0	
ICU admission				
Yes	4(2.3)	27(17.2)	1.9 (1.6, 2.4)	<0.001
No	168(97.7)	130(82.8)	1.0	
Perinatal mortality				
Yes	8(4.5)	31(17.4)	1.7(1.4, 2.0)	<0.001
No	170(95.5)	147(82.6)	1.0	
Stillbirth				
Yes	6 (3.4)	21(11.8)	1.6(1.3, 2.05)	<0.001
No	172(96.6)	157(88.2)	1.0	
Early neonatal death				
Yes	2(1.2)	10(6.4)	1.7(1.3, 2.3)	<0.001
No	170(98.8)	147(93.6)	1.0	

The risk of undergoing cesarean section was 90% higher among women with hypertensive disorders (cRR 1.9, 955CI; 1.1, 3.2) compared with the normotensive women. Further analysis was made to see the effect of the different hypertensive disorders. Hence, preeclampsia and eclampsia cases had 2.3 and 4.3 times higher risk of undergoing cesarean section compared with the women without hypertensive disorders. Women who were induced for labour before delivery had an increased risk by 80% to go in to cesarean section (cRR 1.8, 955CI; 1.02, 3.1) compared with those initiated spontaneously. In this study variables such as attendance status, age, time at first ANC, gestational diabetes mellitus, antepartum hemorrhage and preterm birth were not risk factors for cesarean section (**Table 16**).

Table 16: The effect of hypertensive disorders of pregnancy on emergency cesarean section among mothers in public hospitals of Tigray, 2017

Variables	Cesarean section		RR (95%, CI)	P-value
	Yes N (%)	No N (%)		
Status of mother				
Normotensive	19(10.7)	159(89.3)	1.0	
Hypertensive	36(20.2)	142(79.8)	1.9(1.1, 3.2)	0.015
Type of HDP				
Normotensive	19(10.7)	159(89.3)	1.0	
GHTN	4(8)	46(92)	0.7(0.3, 2.1)	0.584
Preeclampsia	25(24.7)	76(75.3)	2.3(1.3, 4.0)	0.002
Eclampsia	6(46.2)	7(53.8)	4.3(2.1, 8.9)	≤0.001
CHTN/CHTNsuperimposed	1(7.1)	13(92.9)	0.7(0.1, 4.6)	0.684
Attendance status				
Referred	14(16.7)	70(83.3)	1.1(0.6, 1.9)	0.723
Not referred	41(15.1)	231(84.9)	1.0	
Mean (SD) age	27.0(6.6)	26.7(5.2)	1.01(0.9, 1.05)	0.686
Time at first ANC				
First trimester	3(9.4)	29(90.6)	1.0	
Second trimester	47(16.5)	237(83.5)	1.7(0.6, 5.3)	0.315
Third trimester	5(12.5)	35(87.5)	1.3(0.3, 5.1)	0.677
APH				
Yes	4(33.3)	8(66.7)	2.4(0.9, 5.2)	0.058
No	51(14.8)	293(85.2)	1.0	
Gestational Diabetes mellitus				
Yes	2(18.2)	9(81.8)	1.2(0.3, 4.2)	0.796
No	53(15.4)	292(84.6)	1.0	
Preterm birth				
Yes	17(16.4)	87(83.6)	1.08(0.6, 1.8)	0.763
No	38(15.1)	214(84.9)	1.0	
Initiation of labour				
Spontaneous	43(14)	265(86)	1.0	
induced	12(25)	36(75)	1.8(1.02, 3.1)	0.043

Perinatal death

In the bivariate analysis perinatal mortality was significantly different between the normotensive and hypertensive mothers. The risk of death in the late fetal stage or in the early neonatal period was 3.8 (cRR=3.8 95% CI; 1.8, 8.2) times higher in the hypertensive mothers compared with those who were normotensive. Further analysis was also made to check whether there is variation among the different types of hypertensive disorders of pregnancy compared with the normotensives as a reference category. Thus preeclampsia, eclampsia and preeclampsia superimposed on chronic hypertension were significantly different from the normotensive mothers (**P<.001, .008, .011** respectively) while there was no difference when compared with gestational hypertension. Furthermore, gestational diabetes mellitus and preterm birth were risk factors for perinatal death (**Table 17**).

Table 17: Bivariate analysis on the effect of hypertensive disorders of pregnancy on perinatal mortality among mothers in public hospitals of Tigray, 2018

Variables	Perinatal death		RR (95%, CI)	P-value
	Yes, N (%)	No, N (%)		
Status of mother				
Normotensive	8(4.5)	170(95.5)	1.0	
Hypertensive	31(17.4)	147(82.6)	3.8(1.8, 8.2)	<0.001
Type of HDP				
Normotensive	8(4.5)	170(95.5)	1.0	
GHTN	4(8)	46(92)	1.7 (0.6, 5.6)	0.329
Preeclampsia	21(20.8)	80(79.2)	4.6(2.1, 10.0)	<0.001
Eclampsia	3(23.1)	10(76.9)	5.1(1.5, 17.0)	0.008
CHTN/CHTNsuperimposed	3(21.4)	11(78.6)	4.7(1.4 15.9)	0.011
Residence				
Urban	14(10.7)	117(89.3)	1.0	
Rural	25(11.1)	200(88.9)	1.03(0.6, 1.9)	0.9
Attendance status				
Referred	12(14.3)	72(85.7)	1.4(0.7, 2.7)	0.26
Not referred	27(9.9)	245(90.1)	1.0	
Parity				0.890
Primipara	12(10.6)	101(89.4)	0.9(0.5, 1.8)	
Multipara	27(11.1)	216(88.9)	1.0	
Mean (SD) age	25.7(5.1)	27(5.4)	0.9(0.9, 1.02)	0.2
Mean (SD) Pre-pregnancy weight	53.5(9.9)	52.3(7.3)	1.01(0.9, 1.06)	0.37
Time at first ANC				
First trimester	1(3.1)	31(96.8)	1.0	
Second trimester	33(11.6)	251(88.4)	3.7(0.5, 26.2)	0.18
Third trimester	5(12.5)	35(87.5)	4.0(0.5, 32.5)	0.19
Anemia				
Yes	4(8.5)	43(91.5)	0.7(0.3, 2.0)	0.57
No	35(11.3)	274(88.7)	1.0	
APH				
Yes	1(8.3)	11(91.7)	0.7 (0.11, 5.0)	0.7
No	38(11.0)	306(89)	1.0	
BMI category				
<18.5	14(12.7)	96(87.3)	0.7(0.2, 2.2)	0.37
18.5-24.9	20(9.3)	196(90.7)	0.5(0.1, 1.4)	0.57
≥25	5(16.7)	25(83.3)	1.0	
Gestational Diabetes mellitus				
Yes	4(36.4)	7 (63.6)	3.5(1.5, 8.3)	0.003
No	35(10.1)	310(89.9)	1.0	
Preterm birth				
Yes	24(23.1)	80(76.9)	3.8(2.1, 7.0)	<0.001
No	15(6.0)	237(94.0)	1.0	

The effect of hypertensive disorders on cesarean delivery and perinatal death

Variables that were found associated with the perinatal outcomes (p<0.2) in the bivariate analysis were taken to the multivariable analysis in the logistic regression to check for independent effect of hypertensive disorders by adjusting the possible confounders. Accordingly, women with hypertensive disorders had 70% increased risk (aRR=1.7, 95%CI; 1.02, 2.9)to undergo cesarean section compared with the normotensive women maintaining the other variables constant. Besides, women with hypertensive disorders had 2.6 times (aRR=2.6, 95%CI; 1.2, 5.7) higher risk of perinatal death compared with the normotensive women.

Table 18: Multivariable analysis for the effect of hypertensive disorders on perinatal outcomes in public hospitals of Tigray, 2017

Pregnancy and delivery outcomes	Crude RR (95%CI)	P-value	Adjusted RR (95%CI)	P-value
Cesarean section				
Hypertensive disorders of pregnancy	1.9(1.1, 3.2)	0.015	1.7(1.1, 2.9)	0.041
Presence of antepartum hemorrhage	2.4(0.9, 5.2)	0.058	1.8(0.8, 4.2)	0.149
Induced labour	1.8(1.1, 3.1)	0.043	1.4(0.8, 2.5)	0.248
Perinatal death				
Hypertensive disorder of pregnancy	3.8(1.8, 8.2)	<0.001	2.6 (1.2, 5.7)	0.017
Age	0.9(0.9, 1.1)	0.2	0.9 (0.9, 1.1)	0.686
Gestational DM	3.5(1.5, 8.3)	0.003	2.3(1.1, 5.1)	0.043
Preterm birth	3.8(2.1, 7.0)	<0.001	2.7(1.5, 5.2)	0.001

6.4 Barriers for early detection and management of hypertensive disorders of pregnancy

A total of 22 in-depth interviews involving health professionals, health care managers and administrators as well as mothers were undertaken. The service year of the professionals ranged from 5 to 20 years. Similarly, the study women were aged between 25 and 40 years. Six themes were emerged from the qualitative analysis namely: traditional believes do not go away, late referral and incomplete care, antenatal care (ANC) prioritised but quality compromised, unpredictability of the disease and atypical cases, resource scarcity as a barrier and flaws in technical support and supervision. These themes were also organized in three main areas according to the delay model.

First delay: Delay in decision to seek care

Knowledge deficient and traditional believes do not go away

Participants reported that pregnant mothers have less awareness towards hypertensive disorders of pregnancy in general and preeclampsia/eclampsia in particular. They do not properly understand the dangers signs in pregnancy and decide to seek care timely. This was reiterated by a study women saying "*I used to attend antenatal care follow up in the health centers in my previous pregnancy but I did not know the danger signs…I felt headache around my forehead and did not seek medical attention because I thought that it is minor but after few hours I lost my conscious and taken to the hospital* (primipara women from a rural area). Another participant added the following

…..we can't say that mothers have good awareness on dangers signs of pregnancy including the signs and symptoms of pregnancy induced hypertension, I know mothers who had completed the four ANC visits but not aware about danger signs during pregnancy…imagine how the knowledge could be lower among those with interrupted ANC follow up or without any follow up visits (an obstetrician from a general hospital).In addition participants raised that there is a misconception towards the disorders particularly regarding convulsion among women and the community. Both mothers and health professionals revealed that whenever a woman convulses the community perceive it as an evil

spirit and they used to describe it as "*buda*", "*qole*", "*tehazi*" in local language. As a result, they do not take them to the health facility rather they take them either to the holly water or traditional healers. A physician stated that *"pregnant mothers do not immediately come to the health facility after they develop eclampsia and experience convulsion, they try other managements in the community such as holly water or traditional remedies….when they come to us it would be too late to save them, it might have already involved organ failure in this stage. It is not the disease killing them but the complication of it which is associated with unnecessary delay"* (an obstetrician from a referral hospital). This community perception is also further manifested at health facilities, the caregivers do not allow professionals to inject medications as they believe that injection can kill a person having evil spirit. Besides, home delivery was mentioned as one of the barriers for early detection and management of hypertensive disorders of pregnancy as any of these disorders have a possibility to develop in the intrapartum and postpartum periods in addition to the antepartum period.

Second delay: Delay in reaching care

Late referral and incomplete care

Multiple referrals before reaching to the final health care facility where the mother could get advanced care was prominently recurring theme. Mothers usually seek care in the nearest health facility possible when they develop any complication which is the health post (in rural areas). Then they will be referred to the health center; the health centers are supposed to provide magnesium sulphate loading dose for severe preeclampsia and eclampsia cases and refer them to the general hospital immediately. The interview revealed that there is delay in this regard especially in the health centers, mothers are unnecessarily delayed and sent without any pre-referral treatments that could in turn lead to complication when they arrive at the hospital. This was expressed as *"……They are not properly discharging their responsibility as a health centre staff if they just send the patient without doing anything. When they are referring a patient at health centre they have to provide pre-referral treatment otherwise it would be serious for the mother ……. most of the time they send cases after*

they start convulsion, even they do not give magnesium sulphate, mothers do not have IV line and catheter though the diagnosis is put as ***'severe preeclampsia/eclampsia'****"(*BSc midwives and MCH head from a general hospital*).* It was further emphasised that the referral may not end at the general hospital, it is not uncommon to send eclamptic mother to the referral hospitals. Thus, even a mother decides to seek care in health facilities it takes long time to get the appropriate care in cases of severe preeclmampsia/eclampsia as it necessitates advanced care which is not found in the nearby health facilities. Transportation problem was another barrier raised by the participants as ambulances are not functional most of the time due to delayed maintenance.

Third delay:Delay in receiving appropriate care

Antenatal care (ANC) prioritised but quality compromised

The uptake of antenatal follow up is increasing in Tigray. Currently, almost every pregnant woman has a contact with the skilled professionals in a health facility at least once. The problem is that women do not consistently follow antenatal care services according to the recommended standard; they start the follow up lately like after five months and/or interrupt the follow up. In addition, the focus of the health care system is on increasing coverage not on enhancing the quality of maternal services. Professionals are not properly counselling mothers on birth preparedness and complication readiness; including how to prevent hypertensive disorders of pregnancy and how to early identify warning symptoms before the severe manifestations. According to the focused antenatal care guideline developed by WHO, there are basic and specialised care given for pregnant women according to their status but commonly only the basic care is given to every pregnant woman *"……we health professionals working in the ANC as well as in the delivery units are not good in counselling mothers on preventing complications…. we are better in treating the case once the problem has occurred (*BSc midwife*).* This is associated with negligence, workload as a result of high client flow or because of having demotivated staff. Furthermore, participants reported that

laboratory materials which are helpful to diagnose hypertensive disorders of pregnancy are not consistently provided that makes the follow up incomplete.

Unpredictability of the disease and atypical cases

The health professionals and health care managers mentioned that the very nature of the disease makes it unpredictable because the exact cause is unknown. Likewise, there are no practical models to predict severities. In some cases it can develop at any time without giving warning signs and symptoms and without having the typical features. Hence; one of the barriers is lack of exact preventive and treatment strategies apart from the recommendation to minimize risk factors or terminating the pregnancy. Respondents said *"sometimes it is confusing, after having complete follow up in the ANC with a stable blood pressure, they develop convulsion during labour…..this is really unusual, investigations are normal but they convulse. For instance, in the mid 2017 there was one woman who was under ANC follow up here without any finding but during labour she become eclamptic*(BSc midwives). Another participant added *"Preventing preeclampsia/eclampsia is not effective, it is more productive to work on effective management once the disease has occurred because serious adverse outcomes are associated with the complications of the disease"* (Obstetrician). This would also be more complicated in areas with high prevalence of home delivery habits.

Resource scarcity as a barrier

Participants reported that there are some materials and supplies used to identify and manage hypertensive disorders of pregnancy. The frequent stock out of these materials is another barrier to early identify and treat the problem. This is very common in laboratory materials and some medications. Midwives from two hospitals stated *"….Hydralazine was stock out for2 weeks, and we were asked to buy from the private facilities ahead of time when we suspect raised blood pressure."*

"……. antihypertensive and diazepam were frequently interrupting and even I remember mothers who were referred due to lack of antihypertensive….we had also a time when we were not able to catheterize a mother to measure urine output as a result of shortage."

Some institutions do not provide organ function tests at all and others do not provide the service for 24 hours. In such cases women would be forced either to go to the private clinics or to come back another time. This in turn will lead to unnecessary delay and late diagnosis or even it may go undetected. The following quotes exemplify hospital managers' description

"….Sometimes, especially during lunch time and weekends organ function tests are not done, so we send them to private clinics and that creates discomfort and unnecessary delay in decision as we want to get the result before we make decisions. At times, hydralazine stock outs though very rarely. Common problem is the organ function test; it should not be only available in working hours it should be done at any time. Some of them are also unable to afford the payment for the laboratory test fees in private centers and because of this miss diagnosis and mismanagement may happen." They explained that the dysfunctional laboratory service is associated with lack of competent professionals, interrupted supply of reagents or frequent damage to the testing machine.

Lack of adequate space to admit mothers in health facilities was also raised as a barrier by health care providers, managers and client women.

……. "*if there are many patients deserving the service, we are forced to send mild preeclampsia cases to stay at home and follow every week though we were supposed to admit and follow them continuously"* (Maternity head of a referral hospital). A Midwife from a general hospital also added "*…..Recently I remember three cases, after we discharged them home they came back to the hospital after developing convulsion. This is due to space problem. We have very limited rooms and many*

delivering mothers." Lack of appropriate screening practice for hypertensive disorders of pregnancy in the postpartum period was also raised as a gap.

Flaws in technical support and supervision

There are linkages between the different health care facilities in catchment areas to help to each other. For instance, health professionals working in the primary and general hospitals pay visits to the health centres in their catchment to strengthen the service provision. Besides the health care administrators and managers from the district health office and/or from the regional health bureau also have a supportive supervision visits to the health facilities occasionally. However, the visits are not focused; they only provide comprehensive directions and suggestion. The participants suggested that supervision should have been focused and accompanied by experts on specific areas. For instance, experts in obstetrics care should be part of the supervisory team to share their clinical expertise as mentors. …. "*In the traditional way of supervision, they tell you the weakness or gaps but they do not help you to fill the gap or to be part of the solution"*. In addition, refresher trainings are limited and they are not usually given by experts who have rich expertise in both theory and practice in the specific field. Hence, practicing professions in these facilities do not have detailed knowledge on hypertensive disorder of pregnancy apart from defining the terminologies. *".....in the health centers, only few staffs dare to provide magnesium sulphate loading dose for preventing or controlling preeclampsia/eclampsia"*(Midwives from a general hospital)

The need for updated clinical protocols and guidelines was another sub-theme emphasized by participants. The institutions do not have updated guideline that incorporates current evidences which could facilitate for possible prevention, early detection and management of hypertensive disorders of pregnancy,

In health facilities which are also serving as a teaching institution, delay in consultation and decision was emerged as an important barrier for early detection and treatment of hypertensive disorders of

pregnancy. There are multiple consultations before the case is seen by resident four or the senior obstetrician for final decision. This was further explained as *"Diagnosis is usually straightforward but delay is very common in providing care after the diagnosis is made because the case does not directly go to the decision maker. Even after the decision is made there is delay for instance, after they decide that a mother needs to undergo emergency cesarean section, it takes longer time until the delivery of the baby"* (head of maternity ward). In addition a woman who experienced eclampsia said "*many people examined me multiple times in the hospital for my previous pregnancy but none of them gave me treatment and when I got extremely exhausted they ordered operation*".

VI. Review of Main Findings in Manuscripts I–IV

In this section, main findings from the four manuscripts are outlined & reviewed.

Table 19: Summary of main findings from the four manuscripts

MS	Objective	Main findings
I	To describe the pattern of hypertensive disorders of pregnancy among women in hospitals of Tigray	• A total of 45,329 mothers were admitted for delivery in the five years period (September 2012 to August 2017) in 5 general/zonal hospitals and 1 referral hospital. • Out of the total deliveries, 1347 (3%) women were managed for one of the hypertensive disorders of pregnancy • Of the total women with hypertensive disorders, 132 (9.8%) were diagnosed for gestational hypertension, 724 (53.7%) suffered from severe preeclampsa and 143 (12.1%) from eclampsia. The overall magnitude of hypertensive disorders of pregnancy showed an increasing trend over the review period ranging from 1. 4% in 2013 to 4% in 2017. The average percentage increase was 31% per annum • Similarly, severe preeclampsia/eclampsia ranged from 0.9 in 2013 to 2.6 in 2017. • The change over the five years period was checked whether it is significant using chi-square trend analysis and it was found that the trend was significant (X^2= 153, p≤0.001).
II	To assess risk factors for hypertensive disorders of pregnancy among women in hospitals of Tigray	• The Mean ±(SD) age of cases and controls were 27.6±5.6 and 26.7 ±5.8 years respectively • Twenty six (23.6%) cases and 26(11.8%) controls were women with age≥35 years • Seventy one (64.5%) cases and 76 (34.5%)

		controls were rural residents • Twenty two (20%) cases and14(6.4 %) had family history of hypertension • The pre-pregnancy BMI of cases and controls were 20.36±3.0and 19.8±2.6 respectively • Sixty (54.5%) cases and 193(87.7%) controls consumed fruits greater than two times a week • Seven(6.36%) cases and 3(1.4%) controls had gestational diabetes mellitus • Rural residency (AOR = 3.7, 95% CI; 1.9, 7.1), less amount of fruits consumption (OR =5.1, 95% CI;2.4, 11.15). Overweight (BMI>25 Kg/m2) (AOR= 5.5 95% CI; 1.12, 27.6), gestational diabetes mellitus (AOR = 5.4, 95%CI; 1.1, 27.0)and multiple pregnancy (AOR= 4.2 95%CI;1.3, 13.3) were independent predictors of hypertensive disorders of pregnancy
III	To assess maternal and perinatal outcomes of hypertensive disorders of pregnancy among women in hospitals of Tigray	• The mean± (SD) gestational age at birth for the hypertensive women was 36.6(3.3) weeks and 38.4(2.1) weeks for the women without hypertensive disorders. • Cesarean section rate was found to be almost twice higher among the exposed group compared with the unexposed mothers (**P=.004)** • Thirty six (20.2%) of hypertensive women and 19(10.7%) normotensive women undergone cesarean section delivery • In this study 2 women were died and both of them were among the hypertensive disorder cases, particularly in the severe preeclampsia category. • Preterm birth (cRR=1.8; 95%CI, 1.5, 2.2),

		stillbirth (cRR=1.6; 95%CI, 1.3, 2.02), low birth weight (cRR=1.9; 95%CI, 1.6, 2.3), early neonatal death (cRR=1.7; 95%CI, 1.3, 2.3), perinatal death (aRR=2.6, 95%CI; 1.2, 5.7) and cesarean section delivery(aRR=1.7; 95%CI, 1.02, 2.9) were significantly higher among women with hypertensive disorders of pregnancy
IV	To explore barriers for early detection and management of hypertensive disorders of pregnancy in Tigray	• The study demonstrated the presence of multiple barriers for early detection and management of hypertensive disorders of pregnancy from different health professionals, health care leaders as well as women's perspectives. • Poor awareness of mothers and the community, misconceptions towards hypertensive disorders of pregnancy, multiple referrals before reaching the final functional health care facility were mentioned • In addition, less focus on the quality of antenatal care; scarcity of supplies, medicine and lab reagents as well as limited capacity building programs such as in service training and mentorship were claimed for the late detection and management of hypertensive disorders of pregnancy

VII. Discussion

This study attempted to assess the pattern, risk factors, birth outcomes and barriers for hypertensive disorders of pregnancy among women in Tigray.

7.1 Patterns of hypertensive disorders of pregnancy

The present study revealed that the overall magnitude of hypertensive disorders of pregnancy was 3% (95%CI; 2.82, 3.13) and severe pre-eclampsia/eclampsia was found in 2% (95%CI; 1.84, 2.09) of the deliveries. In both cases an increasing trend was observed. Besides, preeclampsia was the most commonly reported type of hypertensive disorders of pregnancy.

According to previous studies, wide variations have been reported on the prevalence of hypertensive disorders of pregnancy in different parts of the globe and this is believed to be influenced by parity, genetic predisposition, and environmental factors[10]. The 3% prevalence of hypertensive disorders of pregnancy in this study is lower than the reports from high income countries which was estimated at 5-10%% [38-43] but in line with other studies from low and middle income countries [17, 53, 58]. [20]. The reason for the variations might be the study design and settings where the studies conducted. In addition, the time and geographical difference may contribute to the discrepancy.

Even though prevalence is lower in low and middle income countries compared to high income countries; the complications and maternal as well as perinatal burden of death are extremely higher in developing countries[19]. Hence, lower prevalence does not mean that the impact of the disease is low as the outcome depends on the health facilities capacity of case detection and management[18].

In line with previous studies[15, 47, 48, 63], the review over the five years period showed an increasing trend for the overall types of hypertensive disorders of pregnancy in general and severe pre-eclampsia/eclampsia in particular. The antenatal follow up and institutional delivery is increasing from time to time which increases the probability of a woman to undergo screening for hypertensive disorders of pregnancy which in turn increases the prevalence. The increasing trend for severe preeclampsia/eclampsia could be due to the fact that screening and counselling practices in the prenatal care might not be strong to identify gestational hypertension and mild preeclampsia cases and eventually to prevent development of severe preeclampsia. It could also be attributable to increased referrals from the lower level health care facilities as the study was conducted in general and referral hospitals. On the other hand the prevalence of severe preeclampsia/eclampsia showed a

slight decline from 206 to 2017. This could be explained by a relatively better obstetrics care in general and routine provision of magnesium sulphate for severe preeclampsia cases in particular after the implementation of the health sector transformation plan as it gives due emphasis for quality of care[100]

In the current study, severe pre-eclampsia/eclampsia contributed for two third of the overall cases of hypertensive disorders. This implies that the severe forms of the disorder which are associated with adverse maternal and perinatal outcomes are predominating. This could be related to late initiation and interruption of the ANC and improper counselling with a less focus to prevention.

The prevalence of eclampsia among all deliveries was 0.7% which is higher than the one reported in Iran (0.03%)[12]and the higher next to preeclampsia among the types of hypertensive disorders in the current study. Likewise, the prevalence of chronic hypertension was 0.08% among all deliveries which is lower than previous reports[12, 21]. The lower prevalence of chronic hypertension might be associated with the predominantly younger population of the cases studied, noting that chronic hypertension is associated with age[101].

7.2 Risk factors for hypertensive disorders of pregnancy

In this study residence, fruit consumption, higher pregnancy BMI, multiple pregnancy and gestational diabetes mellitus were found to be associated hypertensive disorders of pregnancy. On the other hand, family history of hypertension, taking coffee, age, literacy level and pregnancy interval were not associated with the outcome

Rural residence was associated with the development of hypertensive disorder of pregnancy. This finding is consistent with a previous finding in an epidemiological study among pregnant mothers in Cairo, Egypt[69]. This could be due to the fact that mothers from rural areas book antenatal care later in pregnancy and have fewer ANC visits which could be associated with delay in health seeking behaviour. This delay in health care seeking could in turn be influenced by lack of awareness on pregnancy related problems, husband and family influences, local cultural influence and bad experiences in health facilities[84, 87].

Similarly, fruit consumption was found to be important predictor in this study , mothers who consume less fruits in their diets were at higher risk of developing hypertensive disorders of pregnancy which is in line with previous findings [75]. This was also supported by a systematic

review and meta-analysis of studies whereby calcium intake was found to be protective to hypertensive disorders of pregnancy in a multivariable analysis[74]. The relationship between fruit consumption and hypertensive disorders of pregnancy is paramount important; especially in areas like Ethiopia where the awareness towards nutrition and practice of self-consumption is low[102]. Fruits are rich in micronutrients and many of the vitamins and minerals play antioxidant role which could in turn help in the prevention of hypertensive disorders of pregnancy[103].

Pre-pregnancy body mass index was calculated and overweight mothers were at higher odds of developing hypertensive disorders of pregnancy as compared with low and normal body mass index which is in agreement with reports from USA[77, 104]. Likewise, multiple pregnancy has been reported as an independent predictor of hypertensive disorders of pregnancy from various studies in different parts of the globe [44, 64, 105]. The current finding is also in support of those previous reports which showed 4.2 times increased risk of developing hypertensive disorders of pregnancy compared with the singleton pregnancy.

Gestational diabetes mellitus was also found to be an independent predictor of hypertensive disorders of pregnancy that supported the existing knowledge; because literatures noted that pregnant mother who developed diabetes mellitus would have higher predisposition to develop hypertensive disorders of pregnancy and it has been identified as the most common predictor in previous studies [16, 44, 55, 70, 105]. WHO recommends to provide specialized care apart from the basic care for women found to have gestational diabetes or multiple pregnancy as they have higher possible to develop complications including hypertensive disorders of pregnancy[106]

Family history of hypertension was a predictor in the bivariate analysis but its effect vanished in the adjusted model and this contradicts with previous reports. These studies reported an increased risk of hypertensive disorders with a positive family history of chronic hypertension [65, 68, 70, 72, 79, 107].

Similarly, drinking more than 3 cups of coffee per day was not a significant risk factor in this study which means it is in conformity with some studies showing no difference[108]and contradicted with others which reported positive association[75]. However, another study in Rotterdam, the Netherlands reported the substantial protection of coffee against the development of pregnancy induced hypertension[108]. This variation may be associated with the design and the method of measuring the amount of consumption

Extreme lower or higher ages in pregnancy (age<20 and >35 years) were reported as a risk factor for hypertensive disorders of pregnancy in previous studies; *Tebeu PM et.al* reported that teenage mothers were at increased risk of developing hypertensive disorders[68] on the other hand, *Suzuki. S.* and *Igarashi M.* in their study revealed that age >= 35 was a significant factor for the development of preeclampsia[109] but in the current study, no difference was observed. The difference may be due to the fact that few number of cases were having are >= 35 year that made the difference undetectable.

In many studies nulliparity was reported as a common risk factor for the development of hypertensive disorders of pregnancy [44, 77, 104, 107] but in this study its effect was not possible to measure as it was a matching variable. Unlike the current finding, partner change was reported as a risk factor for hypertensive disorders of pregnancy in other literatures[69]. The reason may be there were few mothers who changed their partner in the study and this in turn could make the difference invisible

In previous studies illiteracy was reported to be a risk factor for hypertensive disorders of pregnancy [68]as it affects the age at marriage and pregnancy as well as health seeking behaviour but in the current study no association was reported. The continuous health education program provided by the health extension workers at the community and household levels might have helped to have similar level of awareness about the issue.

