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ASSESSMENT OF THE INFLUENCE OF DURATION OF COHABITATION,  
OBSTETRICS & GYNECOLOGIC, BEHAVIORAL AND NUTRITIONAL RISK  
FACTORS ON PREECLAMPSIA AMONG NULLIPAROUS WOMEN IN  
SELECTED HOSPITALS OF WEST AMHARA ZONES, ETHIOPIA

BY: MARU MEKIE (BSc.)

ADVISORS: DR. WUBEGZIER MEKONNEN (Ph.D.)

MESELECH ASSEGID (MPH, Ph.D. CANDIDATE)

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### **Advisor's Approval Sheet**

This is to verify that the thesis entitled “*Assessment of the influence of duration of cohabitation, obstetrics and gynecologic, behavioral and nutritional risk factors on preeclampsia among nulliparous women in selected hospitals of West Amhara Zones, Ethiopia*” is submitted in partial fulfillment of the requirements for the degree of masters of public health with specialty in “Reproductive and family health” to the Graduate Program of the School of Public Health in Addis Ababa University and has been carried out by Maru Mekie under our supervision.

The student has fulfilled the thesis requirements and hence here by can submit the thesis to the school.

Name of advisors

Dr. Wubegzier Mekonnen (Ph.D., Associate professor)      Date: 11/6/2018      Signature: \_\_\_\_\_

Meselech Assegid (MPH, Ph.D. Candidate)                      Date: 11/6/2018      Signature: \_\_\_\_\_

### **Examiners' Approval Sheet**

We, the undersigned, members of the Board of Examiners of the final open defense by Maru Mekie Dagnew, have read and evaluate his thesis entitled “*Assessment of the influence of duration of cohabitation, obstetrics and gynecologic, behavioral and nutritional risk factors on preeclampsia among nulliparous women in selected hospitals of West Amhara Zones, Ethiopia*”. This is to verify that the thesis has been accepted in partial fulfillment of the requirements for the masters of public health degree in “Reproductive and family health”

Name of internal examiner:

Abiy Seifu (BSc, MPH)      Date: 19/06/2018 signature \_\_\_\_\_

Name of external examiner:

Dr. Abiy Girmay (MD, MPH, Ph.D.)      Date: 19/06/2018 signature \_\_\_\_\_

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## **Dedication**

This research paper is dedicated to my brother in-law Tadesse Wendie who lost his life due to traffic accident during my stay at the university. It is also dedicated to all Ethiopians who died of traffic accidents due to reckless driving.

## **Acronyms and Abbreviations**

AAH	Addis Alem Hospital
AAU	Addis Ababa University
ACOG	American College of Obstetrics and Gynecology
ANC	Antenatal Care
AOR	Adjusted Odds Ratio
APGAR	Appearance, Pulse, Grimace, Activity, Respiration
BMI	Body Mass Index
BP	Blood Pressure
CHS	College of Health Sciences
CHTN	Chronic hypertension
CI	Confidence Interval
DM	Diabetes Mellitus
DTGH	Debre Tabor General Hospital
EDHS	Ethiopian Demographic and Health Survey
FHRH	Felege Hiwot Referral Hospital
HDP	Hypertensive Disorders of Pregnancy
HELLP	Hemolysis, Elevated Liver Enzyme, and Low Platelet Count
Hgb	Hemoglobin
LNMP	Last Normal Menstrual Period
mmHg	millimeter Mercury
MNCH	Maternal, Newborn, and Child Health

MUAC	Mid-Upper Arm Circumference
PE	Preeclampsia
REC	Research Ethics Committee
SDCH	Short Duration of Cohabitation
SPH	School of Public Health
SPSS	Software Package of Social Science
WHO	World Health Organization

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## **Abstract**

**Introduction:** Preeclampsia is the major cause of maternal and perinatal morbidity and mortality in developing countries. Identifying risk factors of preeclampsia is crucial for early diagnosis and management. Though several studies have been conducted related to preeclampsia, the influence of duration of cohabitation, obstetrics and gynecologic, behavioral and nutritional factors have not been well understood among nulliparous women.