Some studies reported inter-pregnancy interval as a risk factor for hypertensive disorders of pregnancy. Longer inter-pregnancy interval had higher risk of developing hypertensive disorders of pregnancy[110] but in the current study no association was found.

7.3 Maternal and perinatal outcomes of hypertensive disorders of pregnancy

This study revealed that early gestational age at birth, induction of labour, caesarean section delivery, preterm delivery rand perinatal mortality were more common among women with hypertensive disorders compared to women without hypertensive disorders disorder

Development of hypertensive disorders at earlier gestational age poses a risk for different maternal and perinatal adverse birth outcomes associated with prematurity. The more the mother approaches to her term gestational age the better the outcome of delivery. In this study, the average gestational age at birth was 1.5 weeks shorter in the women with hypertensive disorders compared with the normotensive women. This finding was consistent with a study in China where women with severe preeclampsia give birth at a gestational age which is 0.6 week shorter than the normotensive women[111]. This finding implies that when the disease gets worse there is no time to allow the pregnancy continue and get the fetus matured due to the maternal risk. Looking in to women with hypertensive disorders only, the gestational age at birth was almost the same with a previous study in Pakistan which was 37.37±2.25 weeks[112].

Induction of labour was significantly higher in the hypertensive disorders of pregnancy cases compared with the normotensive women (21.9% versus, 5.1% **P<0.001**) which was lower than the 44.3%, from the previous study in Addis Ababa among HDP cases[15].Physiologically as well as mechanically the uterus is resistant to be contracted and to establish labour early in the pregnancy. It is commonly initiated as it gets to term. Despite the fact it might be lifesaving to the mother and the

fetus to initiate labour before it is spontaneously initiated in cases of severe obstetric complications such as preeclampsia and eclampsia as a result the induction rate tend to increase.

In this study preterm birth was observed in 27 (15.2%, 95%CI; 10.4%, 21.5% and 77(43.3%, 95%CI; 36%, 50.9%)of normotensive and hypertensive women and the difference was statistically significant (**P<0.001**). Similar finding was reported from another study in Addis Ababa in which preterm delivery rate was 48.6% for all cases of HDP[15] and (36.6%) in Thailand[113]. On the other hand, in USA preterm birth was similar in women with hypertension and without hypertension (10.8% versus 10.4%)[114]. In developed countries such as USA there might be advanced therapies that help to maintain pregnancy and keep the fetus developing to term which makes no difference among the groups regarding the time of birth but in developing countries this is far from reach. Likewise, the same report was found from china in which there was no association between the different types of hypertensive disorders of pregnancy and the risk of preterm birth[111]. This could be further justified as, women in developing countries do not strictly follow antenatal care and the service itself is not up to standard. As a result, prevention, early diagnosis and treatment of obstetrics complications including hypertensive disorders of pregnancy are not effective which in turn leads to termination of the pregnancy preterm to save the mother.

Cesarean section rate was found to be 20.2% among the exposed group compared with 10.7% among the unexposed group. This finding was much lower than a study in China where the cesarean section delivery rate was 45.7% in normotensive women and 55.7% in women with hypertensive disorders[115]. Another study in Addis Ababa among hypertensive disorders of pregnancy cases also reported caesarean section rate of 44.3% which is much higher than the 20.2% of the current report[15]. The reason for this might be, clinicians tend to wait for expectant delivery taking the adverse effect of cesarean section in to account. In addition operation theatres may be so busy by other emergency cases and mothers might be forced to wait and spontaneous delivery to be

attempted. Furthermore, induction of labour might be also effective that minimizes the occurrence of cesarean section but in other studies direct cesarean section might be the trend.

In the multivariable analysis the risk of undergoing cesarean section was 70% higher among the women with hypertensive disorders (aRR 1.7, 95%CI; 1.02, 2.9) compared with the normotensive women. A study in Pakistan reported no significant difference among hypertensive disorders of pregnancy groups in light of cesarean section rate[112]. On the other hand, it was in line with a study in USA in which cesarean delivery was significantly increased among the hypertensive group[114]. The ultimate treatment of hypertensive disorders of pregnancy is delivering the baby[5]. Thus, it is obvious that pregnant women who developed severe preeclampsia and eclampsia would have higher chance of undergoing cesarean section as it would be a risk for both the mother and the fetus if it is allowed to continue. This is to mean that the difference in the rate of cesarean section mainly depends on the type or severity of hypertensive disorder of pregnancy.

Perinatal mortality in this study was reported 8(4.5%, 95%CI; 2.1, 9) and 31(17.4%, 95% CI, 12.3, 24) in the normotensive and hypertensive women respectively and the difference was significant. Women with hypertensive disorders had 2.6 times (aRR 2.6, 95%CI; 1.2, 5.7) higher risk of having perinatal mortality compared with the normotensive women. In addition, gestational diabetes mellitus and preterm birth were significant predictors for perinatal death. In a study elsewhere (USA) when normotensive/ gestational hypertension and mild preeclampsia cases were compared to each other, there was no any significant difference in perinatal outcomes[116]. This is because the comparison was made only with the mild preeclampsia cases. In addition, the level of care could be different in these settings.

The overall findings of this study imply that hypertensive disorders of pregnancy have continued to be the major contributor for obstetric complications leading to maternal and perinatal morbidity and mortalities.

7.4 Barriers for early detection and management of hypertensive disorders of pregnancy

Participants have shared their experiences from different perspectives regarding the barriers for early detection and management of hypertensive disorders of pregnancy. Unnecessary delays in detection and management of hypertensive disorders of pregnancy at different levels were reported as main barriers and this in fact leads to serious maternal and perinatal adverse outcomes, Berhan and Firoz reported similar findings[87, 117].

Inadequate awareness in the community regarding hypertensive disorders of pregnancy in general and preeclampsia/eclampsia in particular has surfaced in the interviews. This is mainly due to flaws in the implementation of focused antenatal care; especially due to compromised counselling as emerged from the interviews. According to the Ethiopian health sector transformation plan, quality of care is emphasized[100]. However, facilities are still focusing mainly on coverage, the uptake of antenatal care in this case. Even the coverage is not complete, mothers initiate the visit lately and or/interrupt the follow up which is in favour of previous studies in Tanzania and Ethiopia that indicated initiation of antenatal care after five months[118, 119]. An entrenched community misconception towards the disorders has also contributed for the limited awareness about the disease. Similar report was documented in previous studies that myths and misperceptions regarding pre-eclampsia and eclampsia were indicated[120]. This implies that much has to be done in creating awareness about the disease by strengthening the quality of antenatal care and involving the community.

Multiple referrals before reaching to the final health care facility and sending pregnant women without any pre-referral treatments were common according to the current study. This could in turn lead to serious maternal and perinatal complication when they arrive at the hospital as it was indicated in a previous study in Ethiopia[87]. Such delays are associated with the dysfunctional

nature of the lower level health care facilities due to lack of resource and weak decision making practices.

The unpredictable nature of the disease and lack of updated clinical guideline in all the health facilities was raised as one of the barriers for early detection and management of hypertensive disorders of pregnancy. Trials to prevent hypertensive disorders of pregnancy have never been successful nor the prediction of complications [5, 9, 117]. The only successful solution is to make pregnant mothers have continuous contact with skilled professionals or make them remain closer to the health facilities in order to timely identify and manage the problem or prevent complications.

Frequent interruptions in the supply of medicine and materials in the hospitals contributed for late detection and management of hypertensive disorders of pregnancy. Laboratories in some health institutions do not provide services 24 hours a day for 7 days in a week. This contributes for delayed decision making and in appropriate follow up of cases. In addition, it has cost implications for the service receivers. Resource related barriers were identified as a major gap in a study conducted at health facilities in Northern Nigeria[91].

In this study capacity building activities were described as incomplete and unfocused. Trainings were given occasionally and the focus is not on clinical skills. Besides, the routine supervisions were unconstructive. Mentorship programs involving experts on the specific obstetrics area were suggested by the participants. Previous reports also indicated weak professional's clinical and problem solving skills and supportive supervision programs as barriers for dealing with obstetrics cases and complications[91, 121].

VIII. Validity and Generalizability

Internal validity refers to the extent of making an inference that the independent variable is truly causing or influencing the dependent variable[122].

To minimize bias different activities were undertaken starting from designing the data collection tools to data analysis. Questionnaires and checklists were adapted from standard guidelines and relevant literatures, data collectors were experienced, trainings were given for the data collectors and supervisors before the commencement of data collection and there was close supervision during the data collection period. These activities were meant to reduce interviewer and other measurement biases.

Content validity concerns the degree to which an instrument has an appropriate sample of items for the construct being measured[122]. Thus, to ensure content validity an exhaustive literature review was conducted to conceptualize the variables measured.

To enable statistical conclusion validity, adequate statistical power was achieved by taking sufficient sample size and variables were clearly defined. In addition, Matching was done in the design stage for the case control study and multivariable binary logistic regression analysis was done for both the case control and cohort studies to control the effect of potential confounders

The term external validity refers to the generalizability of the research findings to other settings or population[122, 123].Since the health care system organizations in the country are operating in a similar setting in terms of patient mix, resources and professionals mix, the findings can reasonably be applicable to other similar health facilities.

To ensure trustworthiness of the qualitative data, prolonged engagement, data triangulation and continuous investigation of the data (transcription and investigating the data until the main theme emerges) and peer check were performed.

IX. Strengths and Limitations

This study possessed a couple of strengths. In the first objective the study utilized all medical records of women who had been diagnosed with hypertensive disorders of pregnancy over the review years which gave us the true image of the target population. Besides, cases and controls were ascertained by obstetricians and it was in health facilities (general and referral hospitals) where better equipment and material supply is available. Moreover, the data collectors were kept blinded for the cases and non-cases during the data collection process of the case control as well as cohort studies. Furthermore, the use of maximum variation sampling to better understand the barriers from different perspectives could be taken as strength in the qualitative study.

However, the findings should be viewed in light of some limitations. The nature of the data being record review had its limitation as there was incomplete data. To decrease this limitation mothers' data in the logbooks for high risk women was cross checked with the one in the patient chart. Similarly, since cases were selected consecutively as soon as they were identified, selection bias might be introduced; dietary assessment was self-reported and assessed at diagnosis which could have introduced recall bias. Besides, in the cohort study merging the different types of hypertensive disorders could be taken as a limitation as the effect of each type of hypertensive disorder might not be the same. Likewise, since the current study is hospital based it might not be generalized to the whole community in the region and the country. In the qualitative study, a possible limitation is that the health care managers and administrators might have given socially desirable answers rather than their genuine reflection as they are part of the system.

X. Conclusion

Hypertensive disorder of pregnancy in Tigray is found to be 3%; it has showed increasing trend ranging from 1.4% in 2013 to 4% in 2017.In this study severe preeclampsia is the most common of all pregnancy related hypertensive disorders followed by mild pre-eclampsia and Eclampsia.

Rural residence, less fruit consumption, multiple pregnancy, presence of gestational diabetes mellitus and pre-pregnancy overweight were identified as independent risk factors in the current study.

Besides, women with hypertensive disorders in pregnancy were at significantly higher risk of having pregnancies complicated by maternal and perinatal adverse outcomes. Significant risk of cesarean section delivery, preterm birth, perinatal death, stillbirth and low birth weight delivery were reported among women with hypertensive disorders of pregnancy.

Moreover, poor awareness of mothers and community misconceptions towards hypertensive disorders of pregnancy, multiple referrals before reaching the final functional health care facility, less focus on the quality of antenatal care, scarcity of resources and limited capacity building programs were reported as barriers for early detection and management of hypertensive disorders of pregnancy.

XI. Recommendation

Regional Health Bureau/health offices

- Health offices and health bureaus should avail necessary diagnostic and treatment materials/supply on time and should be augmented by a strong supportive supervision/ mentorship activities.
- Obstetric services in general and care to women with hypertensive disorders of pregnancy should be decentralized to the grass root level so that women can get all types of services in a closer distance.
- Health care managers and administrators at different levels of the health care system should give more emphasis to hypertensive disorders of pregnancy because its' magnitude is increasing from time to time and the severe forms such as severe preeclampsia and eclampsia are prevailing.
- Health institutions should have strong strategies of screening for the risk factors such as nutritional condition and medical complications during pregnancy, counselling women, proper follow-up and referral linkage of mothers in the antenatal clinic and maternity wards.

Health care professionals

- Health care professionals should focus on the timely identification and proper management of pregnant mothers with hypertensive disorders to minimize the burden of the problem.
- Health professionals should create awareness in the community especially in the rural areas regarding the risk factors and the danger signs. Likewise, they have to properly follow mothers diagnosed with hypertensive disorders of pregnancy as the possibility of complication is high

Research institutions/ Researchers

- Further large scale prospective studies should be conducted on each of the hypertensive disorders of pregnancy to assess risk factors and effects on birth outcomes.

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Annexes

Annex 1- Original Papers

Original Paper-One

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Patterns of Hypertensive Disorders of Pregnancy in Selected Hospitals of Tigray, Ethiopia

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Authors' contributions

This work was carried out in collaboration between all authors. Author HBK is the primary author, participated in the conceptualisation, design, acquisition, analysis and interpretation of the data and drafted the manuscript. Author FEG was the primary academic advisor, contributed for design, acquisition, analysis and interpretation of the data and critically revised the manuscript. Author WMA was co-advisor, contributed for design, acquisition, analysis and interpretation of the data and critically revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

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ABSTRACT

Background: Hypertensive disorders of pregnancy is a common maternal health condition representing a spectrum of disease which is associated with increased risk of both adverse maternal and fetal outcomes. Despite the fact, there is limited evidence on the magnitude and trend of hypertensive disorders of pregnancy in Ethiopia.
Objective: This study aimed to describe the pattern of hypertensive disorders of pregnancy in selected hospitals of Tigray region.
Methods: The study was done in 6 randomly selected hospitals of Tigray region by reviewing medical records of all mothers admitted to the maternity units with the diagnosis of hypertensive disorders of pregnancy from September 2012 to August 2017. Data were abstracted using a checklist from the client's chart, delivery registration, health management information system

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database and the admission logbook. Data analysis was performed using SPSS for windows version 20.0 and presented using text, tables, graphs and chart.

Results: A total of 45,329 mothers were admitted for delivery in the selected hospitals in the last five years. Out of the total deliveries, 1347 (3%) were managed for one of the hypertensive disorders of pregnancy during the review period. Of the total cases, 132 (9.8%) were diagnosed for gestational hypertension, 724 (53.7%) suffered from severe preeclampsa and 143 (12.1%) from eclampsia. The overall magnitude of hypertensive disorders of pregnancy showed an increasing trend over the last 5 years ranging from 1. 4% in 2013 to 4% in 2017. Similarly, severpreeclampsia/eclampsia showed a sharp increment in the first four years and a slight decline in the last 1 year.

Conclusion: Despite the major achievements in reducing maternal and perinatal morbidity and mortality in Ethiopia, the magnitude of hypertensive disorders of pregnancy remained high and with an increasing trend. Hence, health institutions should implement strong strategies of counselling, screening, and follow-up of mothers in the antenatal clinics.

Keywords: HDP; preeclampsia/eclampsia; gestational hypertension; PIH.

1. BACKGROUND

Globally, over half a million mothers die each year as a result of complications in pregnancy and childbirth; more than 99% of these deaths are in low and middle income countries and more than half occur in sub-Saharan region alone. Hypertensive disorder in pregnancy is one of the common causes of maternal death which complicates about10% of pregnancies where by 2-8% of them go through preeclampsia/ eclampsia [1-3].

Hypertensive disorders of pregnancy are common disorders representing a spectrum of disease that can be developed during pregnancy, labor/delivery or in the postpartum period. They are associated with an increased risk of both adverse maternal and fetal outcomes [1]. According to the national high blood pressure education program working group and task force on hypertension in pregnancy, American College of Obstetricians and Gynaecologists (ACOG), hypertensive disorders of pregnancy is classified in to four categories: Chronic hypertension (of any cause that predates pregnancy), gestational hypertension (blood pressure elevation after 20 weeks of gestation in the absence of proteinuria or any of the severe features), preeclampsia-eclampsia (blood pressure elevation after 20 weeks of gestation with proteinuria or any of the severe features) and chronic hypertension superimposed with preeclampsia (chronic hypertension in association with preeclampsia) [1,4-6].

The world health organization (WHO) global analysis on causes of maternal death between 2003 and 2009 reported 14·0% of maternal deaths due to hypertensive disorders of pregnancy [4]. In united states of America (USA), hypertensive disorders of pregnancy was identified as a cause of death in 12% of maternal demise [5]; the overall prevalence of hypertensive disorders of pregnancy increased from 6.7% to 8.1% in eight years period [6] and the incidence of preeclampsia increased by 25% in the past two decades [1]. Hypertensive disorders of pregnancy are the second major contributors to maternal deaths in developing countries [7]. Hypertensive disorders of pregnancy even remain as the main cause of maternal mortality in some African countries. For example, in a hospital based study in Ghana, hypertensive disorders of pregnancy, is attributed for 31.7% of maternal death surpassing haemorrhage [8].

Even though the overall maternal mortality appears to be decreasing over time, mortality due to hypertensive disorders is increasing. According to the limited information in Ethiopia, maternal mortality associated with hypertensive disorders of pregnancy (HDP), specifically preeclampsia/eclampsia is increasing in the last 25 years in general [9] and mainly in the last decade [10]. In addition, the EmONC study 2008, in Ethiopia showed that 11% of all maternal deaths and 16% of direct maternal deaths were due to the complication of hypertensive disorders/ preeclampsia-eclampsia [11]. In Tigray hypertensive disorder of pregnancy contributed for a direct maternal death of 19% [12] in 2013 to 8.1% in 2015 [13].

Despite the fact that there are some studies regarding the trends of maternal mortality and the causes of maternal death in Ethiopia, studies

on the magnitude and patterns of hypertensive disorders are limited. The studies are not only inadequate in terms of the number, but also they are limited to a single center/institution and conducted in a short period of time (commonly one year) in a small sample which failed to give a complete picture about the issue. Furthermore, some of the studies were conducted more than a decade ago and to our knowledge, there is no a single study in the study area, Tigray region on the topic of interest.

The main rationale for this study is to help policy makers to have a clear picture about the magnitude and distribution of hypertensive disorders of pregnancy and make evidence based decisions and resource mobilisations. Hence, it could contribute towards decreasing maternal and perinatal morbidity and mortality. It will also guide health professionals working in clinical areas to provide evidence based health services to prevent and manage complications associated with hypertensive disorders of pregnancy. Therefore; the aim of this study was to describe the pattern of hypertensive disorders of pregnancy in Tigray region over the last 5 years.

2. METHODS

The study was conducted in Tigray region, Ethiopia. Tigray Region is the northernmost of the nine regions of Ethiopia. It is bordered by Eritrea to the north, Sudan to the west, the Afar region to the east and the Amhara region to the south. The total projected population of the region is 5,396,235 in 2017; of which 2,654,947 are males and 2,741,287 females. Reproductive age group females (15-49years) comprise 23.5% of the population. The annual population growth rate and total fertility rate of the region was 2.5 and 4.6, respectively in 2015. There were 173,892 total expected pregnancies for the year 2015 which gives pregnancy rate of 3.4%. Of which 100 % of them received antenatal care service at least once and 60% have received antenatal care service 4 and more times; besides 63% of them were attended by skilled professionals at delivery. There are 201 health facilities providing basic emergency obstetrics and newborn care (BEmONC) services and 91 health facilities which provide comprehensive emergency obstetric and newborn care (CEmONC) services. Milder forms of hypertensive disorders are managed at the health center level, whereas the severe forms like severe pre-eclampsia and eclampsia are managed in hospitals. There are 712 health posts, 201 health centers and 15 hospitals in the region. There are 3, 4, 77, 60, and 50 hospitals, health centres, medium clinics, primary clinics and specialty clinics respectively owned by private owners and Non Governmental Organizations (NGOs) [14,15].

This study was conducted in 6 randomly selected hospitals, which are geographically distributed over the entire Tigray region, namely; Ayder comprehensive, specialised, Lemlem Carl, Adigrat, Saint Marry, Suhul and Kahsay Abera hospitals. The average number of delivery is about 1500 and the average number of cases for hypertensive disorders of pregnancy is around 50 in each hospital every year. These hospitals provide comprehensive diagnostic and management services for hypertensive disorders of pregnancy starting from the mild form of gestational hypertensive to the severe forms of preeclampsia/eclampsia and hemolysis, elevated liver enzyme and low platelet (HELLP) syndrome. Thus, a complete record on the patterns of hypertensive disorders can be found in these hospitals. On the contrary, the lower health facilities such as health centers provide only the primary care, so a mother with a severe form of the hypertensive disorder is supposed to be referred to the higher level which makes the follow up interrupted.

This study employed a hospital based retrospective study design and the source population was mothers who were admitted to the maternity ward in the selected hospitals in the last five successive years (September 1, 2012 to August 31, 2017). The study population was mothers admitted to the maternity ward with the diagnosis of hypertensive disorders of pregnancy in the last five years. The inclusion criteria were, gestational age beyond 20 weeks, blood pressure measurement $\geq$ 140/90 mmHg and those whose admission cards were identified, retrieved and with complete information. All mothers with the diagnosis of hypertensive disorders and registered in the selected hospitals in the last five years were included in the sample and the sampling techniques used was consecutive sampling.

To collect the data, a checklist was adapted from the national basic emergency obstetrics and newborn care (BEmONC) module [16] and WHO guideline [17] to extract relevant data from the client's medical records. The checklist consisted of information regarding maternal demographic

data, reproductive history, characteristics of pregnancy and delivery. Information regarding the variables of interest was retrieved from delivery and admission records, health management information system (HMIS) records and client cards of all mothers with hypertensive disorders of pregnancy who delivered in the last five years.

Six BSc midwives were recruited as data collectors and trained for 3 days. The data collection proceeded from June to September 2017. The data collection process was overseen by supervisors and the collected data was checked on a daily basis to avoid inconsistencies and errors. The investigator closely followed the supervisors and data collectors. Data was coded, entered, cleaned and analysed using SPSS version 20 software. Descriptive statistics were computed and proportionate cause specific morbidity ratio was calculated for each type of hypertensive disorders of pregnancy (HDP). Data were presented using figures, tables and texts.

In this study some terms were operationalised as follows:

Mild Preeclampsia: Blood pressure (BP) ≥ 140/90 mmHg after 20 weeks of pregnancy without severity features.

Severe pre-eclampsia: Diastolic blood pressure of 110 mm Hg or higher; proteinuria of 3+ or higher; signs and symptoms, including headache, hyperreflexia, blurred vision, oliguria, epigastric pain, and pulmonary oedema.

Eclampsia: Convulsions; diastolic blood pressure of 90 mm Hg or higher after 20 weeks of pregnancy; proteinuria of 2+ or higher; signs and symptoms of severe pre-eclampsia may be present.

HDP: Any type, including gestational hypertension, chronic hypertension, preeclampsia/ eclampsia, or preeclampsia/ eclampsia superimposed on chronic hypertension.

Ethical clearance was sought from the Institutional Review Board (IRB) of Addis Ababa University, College of Health Sciences. Support letter was written from the Tigray Regional Health Bureau to respective health institutions. Permission was obtained from the administrators of the institutions to take client's data. It was explained that any client information would not be revealed; the name of participants would not be written in the form and all information given by the study participants would be kept confidentially. The output of this study would benefit mothers, health facilities, researchers, policy makers and the community.

3. RESULTS

A total of 45,329 mothers were admitted for delivery in the selected hospitals in the last five years. Among all deliveries, 1404 cases of hypertensive disorders in pregnancy were retrieved. However, only 1347 cases were used for analysis after excluding 57 patient cards due to either incomplete or failure to identify. Thus, out of the total deliveries, 1347 (2.97%) were found to have hypertensive disorders of pregnancy and 887 (1.95%) were diagnosed as severe preeclampsia/eclampsia in the review period (from 1st September 2012 to August 31, 2017) (Table 1). Among the participating hospitals, Adigrat hospital took the major share of hypertensive disorders of pregnancy, accounting 24.3%, while the other hospitals have a similar share with an average of 15.16%. More than half of the cases (56.1%) were rural residents. The mean ± SD age of the mothers was 26.43±5.88; the minimum and maximum ages were 15 and 48 respectively. Besides, majority of the mothers (83.7) were between 18 and 33 years old and only 1.3% of mothers were less than 18 years (Table 2).

Of the total cases, 132 (9.8%) were diagnosed as gestational hypertension, 724 (75.1%) as preeclampsia, 40(3%) as chronic hypertension and 143 (12.1) as eclampsia (Fig. 2). The majority of the cases were diagnosed either during pregnancy or labor/delivery; only in 28 (2.07%) cases hypertensive disorder was diagnosed in the postpartum period. Three (0.22%) mothers had developed preeclampsia superimposed on chronic hypertension and 16 (1.18%) mother developed atypical preeclampsia/eclampsia. Of the total maternal records reviewed around 60 % were primiparas. The mean value for gravidity and parity were 2.61 and 1.97 respectively. Among the cases 92.3% of them had a history of ANC follow up and 72 % of them attended less than four visits (Table 2).

The overall magnitude of hypertensive disorders of pregnancy showed an increasing trend over the last 5 years, ranging from 1.4% in 2013 to 4% 2017. Similarly, severe preeclampsia/

eclampsia ranged from 0.9 in 2013 to 2.8 in 2016. The hypertensive disorders of pregnancy and severe preeclampsia/eclampsia showed a sharp rise in the last four years and maintained in the last 1 year and even slight decline for severe preeclampsia/eclampsia.

Table 1. Distribution of proportionate cause specific morbidity for hypertensive disorders of pregnancy (HDP) cases in selected hospitals of Tigray, Ethiopia

Year	Total births	Overall HDP		S. pre/eclampsia	
		Frequency	%	Frequency	%
2013	6909	98	1.41	61	0.88
2014	7785	148	1.90	95	1.22
2015	9670	269	2.78	169	1.74
2016	10281	404	3.92	287	2.79
2017	10684	428	4.00	275	2.57
Total/average	45329	1347	2.97	887	1.95

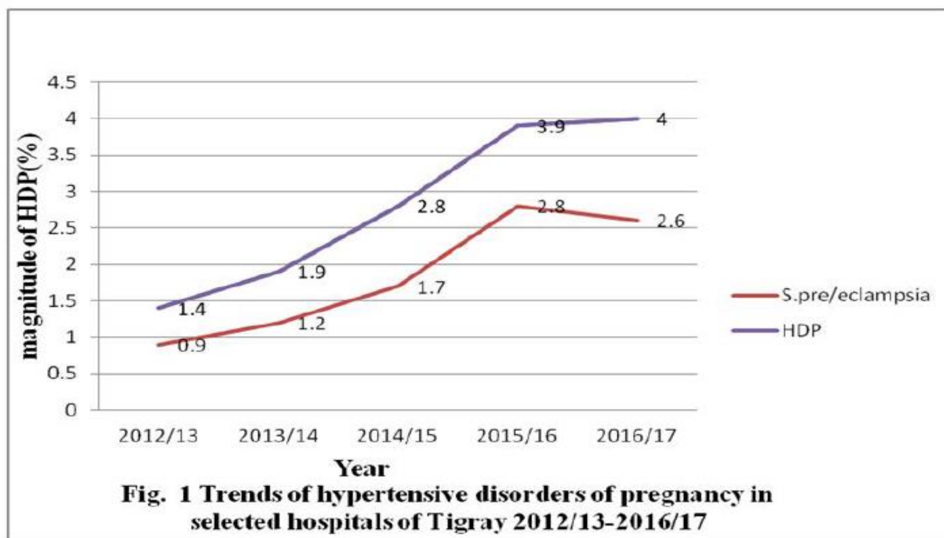

Fig. 1 Trends of hypertensive disorders of pregnancy in selected hospitals of Tigray 2012/13-2016/17

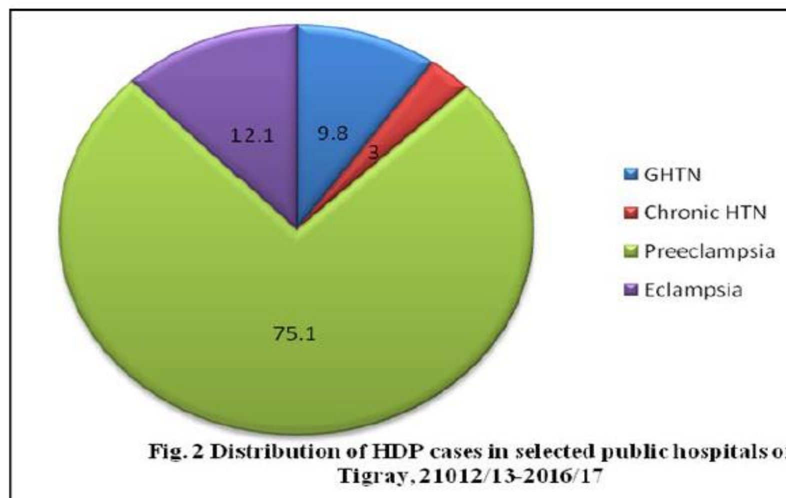

Fig. 2 Distribution of HDP cases in selected public hospitals of Tigray, 21012/13-2016/17

Table 2. Background and obstetrics characteristics of mothers by hypertensive disorders of pregnancy delivered in selected hospitals of Tigray, 2013-2017

S.No	Variable (N=1347)	Frequency	Percent
1	Hospital		
	Ayder referal hospital	215	16.0
	Adigrat Hospital	327	24.3
	Axum Hospital	199	14.8
	Lemlem Carl Hospital	178	13.2
	Kahsay Abera Hospital	230	17.1
	Suhul Hospital	198	14.7
	Total	1347	100
2	Residence		
	Urban	592	43.9
	Rural	755	56.1
3	Year		
	2013	98	7.3
	2014	148	11.0
	2015	269	20.0
	2016	404	30.0
	2017	428	31.8
4	Age category		
	<=18	18	1.3
	19-33	1127	83.7
	34-48	202	15.0
5	ANC follow up		
	Yes	1243	92.3
	No	104	7.7
6	Number of ANC (**N=1243**)		
	Once	69	5.6
	Twice	356	28.6
	3 times	470	37.8
	4 times	303	24.4
	More than 4 times	45	3.6
7	Gravidity		
	1	519	38.5
	2	296	22.0
	3	193	14.3
	>=4	339	25.2
8	Parity		
	1	804	59.7
	2	222	16.5
	3	128	9.5
	>=4	193	14.3

In all the study sites (hospitals) included in the study severe pre-eclampsia predominated except in Humera hospital where it is surpassed by mild pre-eclampsia. The magnitude of eclampsia is similar and comparable across the hospitals.

The mean ± SD gestational age at diagnosis of the cases was 36.4weeks. Likewise, the mean value for newborn's weight, Apgar score at 1 minute and Apgar score at 5 minutes were 2.61Kg, 6.48, and 7.43 respectively. Out of the total birth, 13.2% of newborns to cases were dead and out of them 80.3% accounted for fetal death (born dead). Over the last five years, review period a total of 50 (3.7%) mothers with hypertensive disorders were died. Among the HDP cases admitted to the hospitals 40.1% of them were preterm deliveries and a fifth of deliveries were confirmed to have intrauterine growth restriction. Twenty one point one percent of mothers with hypertensive disorders of pregnancy ended up in caesarean section delivery, whereas 7.1% of them were instrumental delivered (Table 3).

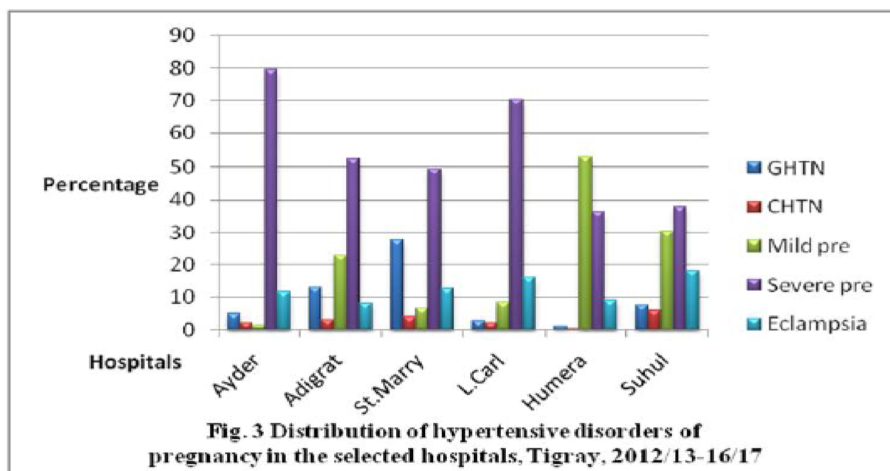

Fig. 3 Distribution of hypertensive disorders of pregnancy in the selected hospitals, Tigray, 2012/13-16/17

Table 3. Obstetrics complications and delivery outcomes of mothers with HDP delivered in selected hospitals of Tigray, 2013-2017

S.No	Variable	Frequency	Percent
	Mode of delivery		
5	Spontaneous vaginal delivery (SVD)	965	71.6
	Caesarean section (CS)	288	21.4
	Instrumental Delivery	94	7.0
6	Type of instrument (N=94)		
	Vacuum	67	71.3
	Forceps	27	28.7
7	Delivery initiation		
	Spontaneous	841	62.4
	Induced	506	37.6
8	Complication		
	Abruption placenta	53	3.9
	Placenta previe	37	2.7
	Postpartum hemorrhage (PPH)	50	3.7
9	Maternal outcome		
	Alive	1297	96.3
	Dead	50	3.7
10	Intrauterine growth restriction (IUGR)		
	Yes	272	20.2
	No	942	69.9
	Unknown	133	9.9
11	Newborn outcome		
	Alive	1169	86.8
	Death	178	13.2
12	Time of death (N=178)		
	Born Dead	143	80.3
	Immediately After birth	24	13.5
	Within the first 24 hours	5	2.8
	Within the first 7 days	6	3.4
13	A measure taken at delivery		
	Nothing done	1051	78.0
	Admitted to ICU	126	9.4
	Resuscitation done	170	12.6

Table 4. Distribution of background and obstetrics variables by types of hypertensive disorders of pregnancy in selected hospitals of Tigray, 2013-2017

Variables	Types of HDP (Fre /%)					
	Gestational Hypertension	Chronic Hypertension	Mild preeclampsia	Sever Preeclampsia	Eclampsia	HELLP syndrome
Year						
2013	27 (20.5)	3 (7.5)	7 (2.4)	46 (6.4)	14 (9.9)	1 (4.8)
2014	23 (17.4)	2 (5.0)	28 (9.7)	80 (11.0)	14 (9.9)	1 (4.8)
2015	26 (19.7)	6 (15.0)	68 (23.6)	141 (19.5)	26 (18.3)	2 (9.5)
2016	30 (22.7)	8 (20.0)	79 (27.4)	239 (33.0)	41 (28.9)	7 (33.3)
2017	26 (19.7)	21 (52.5)	106 (36.8)	218 (30.1)	47 (33.1)	10 (47.6)
Residence						
Urban	64 (48.5)	20 (50.0)	115 (39.9)	337 (46.5)	47 (32.9)	9 (45.0)
Rural	68 (51.5)	20 (50.0)	173 (60.1)	387 (53.5)	95 (66.9)	12(57.1)
Age						
<=18	2 (1.5)	0 (0.0)	5 (1.7)	6 (0.8)	5 (3.5)	0 (0.0)
19-33	104 (78.8)	29 (72.5)	251 (87.2)	604 (83.4)	118 (83.1)	21 (100)
34-48	26 (19.7)	11 (27.5)	32 (11.1)	114 (15.7)	19 (13.4)	0 (0.0)
ANC follows up						
Yes	102 (77.3)	36 (90.0)	280 (97.2)	677 (93.5)	130 (91.5)	18 (85.7)
No	30 (22.7)	4 (10.0)	8 (2.8)	47 (6.5)	12 (8.5)	3 (14.3)
ANC visit						
Once	1 (1.0)	1 (2.8)	19 (6.8)	38 (5.6)	7 (5.4)	3 (16.7)
Twice	25 (24.5)	7 (19.4)	99 (35.4)	178 (26.3)	42 (32.3)	5 (27.8)
3 times	52 (51.0)	19 (52.8)	110 (39.3)	240 (35.5)	41 (31.5)	8 (44.4)
4 times	22 (21.6)	9 (25.0)	49 (17.5)	189 (27.9)	33 (25.4)	1 (5.6)
more than 4	2 (2.0)	0 (0.0)	3 (1.1)	32 (4.7)	7 (5.4)	1 (5.6)
Gravidity						
1	41 (31.1)	6 (15.0)	117 (40.6)	263 (36.3)	80 (56.3)	12 (57.1)
2	30 (22.7)	11 (27.5)	73 (25.3)	159 (22.0)	19 (13.4)	4 (19.0)
3	23 (17.4)	8 (20.0)	41 (14.2)	102 (14.1)	16 (11.3)	3 (14.3)
>=4	38 (28.8)	15 (37.5)	57 (19.8)	200 (27.6)	27 (19.0)	2 (9.5)

Variables	Types of HDP (Fre /%)					
	Gestational Hypertension	Chronic Hypertension	Mild preeclampsia	Sever Preeclampsia	Eclampsia	HELLP syndrome
Parity						
1	63 (47.7)	18 (45.0)	194 (67.4)	418 (57.7)	96 (67.6)	15 (71.4)
2	30 (22.7)	9 (22.5)	48 (16.7)	114 (15.7)	18 (12.7)	3 (14.3)
3	17 (12.9)	6 (15.0)	20 (6.9)	73 (10.1)	10 (7.0)	2 (9.5)
>=4	22 (16.7)	7 (17.5)	26 (9.0)	119 (16.4)	18 (12.7)	1 (4.8)

Table 5. Distribution of delivery outcomes by types of hypertensive disorders of pregnancy in selected hospitals of Tigray, 2013-2017

Variables	Types of HDP (Fre/%)					
	Gestational Hypertension	Chronic Hypertension	Mild preeclampsia	Severe Preeclampsia	Eclampsia	HELLP syndrome
Mode of delivery						
SVD	102 (77.3)	34 (85.0)	210 (72.9)	508 (70.2)	95 (66.9)	16 (76.2)
CS	24 (18.2)	4 (10.0)	44 (15.3)	174 (24.0)	38 (26.8)	4 (19.0)
Instrumental	6 (4.5)	2 (5.0)	34 (11.8)	42 (5.8)	9 (6.3)	1 (4.8)
Delivery initiation						
Spontaneous	105 (79.5)	28 (70.0)	218 (75.7)	381 (52.6)	95 (66.9)	14 (66.7)
Induced	27 (20.5)	12 (30.0)	70 (24.3)	343 (47.4)	47 (33.1)	7 (33.3)
Maternal outcome						
Alive	127 (96.2)	38 (95.0)	285 (99.0)	695 (96.0)	132 (93.0)	20 (95.2)
Dead	5 (3.8)	2 (5.0)	3 (1.0)	29 (4.0)	10 (7.0)	1 (4.8)
IUGR						
Yes	53 (40.2)	8 (20.0)	29 (10.1)	149 (20.6)	24 (16.9)	9 (42.9)
No	79 (59.8)	31 (77.5)	238 (82.6)	489 (67.5)	95 (66.9)	10 (47.6)
Unknown	0 (0.0)	1 (2.5)	21 (7.3)	86 (11.9)	23 (16.2	2 (9.5)
Newborn outcome						
Alive	124 (93.9)	36 (90.0)	280 (97.2)	606 (83.7)	109 (76.8)	14 (66.7)
Death	8 (6.1)	4 (10.0)	8 (2.8)	118 (16.3)	33 (23.2)	7 (33.3)

Variables	Types of HDP (Fre/%)					
	Gestational Hypertension	Chronic Hypertension	Mild preeclampsia	Severe Preeclampsia	Eclampsia	HELLP syndrome
Time of death						
Born Dead	3 (37.5)	3 (75.0)	7 (77.8)	94 (81.0)	30 (88.2)	6 (85.7)
Immediately After birth	4 (50.0)	1 (25.0)	2 (22.2)	13 (11.2)	4 (11.8)	0 (0.0)
Within the first 24h	1 (12.5)	0 (0.0)	0 (0.0)	4 (3.4)	0 (0.0)	0 (0.0)
Within the first 7d	0 (0.0)	0 (0.0)	0 (0.0)	5 (4.3)	0 (0.0)	1 (14.3)
A measure taken at delivery						
Nothing done	107 (81.1)	35 (87.5)	243 (84.4)	538 (74.3)	112 (78.9)	16 (76.2)
Admitted to ICU	3 (2.3)	2 (5.0)	22 (7.6)	83 (11.5)	14 (9.9)	2 (9.5)
Resuscitation done	22 (16.7)	3 (7.5)	23 (8.0)	103 (14.2)	16 (11.3)	3 (14.3)
Gestational age						
<=34 weeks	8 (6.1)	5 (12.5)	24 (8.3)	165 (22.8)	34 (23.9)	7 (33.3)
34.1-36.6	26 (19.7)	5 (12.5)	65 (22.6)	175 (24.2)	26 (18.3)	1 (4.8)
>=37	98 (74.2)	30 (75.0)	199 (69.1)	384 (53.0)	82 (57.7)	13 (61.9)
Weight						
Low birth weight	23 (17.4)	11 (28.2)	58 (20.1)	276 (38.8)	53 (37.6)	7 (35.0)
Normal	109 (82.6)	28 (71.8)	230 (79.9)	436 (61.2)	88 (62.4)	13 (65.0)
APGAR score at 1 minute						
Low	19 (14.4)	13 (32.5)	75 (26.0)	239 (33.0)	58 (40.8)	8 (38.1)
Normal	113 (85.6)	27 (67.5)	213 (74.0)	485 (67.0)	84 (59.2)	13 (61.9)
APGAR score at 5 minutes						
Low	8 (6.1)	4 (10.0)	27 (9.4)	154 (21.3)	38 (26.8)	7 (33.3)
Normal	124 (93.9)	36 (90.0)	261 (90.6)	570 (78.7)	104 (73.2)	14 (66.7)

A higher proportion of mild preeclampsia was observed in Humera hospital. Similarly, the proportion of gestational hypertension is comparable with the proportion of HELLP syndrome in St. Marry hospital Aksum. A similar proportion of gestational and chronic hypertension cases were observed in both rural and urban areas.

Out of the total 506 induced delivery cases, 391 (73.7%) were due to severe pre-eclampsia/eclampsia. Regarding to the measure of delivery 46.7% of newborns born from mothers of sever preeclampsia/eclampsia were resuscitated or admitted to ICU; whereas in the mild cases such as gestational hypertension and mild preeclampsia nothing was done in more than 80% of deliveries. The majority of the fetal deaths (87.4%) occurred among the sever preeclampsia/eclampsia cases.

4. DISCUSSION

The aim of the study was to describe the pattern of hypertensive disorders of pregnancy in selected hospitals of Tigray region over the last 5 years. The present study revealed that the overall magnitude of hypertensive disorders of pregnancy was 2.97%. According to previous studies, wide variations have been reported on the prevalence of hypertensive disorders of pregnancy in different parts of the globe and this is believed to be influenced by parity, genetic predisposition, and environmental factors [18]. Gestational hypertension more often affects nulliparous women than multiparas. The current study is in line with the 3.1% in Urban Ghana by Middendorp et al. [19]; comparable with 2.32% by Zibaeenezhad in Iran [20], 5.22% in China [21], 4.6% in Japan [22], 3.7% in Nigeria [23] 3.9% in Debre Berhan, Ethiopia [24] but lower than the 9.8% in South Wales [25] and 8.5% in Jimma Ethiopia [26]. The reason for the variation might be the fact that some of the studies were conducted in a specialised university referral hospital only which could increase the prevalence. In addition, the time and geographical difference may contribute to the discrepancy. Majority of the cases (56.1%) were from rural areas which is consistent with previous study in Jimma where by 56.9% of mothers affected by HDP were from rural area [26].

The review over the last five years showed an increasing trend for the overall types of hypertensive disorders of pregnancy; it increased from 1.4% in 2013 to 4.0% in 2017 which is comparable with the 1.8% to 5.7% change in Debre Berhan, Ethiopia over four years period [24] and study by *Kuklina EV* in USA [6]. The overall hypertensive disorder and sever preeclampsia/eclampsia showed an increasing trend except the slight decline for preeclampsia/eclampsia in the last 1 year review period. This could be due to the fact that on one hand, screening and counselling practices in the prenatal care might not be strong to identify gestational hypertension and mild preeclampsia cases and eventually to prevent development of severe preeclampsia; on the other hand magnesium sulphate is routinely given for sever preeclampsia cases in recent years in all hospitals and that could in turn decrease the occurrence of eclampsia to some degree.

The prevalence of preeclampsia and eclampsia among all deliveries were 2.2% and 0.7% respectively which is consistent with the 2.13 % for preeclampsia in Iran [20] but lower than the finding in Mongolia where by researchers reported 4.1% prevalence of preeclampsia [27]. The 0.7% prevalence of eclampsia in this study is higher than the one reported in Iran (0.03%) [20]. The prevalence of chronic hypertension was 0.08% among all deliveries which is lower than previous reports [20, 26]. The lower prevalence might be associated with the predominantly younger population of the cases studied, noting that chronic hypertension is associated with age.

In the current study among hypertensive disorder of pregnancy cases, Preeclampsia (75.1%) took the lion share followed by eclampsia (12.1%) and 65.8% for severe preeclampsia/ eclampsia combined. This finding is by far lower than the 78.2% for severe preeclampsia/ eclampsia in another study at Addis Ababa [28]. The reason for the variation may be the intervention instituted recently, specifically routine administration of magnesium sulphate. However, the commonest type of hypertensive disorder of pregnancy in the current study being preeclampsia (75.1%) is in line with previous reports though the magnitude varies, for instance it was 46.4% in Nigeria [23].

In the present study 40% of deliveries among the hypertensive disorders of pregnancy cases were preterm, of which the majority (79%) were seen in pre-eclamptic mothers. This report is in line with the finding from a study in Bebre Berhan (35.4% were preterm and 82.1% were in pre-eclamptic mothers) [24]. Majority of the fetal deaths (87.4%) occurred among the sever

preeclampsia/eclampsia cases. This is consistent with a study conducted in Sudan [29] in which the rate of small for gestational age and neonatal mortality was higher in pre eclampsia compared to other hypertensive groups. Similarly a study in Kampala, Uganda reported that adverse neonatal outcomes were associated with severe preeclampsia [30]. The caesarean section rate in this study was 21.1% which is higher than the caesarean section rate among mothers with hypertensive disorders of pregnancy reported in Zimbabwe (12.5%) by Muti et al. [31] and by far lower than the case in Nigeria (55.2%) [23] as well as in china (76.95%) [21].

This study tried to show the picture of hypertensive disorders of pregnancy in general and the different types of HDP in particular over the last five years. The nature of the data being record review might have its own limitation as there could be a problem in recording and documentation.

5. CONCLUSION

Hypertensive disorder of pregnancy in Tigray is found to be 2.97%; the overall trend showed hypertensive disorders of pregnancy are increasing over time ranging from 1.4% in 2013 to 4% in 2017. In this study, severe preeclampsia is the most common of all pregnancy related hypertension disorders followed by mild pre-eclampsia and Eclampsia. Despite the major achievements in reducing maternal and perinatal morbidity and mortality associated with HDP in general and sever preeclampsia/eclampsia in particular; much has to be done further to decrease the substantial maternal and perinatal mortality. Health institutions should have strong strategies of screening, counselling, follow-up and referral linkage of mothers in the antenatal clinic. Besides, health offices and health bureaus should avail necessary diagnostic and treatment materials/supply on time; should be able to design a strong supportive supervision and implement mentorship activities to narrow the gap. By doing so, it is possible to identify cases of hypertensive disorders of pregnancy early and in turn decrease the severe forms of preeclampsia and eclampsia.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Ethical clearance was sought from the Institutional Review Board (IRB) of Addis Ababa University, College of Health Sciences. Support letter was written from the Tigray Regional Health Bureau to respective health institutions.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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RESEARCH ARTICLE **Open Access**

Risk factors for hypertensive disorders of pregnancy among mothers in Tigray region, Ethiopia: matched case-control study

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Abstract

Background: Hypertensive disorders of pregnancy are a global public health concern both in developed and developing countries. However, evidences regarding the risk factors of hypertensive disorders of pregnancy are limited particularly in Ethiopia. The aim of the study was to assess risk factors associated with hypertensive disorders of pregnancy among mothers in public hospitals of Tigray.

Methods: The study was conducted in seven public hospitals of Tigray region, Ethiopia from June 2017 to November 2017. A facility based matched case-control study was employed to select 110 cases and 220 controls who were pregnant women. Cases and controls were matched by parity status. A case was a mother diagnosed to have hypertensive disorders of pregnancy by an obstetrician in the antenatal period while a control was a mother who did not have a diagnosis of hypertensive disorders of pregnancy. Data were collected by face to face interview technique using a pretested questionnaire and a checklist. Conditional logistic regression analysis was used to identify the independent predictor variables. Adjusted matched odds ratio with its corresponding 95% confidence interval was used and significance was claimed at *P*-value less than 0.05. Overall findings were presented in texts and tables.

Results: Rural residents were at greater odds of suffering from hypertensive disorders (OR = 3.7, 95% CI; 1.9, 7.1). Similarly, mothers who consume less amount of fruits in their diet had 5 times higher odds of developing hypertensive disorders than those who consume fruits regularly (OR = 5.1, 95% CI; 2.4, 11.15). Overweight (BMI > 25 Kg/m2) mothers were also at risk of developing hypertensive disorders of pregnancy as compared with the normal and underweight mothers (AOR = 5.5 95% CI; 1.12, 27.6). The risk of developing hypertensive disorders of pregnancy was 5.4 times higher among diabetic mothers.

Conclusion: Rural residence, less fruit consumption, multiple pregnancy, presence of gestational diabetes mellitus and pre-pregnancy overweight were identified as independent risk factors in this study. It is recommended that health care givers may use these factors as a screening tool for the prediction, early diagnoses as well as timely interventions of hypertensive disorders of pregnancy.

Keywords: Hypertensive disorders of pregnancy, Gestational hypertension, Preeclampsia, Tigray, Ethiopia

Background

According to the American college of obstetricians and gynaecologists (ACOG), Hypertension in pregnancy is defined as: Systolic blood pressure greater than or equal to 140 mmHg and/or diastolic blood pressure greater than or equal to 90 mmHg in two occasions at least 6 h apart after fifth month of gestation for pregnancy induced hypertension or before pregnancy/before 20 weeks of gestation for chronic hypertension. Hypertensive disorders of pregnancy (HDP) refers to categories of conditions characterized by elevated blood pressure and classified as chronic hypertension (of any cause diagnosed before 20 weeks of gestation), gestational hypertension, chronic hypertension with superimposed preeclampsia and preeclampsia –eclampsia [1, 2].

Hypertensive disorder of pregnancy is one of the most common complications in pregnancy forming a triad together with hemorrhage and infection. It affects about 10% of pregnancies [3] and contributes for a significant maternal and perinatal mortality [4]. The World Health Organization (WHO) reported that 14.0% of global maternal deaths are attributed to hypertensive disorders of pregnancy [5]. In Latin-American and Caribbean countries 25.7% of maternal deaths were due to hypertensive disorders of pregnancy; in Asian and African countries, it contributed to 9.1% of maternal deaths and in fact about 16% in sub-Saharan African countries [5–7].

Hypertensive disorder of pregnancy is a global public health concern both in developed and developing countries. However, the risk that a woman in a developing country will die of the complications of hypertensive disorders of pregnancy is approximately 300 times higher than that for a woman in a developed country. A woman who develops pre-eclampsia is three times more likely to progress to eclampsia and if eclampsia is developed it is up to 14 times more likely to die of eclampsia [8].

The Ethiopian National Emergency Obstetric and Newborn Care (EMONC) study showed that pre-eclampsia/eclampsia complicated 1.2% of all institutional deliveries. Besides, 11% of all maternal deaths and 16% of direct maternal deaths were due to this obstetric complication [9] in another study in Ambo, Ethiopia maternal mortality due to hypertensive disorders of pregnancy was reported to be 12.3% [10] . The Ethiopian government has implemented different strategies to improve maternal health through increasing demand for services and easier access to emergency obstetric services. Expansion of health facilities, increased availability of supplies and deployment of appropriately skilled health professionals were among the strategies [11].

Despite the extensive research conducted the exact etiology of hypertensive disorders of pregnancy remained obscure. Thus, it is called a "disease of theories." It is a multisystem disease with a heterogeneous nature and variable progression [12]. It has been proposed that immunological, nutritional and genetic factors as well as vascular and inflammatory changes are contributing for the development of hypertensive disorders of pregnancy [4].

Cognizant that the disease has no definite cause, several studies focusing on risk factors have been conducted in different parts of the globe and identified various risk factors for hypertensive disorders of pregnancy. These risk factors include socio-demographic variables such, personal and lifestyle factors, obstetric related factors, familial factors and medical related variables [13–16]. Specifically, nulliparity, extreme ages, obesity, a family history of hypertension, previous history of hypertensive disorders of pregnancy in multipara women, personal/family history of chronic hypertension/diabetes mellitus, high energy diet, gestational diabetes, mental stress during pregnancy, long inter-pregnancy interval, lower socioeconomic status and inadequate antenatal supervision were found to be associated with higher risk of developing hypertensive disorders of pregnancy in most studies [17–22]. Studies identified rural residence as a risk factor [23] and taking fruit or vegetables during pregnancy were found to be protective of hypertensive disorders of pregnancy [19].

Generally, maternal mortality due to hypertensive disorders of pregnancy remained high in spite of all the efforts. Studies conducted in different parts of the globe reported a range of risk factors though findings were not conclusive showing variations among populations and ethno-geographic groups. Moreover, inconsistent findings prevail across literatures even for a particular risk factor. Besides, there is paucity of evidence regarding factors associated with hypertensive disorders of pregnancy in Ethiopia. Even the few published studies conducted in Ethiopia were based on a document review which might have introduced bias due to incompleteness and poor quality of the data at the health facility [24, 25]. Thus, the current study attempted to assess risk factors for hypertensive disorders of pregnancy in Tigray region to generate evidences which are most relevant to support health policies and strategies.

Methods

Study setting and period

This study was conducted in selected public hospitals in Tigray region. Seven hospitals were included in the study namely Ayder, Mekelle, Adigrat, St. Marry, Suhul, Lemlem Carl and Kahsay Abera hospital. The six hospitals are located at the centre of the six respective zones of Tigray region mainly serving the people of the zones. Ayder referral hospital is found in Mekelle city serving as a referral hospital for about 8 million people from the

entire Tigray region and partly from Afar and Amhara regions. In Tigray region, there are 28 health facilities providing basic emergency obstetrics and newborn care (BEmONC) and 15 facilities providing comprehensive emergency obstetrics and newborn care respectively [26]. The selected hospitals provide services for substantial number of patients with and without obstetrics complications. These hospitals are selected in this study due to the fact that they are staffed by obstetricians who can correctly diagnosed hypertensive disorders of pregnancy and relatively equipped by diagnostic facilities. Data were collected from June 2017 to November 2017.

Study design

A facility based matched case control study was employed. These women were pregnant mothers attending antenatal care clinics in the study hospitals. Cases and control were matched in parity, time and site of the study. The case and control mothers were included after 20 weeks of gestation as per the diagnosis and the criteria set.

Study population

The study population were all pregnant mothers attending the maternity centers of the study hospitals. Mothers with a history of confirmed chronic hypertension or diagnosed before 20 weeks gestation which is greater than or equal to 140/90 mmHg and without superimposed preeclampsia were excluded from the study because chronic hypertension can be a risk factor for preeclampsia but not for gestational hypertension. Since we measured the different hypertensive disorders as a single outcome, chronic hypertension was excluded as it can be an outcome and a risk factor at the same time. Chronic hypertensive women superimposed with preeclampsia-eclampsia was included as an outcome because this category has common exposure as the rest of the categories.

A case was defined as a mother diagnosed to have hypertensive disorders of pregnancy by an obstetrician in the antenatal period (*international classification of disease*/ICD – 10 codes O13, O14 and O15 [27]). Hypertensive disorders of pregnancy included gestational hypertension, preecalampsia-eclampsia and preeclampsia/eclampsia superimposed on chronic hypertension.

A control was defined as a pregnant women enrolled in the antenatal care clinic of the hospital and who did not have a diagnosis of hypertensive disorders. For each case two controls were interviewed in the same day and the same facility where the case was identified. Besides, cases and controls were matched according to their parity category.

Sample size determination and sampling procedure

The sample size was calculated based on the comparison of proportions for matched case-control study using the following assumptions: Considering 95% CI, 80% power, case to control ratio of 1:2 and taking different sample size were produced for different risk factor for hypertensive disorders of pregnancy. Maximum sample size was obtained taking History of paternal hypertension as a risk factor from a previous study in Cameroon [28] where the proportion of exposure among cases to be 17.4% and among controls, 6%. Accordingly, these yields a maximum sample size of 100 cases and 200 controls. Adding a 10% non-response rate, the final sample size required for the study was 110 cases and 220 controls.

All cases who fulfil the defined criteria were consecutively included until the desired sample size was obtained. For every case included, two controls who best matched were identified.

Operational definitions [2]

Hypertensive disorders of pregnancy- mother diagnosed with gestational hypertension, preeclampsia-eclampsia, chronic hypertension with superimposed preeclampsia or chronic hypertension (of any cause).

Gestational hypertension- systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg measured on two occasions at least 4 h apart after twenty weeks of gestation in the absence of proteinuria or other systemic symptoms.

Preeclampsia- characterized by new onset of hypertension after 20 weeks gestation (systolic blood pressure ≥ 140 mmHg and/or diastolic BP ≥90) mmHg and proteinuria. However, in the absence of proteinuria other manifestations such thrombocytopenia (platelet count less than 100,000/μl), impaired liver function (elevated blood levels of liver transaminases to twice the normal concentration), the new development of renal insufficiency (elevated serum creatinine greater than 1.1 mg/dl or a doubling of serum creatinine in the absence of other renal disease), pulmonary edema, or new onset cerebral or visual disturbances are used to diagnose the case.

Eclampsia- characterized by new onset grand mal seizures in a woman with preeclampsia.

Chronic hypertension- includes essential hypertension as well as hypertension secondary to a range of conditions which is characterized by a blood pressure greater than or equal to 140 mmHg systolic and/or 90 mmHg diastolic confirmed before pregnancy or before 20 completed weeks gestation.

Chronic hypertension superimposed with Preeclampsia - mothers known to have hypertension before pregnancy or before 20 weeks of gestation and who had developed signs of preeclampsia after 20 weeks of gestation.

Proteinuria- a dipstick result of 1+ and above in a qualitative measurement.

Data collection

Data collection was carried out in the maternity ward (antenatal care clinic and labor and delivery ward). It was collected by face to face interview technique using a pretested questionnaire. The questionnaire was developed following a thorough review of literatures from different sources and it included information related to socio-demographic condition, obstetrics and medical status, lifestyle and nutritional habits of the participants (Additional file 1). In addition to the questionnaire, patient medical records were reviewed to abstract relevant variables related with laboratory, clinical and obstetrics data. It was conducted by trained midwives and supervised by MPH professionals.

Measurement

Height was measured in standing position bare foot and expressed in centimetres while weight was recorded in killograms. Body mass index (BMI) was calculated as weight (pre-pregnancy weight in the preceding 3 months) divided by height in meter square (kg/m^2). For those who failed to remember their pre-pregnancy weight, the measured weight in the first trimester was taken as the weight gain during this time is low. In areas where women do not book early for antenatal care as the case in developing countries, pregnancy BMI is not recommended. Hence, in this case the pre-pregnancy weight was considered to calculate body mass index. In addition maternal mid-upper arm circumference (MUAC) was measured as it is considered to be relatively stable during pregnancy [29].

Maternal height category was made according to the calculated percentiles of the study participant and classified into four groups: ≥160 cm (25th percentile and lower); 161–162 cm (26th to 50th percentile); 163–165 cm (51th to 75th percentile); and ≥ 166 cm (76th percentile and higher). Body mass index (BMI) defined as pre-pregnancy weight in kilogrammes divided by height in meters squared, was categorised as follows: underweight (BMI < 18.5); normal weight (BMI = 18.5–24.9); overweight (BMI = 25–29.9); and obese (BMI ≥30). Likewise, monthly income was categorized into the lowest 25 percentile (below $91.9), between 25 and 75 percentile ($92–183.7), and above 75 percentile (greater than $183.8). Harvard university food frequency questionnaire [30] was used to assess the fruit and vegetables consumption status of mothers. Accordingly to the FFQ dietary assessment a list of fruits and vegetables were offered and asked how often they eat on average with in the last one year (ranging from never or less than once per month to 6+ per day). Those women who consumed fruits more than 2–4 times per week were considered as regular consumers of fruits or vegetables. For coffee consumption both frequency and volume were assessed.

Data quality control

The questionnaire was prepared in English and translated into Tigrigna and back to English by independent language experts for consistency. Pre-test was conducted ahead of the actual data collection to see the appropriateness of the tool. Three days training was given for data collectors and supervisors on the content of the questionnaire and its administration. In order to maintain data quality primary data were collected from participants prospectively. The supervisors and the principal investigator checked questionnaires for completeness and inconsistencies on a daily basis.

Analysis

Data entry was done in EPI-info 7 and exported to STATA Version 14 for cleaning and analysis; data cleaning was also done. Descriptive summary measures are reported. To identify factors associated with hypertensive disorders of pregnancy bivariate and matched analysis was done for the outcome of interest by comparing the cases with controls. Moreover, crude matched odds ratio and their 95% confidence intervals along with their *p* values in conditional logistic regression were calculated. In multivariable analysis, matched analysis was performed using conditional logistic regression to identify risk factors of hypertensive disorders. Adjusted odds ratio and their 95% confidence intervals were reported. Significance was declared at *P*-value ≤ 0.05. Multi-collinearity was checked among the independent variables by running the *regress* and *vif* syntaxes in the *stata* software. Accordingly, the variance inflation factor (*VIF*) was close to one and the tolerance which is the reciprocal of the variance inflation factor was also far above 0 which showed minimal collinearity. Post estimation command (Hosmer and Lemeshow test) in the logistic regression was run by using the *estat gof* to check the model fitness. Thus, the *p*-value for the Hosmer and Lemeshow chi-square was greater than 0.05 which indicated the fitness of the model. Overall findings were presented in texts and tables.

Ethical consideration

The study was approved by the institutional review board of the college of health sciences Addis Ababa University. Participants involved in the study voluntarily. There were no other risks for the participants to participate in the study, other than those encountered in day-to-day life. It was described that information obtained from this study may be of valuable to mothers and new-borns in general. The anonymity of the study was maintained by excluding personal identifiers from the data collection tool and the records of the study were kept strictly confidential. Finally Informed consent was sought from the participants.

Results

Socio-demographic characteristics

A total of 330 mothers were interviewed in the data collection period that was held from June to November, 2018. Overall 110 cases matched on parity, day of interviews and study site/hospital with 220 controls taken part in the study to identify risk factors of hypertensive disorders of pregnancy. Of the total cases, gestational hypertension, preeclampsia, eclampsia and preeclampsia/eclampsia superimposed on chronic hypertension comprised of 36(32.7%), 55(50%), 14(12.7%), and 5(4.5%) respectively. Respondents were predominantly married, Orthodox Christianity followers and Tigrian by ethnicity in both cases and controls (90% and above in all cases). Regarding the occupation, majority of the mothers were housewives and comparable proportions were reported among cases and controls (64.5% Vs 68.2%). The Mean ± (SD) age of cases and controls were 27.6 ± 5.6 and 26.7 ± 5.8 years respectively. The proportion of older age mothers (age ≥ 35) was found to be higher among cases as compared to controls (23.6% Vs 11.8%)($P = .006$). Besides, rural residents were higher among cases 71(64.5%) as compared to controls 76 (34.5%) ($P < .001$) (Table 1).

Dietary, familial and lifestyle factors

Twenty two (20%) of pregnant mother had family history of hypertension among cases while only 14(6.4%) pregnant women had family history of hypertension among controls. The mean pre-pregnancy weight of cases and controls were 53.6 ± 8.4 and 51.3 ± 6.8 Kg, respectively. The maximum BMI recorded was 29.9 kg/m^2; 65 (59.1%) and 147 (66.8%) of the respondents had BMI ranging from 18.5 to 25 kg/m^2 in cases and controls respectively. The mid-upper arm circumference of mothers was categorized below the mean and above the mean (≥22. 1 and > 22.1) centimeters and more than 60% of the cases and controls were measured less than or equal to the mean. On average, the pre-pregnancy BMI was higher in women with hypertensive disorders than in those with normal pregnancies (20.36 ± 3.0 Vs 19.8 ± 2.6) ($P = .05$). Vegetable and fruit use were found to be less frequent in hypertensive disorders of pregnancy as compared with the normotensive women (42.7% Vs 60.4 and 54.5% Vs 87.7%). Likewise, frequency and volume of coffee use was demonstrated to be higher among cases when compared with controls (P=. 01, P=. 03) (Table 2).

Obstetrics and medical factors

The proportion of multiple pregnancy was 16.4% among cases, while it was 4.5% among controls (p = 0.001). On the other hand, average age at menarche was reported to be 15 years, which were similar among cases and controls. About 3% of study participants had gestational diabetes mellitus and the proportion was different between cases and controls. It was 3.63% in cases while in controls it was 1.4% ($P = 0.02$) (Table 3).

Risk factors of hypertensive disorders of pregnancy

Bivariate analysis was run in the conductional logistic regression considering the discordant pairs between cases and controls to check the association between dependent and independent variables. Accordingly, rural residence, age > = 35 years, family history of hypertension, infrequent use of vegetables/fruits, higher pre-pregnancy weight, body mass index, coffee use, gestational diabetes mellitus and pre-pregnancy oral contraceptive use were identified as risk factors. In contrast, There was no difference among cases and controls with regard to average age, marital status, religion, ethnicity, occupation, maternal educational level, husband's educational level, income, history of abortion, history of smoking, pre-pregnancy interval and age at menarche (Table 4).

Variables which were found to be associated with the outcome variable in the bivariate analysis ($P <=0.2$) were taken to the multivariable analysis. This is basically to compensate for the power of the test since negative findings (that is, $p > 0.05$) may be just because of inadequate power. After adjusting for possible confounding factors in the matched pair conditional logistic regression only residence, fruit use, pre-pregnancy BMI of mothers, types of pregnancy and gestational diabetes mellitus were found to be independent predictors of hypertensive disorders of pregnancy. Mothers who live in a rural area were at greater odds of having hypertensive disorders as compared to mothers who reside in urban area (OR = 3.7, 95% CI; 1.9, 7.1). Similarly, mothers who do not consume at all or consume less amount of fruits in their diet had 5 times higher odds of developing hypertensive disorders than those who consume fruits regularly (AOR = 5.1 95% CI; 2.4, 11.15). Overweight (BMI > 25 Kg/m^2) mothers were also at risk of developing hypertensive disorders of pregnancy as compared with the normal and underweight mothers (AOR = 5.5 95% CI; 1.12, 27.6). In addition, multiple pregnancy and presence of diabetes mellitus were independent risk factors for the development of hypertensive disorders of pregnancy; the risk of developing hypertensive disorders of pregnancy was 5.4 times higher among diabetic mothers compared with those who are free of the disease (AOR = 5.4, 95% CI; 1.1, 27.0). On the other hand, the effect of age, family history of hypertension, use of vegetables, and drinking coffee disappeared in the multivariable analysis when adjusted for possible confounders.

Table 1 Socio-demographic characteristics of mothers with and without hypertensive disorders of pregnancy in Tigray, 2018

variable	HDP/Cases *N* = 110, N (%)	No HDP/Controls *N* = 220, N (%)	COR (95% CI)	*P*-value
Age group				
≤ 18	7(6.4)	10(4.6)	1.5(0.58, 4.1)	0.378
19–34	77(70.0)	184(83.6)	1.0	
≥ 35	26(23.6)	26(11.8)	2.3(1.3, 4.2)	0.006
Residence				
rural	71(64.5)	76(34.5)	3.1 (1.9, 5.0)	< 0.001
urban	39(35.4)	144(65.4)	1.0	
Marital status				
married	104(94.5)	199(90.5)	1.0	
Unmarried	6(5.4)	21(9.5)	0.5 (0.2,1.4)	0.2
Partner change				
Yes	14(12.7)	26(11.8)	1.09 (0.5, 2.2)	0.8
No	96(87.2)	194(88.2)	1.0	
Religion				
orthodox	103(93.6)	199(90.5)	1.4 (0.5, 3.6)	0.49
Muslim	6(5.5)	16(7.3)	1.0	
Maternal education				
literate	74(67.3)	153(69.5)	1.0	
illiterate	36(32.7)	67(30.5)	1.12(0.7, 1.9)	0.65
Ethnicity				
Tigrian	105(95.5)	200(90.9)	1.0	
Amhara	4(3.6)	17(7.7)	0.4 (0.14, 1.36)	0.15
Occupation				
Housewife	71 (64.5)	150(68.2)	1.0	
Government employee	22(20.0)	33(15)	1.4(0.7, 2.7)	0.26
NGO employee	8(7.3)	7(3.2)	2.5(0.8, 7.7)	0.08 0.17
Private employee	7(6.4)	28(12.7)	0.5(0.2,1.3)	
Husband education				
Illiterate	14(12.7)	31 (14.1)	0.9 (0.4, 1.9)	0.8
Read and write	14(12.7)	26(11.82)	1.1(0.5, 2.3)	0.7
Primary	23(20.9)	42(19.1)	1.1(0.6, 2.1)	0.6
Secondary and above	59(53.6)	122(55)	1.0	
Income category				
≤ 2500	37 (33.64)	62 (28.18)	0.8(0.4,1.5)	0.5
2501–4999	48 (43.64)	106 (48.18)	0.9 (0.5, 1.7)	0.8
≥ 5000	25 (22.73)	52 (23.64)	1.0	

Discussion

The current study result showed that rural residence was associated with the development of hypertensive disorder of pregnancy. This finding is consistent with a previous finding in an epidemiological study among pregnant mothers in Cairo, Egypt [23]. This could be due to the fact that mothers from rural areas book antenatal care later in pregnancy and have fewer ANC visits which could be associated with delay in health seeking behaviour. This delay in health care seeking could in turn be influenced by lack of awareness on pregnancy related problems, husband and

Table 2 Dietary, familial and lifestyle characteristics of mothers with/without hypertensive disorders of pregnancy in Tigray, 2018

variable	HDP/Cases N = 110, N (%)	No HDP/Controls N = 220, N (%)	COR (95% CI)	P-value
Family history of hypertension				
Yes	22(20)	14(6.4)	3.6(1.7,7.6)	0.001
No	88(80)	206 (93.6)	1.0	
Mean weight ± (SD)	63.2 (8.7)	60.8 (7.3)		0.01
Mean Height ± (SD)	1.61(.06)	1.62(.05)		0.09
MAUC				
≤ 22.1	69 (62.7)	140(63.6)	1.0	
> 22.1	41(37.3)	80 (36.4)	1.0(0.6, 2.0)	0.82
Pre-pregnancy mean weight ± (SD)	53.6 (8.4)	51.3 (6.8)		0.006
Pre-pregnancy mean BMI ± (SD	20.36(3.0)	19.8 (2.6)		0.05
Fruit use				
Yes	60(54.5)	193(87.7)	1.0	
No	50 (45.5)	27 (12.3)	5.3 (3.0, 9.4)	< 0.001
Vegetable use				
Yes	47(42.7)	133(60.4)	1.0	0.002
No	63(57.3)	87(39.6)	2.1(1.3, 3.3)	
BMI of mothers				
< 18.5	33 (30.0)	67 (30.5)	1.0	
18.5–24.9	65 (59.1)	147 (66.8)	0.9(0.6,1.6)	0.8
≥ 25	12 (10.9)	6 (2.7)	4.3(1.4,13.6)	0.01
Coffee use				
Yes	93(84.5)	149(67.7)	3.0(1.6, 5.9)	0.001
No	17(15.5)	71(32.3)	1.0	
Frequency of coffee use (N = 242)				
≥ once a day	76 (81.7)	104 (69.8)	3.2 (1.3, 8.3)	0.01
< once a day	17 (18.3)	45 (30.2)	1.0	
volume of coffee use (N = 242)				
< 3 cups	28(30.1)	69(46.3)	1.0	
≥ 3 cups	65(69.9)	80(53.7)	2.1(1.0, 4.1)	0.03

family influences, local cultural influence and bad experiences in health facilities.

Similarly fruit consumption was found to be important predictor in this study, mothers who consume less fruits in their diets were at higher risk of developing hypertensive disorders of pregnancy which is in line with previous findings reported from Bahrdar, Ethiopia ([19], Cairo, Egypt [23] and Norway [17]. This was also supported by a systematic review and meta-analysis of studies whereby calcium intake was found to be protective to hypertensive disorders of pregnancy in a multivariable analysis [31]. Fruits are rich in micronutrients and many of the vitamins and minerals play antioxidant role which could in turn help in the prevention of hypertensive disorders of pregnancy.

Pre-pregnancy body mass index was calculated and overweight mothers were at higher odds of developing hypertensive disorders of pregnancy as compared with low and normal body mass index which is in agreement with reports from USA [32, 33]. Likewise, multiple pregnancy has been reported as an independent predictor of hypertensive disorders of pregnancy from various studies in different parts of the globe [22, 34, 35]. The current finding is also in support of those previous reports which showed 4.2 times increased risk of developing hypertensive disorders of pregnancy compared with the singleton pregnancy.

Gestational diabetes mellitus was also found to be an independent predictor of hypertensive disorders of pregnancy that supported the existing knowledge; because literatures noted that pregnant mother who developed

Table 3 Obstetrics and medical characteristics of mothers with/without hypertensive disorders of pregnancy in Tigray, 2018

Variable	HDP/Cases N = 110, N (%)	No HDP/Controls N = 220, N (%)	COR (95% CI)	P-value
Pregnancy type				
Multiple	18 (16.4)	10 (4.5)	4.1(1.8, 9.6)	0.001
Single	92 (83.6)	210 (95.5)	1.0	
Gestational diabetes mellitus				
Yes	7 (6.36)	3 (1.4)	4.7(1.2,18.0)	0.02
No	103 (93.6)	217 (98.6)	1.0	
Pre-pregnancy oral contraceptive use				
Yes	42(38.2)	63 (28.6)	1.5 (0.9, 2.4)	0.08
No	68 (61.8)	157 (71.4)	1.0	
Presence of anemia at first visit				
Yes	94 (85.5)	194(88.2)	1.3 (0.6, 2.9)	
No	16(14.5)	26(11.8)	1.0	0.43
Age at menarche				
≤ 15 years	72 (65.4)	148 (67.3)	0.9(0.6, 1.5)	0.734
> 15 years	38 (34.6)	72 (32.7)	1.0	
Pre-pregnancy interval (N = 216)				
< 5 years	54 (83.08)	117 (77.5)	1.0	
≥ 5 years	11 (16.92)	34 (22.5)	0.9 (0.4, 2.2)	0.88
History of abortion				
Yes	25 (22.7)	39 (17.7)	1.0	0.263
No	85 (77.3)	181 (82.3)	0.7 (0.4,1.2)	

Table 4 Bivariate and multivariable analysis for the predictors of hypertensive disorders of pregnancy in Tigray, 2018

Variables	Matched unadjusted OR(95% CI)	Matched adjusted OR(95% CI)
Residence		
Rural	3.1 (1.9, 5.0)*	3.7(1.9, 7.1)**
Urban	1.0	1.0
Age		
Mean ± (SD)	1.02(0.9, 1.06)	0.96 (0.9, 1.02)
Marital status		
Married	1.0	1.0
Unmarried	0.5(0.2, 1.4)	0.44 (0.12, 1.5)
Family History of hypertension		
Yes	3.6 (1.7, 7.6)*	2.1 (0.7, 6.4)
No	1.0	1.0
Fruit use		
Yes	1.0	1.0
No	5.3 (3.0, 9.4)*	5.1 (2.4, 11.15)**
Vegetable use		1.0
Yes	1.0	1.2(0.6, 2.3)
No	2.08 (1.3, 3.3)*	
History of smoking		
Yes	1.0	1.0
No	0.3 (0.07, 1.2)	0.6 (0.07, 5.2)
BMI of mothers (prepregnancy)		
< 18.5	1.0	1.0
18.5–24.9	0.95 (0.56, 1.6)	1.7 (0.8, 3.4)
25–29.9	4.3 (1.4, 13.6)*	5.5 (1.12, 27.6)*
Coffee use		
Yes	3.08 (1.6, 5.9)*	1.9 (0.8, 4.4)
No	1.0	1.0
Pregnancy type		
multiple	4.1 (1.8, 9.6)*	4.2 (1.3, 13.3)*
single	1.0	1.0
Presence of gestational diabetes mellitus		
Yes	4.6 (1.2, 18.0)*	5.4 (1.1, 27.0)*
No	1.0	1.0
Oral contraceptive use		
Yes	1.5 (0.9, 2.4)	1.2(0.6, 2.4)
No	1.0	1.0

*P-value <0.01, **P-value <0.001

diabetes mellitus would have higher predisposition to develop hypertensive disorders of pregnancy and it has been identified as the most common predictor in previous studies [22, 34, 36–38].

Family history of hypertension was a predictor in the bivariate analysis but its effect vanished in the adjusted model and this contradicts with previous reports. These studies reported an increased risk of hypertensive disorders with a positive family history of chronic hypertension [21, 28, 36, 39–41].

Similarly, drinking more than 3 cups of coffee per day was not a significant risk factor in this study which means it is in conformity with some studies showing no difference [42] and contradicted with others. For instance, a study in Bahrdar, Ethiopia showed that mothers who reported to have taken coffee during pregnancy had higher odds of developing preeclampsia [19]. However, another study in Rotterdam, the Netherlands reported the substantial protection of coffee against the development of pregnancy induced hypertension [42].

Extreme lower or higher ages in pregnancy (age < 20 and > 35 years) were reported as a risk factor for hypertensive disorders of pregnancy in previous studies; *Tebeu PM et.al* reported that teenage mothers were at increased risk of developing hypertensive disorders [28] on the other hand, *Suzuki. S.* and *Igarashi M.* in their study revealed that age > = 35 was a significant factor for the development of preeclampsia [43] but in the current study though age > = 35

showed a significant risk in the first model, no difference was observed in the adjusted model. The difference may be due to the fact that majority of the respondents were within the age range of 19–34.

In many studies nulliparity was reported as a common risk factor for the development of hypertensive disorders of pregnancy [32–34, 41] but in this study its effect was not possible to measure as it was a matching variable. Unlike the current finding, partner change was reported as a risk factor for hypertensive disorders of pregnancy in other literatures [23]. The reason may be there were few mothers who changed their partner in the study and this in turn could make the difference invisible.

In previous studies illiteracy was reported to be a risk factor for hypertensive disorders of pregnancy [28] as it affects the age at marriage and pregnancy as well as health seeking behaviour but in the current study no association was reported. The continuous health education program provided by the health extension workers at the community and household levels might have helped to have similar level of awareness about the issue.

Some studies reported inter-pregnancy interval as a risk factor for hypertensive disorders of pregnancy. Longer inter-pregnancy interval had higher risk of developing hypertensive disorders of pregnancy [44] but in the current study no association was found.

The aforementioned findings should be viewed in light of the following limitations. Since cases were selected consecutively as soon as they were identified, selection bias might be introduced. Moreover, dietary assessment was self-reported and assessed at diagnosis which could have introduced recall bias.

Conclusion

The study assessed different risk factors of hypertensive disorders of pregnancy. Thus, rural residence, less fruit consumption, multiple pregnancy, presence of gestational diabetes mellitus and pre-pregnancy overweight were identified as independent risk factors. This highlights that there is a need to extend obstetric services to the grass root level in which rural residents can get all types of services in a closer distance. In addition, it necessitates strong nutritional education for the community during pregnancy and even the time preceding pregnancy including the routine supply of supplements. There is also a need to remind health professionals to properly identify and manage pregnant women having diabetes mellitus. It is recommended that these factors can be used as a screening tool for the prediction, early diagnoses as well as timely interventions of hypertensive disorders of pregnancy.

Additional file

Additional file 1: The tool used to collect the information (caes-control study) has been attached as additional file. (DOCX 30 kb)

Abbreviations

ACOG: American College of Obstetricians and Gynaecologists; BEmONC: Basic Emergency Obstetrics and Newborn Care; BMI: Body Mass Index; EmONC: Emergency Obstetric and Newborn Care; HDP: Hypertensive Disorders of Pregnancy; ICD: International Classification of Disease; MPH: Master of Public Health; MUAC: Mid Upper Arm Circumference; WHO: World Health Organization

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Availability of data and materials

The STATA dataset for the current study is available from the corresponding author on reasonable request.

Authors' contributions

HBK is the primary author, participated in the conceptualization, design, acquisition, analysis and interpretation of the data and drafted the manuscript. FEG was the primary academic advisor, contributed for design, acquisition, analysis and interpretation of the data and critically revised the manuscript. WMA was co-advisor, contributed for design, acquisition, analysis and interpretation of the data and critically revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The Institutional Review Board of College of Health Sciences, Addis Ababa University approved the study on 15/06/2017 (ref: 035/17/SPH). According to the Institutional Review Board of Addis Ababa University, taking verbal consent is the standard requirement for observational studies. Hence, the participants gave verbal consent to be enrolled in the study after they received an adequate briefing on the purpose and procedure of the study. For women aged less than 18 years verbal consent was obtained from their parents or husbands. The anonymity of all participating women was ensured by not recording any names or other personal identifiers. Their right not to participate, not to answer any or all questions and to withdraw from the interview at any time they want was respected.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Original Paper-Three

The Effect of Hypertensive Disorders in Pregnancy on Maternal and Perinatal Birth Outcomes in public hospitals of Tigray, Ethiopia: A prospective cohort study

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Abstract

Background-globally, hypertensive disorders of pregnancy are the major causes of maternal and perinatal morbidity and mortality. In low and middle income countries including Ethiopia studies on the effect of hypertensive disorders of pregnancy on maternal and perinatal birth outcomes are limited**.** The aim of this study was to examine the effect of hypertensive disorders of pregnancy on maternal and perinatal birth outcomes.

Methods-A prospective cohort study design was employed among pregnant women. Exposure was defined as a woman attending either the antenatal care clinic or the maternity ward and diagnosed to have hypertensive disorders of pregnancy by an obstetrician in the antepartum Period. A control (unexposed) was defined as pregnant women attending the antenatal care clinic of the hospital and who did not have a diagnosis of hypertensive disorders by the same obstetrician. The sample size was 374; 187 for each hypertensive and normotensive group.Participants were consecutively enrolled in 1 to 1 ratio until the desired sample size was obtained. Data was collected prospectively at antepartum, early postpartum and 7 days postpartum periods and components of the tool were complementary to each other. Data were collected face to face using an interviewer administered questionnaire as well as by reviewing medical records of the mothers. Data entry and analysis was done in STATA Version 14.Binary logisticregression was run to produce risk ratio (relative risk) and 95% confidence intervals along with their p- values were calculated in the bivariate and multivariable analysis. Significance was declared at P-value of less than 0.05.

Results- Compared with normotensive, women with hypertensive disorder had significantly increased risk of developing preterm birth (cRR=1.8; 95%CI, 1.5, 2.2), stillbirth (cRR=1.6; 95%CI, 1.3, 2.02), low birth weight (cRR=1.9; 95%CI, 1.6, 2.3) and early neonatal death (cRR=1.7; 95%CI, 1.3, 2.3). Women with hypertensive disorders had 2.6 times (aRR=2.6, 95%CI; 1.2, 5.7) higher risk of perinatal death and1.7 (aRR=1.7; 95%CI, 1.02, 2.9) times higher risk of cesarean section delivery compared with the normotensive women controlling the other variables.

Conclusion-Significant risk of cesarean section delivery, perinatal death, stillbirth, low birth weight delivery and early neonatal death were reported among women with hypertensive disorders of pregnancy. To minimize the burden of the problem much has to be done by health care professionals and stakeholders focusing on the identification and proper management of motherswith hypertensive disorders.

Key words: Pregnancy, hypertensive disorders, perinatal outcome, Tigray

Background

Hypertensive disorders of pregnancy are the major causes of maternal and perinatal morbidity and mortality in the world [1, 2].These are group of disorders classified in to different categories according to different international organizations and societies [3, 4]. According to the American College of Obstetricians and Gynecologists there are four categories. These include gestational hypertension, preeclampsia-eclampsia, chronic hypertension and preeclampsia superimposed on chronic hypertension[1].

The world health organization (WHO) estimated that in the year 2003-2009, 14% of maternal deaths were due to hypertensive disorders of pregnancy[5].In a similar time period, hypertensive disorders in pregnancy contributed for 19% of maternal deaths in Ethiopia[6]. Preeclampsia and eclampsiaalone contributes for 12% of maternal mortality globally and the case fatality rate varies in developing and developed countries[7]. In Ethiopia,preeclampsia and eclampsia contributed for 11% of maternal deaths and 16% of direct maternal mortality[8].

Hypertensive disorders of pregnancy also contributes for a significant perinatal morbidities and mortalities[9]. Previous studies showed that the risk of fetal and neonatal deaths, preterm birth and admission to a neonatal intensive care unit (NICU) were higher among hypertensive disorders of pregnancy cases as compared with their normotensive counterparts [10, 11]. In developing countries 23.6% of perinatal mortality was caused by hypertensive disorders of pregnancy[12].

Hypertensive disorders of pregnancy are characterized by abnormal placentation associated with abnormal inflammatory and vascular responses[9, 13].Poor placentation leads to a release of the substances that damage the endothelial cells of the maternal circulatory system which in turn initiates systemic inflammation and endothelial cell dysfunction, increasing vascular reactivity and leading to vasospasm and increased blood pressure; abnormal coagulation and thrombosis; increased endothelial permeability, resulting in proteinuria, edema and hypovolemia[14].Poor placentation can

also cause feto-placental demands to exceed maternal circulatory supply, restricting fetal growth and increasing the risk of stillbirth or neonatal death[15].

Hypertensive disorders of pregnancy can be developed in the antepartum, intra-partum and postpartum phases and the adverse perinatal outcomes would be higher when the problem is developed during the antepartum phase due to the effect of prematurity[16]. Factors associated with the adverse maternal and perinatal outcomes among mothers with hypertensive disorders of pregnancy include; past and present obstetrics conditions such as parity, time of onset, type of pregnancy, type of the hypertensive disorders of pregnancy; and medical conditions[17].

The Ethiopian ministry of health together with different stakeholder and partners has implemented various strategies to improve maternal and newborn health through increasingavailability and easier access to emergency obstetric services. Expansion of health facilities, increased availability of supplies and deployment of appropriately skilled health professionalswere among the strategies[18]. Despite the fact maternal and perinatal morbidity and mortality remained high[16, 19] and hypertensive disorders of pregnancy is considered to contribute the major share for this burden[16].

In low and middle income countries (LMIC) including Ethiopia studies on the effect of hypertensive disorders of pregnancy on maternal and perinatal birth outcomes are limited. In addition, previous studies mainly focused on estimating the maternal and perinatal outcomes among women with hypertensive disorders without comparing with their counterpart (a control group). Therefore, this study assessed maternal and perinatal adverse outcomes attributable to hypertensive disorders of pregnancy in comparison with normotensive women

Methods

Study setting and period

The study was conducted in hospitals of Tigray regional state,in northern Ethiopia.The total projected population of the region is 5,247,005 in 2017 of which 2,587,003males and 2,660,002females. Reproductive age group females (15-49years) comprised23.5% of the population. The annual population growth rate and total fertility rate of the region are 2.3% and 4.6 children per woman respectively. There were 178, 398 total expected pregnancies for the year 2017 which resulted in a pregnancy rate of 3.4%. In the region there are 22 primary hospitals, 18 general hospitals and 2 referral hospitals, 211 health centers and 712 health posts which are run and owned by the government (Tigray Regional Health Bureau unpublished data,[20]). There are 28 health facilities providing basic emergency obstetrics and newborn care (BEmONC) and 16 facilities providing comprehensive emergency obstetrics and newborn care (CEmONC) in Tigray region [21].The study was conducted in the referral and general public hospitalsconsidering the availability of obstetrician and gynecologists. Data were collected from July to December 2017.

Study design and population

A prospective cohort study was employed. Pregnant women attending the antenatal care clinics or maternity wards in the study hospitals were included in the follow up. women were screened by obstetricians for their status of hypertensive disorders of pregnancy and those with the diagnosis of the specific disease were considered as exposed while without it were taken as unexposed or control. Both groups of women were included in the study after 20 weeks of gestation.The study population was all pregnant mothers attending the maternity centers of the study hospitals. Exposure was defined as a women attending either the antenatal care clinic or the maternity wardand diagnosed to have hypertensive disorders of pregnancy by an obstetrician in the antepartum period [22].Hypertensive disorders of pregnancy can be developed in the antepartum, intra-partum or postpartum phases but for this study only the antepartum hypertensive disorders were included.

A control (unexposed) was on the other hand defined as pregnant womenattending the antenatal care clinic of the hospital and who were not diagnosed to have hypertensive disorders by an obstetrician. Women with any history of hypertensive disorders of pregnancy (preexisting hypertension or pregnancy induced hypertension) were excluded from the unexposed group. For each exposed pregnant womenone unexposed women (control)wasenrolled in to the follow up in the same health facility. Only women with singleton pregnancy were included in both groups.

Sample size and sampling procedure

To compare maternal and perinatal outcomes among hypertensive and normotensive mothers, number of exposed and unexposed mothers has been calculated using Epi Info 7 StatCalc for cohort study based on thefollowing assumptions:Two sided confidence level=95%, Power=80%, Ratio (unexposed: exposed) =1, Proportion of outcome in the exposed group (P1) = 16.1%and proportion of outcome in the unexposed (P1) = 6% from previous study in Harare, Zimbabwe[23]. In this case, proportion for low birth weight was taken as an outcome variable to obtain the maximum sample size. Accordingly the sample size was 340, by considering 10% non-response rate the final sample size was 374; 187 for each group.In Tigray regional state there were 7 hospitals having obstetrician and gynecologist. The sample size was proportionally allocated to each hospitals based on the case load. Accordingly 50, 88, 46, 52, 50, 22, 48mothers were recruited from Lemlem carl, Ayder, Mekelle, Adigrat, KahsayAbera, St.Marry and Suhul hospitals respectively. All exposed cases that fulfilled the defined criteria were consecutively included until the desired sample size was obtained. Controls/unexposed women were selected next to the enrollment of the women with hypertensive disorders.

Data collection method

After including mothers in the study as per the predetermined criteria in the exposed and unexposed category they were followed until the first 7 days of postpartum period. Data were collected face to

face using an interviewer administered pretested questionnaire as well as by reviewing medical records of mothersto extract relevant laboratory, clinical and obstetrics variables . The questionnaire was developed following a thorough review of literatures from different sources including the international guidelines[1, 2, 13]. The data collection tool contained variables mainly on socio-demographic characteristics, obstetric history, current pregnancy condition, birth outcomes and neonatal conditions. Mothers were approached three times during pregnancy, delivery and early postpartum. The follow up was made by communicating with the health care professionals, heath extension workers and the client themselves. To easily trace the mothers in the follow up, detailed address was properly recorded.The questionnaire was prepared in English and translated into the local language, Tigrigna and back to English by independent language experts for consistency. Training was given for data collectors and supervisors for three days regarding to the content of the questionnaire and its administration. During the training follow up data handling and how to trace cases were emphasized because a women needed to be contacted a couple of times to make the questionnaire complete. The study was strictly supervised by the assigned supervisors as well as by the principal investigator. To check for completeness and consistencies of the completed tool, it was checked on a daily basis and corrections were made on the spot.

Data processing and analysis

Data entry and analysis was done in STATA Version 14. Descriptive summary measures were reported as proportions for categorical variables and mean for continuous variables. Besides, the different maternal and perinatal birth outcomes were compared between the hypertensive and normotensive women (exposed and unexposed women). Binary logisticregression was run to produce risk ratio (relative risk) and crude relative risk and their 95% confidence intervals along with their p values were calculated in the bivariate analysis. In multivariable analysis, variables with a P-value of 0.2 and less in the bivariate analysis were included to adjust confounders and to get the independent effect of hypertensive disorders of pregnancy on the different adverse birth outcomes. In

both cases significance was declared at P-value less than 0.05. The overall findings were presented in texts and tables.

Operational definitions

Gestational hypertension- systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg measured on two occasions at least 6 hours apart after twenty weeks of gestation in the absence of proteinuria or other systemic symptoms[1].

Preeclampsia- characterized by new onset of hypertension after 20 weeks gestation (systolic blood pressure ≥140 mmHg and/or diastolic BP ≥90) mmHg and proteinuria. However, in the absence of proteinuria other manifestations such thrombocytopenia (platelet count less than 100,000/microliter), impaired liver function (elevated blood levels of liver transaminases to twice the normal concentration), the new development of renal insufficiency (elevated serum creatinine greater than 1.1mg/dl or a doubling of serum creatinine in the absence of other renal disease), pulmonary edema, or new onset cerebral or visual disturbances are used to diagnose the case[1].

Eclampsia- characterized by new onset grand mal seizures in a woman with preeclampsia[13].

Chronic hypertension- includesessential hypertension as well as hypertension secondary to a range of conditions which is characterized by a blood pressure greater than or equal to 140 mmHg systolic and/or 90mmHg diastolic confirmed before pregnancy or before 20 completed weeks gestation[1].

Chronic hypertensionsuperimposed with Preeclampsia - mothers known to have hypertension before pregnancy or before 20 weeks of gestation and who had developed signs of preeclampsia after 20 weeks of gestation.

Proteinuria- a dipstick result of 1+ and above in a qualitative measurement[1]

Maternal adverse outcomes- include at least one of these outcomes (antepartum hemorrhage, postpartum hemorrhage, cesarean section, maternal death, preterm birth)

Perinatal mortality- the death of a fetus after 28 weeks of gestation or in the first 7 days postpartum[9]

Adverse neonatal outcome- at least one of these outcomes (stillbirth, neonatal death, low birth weight, low apgar score, ICU admission)

Ethical consideration

The study was approved by the institutional review board of the College of Health Sciences in Addis Ababa University. Participants were free to choose whether or not to take part in the studyand to withdraw at any time. There were no other risks for the participants to participate in the study, other than those encountered in day-to-day life. It was described that information obtained from this study may be of valuable to mothers and new-borns in general and health education on pregnancy and hypertensive disorders was given to the participant. The anonymity of the study participants was maintained by excluding personal identifiers from the data collection tool and the records of the study were kept strictly confidential. Finally informed consent was sought from the participants.

Results

Socio-demographic characteristics

A total of 374 mothers (187 normotensive and 187 with hypertensive disorders) were planned to be included in the study and finally 356 mothers (178 each) were included giving the response rate of 95%. Among the mothers with hypertensive disorders, 50 (28.1%) had gestational hypertension, 10(5.6%) chronic hypertension, 26 (14.6%) mild preeclampsia, 75(42.1%) severe preeclampsia, 12 (6.7%) eclampsiaand 5(2.8%) chronic hypertension superimposed with preeclampsia. The mean age (SD) for the overall respondents was 26.8(5.4%);(26.5 (5.6) for women with hypertensive disorders and27.0 (5.1) for women without hypertensive disorders. The minimum and maximum ageswere 15 and 46 respectively. Majority of the respondent in both groups were between 20-34 years old. More than 92% of the respondents were married and orthodox Christianity followers (**Table 1**).

Table 1. Frequency distribution of hypertensive and normotensive pregnant women in Tigray, 2017 (N=356)

Variables	Normotensive N(%)	HDP N (%)	P-value
Residence			
Urban	77(43.3)	54(30.3)	0.011
Rural	101(56.7)	124(69.7)	
Age category			
<20	23(12.9)	25(14.0)	
20-34	140(78.7)	134(75.3)	0.710
>34	15(8.4)	19(10.7)	
Mean age (SD) in years	27(5.1)	26.5(5.6)	0.328
Mean pre-pregnancy weight(SD)	51(6.6)	53.8(8.3)	≤0.001
Parity			
Primipara	45(25.3)	68(38.2)	
Multipara	133(74.7)	110(61.8)	0.009
Marital status			
Married	167 (93.8)	168(94.4)	0.82
Unmarried	11(6.2)	10(5.6)	
Religion			
Orthodox	166(93.3)	163(91.6)	
Muslim	12(6.7)	15(8.4)	0.548
Ethnicity			
Tigray	166(93.3)	167(93.8)	0.829
Amhara	12(6.7)	11(6.2)	
Woman's educational status			
No education	45(25.3)	53(29.8)	
Read and write	27(15.2)	21(11.8)	0.835
Primary	45(25.3)	45(25.3)	
Secondary and higher	61(34.3)	59(33.1)	
Occupation			
Housewife	130(73)	125(70.2)	
Gov't employee	31(17.4)	31(17.4)	
Nongovernmental employee	3(1.7)	7(3.9)	0.80
Private Organization	14(7.8)	15(8.4)	
Husband's educational status(N=335)			
No education	24(14.3)	28(16.8)	
Read and write	45(26.8)	38(22.6)	0.728
Primary	28(16.7)	29(17.4)	
Secondary and higher	71(42.2)	72(43.1)	

Pregnancy characteristic and birth outcomes

Preterm birth, cesarean section delivery, antepartum hemorrhage and postnatal hemorrhage were found to be higher in women with hypertensive disorder. On the other hand, spontaneous vaginal delivery was higher among the women without hypertensive disorders (**Figure**).

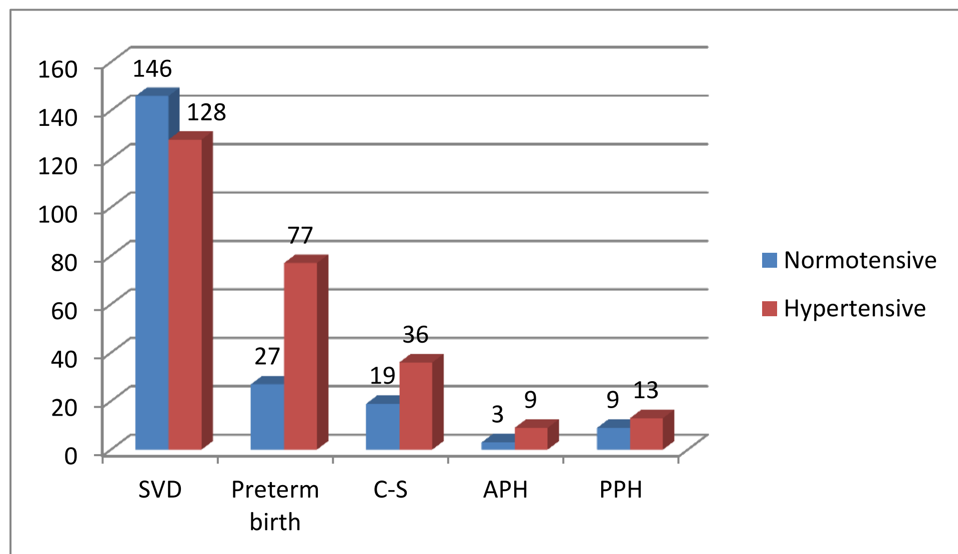

Figure. Pregnancy outcomes among hypertensive and normotensive women in public hospitals of Tigray, 2017.

The average (mean (SD)) gestational age at birth for the hypertensive mothers was 36.6(3.3) weeks and it was38.4(2.1) (**P <.001**) among the women without hypertensive disorders. On average, women with hypertensive disorders deliver 1.5weeks earlier than the normotensive women. Maternal pregnancy or birth complications were assessed among the two groups and it was found that 12(6.7%) and 24(13.5%) women were found to have abruptio placenta, placenta previea or postpartum hemorrhage in the normotensive and hypertensive groups respectively (**P=.023**). In this study 2 women were died and both of them were among the hypertensive disorder cases, particularly in the severe preeclampsia category. Cesarean section rate was found to be almost twice higher among the exposed group compared with the unexposed mothers (36/20.2% Vs 19/10.7%, **P=.004).**

Similarly,39(21.9%) women in the hypertensive category had undergone induction of labour whereas only 9(5.1%) normotensive women had induction of labour (**Table 2**).

Early neonatal death was significantly higher among mothers with hypertensive disorders as compared with the normotensive mothers (6.4% Vs 1.2%, **P<.001**). Term delivery rate was 151(84.8%) among the unexposed groups but it was 101(56.7%) in the exposed group. Women in the hypertensive group were 4 and 4.8 times higher to experience preterm birth at 34-37 and less than 34 weeks respectively.Similarly, significant difference was observed on the birth weight of newborns between the normotensive and hypertensive mothers; the mean birth weight was 3.1(0.5) Kg in the normotensive mothers and 2.7(0.6) Kg in the hypertensive mothers. The risk of developing adverse neonatal outcome increase by 90 % (1.9, 95%CI, 1.6, 2.3)among the hypertensive disorders compared with the normotensive women (**Table 2**).

Table 2. Pregnancy characteristics and birth outcomes of normotensive and hypertensive women in Tigray, 2017

Pregnancycharacteristics and birth outcomes	Normotensive N(%)	HDP N(%)	RR(95% CI)	P-value
Maternal complications				
Yes	12(6.7)	23(13.5)	1.4(1.04, 1.7)	0.023
No	166(93.3)	155(86.5)	1.0	
GA at birth in weeks				
<34	8 (4.5)	26(14.6)	4.8(2.1,11.2)	<0.001
34-37	19(10.7)	51(28.7)	4.0(2.2,7.2)	<0.001
≥37	151(84.8)	101(56.7)	1.0	
Onset of labour				
Spontaneous	169(94.9)	139(78.1)	1.0	
Induced	9(5.1)	39(21.9)	1.8 (1.5, 2.16)	<0.001
Delivery				
Spontaneous vaginal delivery (SVD)	146(82.0)	128(71.9)	1.0	
Cesarean section (CS)	19(10.7)	36(20.2)	1.4(1.1, 1.7)	0.004
Instrumental	13(7.3)	14(7.9)	1.1(0.7, 1.6)	0.59
Mean GA(SD) at birth in weeks	38.4(2.0)	36.6(3.3)	0.9(0.9, 1.01)	0.275
Mean birth weight (SD)	3.1(0.5)	2.7(0.6)	0.7(0.6, 0.8)	<0.001
Preterm birth				
Yes	27 (15.2)	77(43.3)	1.8(1.5, 2.2)	<0.001
No	151 (84.8)	101(56.7)	1.0	
Apgar score (<7) at 1 minute				
Yes	18(10.1)	51(28.6)	1.6(1.4, 2.0)	<0.001
No	160(89.9)	127(71.4)	1.0	
Apgar score (<7) at 5 minute				
Yes	12(6.7)	39(21.9)	1.6(1.4, 2.0)	<0.001
No	166(93.3)	139(78.1)	1.0	
Birth weight in gms				
< 2500	11(6.4)	44(28.0)	1.9 (1.6, 2.3)	<0.001
≥2500	161(93.6)	113(72.0)	1.0	
ICU admission				
Yes	4(2.3)	27(17.2)	1.9 (1.6, 2.4)	<0.001
No	168(97.7)	130(82.8)	1.0	
Perinatal mortality				
Yes	8(4.5)	31(17.4)	1.7(1.4, 2.0)	<0.001
No	170(95.5)	147(82.6)	1.0	
Stillbirth				
Yes	6 (3.4)	21(11.8)	1.6(1.3, 2.05)	<0.001
No	172(96.6)	157(88.2)	1.0	
Early neonatal death				
Yes	2(1.2)	10(6.4)	1.7(1.3, 2.3)	<0.001
No	170(98.8)	147(93.6)	1.0	

The risk of undergoing cesarean section was 90% higher among women with hypertensive disorders (cRR 1.9, 955CI; 1.1, 3.2) compared with the normotensive women. Further analysis was made to see the effect of the different hypertensive disorders. Hence, preeclampsia and eclampsia cases had 2.3 and 4.3 times higher risk of undergoing cesarean section compared with the women without hypertensive disorders.Women who were induced for labour before delivery had an increased risk by 80% to go in to cesarean section (cRR 1.8, 955CI; 1.02, 3.1) compared with those initiated spontaneously. In this study variables such as attendance status, age, time at first ANC, gestational diabetes mellitus, antepartum hemorrhage and preterm birth were not risk factors for cesarean section (**Table 3**).

Table 3. The effect of hypertensive disorders of pregnancy on emergency cesarean section among mothers in public hospitals of Tigray, 2017

Variables	Cesarean section		RR (95%, CI)	P-value
	Yes N (%)	No N (%)		
Status of mother				
Normotensive	19(10.7)	159(89.3)	1.0	
Hypertensive	36(20.2)	142(79.8)	1.9(1.1, 3.2)	0.015
Type of HDP				
Normotensive	19(10.7)	159(89.3)	1.0	
GHTN	4(8)	46(92)	0.7(0.3, 2.1)	0.584
Preeclampsia	25(24.7)	76(75.3)	2.3(1.3, 4.0)	0.002
Eclampsia	6(46.2)	7(53.8)	4.3(2.1, 8.9)	≤0.001
CHTN/CHTNsuperimposed	1(7.1)	13(92.9)	0.7(0.1, 4.6)	0.684
Attendance status				
Referred	14(16.7)	70(83.3)	1.1(0.6, 1.9)	0.723
Not referred	41(15.1)	231(84.9)	1.0	
Mean (SD) age	27.0(6.6)	26.7(5.2)	1.01(0.9, 1.05)	0.686
Time at first ANC				
First trimester	3(9.4)	29(90.6)	1.0	
Second trimester	47(16.5)	237(83.5)	1.7(0.6, 5.3)	0.315
Third trimester	5(12.5)	35(87.5)	1.3(0.3, 5.1)	0.677
APH				
Yes	4(33.3)	8(66.7)	2.4(0.9, 5.2)	0.058
No	51(14.8)	293(85.2)	1.0	
Gestational Diabetes mellitus				
Yes	2(18.2)	9(81.8)	1.2(0.3, 4.2)	0.796
No	53(15.4)	292(84.6)	1.0	
Preterm birth				
Yes	17(16.4)	87(83.6)	1.08(0.6, 1.8)	0.763
No	38(15.1)	214(84.9)	1.0	
Initiation of labour				
Spontaneous	43(14)	265(86)	1.0	
induced	12(25)	36(75)	1.8(1.02, 3.1)	0.043

Perinatal death

In the bivariate analysis perinatal mortality was significantly different between the normotensive and hypertensive mothers. The risk of death in the late fetal stage or in the early neonatal period was 3.8 (cRR=3.895% CI; 1.8, 8.2) times higher in the hypertensive mothers compared with those who were normotensive. Further analysis was also made to check whether there is variation among the different types of hypertensive disorders of pregnancy compared with the normotensives as a reference category. Thus preeclampsia, eclampsiaand preeclampsia superimposed on chronic hypertension were significantly different from the normotensive mothers (**P<.001, .008, .011** respectively) while there was no difference when compared with gestational hypertension. Furthermore, gestational diabetes mellitus and preterm birth were risk factors for perinatal death (**Table 4**).

Table 4. Bivariate analysis on the effect of hypertensive disorders of pregnancy on perinatal mortality among mothers in public hospitals of Tigray, 2018

Variables	Perinatal death		RR (95%, CI)	P-value
	Yes, N (%)	No, N (%)		
Status of mother				
Normotensive	8(4.5)	170(95.5)	1.0	
Hypertensive	31(17.4)	147(82.6)	3.8(1.8, 8.2)	<0.001
Type of HDP				
Normotensive	8(4.5)	170(95.5)	1.0	
GHTN	4(8)	46(92)	1.7 (0.6, 5.6)	0.329
Preeclampsia	21(20.8)	80(79.2)	4.6(2.1, 10.0)	<0.001
Eclampsia	3(23.1)	10(76.9)	5.1(1.5, 17.0)	0.008
CHTN/CHTNsuperimposed	3(21.4)	11(78.6)	4.7(1.4 15.9)	0.011
Residence				
Urban	14(10.7)	117(89.3)	1.0	
Rural	25(11.1)	200(88.9)	1.03(0.6, 1.9)	0.9
Attendance status				
Referred	12(14.3)	72(85.7)	1.4(0.7, 2.7)	0.26
Not referred	27(9.9)	245(90.1)	1.0	
Parity				0.890
Primipara	12(10.6)	101(89.4)	0.9(0.5, 1.8)	
Multipara	27(11.1)	216(88.9)	1.0	
Mean (SD) age	25.7(5.1)	27(5.4)	0.9(0.9, 1.02)	0.2
Mean (SD) Pre-pregnancy weight	53.5(9.9)	52.3(7.3)	1.01(0.9, 1.06)	0.37
Time at first ANC				
First trimester	1(3.1)	31(96.8)	1.0	
Second trimester	33(11.6)	251(88.4)	3.7(0.5, 26.2)	0.18
Third trimester	5(12.5)	35(87.5)	4.0(0.5, 32.5)	0.19
Anemia				
Yes	4(8.5)	43(91.5)	0.7(0.3, 2.0)	0.57
No	35(11.3)	274(88.7)	1.0	
APH				
Yes	1(8.3)	11(91.7)	0.7 (0.11, 5.0)	0.7
No	38(11.0)	306(89)	1.0	
BMI category				
<18.5	14(12.7)	96(87.3)	0.7(0.2, 2.2)	0.37
18.5-24.9	20(9.3)	196(90.7)	0.5(0.1, 1.4)	0.57
≥25	5(16.7)	25(83.3)	1.0	
Gestational Diabetes mellitus				
Yes	4(36.4)	7 (63.6)	3.5(1.5, 8.3)	0.003
No	35(10.1)	310(89.9)	1.0	
Preterm birth				
Yes	24(23.1)	80(76.9)	3.8(2.1, 7.0)	<0.001
No	15(6.0)	237(94.0)	1.0	

The effect of hypertensive disorders on cesarean delivery and perinatal death

Variables that were found associated with the perinatal outcomes in the bivariate analysis were taken to the multivariable analysis in the logistic regression to check for independent effect of hypertensive disorders by adjusting the possible confounders. Accordingly, women with hypertensive disorders had 70% increased risk (aRR=1.7, 95%CI; 1.02, 2.9)to undergo cesarean section compared with the normotensive women maintaining the other variables constant.Besides, women with hypertensive disorders had 2.6 times (aRR=2.6, 95%CI; 1.2, 5.7)higher risk of perinatal death compared with the normotensive women.

Table 5. Multivariable analysis for the effect of hypertensive disorders on perinatal outcomes in Tigray, 2017

Pregnancy and delivery outcomes	Crude RR (95%CI)	P-value	Adjusted RR (95%CI)	P-value
Cesarean section				
Hypertensive disorders of pregnancy	1.9(1.1, 3.2)	0.015	1.7(1.02, 2.9)	0.041
Presence of antepartum hemorrhage	2.4(0.9, 5.2)	0.058	1.8(0.8, 4.2)	0.149
Induced labour	1.8(1.02, 3.1)	0.043	1.4(0.8, 2.5)	0.248
Perinatal death				
Hypertensive disorder of pregnancy	3.8(1.8, 8.2)	<0.001	2.6 (1.2, 5.7)	0.017
Age	0.9(0.9, 1.02)	0.2	0.9 (0.93, 1.04)	0.686
Gestational DM	3.5(1.5, 8.3)	0.003	2.3(1.02, 5.1)	0.043
Preterm birth	3.8(2.1, 7.0)	<0.001	2.7(1.5, 5.2)	0.001

Discussion

This prospective cohort study examined the effect of hypertensive disorders of pregnancy on maternal and perinatal birth outcomes. Delivery at earlier gestational age poses a risk for different maternal and perinatal adverse birth outcomes associated with prematurity. The more the mother approaches to her term gestational age the better the outcome of delivery. In this study, the average gestational age at birth was 1.5 weeks shorter in the women with hypertensive disorders compared with the normotensive women. This finding was consistent with a study in China where women with severe preeclampsia give birth at a gestational age which is 0.6 week shorter than the normotensive women[24]. This finding implies that when the disease gets worse there is no time to allow the pregnancy continue and get the fetus matured due to the maternal risk. Looking in to women with hypertensive disorders only, the gestational age at birth was almost the same with a previous study in Pakistan which was 37.37±2.25 weeks[25].

Induction of labour was significantly higher in the hypertensive disorders of pregnancy cases compared with the normotensive women (21.9% versus, 5.1% **P<0.001**) which was lower than the 44.3%, fromthe previous study in Addis Ababa among HDP cases[26].Physiologically as well as mechanically the uterus is resistant to be contracted and to establish labour early in the pregnancy. It is commonly initiated as it gets to term. Despite the fact it might be lifesaving to the mother and the fetus to initiate labour before it is spontaneously initiated in cases of severe obstetric complications such as preeclampsia and eclampsia as a result the induction rate tend to increase.

In this study preterm birth was observed in 27 (15.2%, 95%CI; 10.4%, 21.5% and 77(43.3%, 95%CI; 36%, 50.9%)of normotensive and hypertensive women and the difference was statistically significant (**P<0.001**). Similar finding was reported from another study in Addis Ababa in which preterm delivery rate was 48.6% for all cases of HDP[26] and (36.6%) in Thailand [27]. On the other hand, in USA preterm birth was similar in women with hypertension and without hypertension (10.8%

versus 10.4%)[28]. In developed countries such as USA there might be advanced therapies that help to maintain pregnancy and keep the fetus developing to term which makes no difference among the groups regarding the time of birth but in developing countries this is far from reach. Likewise, the same report was found from china in whichthere was no association between the different types of hypertensive disorders of pregnancy and the risk of preterm birth[24]. This could be further justified as, women in developing countries do not strictly follow antenatal care and the service itself is not up to standard. As a result,prevention, early diagnosis and treatment of obstetrics complications including hypertensive disorders of pregnancy are not effective which in turn leads to termination of the pregnancy preterm to save the mother.

Cesarean section rate was found to be 20.2% among the exposed group compared with 10.7% among the unexposed group. This finding was much lower than a study in China where the cesarean section delivery rate was 45.7% in normotensive women and 55.7% in women with hypertensive disorders[29]. Another study in Addis Ababa among hypertensive disorders of pregnancy cases also reported caesarean section rate of 44.3%[26]which is much higher than the 20.2% of the current report.The reason for this might be, clinicians tend to wait for expectant delivery taking the adverse effect of cesarean section in to account. In addition operation theaters may be so busy by other emergency cases and mothers might be forced to wait and spontaneous delivery to be attempted. Furthermore, induction of labour might be also effective that minimizes the occurrence of cesarean sectionbut in other studies direct cesarean section might be the trend.

In the multivariable analysis the risk of undergoing cesarean section was 70% higher among the women with hypertensive disorders (aRR 1.7, 95%CI; 1.02, 2.9) compared with the normotensive women.A study in Pakistan reported no significant difference among hypertensive disorders of pregnancy groups in light of cesarean section rate[25]. On the other hand it was in line with a study in USA in which cesarean delivery wassignificantly increased among the hypertensive group[28].The

ultimate treatment of hypertensive disorders of pregnancy is delivering the baby[1]. Thus, it is obvious that pregnant women who developedsevere preeclampsia and eclampsia would have higher chance of undergoing cesarean section as it would be a risk for both the mother and the fetus if it is allowed to continue. This is to mean that the difference in the rate of cesarean section mainly depends on the type or severity of hypertensive disorder of pregnancy.

Perinatal mortality in this study was reported 8(4.5%, 95%CI; 2.1, 9) and 31(17.4%, 95% CI, 12.3, 24) in the normotensive and hypertensive women respectively and the difference was significant.Women with hypertensive disorders had 2.6 times (aRR 2.6, 95%CI; 1.2, 5.7) higher risk of having perinatal mortality compared with the normotensive women. In addition, gestational diabetes mellitus and preterm birth were significant predictors for perinatal death. In a study elsewhere (USA) when normotensive/mild gestational hypertension and mild preeclampsia cases were compared to each other, there was no any significant difference in perinatal outcomes[30].This is because the comparison was made only with the mild preeclampsia cases.Inaddition, the level of care could be different in these settings.

The overall findings of this study imply that hypertensive disorders of pregnancy have continued to be the major contributor for obstetric complications leading to maternal and perinatal morbidity and mortalities. In this study the overall hypertensive disorder of pregnancy was compared with the normotensive women to see the maternal and perinatal outcomes. Hence, merging the different types of hypertensive disorders could be taken as a limitation as the effect of each type of hypertensive disorder might not be the same.

Conclusion

This prospective cohort study revealed that women with hypertensive disorders in pregnancy are at significantly higher risk of having pregnancies complicated by maternal and perinatal adverse outcomes. Significant risk of cesarean section delivery, preterm birth, perinatal death, stillbirth, low birth weight delivery and adverse neonatal outcomes were reported among women with hypertensive disorders of pregnancy. To minimize the burden of the problem much has to be done by health care professionals and stakeholders focusing on the identification and proper management of mothers with hypertensive disorders.

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Authors' Contributions

HBK is the primary author, participated in the conceptualization, design, acquisition, analysis and interpretation of the data and drafted the manuscript. FEG was the primary academic advisor, contributed for design, acquisition, analysis and interpretation of the data and critically revised the manuscript. WMA was co-advisor, contributed for design, acquisition, analysis and interpretation of the data and critically revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

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Original Paper- Four

Why mothers are not early screened and treated for hypertensive disorders of pregnancy in Tigray, Ethiopia: A Qualitative study

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Abstract

Background- Globally maternal mortality is a top public health priority and about 99% of these deaths occur in developing countries. The majority of maternal deaths attributable to hypertensive disorders of pregnancy can be avoided through early detection followed by timely and effective management but there is paucity of evidences on why pregnant women fail to get screened and treated early. This study explored barriers for early detection and management of hypertensive disorders of pregnancy in Tigray, Ethiopia.

Method-A descriptive qualitative study using maximum variation sampling procedure was conducted in Tigray region from November to December 2017. Twenty two in-depth interviews were conducted on 7 midwives, 5 physicians, 5facility managers and 5 mothers based on the level of information saturation. The data were transcribed verbatim and analysed thematically supported by Atlas ti 7 software. Results were presented in themes and subthemes accompanied by direct quotes.

Results-The study demonstrated the presence of multiple barriers for early detection and management of hypertensive disorders of pregnancy. Poor awareness of mothers and the community, misconceptions towards hypertensive disorders of pregnancy, multiple referrals before reaching the final functional health care facility, less focus on the quality of antenatal care, scarcity of resources and limited capacity building programs such as service related trainings to make professionals competent were claimed for the late detection and management of hypertensive disorders of pregnancy

Conclusion-limited community awareness and misconceptions, delays in reaching the health facility, scarcity of resources and less focus on the quality of antenatal care were identified as barriers for early screening and treatment of hypertensive disorders of pregnancy. Health care professionals, health care managers and administrators need to work more on quality of care, decentralizing obstetric services and capacity building activities.

Key words: **Hypertensive disorders of pregnancy, screening, treatment**

Background

Globally maternal mortality is a top public health priority and about 99% of these deaths occur in developing countries; Sub-Saharan Africa alone accounted for about 66% of these deaths[1, 2]. More than half of thesematernal mortality is caused by haemorrhage, hypertensive disorders, and sepsis;each constituting 27·1%, 14·0% and 10·7% respectively. In Sub-Saharan African countries these disorders constitute24·5%, 16·0%, and 10.3% respectively[1]. In Ethiopia, 11% of all maternal deaths and 16% of direct maternal deaths were due to hypertensive disorders of pregnancy[3]. Not only this but also 23% of perinatal mortality in developing countries is caused by the complications associated with hypertensive disorders of pregnancy[4].

Maternal mortality in Ethiopia is among the highest in the world[5]. However, it is undeniable that the country has achieved a substantial reduction in maternal mortality targeting on the major obstetrics complications through expansion of health facilities, increased availability of supplies and deployment of appropriately skilled health professionals to the lower level[6].

The majority of maternal deaths attributable to hypertensive disorders of pregnancy can be avoided throughearly detection followed by timely and effective managementofpregnant women with the disorders. This includes prenatal care, timely diagnosis, proper management, and timely delivery[7, 8].It is recommended that hypertensive disorders of pregnancy should be early detected by universally screening all women during pregnancy, labour and delivery as well as in the postpartum period. Once the problem is identified,there should be an intervention without delay as it can escalate to more severe maternal and perinatal complications due to its progressive nature[9].

Overcoming the prevailing challenges in the control of hypertensive disorders in developing countries depends on the ability of health care systems to identify and manage women at high risk[10]. In low and middle income countries many public hospitals have limited access to intensive

care units, and so the mortality and morbidity is likely to be considerably higher than in settings where such facilities are available[11].

In developing countries adverse maternal and perinatal birth outcomes associated with hypertensive disorders remained high; mainly as a result of scare resources and lack of routine screening practices[9]. According to previous studies,stock outs of supplies, competency of health care professionals, unavailability of standardized service delivery guidelines and clinical protocols were reported as barriers for early detection and management of hypertensive disorders of pregnancy[12-15].

Even though early detection and management is the best strategy to prevent and control hypertensive disorders of pregnancy, the reason why pregnant women fail to get screened and being managed early remained unanswered. Therefore, this study exploredbarriers for early detection and management of hypertensive disorders of pregnancy.

Method

Study setting and period

The study was conducted in Tigray Regional State, northern Ethiopia.There were 178, 398 total expected pregnancies for the year 2017 which gives pregnancy rate of 3.4%. In the region there are 22 primary hospitals 18 general hospitals and 2 referral hospitals, 211 Health centers and 712 Health posts which are run and owned by the government[16]. There are 28 functional health facilities providing basic emergency obstetrics and new-born care (BEmONC) and 16 facilities providing comprehensive emergency obstetrics and new-born care (CEmONC) in Tigray region[17]. Data were collected from November to December 2017.

Study design

A descriptive qualitative study design was used in this study. This study design enables to explore experiences of participants and share their insights in-depth from their own perspective[18, 19].

Participants

Participants of the study were health professionals particularly midwives and senior obstetricians, managers working in areas of maternal and child health and women who experienced hypertensive disorders of pregnancy. These participants were selected purposively through maximum variation sampling. Maximum variation sampling involves purposefully picking a wide range of variation on dimensions of interest to obtain information about the significance of various circumstances. It often helps to understand how a phenomenon is seen and understood among different people, in different settings and at different times. When using amaximum variation sampling method, a number of units or casesthat maximize the diversity relevant to the research question could be involved in the research[20].Health professionals and health care managers with a work experience of five years and above in maternal and child health related areas were included in the study to extract their experience and shed light on the issue of hypertensive disorders of pregnancy. Health care managers were those working as maternal and child health department heads and director for maternal and child health in the regional health bureau. Besides mothers who had an experience of hypertensive disorders of pregnancy in the last one year were eligiblefor the interview. A total of 22 in-depth interviews were conducted of which 7 were health care managers and administrators, 5 midwives, 5 obstetricians and 5 women with an experience of hypertensive disorder of pregnancy. The recruitment of study participants, particularly study women were facilitated by health professionals and health extension workers. Sample size was guided and determined by the level of information saturation.

Methods of data collection

Data collection was donein the usual setting of the participant's office for the health professionals and managers and for women it was conducted at their home using unstructured in-depth interview guide. Each in-depth interview lasted between 40 to 60 minutes and conducted in the local Tigrinya language.Face to face interview was done starting with a more general question; the interviews were tape recorded and transcribed verbatim at the end of the interviewon the same day of data collection.

Analysis

The audio records were transcribed verbatim in the local language, Tigrinya and then translated in to English. For coding the transcript it was necessary to go through the transcripts line by line and paragraph by paragraph, looking for significant statements and codes according to the topics addressed. In this way, each transcribed interview was read for several times and the primary codes were extracted. Then, the related codes were put in one group/category and each code was matched with what the participants had said. Finally, based on similarity and content, the subcategories were used to make the main categories or themes.Atlas ti7 software was used to manage the transcript and analyse the data.The three delay model was used as a framework to summarize the ideas emerged[21, 22]. This model was proposed by Thaddeus and Maineto explain maternal mortality and it includes delays in decision to seek care, reaching care and receiving appropriate care.

First delay: Delay in decision to seek care

Effective emergency care depends on the patient's or caregiver's ability to recognize the problem and their perception towards the severity of the disease.The first delay refers to recognizing a problem and deciding to seek care. Factors shaping this decision-making process include knowledge about pregnancy and childbirth complications, recognizing the seriousness of symptoms, cultural beliefs, and traditional decision-making roles.

Second delay: Delay in reaching care

The second delay is reaching a facility that provides an appropriate level of care. Factors contributing to this delay include physical accessibility, transport cost and availability, distance, and infrastructure conditions.

Third delay: Delay in receiving appropriate care

This refers to the delay in gettingappropriate care once the patient has reached at the health facility. Availability of supplies and equipment, trained and competent personnel, and the quality of care received all contribute to this delay.

To ensure trustworthiness of data, continuous investigation of the data (transcription of the data and investigating them until the main themes were obtained) and peer check were performed. The objectivity of the data was determined through continuous, accurate, and proper treatment of all stages of the research study and clarity of the research method. Moreover, the researcher documented research details in order to provide the possibility of external review.

Ethical consideration

Ethical approval was obtained from the institutional review board of the College of Health Sciences at Addis Ababa University. Permission was also granted from Tigray Regional Health Bureau. The aim of the study was explained to the study participants and they were informed that their participation was voluntary and they could withdraw at any time, without giving any reason. They were aware that although the conversation was audio-recorded, their identity would not be revealed. The information that they provided would only be used for research purposes and would not to be disclosed to anyone. Verbal consent to participate in the in depth interview was given by each of the participants.

Results

A total of 22 in-depth interviews involving health professionals, health care managers and administrators as well as mothers were undertaken. The service year of the professionals ranged from 5 to 20 years. Similarly, the study women were aged between 25 and 40 years. Six themes were emerged from the qualitative analysis namely: traditional believes do not go away, late referral and incomplete care, antenatal care (ANC) prioritised but quality compromised, unpredictability of the disease and atypical cases, resourcescarcity as a barrier and flaws in technical support and supervision. These themes were also organized in three main areas according to the delay model.

First delay: Delay in decision to seek care

Knowledge deficient and traditional believes do not go away

Participants reported that pregnant mothers have less awareness towards hypertensive disorders of pregnancy in general and preeclampsia/eclampsia in particular. They do not properly understand the dangers signs in pregnancy and decide to seek care timely.This was reiterated by a women saying "*I used to attend antenatal care follow up in the health centers in my previous pregnancy but I did not know the danger signs…I felt headache around my forehead and did not seek medical attention because I thought that it is minor but after few hours I lost my conscious and taken to the hospital*(primipara women from a rural area). Another participant added the following

…..we can't say that mothers have good awareness on dangers signs of pregnancy including the signs and symptoms of pregnancy induced hypertension, I know mothers who had completed the four ANC visits but not aware about danger signs during pregnancy…imagine how the knowledge could be lower among those with interrupted ANC follow up or without any follow upvisits (an obstetrician from a general hospital).In addition participants raised that there is a misconception towards the disorders particularly regarding convulsion among women and the community. Both mothers and health professionals revealed that whenever a woman convulses the community perceive it as an evil

spirit and they used to describe it as "*buda*", "*qole*", "*tehazi*" in local language. As a result, they do not take them to the health facility rather they take them either to the holly water or traditional healers. A physician stated that *"pregnant mothers do not immediately come to the health facility after they develop eclampsia and experience convulsion, they try other managements in the community such as holly water or traditional remedies….when they come to us it would be too late to save them, it might have already involved organ failure in this stage. It is not the disease killing them but the complication of it which is associated with unnecessary delay"*(an obstetrician from a referral hospital). This community perception is also further manifestedathealth facilities, the caregivers do not allow professionals to inject medications as they believe that injection can kill a person having evil spirit. Besides, home delivery was mentioned as one of the barriers for early detection and management of hypertensive disorders of pregnancy as any of these disorders have a possibility to develop in the intrapartum and postpartum periods in addition to the antepartum period.

Second delay: Delay in reaching care

Late referral and incompletecare

Multiple referrals before reaching to the final health care facility where the mother could get advanced care was prominently recurring theme. Mothers usually seek care in the nearest health facility possible when they develop any complication which is the health post (in rural areas). Then they will be referred to the health center; the health centers are supposed to provide magnesium sulphate loading dose for severe preeclampsia and eclampsia cases and refer them to the general hospital immediately. The interview revealed that there is delay in this regard especially in the health centers, mothers are unnecessarily delayed and sent without any pre-referral treatments that could in turn lead to complication when they arrive at the hospital.This was expressed as *"……They are not properly discharging their responsibility as a health centre staff if they just send the patient without doing anything. When they are referring a patient at health centre they have to provide pre-referral treatment otherwise it would be serious for the mother ……. most of the time they send cases after*

they start convulsion, even they do not give magnesium sulphate, mothers do not have IV line and catheter though the diagnosis is put as ***'severe preeclampsia/eclampsia'****"(*MCH head from a general hospital*).* It was further emphasised that the referral may not end at the general hospital, it is not uncommon to send eclamptic mother to the referral hospitals. Thus, even a mother decides to seek care in health facilities it takes long time to get the appropriate care in cases of severe preeclmampsia/eclampsia as it necessitates advanced care which is not found in the nearby health facilities. Transportation problem was another barrier raised by the participants as ambulances are not functional most of the time due to delayed maintenance.

Third delay:Delay in receiving appropriate care

Antenatal care (ANC) prioritised but quality compromised

The uptake of antenatal follow up is increasing in Tigray. Currently, almost every pregnant woman has a contact with the skilled professionals in a health facility at least once. The problem is that women do not consistently follow antenatal care services according to the recommended standard; they start the follow up lately like after five months and/or interrupt the follow up. In addition, the focus of the health care system is on increasing coverage not on enhancing the quality of maternal services. Professionals are not properly counselling mothers on birth preparedness and complication readiness; including how to prevent hypertensive disorders of pregnancy and how to early identify warning symptoms before the severe manifestations. According to the focused antenatal care guideline developed by WHO, there are basic and specialised care given for pregnant women according to their status but commonly only the basic care is given to every pregnant woman *"……we health professionals working in the ANC as well as in the delivery units are not good in counselling mothers on preventing complications…. we are better in treating the case once the problem has occurred (*BSc midwife*).* This is associated with negligence, workload as a result of high client flow or because of having demotivated staff. Furthermore, participants reported that laboratory materials

which are helpful to diagnose hypertensive disorders of pregnancy are not consistently provided that makes the follow up incomplete.

Unpredictability of the disease and atypical cases

The health professionals and health care managers mentioned that the very nature of the disease makes it unpredictable because the exact cause is unknown. Likewise, there are no practical models to predict severities. In some cases it can develop at any time without giving warning signs and symptoms and without having the typical features. Hence; one of the barriers is lack of exact preventive and treatment strategies apart from the recommendation to minimize risk factors or terminating the pregnancy. Respondents said*"sometimes it is confusing, after having complete follow up in the ANC with a stableblood pressure, they develop convulsion during labour…..this is really unusual, investigations are normal but they convulse. For instance, in the mid 2017 there was one woman who was under ANC follow up here without any finding but during labour she become eclamptic*(BSc midwife). Another participant added *"Preventing preeclampsia/eclampsia is not effective, it is more productive to work on effective management once the disease has occurred because serious adverse outcomes are associated with the complications of the disease"* (Obstetrician). This would also be more complicated in areas with high prevalence of home delivery habits.

Resourcescarcity as a barrier

Participants reported that there are somematerials and supplies used to identify and manage hypertensive disorders of pregnancy. The frequent stockout of these materials is another barrier to early identify and treat the problem. This is very common in laboratory materials and some medications.A Midwife from hospital stated *"….Hydralazine was stock out for2 weeks, and we were askingthem to buy from the private facilities ahead of time when we suspect raised blood pressure."*

"……. antihypertensive and diazepam were frequently interrupting and even I remember mothers who were referred due to lack of antihypertensive….we had also a timewhen we werenot able to catheterize a mother to measure urine output as a result of shortage."

Some institutions do not provide organ function tests at all and others do not provide the service for 24 hours. In such cases women would be forced either to go to the private clinics or to come back another time. This in turn will lead to unnecessary delay and late diagnosis or even it may go undetected. The following quotes exemplify hospital managers' description

"….Sometimes, especially during lunch time and weekends organ function tests are not done, so we send them to private clinics and that creates discomfort and unnecessary delay in decision as we want to get the result before we make decisions. At times, hydralazine stock outs thoughvery rarely. Common problem is the organ function test; it should not be only available in working hours it should be done at any time. Some of them are also unable to afford the payment for the laboratory test fees in private centers and because of this miss diagnosis and mismanagement may happen."
They explained that the dysfunctional laboratory service is associated with lack of competent professionals, interrupted supply of reagents or frequent damage to the testing machine.

Lack of adequate space to admit mothers in health facilities was also raised as a barrier by health care providers, managers and clients.

……. "*if there are many patients deserving the service, we are forced to send mild preeclampsia cases to stay at home and follow every week though we were supposed to admit and follow them continuously"* (Maternity head of a referral hospital). A Midwife from a general hospital also added "*…..Recently I remember three cases, after we discharged them home they came back to the hospitalafter developing convulsion. This is due to space problem.We have very limited rooms and*

many delivering mothers." Lack of appropriate screening practice for hypertensive disorders of pregnancy in the postpartum period was also raised as a gap.

Flaws in technical support and supervision

There are linkages between the different health care facilities in catchment areas to help to each other. For instance, health professionals working in the primary and general hospitals pay visits to the health centres in their catchment to strengthen the service provision. Besides the health care administrators and managers from the district health office and/or from the regional health bureau also have a supportive supervision visits to the health facilities occasionally. However, the visits are not focused; they only provide comprehensive directions and suggestion. The participants suggested that supervision should have been focused and accompanied by experts on specific areas. For instance, experts in obstetrics care should be part of the supervisory team to share their clinical expertise as mentors. …. "*In the traditional way of supervision, they tell you the weakness or gaps but they do not help you to fill the gap or to be part of the solution" (*Obstetrician from a Referral Hospital*).*In addition, refresher trainings are limited and they are not usually given by experts who have rich expertise in both theory and practice in the specific field.Hence, practicing professions in these facilities do not have detailed knowledge on hypertensive disorder of pregnancy apart from defining the terminologies. *".....in the health centers, only few staffs dare to provide magnesium sulphate loading dose for preventing or controlling preeclampsia/eclampsia"*(Midwife from a general hospital)

The need for updated clinical protocols and guidelineswas another sub-theme emphasized by participants. The institutions do not have updated guideline that incorporates current evidences which could facilitate for possible prevention, early detection and management of hypertensive disorders of pregnancy,

In health facilities which are also serving as a teaching institution, delay in consultation and decision was emerged as an important barrier for early detection and treatment of hypertensive disorders of pregnancy. There are multiple consultations before the case is seen by resident four or the senior obstetrician for final decision. This was further explained as *"Diagnosis is usually straightforward but delay is very common in providing care after the diagnosis is made because the case does not directly go to the decision maker. Even after the decision is made there is delay for instance, after they decide that a mother needs to undergo emergency cesarean section, it takes longer time until the delivery of the baby"*(head of maternity ward). In addition a woman who experienced eclampsia said "*many people examined me multiple times in the hospital for my previous pregnancy but none of them gave me treatment and when I got extremely exhausted they ordered operation*"(BSc Midwife from Referal Hospital).

Discussion

Participants have shared their experiences from different perspectives regarding the barriers for early detection and management of hypertensive disorders of pregnancy. Unnecessary delays in detection and management of hypertensive disorders of pregnancy at different levels were reported as main barriers and this in fact leads to serious maternal and perinatal adverse outcomes, Berhanand Firozreportedsimilarfindings[23, 24].

Inadequate awareness in the community regarding hypertensive disorders of pregnancy in general and preeclampsia/eclampsia in particular has surfaced in the interviews. This is mainly due to flaws in the implementation of focused antenatal care; especially due to compromised counselling as emerged from the interviews. According to the Ethiopian health sector transformation plan,quality of care is emphasized[6]. However, facilities are still focusing mainly on coverage, the uptake of antenatal care in this case. Even the coverage is not complete, mothers initiate the visit lately and or/interrupt the follow up which is in favour of previous studies in Tanzania and Ethiopia that

indicated initiation of antenatal care after five months[25, 26].An entrenched community misconception towards the disorders has also contributed for the limited awareness about the disease. Similar report was documented in previous studies that myths and misperceptions regarding pre-eclampsia and eclampsia were indicated[27].This implies that much has to be done in creating awareness about the disease by strengthening the quality of antenatal care and involving the community.

Multiple referrals before reaching to the final health care facility and sending pregnant women without any pre-referral treatments were common according to the current study. This could in turn lead to serious maternal and perinatal complication when they arrive at the hospital as it was indicated in a previous study in Ethiopia[23]. Such delays are associated with the dysfunctional nature of the lower level health care facilities due to incomplete resource and weak decision making practices.

The unpredictable nature of the disease and lack of updated clinical guideline in all the health facilities was raised as one of the barriers for early detection and management of hypertensive disorders of pregnancy. Trials to prevent hypertensive disorders of pregnancy have never been successful nor the prediction of complications[7, 9, 24]. The only successful solution is to make pregnant mothers have continuous contact with skilled professionals or make them remain closer to the health facilities in order to timely identify and manage the problem or prevent complications.

Frequent interruptions in the supply of medicine and materials in the hospitals contributed for late detection and management of hypertensive disorders of pregnancy. Laboratories in some health institutions do not provide services 24hours a day for 7 days in a week. This contributes for delayed decision making and in appropriate follow up of cases. In addition, it has cost implications for the service receivers. Resource related barriers were identified as a major gap in a study conducted at health facilities in Northern Nigeria[14].

Capacity building activities were described as incomplete and unfocused. Trainings were given occasionally and not on clinical skills. Besides, the supervisions wereroutineand unconstructive. Mentorship programs involving experts on the specific obstetrics area were suggested by the participants. Previous reports also indicated weak professional's clinical and problem solving skills and supportive supervision programs as barriers for dealing with obstetrics cases and complications[14, 28]. Continuous capacity building programs in the form of in-service training and mentorship is paramount important to make professionals competent in dealing with emergency obstetric conditions.

The strengths of this study include the use of maximum variation sampling to better understand the barriers for early detection and management of hypertensive disorders of pregnancy from different perspectives.A possible limitation is that the health care managers and administrators might have given socially desirable answers rather than their genuine reflection as they are part of the system.

Conclusion

The study demonstrated the presence of multiple barriers for early detection and management of hypertensive disorders of pregnancy. Poor awareness of mothers and community misconceptions towards hypertensive disorders of pregnancy, multiple referrals before reaching the final functional health care facility, less focus on the quality of antenatal care, scarcity of resources and limited capacity building programs were explained all contributing to the late detection and management of hypertensive disorders of pregnancy.The findings suggested the need for decentralized care to the lower level of health care system, quality of care, continuous capacity building programs and supply of necessary resources.

Acknowledgement

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Funding

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Availability of data and materials

The dataset for the current study is available from the corresponding author on reasonable request.

Consent for publication

Not applicable

Authors' contributions

HBK is the primary author, participated in the conceptualization, design, acquisition, analysis and interpretation of the data and drafted the manuscript. FEG was the primary academic advisor, contributed for design, acquisition, analysis and interpretation of the data and critically revised the manuscript. WMA was co-advisor, contributed for design, acquisition, analysis and interpretation of the data and critically revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The Institutional Review Board of College of Health Sciences, Addis Ababa University approved the study on 15/06/2017 (ref: 035/17/SPH).The anonymity of all participants was ensured by not

recording any names or other personal identifiers. Their right not to participate, not to answer any or all questions and to withdraw from the interview at any time they want was respected.

Competing interests

The authors declare that they have no competing interests.

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Annex 2- Data collection tools

Annex 2.1: Checklist

ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

Facility Consent sheet

This document invites this facility to participate in the study aimed to assess the Hypertensive Disorders of Pregnancy and its Effect on Birth Outcomes among Mothers in Selected Hospitals of Tigray, North Ethiopia. The study has important contribution by providing information on hypertensive disorders among pregnant women and for future mitigation of the problem and to improve maternal and newborn health. Your facility was selected as candidate for this study randomly.

For the purpose of this study, different registers of the health facility like antenatal register, delivery register, patient charts etc will be used. The information gained from this facility will not be used for any purpose other than the objective of the study. Any information that is obtained in this assessment will be kept completely confidential.

We, the investigators encourage the participant/facility to ask any questions regarding the study that he/she might have at this time. If the facility has any further question in the future, Mr. Hailemariam Berhe, who is the principal investigator of the study will be available to respond to them. The facility will be given a copy of this form to retain for his/her records.

Any individual who has questions regarding this study should contact Mr. Hailemariam Berhe, PI of this research, Tel-0914707632.

A. General instruction for data collectors/supervisors

This checklist is prepared to collect data from mothers chart and/or logbook regarding their history of hypertensive disorders of pregnancy, you as part of research team are responsible to adhere to the ethical issues in maintaining confidentiality and hand over the charts to appropriate body and place immediately after taking the necessary information needed without damaging and distorting any data, and acknowledge the health facility staffs.

Name of the data collector: ______________________________

Name of hospital: _____________________

B. Birth history

No	Questions	Response/Answer	Remark
	I. Maternal condition		
101	Registration Number of the mother	________________	
102	Where was her residence	1. Urban 2. Rural	
103	What is the age of the mother	_____________(Years)	
104	When was the birth conducted?	_____________(dd/mm/yy)	
105	What was the gravidity for that specific delivery?	____________	
106	What was the Parity for the specific delivery?	___________	
107	Did the mother have ANC follow up for that specific pregnancy?	1. Yes 2. No	2→ 109
108	If the answer for Q.No107 is yes, how many visits she attended?	1. Once 2. 2 times 3. 3 times 4. 4 times 5. More than 4 times	
109	What was the gestational age at diagnosis?	____________(weeks)	
110	What was the gestational age at delivery?	____________(weeks)	
111	What was the mode of delivery	1. SVD 2. CS 3. Instrumental delivery	1/2 → 113
112	If the answer for Q. No 111 is Instrumental delivery, what type was it?	1. Vacuum 2. Forceps	
113	How was the delivery initiated?	1. Spontaneously 2. Induced	
114	What was the type of HDP the mother experienced?	1. Gestational hypertension 2. Chronic hypertension 3. Mild preeclampsia	

		4. Sever preeclampsia 5. Eclampsia 6. HELLP syndrome	
115	What complications did the mother encounter? **Multiple answer is possible**	1. None 2. Abruptio placenta 3. Placenta previea 4. Postpartum Hemorrhage 99. Others specify_______________	
116	What was the mother's outcome after delivery?	1. Alive 2. Dead	
	Fetal and newborn condition		
117	Was there intrauterine growth restriction?	1. Yes 2. No 3. unknown	
118	What was the weight of the Newborn?	_________(Kg)	
119	What was the APGAR score of the Newborn at 1 minute	__________	
120	What was the APGAR score of the Newborn at 5 minutes	___________	
121	What was the newborn's outcome after delivery?	1. Alive 2. Dead	
122	If the answer for Q. No 121 is dead, when did the death happen?	1. Born dead 2. Immediately after birth 3. Within the first 24 hours 4. Within the first 7 days	

Annex 2.1: Structured questionnaire I

Information sheet and consent form

Title: Assessment of risk factors of hypertensive disorders of pregnancy among mothers in selected hospitals of Tigray

Introduction

Good Morning/Good Afternoon

My name is ……………………………………, from Addis Ababa university college of health sciences school of public health carrying out a research on 'the assessment of risk factors of hypertensive disorders of pregnancy among mothers in selected hospitals of Tigray. I am interviewing pregnant mothers here whose gestational age is 20weeks and above; you are also included in this study because you are pregnant mother. To attain its purpose, your honest and genuine participation by responding to the question prepared is very important & highly appreciated.

We ask that you read this form and ask any questions that you may have before agreeing to participate in the study.

PURPOSE OF STUDY

The purpose of the study is to identify the different types of risk factors for developing various kinds of hypertensive disorders in mothers. At the end we will be able to unveil the significant risk factors associated with the development of hypertensive disorders and recommendations will be given so as to improve the management and reduce morbidity and mortality associated with hypertensive disorders of pregnancy. Ultimately, this research will be published in national and international journals for wider visibility and usage.

STUDY PROCEDURES

If you agree to be in this study, you will be asked regarding your socio-demographic characteristics and about your usual activities in your everyday life. The interview will take about 20 to 25 minute.Again I am very much appreciating your participation in this interview.

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher or your decision will not result in any loss or benefits to which you are otherwise entitled. Additionally, you have the right to request that the interviewer not use any of your interview material.

RISKS

There are no reasonable foreseeable (or expected) risksto you for participating in this study other than those encountered in day-to-day life. Some questions may make you feel uneasy. You may not be familiar with some of the questions or issues. You can ask for elaborations on questions you think you do not properly understand.

BENEFITS

There will be no direct benefit to you for your participation in this study. However, we hope that the information obtained from this study may be of valuable to mothers and newborns in general.

CONFIDENTIALITY

This study is anonymous. We will not be collecting or retaining any information about your identity. The records of this study will be kept strictly confidential. Research records will be kept in a locked file, and all electronic information will be coded and secured using a password protected file; only the researcher will have access to the records. In any sort of report we make public we will not include any information that will make it possible to identify you.

COMPENSATION

No compensation for participating in this study. You will not receive any monetary or any other kind of compensation for participating in this interview.

CONTACT INFORMATION

You have the right to ask questions about this research study and to have those questions answered by me before, during or after the research. If you have any further questions about the study, at any time feel free to contact me, data collector by telephone at *phone number*. If you like, a summary of the results of the study will be sent to you.If you have any other concerns about your rights as a research participant that has not been answered by the data collector, you may contact **Hailemariam Berhe** the principal investigator by telephone at *+251914707632*.

If you have any further problems or concerns that occur as a result of your participation, you can report them to the IRB at Addis Ababa University, college of health sciences.

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I do also understand that there is no risk in participating in the study, so I voluntarily agree to take part in this study.

Participant's signature ________________________________ Date ______________

Data collector’s Name and signature________________________________Date ______________

Participant’s status

1. With hypertensive disorder **(case)** ☐
2. Without hypertensive disorder **(control)** ☐

Put (√) sign in the box above

No	Question	Response	Remark
1	**Socio-demographic characteristics**		
201	How old are you?	______(years)	
202	Where do you live?	1. Urban 2. Rural	
203	What is your marital status	1. Married 2. Single 3. Divorced 4. widowed 5. Separate	
204	Have you got pregnant from your first partner for this index pregnancy?	1. Yes 2. No	1→206
205	If the answer for Q. Number 204 is No, what is the order of the partner for this index pregnancy?	1. 2nd 2. 3rd 3. 4th 99. others (specify)________	
206	What is your religion?	1. Orthodox 2. Muslim 3. Catholic 4. Protestant 99. Others(specify)_____________	
207	What is your Ethnicity?	1. Tigraway 2. Amhara 99. Others (specify)_____________	
208	What is your level of education?	1. No education 2. read and write 3. primary 4. Secondary and higher	
209	What is your occupation?	1. Housewife 2. Government employee 3. Nongovernmental employee 4. Private Organization 5. Daily labourer 99. Other (specify)_____________	

210	What is your spouse's education level	1. No education 2. read and write 3. primary 4. Secondary and higher	
211	What is your monthly household in come	_______________Birr	
2	**Familial and Life style variables**		
212	Family history of hypertension (parents, father, grandparents and siblings)	1. Yes 2. No	
213	Weight	_______kg	
214	Height	_____________m	
215	MUAC	____________cm	
216	Have you ever used traditional treatment for any problem developed during the index pregnancy?	1. Yes 2. No	2→218
217	If the response to Q. No 217 is yes, specify the type of remedy taken?	___________________________ ___________________________ __________________________	
218	What was your pre-pregnancy weight	_____________kg	
219	Do you drink coffee (before pregnancy and/or now)	1. Yes 2. No	2→222
220	If the response to Q No 219 is yes? How often do you drink at home and outside?	1. More than once daily 2. Daily 3. 2-3 times a week 4. Once a week 5. Less than once a week 99. Others specify _____________	
221	If the response to Q No 219 is yes? How much do you drink at each episode at home and outside?	1. 1 cup of coffee 2. 2 cup of coffee 3. 3 cup of coffee 4. More than 3 cup of coffee 99. Others specify _________	
Obstetrics and medical related variables			
222	Multiple gestation	1. Yes 2. No 3. Unknown	
223	Gestational diabetes mellitus	1. Yes 2. No	

224	Have you been using Combined oral contraceptive before you get pregnant?	1. Yes 2. No	
225	What was your age at menarche	_______years	
226	Have you had hypertensive disorders of pregnancy in previous pregnancy	1. Yes 2. No 3. I got pregnant for the first time	3→228
227	If the answer for Q. No 229 is 1or 2 what is the pregnancy interval between this pregnancy and the immediate previous delivery	_________ (years)	
228	History of abortion	1. Yes 2. No	2→230
229	If the answer for Q. No 229 is yes, how many times?	___________	
230	Pre-gestational diabetes mellitus	1. Yes 2. No	
231	Do you have known co-morbidities **Multiple response is possible**	1. Anemia 2. Autoimmune disease 3. Cardia disease 4. Renal disease 5. Others_____________	
232	Gestational age at diagnosis	___________(weeks)	
233	Type of hypertensive disordedrs of pregnancy	________________________________ ________________________________ __________	

For each food listed, fill in the circle indicating how often on average you have used the amount specified during the last year

Fruits	Never, or less than once a month	1-3 per month	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day
Banana									
Avocado									
Apples									
Apples juice									
Orange									
Orange juice									

Grape fruits									
Papaya									
Mango									
Strawberries									
Vegetable									
Tomatoes (juice, slice, sauce)									
Cabbage									
Carrots									
Mixed vegetables									
Sweet potatoes									
Green mustard									
Spinach									
Lettuce									
Pepper									
Onions (including in salad)									

Annex 2.3: Structured questionnaire II

Information sheet and consent form

Title: Assessement of maternal and perinatal outcomes of hypertensive disorders of pregnancy among mothers in selected hospitals of Tigray, North Ethiopia

Introduction

Good Morning/Good Afternoon

My name is ………………………………………, from Addis Ababa university college of health sciences school of public health carrying out a research on 'the assessment of risk factors of hypertensive disorders of pregnancy among mothers in selected hospitals of Tigray. I am interviewing pregnant mothers here whose gestational age is 20weeks and above; you are also included in this study because you are pregnant mother. To attain its purpose, your honest and genuine participation by responding to the question prepared is very important & highly appreciated. We ask that you read this form and ask any questions that you may have before agreeing to participate in the study.

PURPOSE OF STUDY

The purpose of the study is to identify the different types of maternal and perinatal adverse birth outcomes associated with hypertensive disorders of pregnancy. At the end we will be able to unveil the significant risk factors associated with the development of hypertensive disorders and recommendations will be given so as to improve the management and reduce morbidity and mortality associated with hypertensive disorders of pregnancy. Ultimately, this research will be published in national and international journals for wider visibility and usage.

STUDY PROCEDURES

If you agree to be in this study, you will be asked regarding your socio-demographic characteristics and about your usual activities in your everyday life. The interview will take about 20 to 25 minute.Again I am very much appreciating your participation in this interview.

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher or your decision will not result in any loss or benefits to which you are otherwise entitled. Additionally, you have the right to request that the interviewer not use any of your interview material.

RISKS

There are no reasonable foreseeable (or expected) risksto you for participating in this study other than those encountered in day-to-day life. Some questions may make you feel uneasy. You may not be familiar with some of the questions or issues. You can ask for elaborations on questions you think you do not properly understand.

BENEFITS

There will be no direct benefit to you for your participation in this study. However, we hope that the information obtained from this study may be of valuable to mothers and newborns in general.

CONFIDENTIALITY

This study is anonymous. We will not be collecting or retaining any information about your identity. The records of this study will be kept strictly confidential. Research records will be kept in a locked file, and all electronic information will be coded and secured using a password protected file; only

the researcher will have access to the records. In any sort of report we make public we will not include any information that will make it possible to identify you.

COMPENSATION

No compensation for participating in this study. You will not receive any monetary or any other kind of compensation for participating in this interview.

CONTACT INFORMATION

You have the right to ask questions about this research study and to have those questions answered by me before, during or after the research. If you have any further questions about the study, at any time feel free to contact me, data collector by telephone at *phone number*. If you like, a summary of the results of the study will be sent to you.If you have any other concerns about your rights as a research participant that has not been answered by the data collector, you may contact **Hailemariam Berhe** the principal investigator by telephone at *+251914707632*.

If you have any further problems or concerns that occur as a result of your participation, you can report them to the IRB at Addis Ababa University, college of health sciences.

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I do also understand that there is no risk in participating in the study, so I voluntarily agree to take part in this study.

Participant's signature ________________________________ Date ______________

Data collector’s Name and signature ________________________________Date ______________

Participant’s status

1. With hypertensive disorder **(exposed)** ☐
2. Without hypertensive disorder **(non-exposed)** ☐

   Put (√) sign in the box above

No	Question	Response	Remark
301.	How old are you?	_______________(Years)	
302	Where do you live?	1. Urban 2. Rural	
303	What is your marital status?	1. Married 2. Single 3. Divorced 4. widowed 5. Separate	
304	What is your religion?	1. Orthodox 2. Muslim 3. Catholic 4. Protestant 1. Others(specify)____________	
305	What is your Ethnicity?	1. Tigraway 2. Amhara 99. Others (specify)______________	
306	What is your education level?	1. No education 2. Read and write 3. Primary 4. Secondary and higher	
307	What is your occupation?	1. Housewife 2. Government employee 3. Nongovernmental employee 4. Private Organization 5. Daily labourer 99. Other (specify)____________	
308	What is your spouse's education level	1. No education 2. Read and write 3. Primary 4. Secondary and higher	
309	What is your monthly household in come	______________Birr	
2. Maternal and perinatal outcomes			
310	What is the gestational age at delivery?	____________(weeks)	
311	Is there intrauterine growth restriction?	1. Yes 2. No 3. unknown	

312	What was the type of HDP the mother experienced?	1. Gestational hypertension 2. Chronic hypertension 3. Mild preeclampsia 4. Sever preeclampsia 5. Eclampsia 6. HELLP syndrome	**For the exposed group**
313	What complications did the mother encounter? **Multiple answer is possible**	1. None 2. Abruptio placenta 3. Placenta previea 4. Postpartum Hemorrhage 99. Others (specify)____________	
314	What is the newborn's outcome after delivery?	1. Alive 2. Dead	2→319
315	What is the weight of the Newborn?	_________(Kg)	
316	What is the APGAR score of the Newborn at 1 minute	__________	
317	What is the APGAR score of the Newborn at 5 minutes	___________	
318	Early neonatal death	1. Yes 2. No	
319	What was the mode of delivery	1. SVD 2. CS 3. Instrumental delivery	
320	If the answer for Q. No 319 is Instrumental delivery, what type is it?	1. Vacuum 2. Forceps	
321	How is the delivery initiated?	1. Spontaneously 2. Induced	
322	Maternal condition	1. Alive 2. Dead	
323	If alive is she admitted to intensive care unit	1. Yes 2. No	

Annex 2.4: In-depth interview guide

Information sheet and consent form

Title: Assessment of barriers for early detection and management of hypertensive disorders of pregnancy in selected hospitals of Tigray, North Ethiopia

Introduction

Good Morning/Good Afternoon

My name is ……………………………………, from Addis Ababa university college of health sciences school of public health carrying out a research on assessment of barriers for early detection and management of hypertensive disorders of pregnancy in selected hospitals of Tigray, North Ethiopia. I am interviewing mothers with a history of hypertensive disorders, health professionals and health care adminstrotors; you are also included in this study because you are included in the predetermined group. To attain its purpose, your honest and genuine participation by responding to the question prepared is very important & highly appreciated. We ask that you read this form and ask any questions that you may have before agreeing to participate in the study.

PURPOSE OF STUDY

The purpose of the study is to identify the barriers for early detection and management of hypertensive disorders of pregnancy in selected hospitals of Tigray. At the end we will be able to unveil the common barriers associated with the late detection and management of hypertensive disorders and recommendations will be given so as to improve the diagnosis management so as reduce morbidity and mortality associated with hypertensive disorders of pregnancy. Ultimately, this research will be published in national and international journals for wider visibility and usage.

STUDY PROCEDURES

If you agree to be in this study, you will be asked regarding your experience on the possible barriers for early detection and management of hypertensive disorders of pregnancy. The interview will take about 40 minutes to 1 hour.With your permission, we would also like to tape-record the interview. Again I am very much appreciating your participation in this interview.

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher or your decision will not result in any loss or benefits to which you are otherwise entitled. Additionally, you have the right to request that the interviewer not use any of your interview material.

RISKS

There are no reasonable foreseeable (or expected) risksto you for participating in this study other than those encountered in day-to-day life. Some questions may make you feel uneasy. You may not

be familiar with some of the questions or issues. You can ask for elaborations on questions you think you do not properly understand.

BENEFITS

There will be no direct benefit to you for your participation in this study. However, we hope that the information obtained from this study may be of valuable to mothers and newborns in general.

CONFIDENTIALITY

This study is anonymous. We will not be collecting or retaining any information about your identity. The records of this study will be kept strictly confidential. Research records will be kept in a locked file, and all electronic information will be coded and secured using a password protected file; only the researcher will have access to the records. We will destroy the tape after it has been transcribed.In any sort of report we make public we will not include any information that will make it possible to identify you.

COMPENSATION

No compensation for participating in this study. You will not receive any monetary or any other kind of compensation for participating in this interview.

CONTACT INFORMATION

You have the right to ask questions about this research study and to have those questions answered by me before, during or after the research. If you have any further questions about the study, at any time feel free to contact me, data collector by telephone at *phone number*. If you like, a summary of the results of the study will be sent to you.If you have any other concerns about your rights as a research participant that has not been answered by the data collector, you may contact **Hailemariam Berhe** the principal investigator by telephone at *+251914707632*.

If you have any further problems or concerns that occur as a result of your participation, you can report them to the IRB at Addis Ababa University, college of health sciences.

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I do also understand that there is no risk in participating in the

study, so I voluntarily agree to take part in this study.

Participant's signature ______________________________ Date _____________

In addition to agreeing to participate, I also consent to having the interview tape-recorded.

Signature ___________________________________ Date _________________________

Data collector’s Name and signature______________________________Date _____________

Name of health facility____________________

Discipline________________

Position ________________

How old are you__________?

Your gender __________

When were you employed__________?

For how long have you worked in the maternity unit/this position_____________?

Have you attended training on hypertensive disorders of pregnancy?

a) Yes b) No

Guiding questions for health professionals and administrators

1. How do you explain HDP? (What are the defining criteria), which classification do you use?
2. Why is a hypertensive disorder of pregnancy still a burden (high magnitude, top causes of mortality (maternal and perinatal)? (**Probe**: Nature of the disease (atypical), system, policy, leadership and management, infrastructure, problem of delays others…
3. What is your experience regarding HDP? (**Probe**: how do you differentiate the minor from the severe forms, convulsion and other complications? How it is diagnosed and treated? How do you diagnose hypertension, protein urea and others? Your vivid memories regarding this?
4. What differences do you observe among women? Who are most affected women (**Probe**: Do you observe differences between the ANC booked women and those without ANC regarding HDP? Rural and urban?

5. How do you explain the readiness of health facilities to identify and treat HDP cases(**probe**: How do you see the counselling and follow up in the ANC? Admitting high risk cases, **maternity waiting homes**, screening in the postpartum period)
6. How do you explain the supply of materials which are helpful to diagnose and treat HDP? (**Probe**: BP measurement apparatus, urinalysis materials, drugs (anti-hypertension and anticonvulsants); storage and stock conditions for example stock outs including in health centers (**for TRH**B). What Do patients buy from private pharmacies or sent for lab. investigation? Does this affect the service they should get?
7. How do you explain the availability and implementation of guidelines and policies? (**Probe**: Presence of written clinical protocols and guidelines for the management of PE/E For example, regarding magnesium sulphate provision, anti-hypertensives. In case the guideline is not available, do you recommend specific guideline on HDP? If yes/no, why?
8. Knowledge of health care professionals regarding HDP, magnesium sulphate, acceptance, monitoring and supervision (mentorship) (**Probe**: is BEmONC training adequate?)
9. What is the scope of practice and authorization of health care professionals regarding HDP and magnesium sulphate provision?
10. What about patient referral (internal and external) and reporting systems)- (**probe**: Conditions and reasons for referral)
11. What types of drugs (anticonvulsants and anti-hypertension) are usually given in your facility?
12. What are the positive and negative experiences in diagnosing and treating hypertensive disorders of pregnancy? (**Probe**: policy support or failure, system, leadership…..)
13. What challenges are observed in diagnosis, treatment and care of HDP? (**Probe**: Supply, logistics, human power)?
14. What is the attitude of mothers and the community about HDP? (**Probe**: magnesium sulphate, blood pressure, convulsion)
15. What do you think should be done to control HDP?

Guiding questions for mothers

Age________Parity_____________

History of ANC in last pregnancy 1. Yes 2. No; if yes how many visits_______________

Birth place 1.Home 2. Health center 3. Hospital

Delivery type 1.CS 2. SVD

I. What do you know about blood pressure in pregnancy?

2. What was your experience regarding high blood pressure in pregnancy? Have you had ANC follow up? Explain about it? (**Probe**: Number of ANC visit if any, education during ANC, birth preparedness and others)
3. What positive and negative things did you feel during the high blood pressure pregnancy screening, diagnosis and treatment? What were the challenges (**Probe**: supply, delay in giving care, management and leadership, poor awareness others….)
4. What was your feeling when you were told that you had high blood pressure in your pregnancy?
5. How was your care from the health professionals after you were diagnosed with HDP?
6. What was the birth outcome- How did you feel after the birth? How was your baby after the birth?
7. What worried you the most about having high blood pressure in your pregnancy?
8. Looking back, how do you feel about your pregnancy now?
9. What is the attitude of mothers and the community about HDP? (**Probe**: magnesium sulphate, blood pressure, convulsion)
10. What do you think should be done to properly prevent and treat HDP?

ሊጋባት

ሊጋብ I: ካብጥዕናትካልሓበሬታንምእካብዝተዳለወቅጥዒ

ኣዲስ ኣበባ ዩኒቨርስቲ

ኮለጅ ጥዕና ሳይንስ

ሕ/ሰብ ጥዕና ት/ት ቤት

ንጥዕናትካልዝተዳለወናይስምምዕነትቅጥዒ

እዚ ቅጥዒ ዝተዳለወሉ ምክንያት ‘‘ኩነታት ድፍኢት ደምን ሳዕብየናቱን ኣብ እዋን ጥንሲ ኣብ ዝተመረፃ ሆስፒታላት ትግራይ” ብዝብል ርእሲ ኣብ ዝካየድ ምርምር ተሳታፊ ንክትኮና ንምዕዳም እዩ፡፡ እዚ መፅናዕቲ ኣብ እዋን ጥንሲ ዝፍጠር ድፍኢት ደምን ሳዕብየናቱን ብምፍላይ ኣድላዪ ሓበሬታ ንምሃብ ከክእል እዩ፡፡ ብምኻኑ ድማ ብዙይ ሕማም ክመፅኡ ዝክእሉ ፀገማት ብኣግኡ ብምፍላይን ብምእላይን ናይ ኣዴታትን ህፃናትን ጥዕና ንምምሕያሽ ክሕግዝ እዩ፡፡ ናትኩም ጥዕና ትካል እውን ኣብዚ መፅናዕቲ ንምስታፍ ብዕፃ ተመሪፁ ኣሎ፡፡

ነዚ መፅናዕቲ ከምዝሕግዙ ብምእማን፡ ዝተፈላለዩ ናይቲ ጥዕና ትካል መዛግብቲ ማለት እውን ከም ናይ ቅድም ወሊድ ክትትል መዝገበ፣ ወሊድ መዝገብ ከምኡ እውን ናይ ሕሙማት ካርድን ካልኦትን ክንጥቀም ኢና፡፡ ካብዚ ጥዕና ትካል ዝርከብ ሓበሬታ ካብ ናይቲ መፅናዕቲ ዓላማን ድሌትን ወፃኢ ንካልእ ዓላማ ፈፂሙ ኣይውዕልን፡፡ብተወሳኺ እውን ካብዚ መፅናዕቲ ዝርከብ ሓበሬታ ኩሉ ምሽጥራውነቱ ዝተሓለወ እዩ፡፡

ንሕና፣ ናይዚ መፅናዕቲ መራሕቲ እውን ናትኩም ትካል ኣካል እዚ መፅናዕቲ ከኸውን እንተሎ ዝህልዉኩም ሕቶታትን ግልፅነት ዘድልዮም ነገራት እንተሃልዮም ሐዚ ክትሓቱና ክነበረታትዐኩም ንፈቱ፡፡ እዚ ጥዕና ትካል ተወሳኺ ዝኮነ ሕቶ እንተሃልዩዎ ዋና መራሒ ናይዚ መፅናዕቲ ዝኾነ ኣይተ ሃ/ማርያም በርሀ መልሲ ንምሃብ ኣብ ዝኾነ እዋን ድልው እዩ፡፡ናይዚ ቅጥዒ ቅዳሕ እውን ኣብ ትካልኩም ክቅመጥ ክንገብር ኢና.

ምስዚ መፅናዕቲ ዝተሓሓዝ ዝኾነ ሕቶ ዘለዎ ሰብ ብቁፅሪ ሞባይል 0914707632 ንመራሒ ናይቲ መፅናዕቲ ኣይተ ሃ/ማርያም በርሀ ምርካብን ምሕታትን ይከኣል እዩ፡፡

ሀ. ንሓበሬታ ኣከብትን ተቆፃፀርትን ዝተዳለወ መምርሒ

እዚ ሐበሬታ መአከቢ ቅጥዒ ኣብ እዋን ጥንሲ ዝፍጠር ድፍኢት ደም ዝምልከት ካብ ናይ ኣዴታት ካርድን መዝገብን ሓበሬታ ንምእካብ ዝተዳለወ እዩ፡፡ንሶም እውን ከም ኣካል ናይተ መፅናዕቲ ነቶም መርሆታት ስነምግባር ተገዛኢ ብምኟን ምሸጥራውነቱ ብዝተሓለወ መንገዲ እቶም ካርድታት ምስተጠቀምኩምሎም ሽዑንሽዑ ምንም ዓይነት ጉድኣት ከይኣስዐብኩም ወይ ሓበሬታ ብዘይምጥማም ናብ ዝምልከቶ ሰብን ቦታን ኣመስጊንኩም ክትምሉሱ ንላቦ፡፡

Name of the data collector: ______________________________

Name of hospital: _____________________

C. Birth history

No	Questions	Response/Answer	Remark
	II. Maternal condition		
101	Registration Number of the mother	________________	
102	Where was her residence	3. Urban 4. Rural	
103	What is the age of the mother	_____________(Years)	
104	When was the birth conducted?	_____________(dd/mm/yy)	
105	What was the gravidity for that specific delivery?	____________	
106	What was the Parity for the specific delivery?	___________	
107	Did the mother have ANC follow up for that specific pregnancy?	3. Yes 4. No	2→ 109
108	If the answer for Q.No107 is yes, how	6. Once 7. 2 times	

	many visits she attended?	8. 3 times 9. 4 times 10. More than 4 times	
109	What was the gestational age at diagnosis?	____________(weeks)	
110	What was the gestational age at delivery?	____________(weeks)	
111	What was the mode of delivery	4. SVD 5. CS 6. Instrumental delivery	1/2 → 113
112	If the answer for Q. No 111 is Instrumental delivery, what type was it?	3. Vacuum 4. Forceps	
113	How was the delivery initiated?	3. Spontaneously 4. Induced	
114	What was the type of HDP the mother experienced?	7. Gestational hypertension 8. Chronic hypertension 9. Mild preeclampsia 10. Sever preeclampsia 11. Eclampsia 12. HELLP syndrome	
115	What complications did the mother encounter? **Multiple answer is possible**	5. None 6. Abruptio placenta 7. Placenta previea 8. Postpartum Hemorrhage 100. Others specify_______________	
116	What was the mother's outcome after delivery?	3. Alive 4. Dead	
	Fetal and newborn condition		
117	Was there intrauterine growth restriction?	4. Yes 5. No 6. unknown	
118	What was the weight of the Newborn?	_________(Kg)	
119	What was the APGAR score of the Newborn at 1 minute	__________	
120	What was the APGAR score of the Newborn at 5 minutes	___________	
121	What was the newborn's outcome after delivery?	3. Alive 4. Dead	

122	If the answer for Q. No 121 is dead, when did the death happen?	5. Born dead 6. Immediately after birth 7. Within the first 24 hours 8. Within the first 7 days	

ልጋብ II: ንኬዝኮንትሮልመፅናዕቲዝተዳለወመሕትት

ሓበሬታ

ሰላም: ሽመይ ....ይበሃል:ካብ ኣዲስ ኣበባ ዩኒቨርሲቲ ኮለጅ ጥዕና ሳይንስ ሕ/ሰብ ጥዕና ት/ት ቤት ዝመፃእኹ ኮይነ ''ኩነታት ድፍኢት ደምን ሳዕብየናቱን ኣብ እዋን ጥንሲ ኣብ ዝተመረፃ ሆስፒታላት ትግራይ" ብዝብል ርእሲ ምርምር እናካየድና ንርከብ፡፡ኣነ ሎማዓንቲ ኣብዚ ዝተረከብኩሉ ዋና ዕላማ እውን ንዙይ ዝምልከት ሓበሬታ ንምእካብ እዩ፡፡

ናይዚ መፅናዕቲ ዕላማ ኣብ እዋን ጥንሲ ንዝፍጠሩ ዝተፈላለዩ ዓይነታት ድፍኢት ደም ምክንያት ክኾኑ ዝክእሉ ነገራት ንምፍላይ እዩ፡፡ ኣብ መወዳእታ እቶም ኣብ እዋን ጥንሲ ንዝፍጠሩ ዝተፈላለዩ ዓይነታት ድፍኢት ደም ምክንያት ክኾኑ ዝክእሉ ነገራት ብኣግባቡ ብምፍላይ ክውሰዱ ዝግበኦም ስጉምትታት ንዝምልከቶም ኣካላት ክንሕብር ኢና ብተወሳኺ እውን ኣብ ዝፈትሕሉ መንገድታት ምስ ዝምልከቶም ኣካላት ሓቢርና ክንሰርሕ ኢና፡፡ ብምኽኑ እውን ንከይዲ ኣፈላልያን ኣተኣላልያን ድፍኢት ደም ኣብ እዋን ጥንሲ ብምምሕያሽ ኩነታት ሕማምን ሞትን ኣብ ኣዴታትን ህፃናትን ክቕንስ እዩ ተባሂሉ ይእመን

ኣብዚ መፅናዕቲ ብምስታፈን ዝስዕብ ዝኮነ ኣይነት ፀገም ወይ ሳዕቤን የለን፡ንኣስታት 25 ደቓይቕ ዝኣክል ጥራሕ ግዜኤን መስዋእቲ ክገብራልና እየን፡፡ ኣብዚ መፅናዕቲ ሽምን ካልኦት መለለይታትን ዘይንጥቀም እንትንከውን ኣብቲ መፅናዕቲ ምስታፍ፣ ዘይምስታፈ ከምኡውን ኣብ ዝኮነ እዋን ምቑራፅ ይከኣል እዩ፡፡ ኩሎም ዝእከቡ ሓበሬታታት ምሽጥራዊነቶም ዝተሓለወኮይኑ ሓበሬታ ንምርምር ዕላማ ጥራሕ ዝውዕል እዩ፡፡ዝኮነ ዘተሓሳስበን ነገር እንተሃልዩ ብዘይስክፋት ንኣይተ ሃ/ማርያም በርሀ ዋና መራሒ እቲ መፅናዕቲ ብቁፅሪ ሞባይል +**251914707632**ምርካብን ምዝርራብን ይከኣል፡፡
ስለዚ ነዚ ቃለ መሕትት ብምምላስ ክትትሓባበራና ንላቦ፡ የቐንየለይ

ናይ ስምምዕነት ቅጥዒ

ቅድም ኢሉ ኣብ ላዕሊ ከምዝተጠቀሰ ኣከያይዳ ናይዚ መፅናዕቲ ብኣግባቡ ተረዲኣ ኣለኹ፡፡ኣብዚ መፅናዕቲ ብምስታፈይ ምንም ዓይነት ሓደጋ ከምዘይበፅሐኒ ተረዲአ ኣለኹ፡፡ብዙይ ምክንያት ኣብዚ መፅናዕቲ ንምስታፍን ንዕውትንት እቲ መፅናዕቲ ንምስራሕን ሙሉእ ንሙሉእ ፍቓደኛ እየ፡፡

እወፍ◯ኛ እየ.

ኣይፋ◯ፍቃደኛ ኣይኮንኩን

ኩነታት ተሳታፊ

1. ድፍኢት ደም ዘለዋ(**ኬዝ**)☐
2. ድፍኢት ደም ዘይብላ (**ኮንትሮል**)☐

እዚ (√) ምልክትኣብቲ ሳፁን የቅምጡ

ተ.ቑ	ሕቶ	መልሲ	መብርሂ
1	**ማሕበራውን ስነህዝባውን ባህርያት**		
201	ዕድመኺ ክንደይ እዩ?	_______(ብዓመት)	
202	ኣበይ ትነብሪ?	1. ገጠር 2. ከተማ	
203	ኩነታት ሓዳርኪ እንታይ ይመስል	1. ዝተመርዐወት 2. ዘይተመርዐወት 3. ዝተፋተሐት 4. ስብኣያ ዝሞታ 5. ተፈላልዮም ዝነብሩ	
204	እዚ ናይ ሐዚ ጥንሲ ካብ ናይ መጀመርያ ሰብኣይኪ ድዩ?	1. እወ 2. ኣይፋሉን	1→206
205	ናይ ተ.ቑ 204 መልሲ ኣይፋሉን እንተኮይኑ እዚ ናይ ሐዚ ጥንስኪ ካብ ናይ መበል ክንደይ ሰብኣይኪ እዩ?	1. ካልኣይ 2. ሳልሳይ 3. ራብዓይ 99. ካልእ (ይገለፅ)_________	
206	ሃይማኖትኪ እንታይ እዩ?	1. ኦርቶዶክስ 2. ሙስሊም 3. ካቶሊክ 4. ፕሮቲስታንት 99. ካልእ (ይገለፅ)_________	
207	ብሄረሰብኪ እንታይ እዩ?	1. ትግራወይቲ 2. ኣምሓራ 99. ካልእ (ይገለፅ)_________	
208	ናይ ትምህርቲ ደረጃኺ ክንደይ እዩ?	1. ምንም ዘይተመሃረት 2. ምንባብን ምፅሓፍን ትክእል 3. ቀደማይ ደረጃ 4. ካልኣይ ደረጃን ልዕሊኡን	
209	ስራሕኺ እንታይ እዩ?	1. ስራሕ ገዛ 2. ሰራሕተኛ መንግስቲ 3. ሰራሕተኛ ዘይመንግስታዊ ትካል 4. ናይ ግሊ ትካል 5. መዓልታዊ ሰራሕተኛ 99. ካልእ (ይገለፅ)_________	
210	ናይ በዓል ገዛኺ ደረጃ ትምህርቲ ክንደይ እዩ?	1. ምንም ዘይተመሃረ 2. ምንባብን ምፅሓፍን ዝክእል 3. ቀደማይ ደረጃ 4. ካልኣይ ደረጃን ልዕሊኡን	
211	ናይ ገዛኺ ወርሓዊ እቶት ክንደይ እዩ?	________________ብር	
2	**ባህርያት ቤተሰብን ኩነታት ኣነባብራን**		
212	ኣብ ቤተሰብ ደም ድፍኢት ዝነበሮ ወይ ዘለዎ ሰብ ኣሎ ዶ (ወለዲ፡ኣቦ/እኖ ሓንታትሐው/ሐፍቲ)	1. እወ 2. ኣይፋሉን	
213	ክብደት	________ኪግ	

214	ቁመት	______________ሜ	
215	ዙርያ ላዕለዋይ ኩርናዕ ኢድ	_____________ሳ.ሜ	
216	ኣብ እዋን ጥንሲ ንዝፍጠሩ ናይ ጥዕና ፀገማት ንምሕካም ናይ ባህሊ መድሓኒት ተጠቂምኪ ዶ ትፈልጢ?	1. እወ 2. ኣይፋሉን	2→218
217	ናይ ተ.ቑ 216መልሲ እወ እንተኮይኑ, ዝተወሰደ መድሓኒት ይጥቀሳ?	_____________________________ _____________________________ ____________________________	
218	ቅድሚ ምጥናስኪ ክብደትኪ ክንደይ ነይሩ?	______________ኪ.ግ	
219	ቡና ትሰቲ ዶ (ሐዚ ወይ ቅድሚ መጥናስኪ)	1እወ 2. ኣይፋሉን 3. ኣቛሪፀዮ	2→222
220	ናይ ተ.ቑ 219 መልሲ እወ እንተኮይኑ? ክንደይ ዝኣክል ትሰትዪ (ኣብ ደገ ይኹን ኣብ ገዛ)	1. ልዕሊ ሓደ ግዜ ኣብ መዓልቲ 2. መዓልታዊ 3. ኣብ ሰሙን ሓደ ግዜ 4. ኣብ ሰሙን 2-3 ግዜ 5. ሓደሓደ ግዜ 99. ካልእ (ይገለፅ)_________	
221	ናይ ተ.ቑ 219 መልሲ እወ እንተኮይኑ፡ኣብ ሕድሕድ ትሰትይሉ እዋን ክንደይ ዝኣክል ትሰትዪ?	1. 1 ፊንጃል 2. 2 ፊንጃል 3. 3 ፊንጃል 4. ልዕሊ 3 ፊንጃል 99. ካልእ (ይገለፅ)_________	
ምስ ሕክምናን ጥንስን ዝተትሓዙ ባህርያት			
222	እዚ ጥንሲ ማንታን ልዕሊኡን ድዩ?	1. እወ 2. ኣይፋሉን 3. ኣይተፈለጠን	
223	ኣብእዋን ጥንሲ ዝተፈለጠ ሽኮርያ ኣለኪ ድዩ?	1. እወ 2. ኣይፋሉን	
224	ቅድሚ ምጥናስኪ ኦስትሮጂን ዘሎዎ ብኣፊ ዝውሰድ መከላከሊ ጥንሲ ትወስዲ ዶ ነይርኪ?	1. እወ 2. ኣይፋሉን	
225	ወርሓዊ ፅግያት ኣብ ክንደይ ዕድመኪ ጀሚሩኪ?	________ብዓመት	
226	ኣብ ዝሓለፈ ጥንስኪ ደም ድፍኢት ወይ ምስኡ ዝተትሓሓዘ ምንቅጥቃጥ ኣጋጢሙኪ ዶ ነይሩ?	1. እወ 2. ኣይፋሉን 3. ናይ መጀመርያየይ እዩ	3→228
227	ናይ ተ.ቑ 226 መልሲ 1 ወይ 2 እንተኮይኑ፡ ኣብ መንጎ እዚ ናይ ሐዚ ጥንስን ቅድሚኡ ዝነበረ ጥንስን ዘሎ ናይ ዕድመ ኣፈላላይ ክንደይ እዩ?	__________ (ብዓመት)	
228	ጥንሲ ምንፃል ኣጋጢሙኪ ዶ ይፈልጥ?	1. እወ 2. ኣይፋሉን	2→230

229	ናይ ተ.ቑ 228 መልሲ እወ እንተኮይኑ፡ ክንደይ ግዜ ኣጋጢሙኪ?	____________	
230	ቅድሚ ምጥናስኪ ዝፍለጥ ናይ ሽኮርያ ሕማም ኣለኪ ድዩ?	1. እወ 2. ኣይፋሉን	
231	ካልኦት ተደረብቲ ሕማማት ኣለውኺ ድዮም? እንተሃሊዮም ይጠቐሱ **ካብ ሓደ ብላዕሊ መልሲ ይከኣል እዩ**	1. ደም ዋሕዲ 2. ብኣለርጂ ዝመፅእ ሕማም 3. ናይ ልቢ ሕማም 4. ናይ ኩላሊት ሕማም 5. ካልእ (ይገለፅ)______________	
232	ዕድመ ጥንሲ ኣብ እዋን ምርመራ	____________(ብሰሙን)	ንኬዛት
230	ዓይነት ፀቕጢ ደም	________________________________ ________________________________ ______________________________	

ልጋብ III: ንኮሆርትመፅናዕቲዝተዳለወመሕትት

ሓበሬታ

ሰላም: ሽመይ ……………………………………….ይበሃል:ካብ ኣዲስ ኣበባ ዩኒቨርሲቲ ኮለጅ ጥዕና ሳይንስ ሕ/ሰብ ጥዕና ት/ት ቤት ዝመፃኹ ኮይነ‘‘ኩነታት ድፍኢት ደምን ሳዕቤናቱን ኣብ እዋን ጥንሲ ኣብ ዝተመረፃ ሆስፒታላት ትግራይ” ብዝብል ርእሲ ምርምር እናካየድና ንርከብ፡፡ኣነ ሎማዓንቲ ኣብዚ ዝተረከብኩሉ ዋና ዕላማ እውን ንዙይ ዝምልከት ሓበሬታ ንምእካብ እዩ፡፡

ናይዚ መፅናዕቲ ዕላማ ኣብ እዋን ጥንሲ ዝፍጠሩ ዝተፈላለዩ ዓይነታት ድፍኢት ደምን ኣብ ኣዶ፣ድቂ ከምኡ እውን ኣብ ዕሸል ዘምፅእዎ ሳዕቤናትን እንታይ ከምዝመስል ንምፅናዕ እዩ፡፡ኣብ መወዳእታ እቶም ኣብ እዋን ጥንሲ ዝፍጠሩ ዝተፈላለዩ ዓይነታት ድፍኢት ደም ዘምፅእዎም ሳዕቤናት ብኣግባቡ ብምፍላይ ከውሰዱ ዝግበኦም ስጉምትታት ንዝምልከቶም ኣካላት ክንሕብር ኢና ብተወሳኪ እውን ኣብ ዝፈትሕሉ መንገድታት ምስ ዝምልከቶም ኣካላት ሓቢርና ክንሰርሕ ኢና፡፡ ብምዃኑ እውን ንከይዲ ኣፈላልያን ኣተኣላልያን ድፍኢት ደም ኣብ እዋን ጥንሲ ብምምሕያሽ ኩነታት ሕማምን ሞትን ኣብ ኣዴታትን ህፃናትን ክቕንስ እዩ ተባሂሉ ይእመን፡፡

ኣብዚ መፅናዕቲ ብምስታፈን ዝስዕብ ዝኾነ ኣይነት ፀገም ወይ ሳዕቤን የለን፡ንኣስታት 30 ደቓይቕ ዝኣክል ጥራሕ ግዜኤን መስዋእቲ ክገብራልና እየን፡፡ ኣብዚ መፅናዕቲ ሽምን ካልኦት መለለይታትን ዘይንጥቀም እንትንከውን ኣብቲ መፅናዕቲ ምስታፍ፣ ዘይምስታፈ ከምኡውን ኣብ ዝኾነ እዋን ምቑራፅ ይከኣል እዩ፡፡ ኩሎም ዝእከቡ ሓበሬታታት ምሽጥራዊነቶም ዝተሐለወኮይኑ

ሓበሬታ ንምርምር ዕላማ ጥራሕ ዝውዕል እዩ፡፡ዝኮነ ዘተሓሳስበን ነገር እንተሃልዩ ብዘይስክፋት ንኣይተ ሃ/ማርያም በርሀ ዋና መራሒ እቲ መፅናዕቲ ብቁፅሪ ሞባይል +251914707632ምርካብን ምዝርራብን ይከኣል፡፡

ስለዚ ነዚ ቃለ መሕትት ብምምላስ ክትትሓባበራና ንላቦ፡ የቐንየለይ

ናይ ስምምዕነት ቅጥዒ

ቅድም ኢሉ ኣብ ላዕሊ ከምዝተጠቀሰ ኣከያይዳ ናይዚ መፅናዕቲ ብኣግባቡ ተረዲአ ኣለኹ፡፡ኣብዚ መፅናዕቲ ብምስታፈይ ምንም ዓይነት ሓደጋ ከምዘይበፅሐኒ ተረዲአ ኣለኹ፡፡ብዙይ ምክንያት ኣብዚ መፅናዕቲ ንምስታፍን ንዕውትንት እቲ መፅናዕቲ ንምስራሕን ሙሉእ ንሙሉእ ፍቓደኛ እየ፡፡

እወፍ◯ኛ እየ.

ኣይፋ◯ፍቃደኛ ኣይኮንኩን

ኩነታት ተሳታፊ

1. ድፍኢት ደም ዘለዋ(**ዝተጋለፀት**)☐
2. ድፍኢት ደም ዘይብላ (**ዘይተጋለፀት**)☐

እዚ (√) ምልክትኣብቲ ሳፁን የቅምጡ

ተ.ቑ	ሕቶ	መልሲ	መብርሂ
1	**ማሕበራውን ስነህዝባውን ባህርያት**		
301.	ዕድመኺ ክንደይ እዩ?	_________________(ብዓመት)	
302	ኣበይ ኢኺ ትነብሪ?	3. ገጠር 4. ከተማ	
303	ኩነታት ሓዳርኪ እንታይ ይመስል?	1. ዝተመርዐወት 2. ዘይተመርዐወት 3. ዝተፋተሐት 4. ሰብኣያ ዝሞታ 5. ተፈላልዮም ዝነብሩ	
304	ሃይማኖትኪ እንታይ እዩ?	1. ኦርቶዶክስ 2. ሙስሊም 3. ካቶሊክ 4. ፕሮቲስታንት 99. ካልእ (ይገለፅ)_________	
305	ብሄረሰብኪ እንታይ እዩ?	1. ትግራወይቲ 2. ኣምሓራ 99. ካልእ (ይገለፅ)_________	
306	ናይ ትምህርቲ ደረጃኺ ክንደይ እዩ?	1. ምንም ዘይተመሃረት 2. ምንባብን ምፅሓፍን ትክእል 3. ቀደማይ ደረጃ 4. ካልኣይ ደረጃን ልዕሊኡን	

307	ስራሕኺ እንታይ እዩ?	1. ስራሕ ገዛ 2. ሰራሕተኛ መንግስቲ 3. ሰራሕተኛ ዘይመንግስታዊ ትካል 4. ናይ ግሊ ትካል 5. መዓልታዊ ሰራሕተኛ 99. ካልእ (ይገለፅ)_________	
308	ናይ በዓል ገዛኺ ደረጃ ትምህርቲ ክንደይ እዩ?	1. ምንም ዘይተመሃረ 2. ምንባብን ምፅሓፍን ዝክእል 3. ቀደማይ ደረጃ 4. ካልኣይ ደረጃን ልዕሊኡን	
309	ናይ ገዛኪ ወርሓዊ እቶት ክንደይ እዩ?	________________ብር	
2	**ኩነታት ጥንስን ሳዕቤኑን**		
310	ኣብ ክንደይ ዕድመ ጥንሲ ተወሊዱ?	______________(ብሰሙን)	
311	ምድንጓ ዕብየት ጥንሲ ኣብ ማህፀን ኣጋጢሙ ነይሩ ዶ?	4. እወ 5. ኣይፋሉን 6. ኣይተፈልጠን	
312	ዘጋጠማ ድፍኢት ደም እንታይ ዓይነት ነይሩ?	1. ኣብ እዋን ጥንሲ ዝፍጠር ድፍኢት ደም ጥራሕ 2. ዝፀሐ ድፍኢት ደም 3. ቀሊል ፕሪኢክላምፕስፓ 4. ከቢድፕሪኢክላምፕስፓ 5. ኢክላምፕስፓ 6. ሄልፕ ሲንድሮም	**ደም ድፍኢት ንዘለወን ጥራሕ**
313	እታ ኣዶ እንታይ ዓይነት ሕልኽላኽ ገጢሙዋ? **ካብ ሓደ ንላዕሊ መልሲ ምሃብ ይከኣል እዩ**	5. ምንም 6. ምንፃል መዳሕንቲ ቅድመ ወሊድ 7. ምንፃል መዳሕንቲ ካብ ታሕተዋይ ክፍሊ ማህፀን 8. መድመይቲ ድሕረ ወሊድ 100. ካልእ (ይገለፅ)______________	
314	ኩነታት ሕንጠይ ድሕረ ወሊድ?	3. ብሂወት ኣሎ 4. ሞይቱ/ታ	2→319
315	ናይ ሕንጠይ ክብደት ክንደይ እዩ?	__________(ኪ.ግ)	
316	ናይ ሕንጠይ ኩነታት ኣተነፋፍሳ (ኣፕጋር ስኮር) ኣብ ሓምሻይ ደቒቓ ክንደይ እዩ?	__________	
317	ናይ ሕንጠይ ኩነታት ኣተነፋፍሳ (ኣፕጋር ስኮር) ኣብ ሐደ ደቒቓ ክንደይ እዩ?	___________	
318	ሞት ህፃን ኣብ ናይ መጀመርያ 7 መዓልቲ ድሕሪ ወሊድ ኣጋጢሙ ዶ?	3. እወ 4. ኣይፋሉን	
319	ኩነታት ኣወላልዳ እንታይ ይመስል?	4. ብትክክለኛ መስመር 5. ብቀሳርያዊ መጥባሕቲ 6. ብመሳርሒ	

320	ናይ ተ.ቑ 319 መልሲ ብመሳርሒ እንተኮይኑ:,እንታይ ዓይነት መሳርሒ ነይሩ?	3. ቫኪዩም 4. ፎርሰፕስ	
321	ሕርሲ ከመይ ጀሚሩ?	3. ባዕሉ 4. ብመድሓኒት	
322	ኩነታት ኣዶ ድሕሪ ወሊድ	3. ብሂወት ኣላ 4. ሞይታ	
323	ብሂወት እንተሃልያ ኣብ ብፅኑዕ ዝሓመሙ ሰባት ዝሕከምል ደቂሳ ዶ ነይራ?	3. እወ 4. ኣይፋሉን	

ልጋብ IV: ንዓሚቕቃለ- መሕትትዝተዳለወመምርሒ

<u>ሓፈሻዊ ሓበሬታ</u>:

ሰላም: ሽመይ ....ይበሃል:ካብ ኣዲስ ኣበባ ዩኒቨርሲቲ ኮለጅ ጥዕና ሳይንስ ሕ/ሰብ ጥዕና ት/ት ቤት ዝመፃእኹ ኮይነ‘‘ኩነታት ድፍኢት ደምን ሳዕቤናቱን ኣብ እዋን ጥንሲ ኣብ ዝተመረፃ ሆስፒታላት ትግራይ” ብዝብል ርእሲ ምርምር እናካየድና ንርከብ፡፡ኣነ ሎማዓንቲ ኣብዚ ዝተረከብኩሉ ዋና ዕላማ እውን ንዙይ ዝምልከት ሓበሬታ ንምእካብ እዩ፡፡

ኣካል ናይዚ መፅናዕቲ፣ማሕበረ-ህዝባዊ ባህርያትኩምን ልምድታትኩምን ብዝምልከት ሓበሬታ እናኣከብና ንርከብ፡፡ እዚ ሓበሬታ እንእከቦ ዘለና ድማ ድፍኢት ደም ኣብ እዋን ጥንሲ ዝምልከት ዘሎ ነባራዊ ኩነታት ንምፍላይ እዩ፡፡

ዕላማ ናይዚ መፅናዕቲ ድፍኢት ደም ኣብ እዋን ጥንሲ ብእዋኑ ኣብ ምፍላይ ከምኡ እውን ኣብምእላይ/ምሕካም ተፅዕኖ ክፈጥሩ ዝክእሉ ነገራት ንምፍላይ እዩ፡፡ ናይቲ መፅናዕቲ ውፅኢት መሰረት ገይርካ ዝተፈላለዩ ናይ ዓቕሚ መዐበዪ መንገድታት ክሕንፀፁን ክትገበሩን እዮም፤ ብዙይ መንገዲ እቶም ዘለው ፀገማት ምፅባብ ይከኣል እዩ ኢልካ ይእመን:ːእዚ ቃለ መሕትት ኣስታት 40-60 ደቓይቕ ክወስድ እዩ፡፡ ኣብዚ መፅናዕቲ ናትክን/ኩም መንነት ክፈልዩ ዝክእሉ ነገራት ማለት እውን ከም ስምን ካልኦትን ፈፅምና ከምዘይንጥቀምን ኩሉ ሓበሬታ ምሽጥራውነቱ ዝተሓለወ ምኧኑን ብዘይ ናታትኩም/ክን ፍቓድ ንካልእ ኣካል ኣህሊፍካ ከምዘይወሃብ ክረጋግፀልኩም ይፈቱ፡፡ ሓሳባትኩም/ክን ብዝግባእ ንምምዝጋብን ንምትንታንን ምእንታን ክትዕም እቲ እንገብሮ ቃለ መሕትት ብመቅረፂ ድምፂ ክቕረፅ እዩ፡፡

ኣብዚ መፅናዕቲ ምስታፍ ብድሌት እንትኸውን ሙሉእብሙሉእ ናይ ዘይምስታፍ ከምኡ እውን ናይ ምቁራፅ መሰልክን/ኩም ሙሉእብሙሉእ ዝተሓለወ ኮይኑ ብዝኾነ ይኹን መልክዑ ኣባኽን/ኹም ዘሕድሮ ተፅዕኖ የለን.

ክሳብ ሐዚ ኣብ ዝተዘራረብናሉ ጉዳይ ሕቶ ኣለወን ድዩ? ክህሉ ንዝክእል ዝኮነ ሕቶ ነቲ ዋና መራሒ ናይቲ መፅናዕቲ ኣይተ ሃ/ማሪያም በርሀ ብሞባይል ቁፅሪ +251914707632ምርካብን ምሕታትን ይከኣል እዩ፡፡ኣብዚ መፅናዕቲ ንምስታፍ ድሌትክን ድዩ? እወ_______ ኣይፋሉን _______ኣይፋሉን እንተኮይኑ, ወሳንኣን ይከበር፡፡እወ እንተኮይኑ ቃለ-መሕትት ቀፅል፡፡

ሽም ኣካቢ ሓበሬታ........................ ፊርማ.......... ዕለት................

ናይ ስምምዕነት ቅጥዒ

እዚ መፅናዕቲ ዝምልከት ሙሉእ ገለፃ ስልዝተገበረለይ ናይቲ መፅናዕቲ ዓላማ ሙሉእብሙሉእ ተረዲኡኒ እዩ፡፡ ስለዝኾነ ብድሌተይ ኣብዚ መፅናዕቲ ንምስታፍ ድልው እየ፡፡

ፊርማ: ______________________________ ዕለት _________________________________

መእተዊ

ስም ጥዕና ትካል_____________________

ሞያ________________

ከይዲስራሕ ________________

ዕድመኻ/ኺ ክንደይ እዩ__________?

ፆታ __________

ናይ ስራሕ ሓላፍነት______________

ኣብዚ ትካል መዓዝ ተቖፂርኪ/ካ__________?

ኣብዚ ናይ ኣዴታት ክፍሊ ንክንድይ ግዜ ዝኣክል ሰሪሕካ/ኪ _____________?

ድፍኢት ደም ኣብ እዋን ጥንሲ ብዝምልከት ስልጠና ወሲድኪ/ካ ዶ ትፈልጢ/ጥ?

ሀ) እወለ) ኣይፋሉን

ንበዓልሞያ ጥዕናን ኣመሓደርትን ዝተዳለዉ ሓበርቲ ሕቶታት

1. ፀቕጢደምኣብእዋንጥንሲእንትበሀልከመይትርድኦ/እዮ? (**መወፃዕኢ:** መዐቀንታቱ እንታይ እንታይ እዮምእ?እትጥቀምሉ ጋይድላይ እንታይ ይመስል)
2. ክሳብ ሐዚ ፀቕጢደምኣብእዋንጥንሲኣዝዩ ተፅዕኖ ፈጣሪ ዝኾነሉ ምክንያት እንታይ እዩ? (ብመጠኑን ብቀታላይነቱ? ((**መወፃዕኢ:** ተፈጥሮ ናይቲ ሕማም: ስይስተም: ፖሊሲ ኣመራርሓን ምሕደራን: መሰረተ ልምዓት: ናይ ምዝንጋዕ ፀገምን ካልኦትን....)
3. ፀቕጢደምኣብእዋንጥንሲብዝምልከትናትኪ/ካልመዲ/ተመኩሮእንታይይመስል?(**መወፃዕኢ:** ቀሊል ካብ ከቢድ ከመይ ይፍለ? ምንቅጥቃጥን ካልኦት ሳዕቤናትን ከመይ ይፈለዩ/ ይሕከሙ? ፀቕጢደምን ፕሮቲን ኣብ ሽንትን ከመይ ይፍለዩ? ምሰዚ ተታሓሒዙ ዘይትርስዖ/ዕዮ ኣጋጣሚ እንታይ ነይሩ?
4. ፀቕጢደምኣብእዋንጥንሲብዝምልከት ኣብ ኣዴታት ዝረአ ኣፈላላይ ከመይ ይግለፅ? ኣየነኦም ከ እዮም ኣዝዮም ዝጥቅዑ? (**መወፃዕኢ:**ኣብ ቅድመ ወሊድ ክትትል ዝነበረንን ዘይነበረንን ከምኡ ድማ ኣብ ገጠርን ከተማን ዝነብራ ኣዴታት ኩነታት እቲ ሕማም ኣፈላላይ ኣሎ ዶ?
5. ፀቕጢደምኣብእዋንጥንሲንምፍላይን ንምሕካምን ናይ ትካላት ጥዕና ድልውነት ከመይ ይግለፅ? (**መወፃዕኢ:** ምክርን ክትትልን ቅድመ ወሊድ ከመይ ይግለፅ? ንሓደጋ ዝተጋለፃ ኣዴታት ኣደቂስካ ኣብ ምሕካም ከመይ ይመስል? ድሕሪ ወሊድ ናይ ፀቅጢ ደም ምርመራ ከ?

6. ፀቕጢ ደምኣብእዋንጥንሲ ንምፍላይን ንምሕካምን ዘድልዩ መሳርሕታት ኣቅርቦት እንታይ ይመስል? (**መወፃዕኢ:**ፀቕጢ ደም መዐቀኒ መሳርሒ: ሽንቲ መመርመሪ መሳርሒ: ናይ ፀቕጢ ደምን ምንቅጥቃጥን መድሓኒታት: ኣቀማምጣ መድሓኒታትን ሕፅረት ኣቕርቦትን? ከም ኣብነት ሕሙማት መድሓኒት ንምግዛእ ወይ ንላቦራቶርይ ምርመራ ንደገ ተላኢኮም ዶ ይፈልጡ?

7. ናይ ጋይድላይናት/መምርሕታት ኣቅርቦትን ግልጋሎትን ከመይ እዩ?(**መወፃዕኢ:**ፀቕጢደምኣብእዋንጥንሲ ንምፍላይን ንምሕካምን ዝሕግዙ መምርሕታት ኣለው ዶ? ኣብነት ማግኒዝየም ሳልፌት/ ናይ ፀቕጢ ደም መድሓኒታት ከመይ ከምዝወሃቡ ዝሕብሩ መምርሕታት ዝምልከት ከመይ ይመስል?ጋይድላይናት እንተዘይሀልዮም ትሕብሮ/ዮ ጋይድላይን ኣሎ ዶ? እወ/ኣይፋሉን ንምንታይ?

8. ሰብ ሞያታት ጥዕና ፀቕጢ ደምኣብእዋንጥንሲ: ማግኒዝየም ሳልፌት ዝምልከት ዘለዎም ፍልጠት: ኣመለካኽታን ተቀባልነትን ከ ከመይ እዩ?(**መወፃዕኢ:** ስልጠና BEmONC እኹል ድዩ?

9. ፀቕጢ ደምኣብእዋንጥንሲ ብሓፈሻ ከምኡ እውን ማግኒዝየም ሳልፌት ኣብ ምሃብ ብዝምልከት ናይ ዝተፈላለዩ ሰብ ሞያ ጥዕና ስራሕን ሓላፍነትን እንታይ እዩ? (**መወፃዕኢ:** መን እንታይ ይሰርሕ)

10. ናይ ሕሙማት ቅብብልን (ውሽጣውን ደጋውን) ፀብፃብን እንታይ ይምስል? (**መወፃዕኢ:**ኩነታትን ምኽንያታትን ሪፈራል)

11. ኣብ ትካልኩም እንታይ ዓይነት መድሓኒታት ይወሃቡ (ናይ ፀቕጢ ደምን ምንቅጥቃጥ)?

12. ኣብከይዲምልላይንምእላይንፀቕጢደምኣብእዋንጥንሲዘለውኣወንታውንኣሉታውንጎንታትእንታይይመስሉ? (**መወፃዕኢ:**ፖሊሲ: ስይስተም :ምሕደራን ካልኦትን......)

13. ኣብምፍለይ ምሕካምንክንክንንድፍኢትደምኣብእዋንጥንሲዘለውብድሆታትእንታይይመስለኪ/ካ(**መወፃዕኢ:** ኣቅርቦት: ምሕደራ: ሓይሊ ሰብ ካልኦትን.......).

14. ኣብ ኣዴታት ከምኡ እውን ኣብቲ ሕ/ሰብ ዘሎ ኣመለካኽታ እንታይ ይምስል? (**መወፃዕኢ:**ማግኒዝየም ሳልፌት፡ ፀቕጢ ደም፡ ኮንቨልዥን/ምንቅጥቃጥ ዝምልከት?

15. ድፍኢትደምኣብእዋንጥንሲንምቁፅፃርእንታይክግበርኣለዎትብል/ሊ?

ንኣዴታት ዝተዳለዉ ሓበርቲ ሕቶታት

ዕድመ__________በዝሒ ወሊድ________________

ኣብ ዝሓለፈ ጥነሲ ቅድመ ወሊድ ክትትል ነይሩኪ ዶ1.እወ 2.ኣይፋሉን; እወ እንተኮይኑ ክንደይ ግዜ___________________

ኣበይ ወሊድኪ1.ገዛ 2.ጥዕና ጣብያ 3. ሆስፒታል

ብከመይ ወሊድኪ 1.መጥባሕቲ 2.ብስሩዕ

1. ድፍኢትደምኣብእዋንጥንሲእንትበሀልከመይትርድኢ/እዮ?

2. ድፍኢትደምኣብእዋንጥንሲብዝምልከትናትኪ/ካልመዲ/ተመኩሮእንታይይመስል? ቅድመወሊድ ክትትል ነይሩኪ ዶ? ብዛዕባኡ ግለፅለይ? (**መወፃዕኢ:** በዝሒ ክትትልቅድመወሊ(ቅድመወሊድ ክትትል እንተነይሩ): ኣብ እዋን ቅድመወሊድ ክትትል ዝወሃብ ትምህርቲ: ናይ ወሊድ ቅድመ ድልውነትን ካልኦትን)

3. ኣብከይዲምልላይን ምእላይንድፍኢትደምኣብእዋንጥንሲዘለውኣወንታውንኣሉታውንጎንታትእንታይይመስሉ? ብደሆታት ከ እንታይእዮም? (**መወፃዕኢ :** ኣቅርቦት: ምዝንጋዕ ኣብ ግልጋሎት ምሃብ : ኣመራርሓን ምሕደራን ግንዛበ ምንኣስን….)

4. ፀቕጢ ደም ኣብ እዋን ጥንሲ ምህላዉ እንትንገረኪ ንመጀመርያ ግዜ እንታይ ተሰሚዑኪ?

5. ፀቕጢ ደም ኣብ እዋን ጥንሲ ምህላዉ ምስተፈለጠ ናይ ሰብ ሞያ ጥዕና እንክብካቤ እንታይ ይመስል ነይሩ?
6. ውፅኢት ወሊድ እንታይ ይመስል ነይሩ? ድሕሪ ወሊድ እንታይ ተሰሚዑኪ? ድሕሪ ወሊድ ናይቲ ህፃን ኩነታት ከመይ ኮይኑ?
7. ፀቕጢ ደም ኣብ እዋን ጥንሲ ምህላዉ እንትንገረኪ ብጣዕሚ ዘጨነቀኪ ነገር እንታይ ነይሩ?
8. ሐዚ ኮይንኪ ንድሕሪት እንትዝክሪ ብዛዕባ እቲ ዝሓለፈ ጥንስኪ እንታይ ይሰመዕኪ?
9. ኣብ ኣዴታት ከምኡ እውን ኣብቲ ሕ/ሰብ ዘሎ ኣመለካከታ እንታይ ይምስል? (**መወፃዕኢ:**ማግኒዝየም ሳልፌት፡ ፀቕጢ ደም፡ ኮንቨልዥ/ምንቅጥቃጥ ዝምልከት?
10. ድፍኢትደምኣብእዋንጥንሲበዝምልከትእንታይክግበርኣለዎትብሊ?

ANNEX3: Declaration

Letter for declaration

I, the undersigned, declared that this is my original work, has never been presented in this or any other University, and that all the resources and materials used for the dissertation, have been fully acknowledged.

Name: ___________________________________

Signature: _______________________________

Date: ____

Place:____

Dateof Submission: ______________________________________

This dissertation has been submitted for examinationwith my approval as University Supervisor.

Name: ____

Signature: ____________________________________

Date:________________________