**Objectives:** To assess the effect of duration of cohabitation, obstetrics and gynecologic, behavioral and nutritional risk factors on preeclampsia among nulliparous women in selected public hospitals of West Amhara Zones, Ethiopia

**Method:** Age-matched case-control study design was employed on a total of 330 preeclamptic and non-preeclamptic women who come for delivery at Felege Hiwot, Addis Alem, and Debre Tabor hospitals. Double population proportions formula with a 2:1 control to case ratio was used to calculate sample size with 95% confidence interval and 80% power. Epi data version 3.1 was used for data entry, and analysis was done by SPSS version 20. Descriptive statistics were computed to reveal the magnitude of duration of cohabitation, obstetrics and gynecologic, behavioral and nutritional factors among preeclamptic and non-preeclamptic nulliparous women. Chi-square test was used to assure statistical significance. Conditional bivariable and multivariable logistic regression were also used to calibrate the association between the above factors and preeclampsia. Both crude and adjusted odds ratios were used to measure the strength, direction, and significance of association at 95% confidence interval.

**Result:** The risk of preeclampsia among nulliparous women was 2 times higher among women with short duration of cohabitation (AOR: 2.13(1.10, 4.11), 2.35 times higher among those with unplanned pregnancy (AOR: 2.35 (1.01, 5.52), and 2 times higher among those with MUAC  $\geq$  25cm (AOR: 2.00(1.10, 3.63). On the other hand, the risk was (AOR: 0.52(0.29, 0.96), (AOR: 0.42 (0.22, 0.82) and (AOR: 0.45(0.24, 0.87) lower among nulliparous women who got advise at antenatal care, had vegetable and fruit intakes, respectively compared with counterparts.

**Conclusion:** Special attention should be given to nulliparous women who found to have a short duration of cohabitation, unplanned pregnancy, and high body weight. Nutritional counseling shall be given to women during antenatal care follow-ups to reduce the risk of preeclampsia.

# 1. Introduction

## 1.1 Background

Preeclampsia (PE) is a pregnancy-specific hypertensive disease which is associated with visual disturbances, headache, and epigastric pain in a previously normotensive woman (1). PE is one class of hypertensive disorders of pregnancy (HDP) (2) which is defined as blood pressure (BP) of  $\geq 140/90$  millimeter mercury ( mmHg) with proteinuria measured on two occasions at least 4 hours apart or BP  $\geq 160/110$  mmHg on single measurement diagnosed after 20 weeks of pregnancy. Hemolysis, elevated liver enzymes, and low platelet counts (HELLP) syndrome is an indicator of the presence of multi-organ damage in women with severe PE (3-6).

PE is one of the leading causes of maternal and perinatal mortality. However, its pathogenesis condition has not been understood well. Immunologic maladaptation of maternal antibody to fetal and placental antigens is presumed to cause inflammation which leads to abnormal placentation and placental hypoxia. Placental hypoxia is thought to lead to increased vascular sensitivity to known vasoconstrictor angiotensin II and decrease the formation of vasodilators such as nitric oxide (5, 7, 8). Women who have had a new partner and those with short duration of exposure to paternal antigen have a high risk of developing PE related to lack of adaptation to paternal antigen (9-11) though there are inconsistent findings in this regard.

The world health organization (WHO) and American College of Obstetrics and Gynecology (ACOG) develop guidelines for the prevention, early diagnosis, and management of PE and other HDP. Low dose aspirin and calcium are recommended for prevention and magnesium sulfate is used for management of PE and its complications (1, 4, 6, 8). Despite such recommendations, delay in identification and diagnosis of PE is the problem of most developing countries including Ethiopia. Identifying risk factors and the portion of the population at risk is vital for prevention, early diagnosis, and management PE. Thus, the purpose of this study is to determine the influence of duration of cohabitation, obstetrics and gynecologic, behavioral and nutrition-related risk factors on PE among nulliparous women.

## 1.2 Statement of the Problem

PE complicates 3%-8% of all pregnancies worldwide (12, 13). It is one of the top five causes of maternal mortality (12, 14) and directly responsible for 70,000 maternal deaths annually (8, 15). PE is responsible for 16% of direct maternal deaths in Ethiopia (16). Complications such as fetal growth restriction, preterm birth, low birth weight, admission to neonatal intensive care unit due to this complications, and low mean APGAR score are common complications among babies of women with PE (3, 4).

Preventive measures such as the expansion of health facilities, maternal waiting homes, and training of health professionals are activities undertaken by the government of Ethiopia to reduce maternal and perinatal mortality (17, 18). In spite of the progress made, maternal morbidity and mortality are unacceptably high in the country (19, 20). Unlike that of abortion and other direct obstetric causes, maternal and perinatal mortality related to PE is still on increase (14, 21, 22).

PE is a multifactorial disease which is influenced by socio-demographic factors, medical, obstetric and gynecologic, behavioral and nutritional factors (10, 15, 23). According to the WHO secondary data analysis, women who had chronic hypertension, gestational diabetes mellitus, low educational attainment, high body mass index (BMI), women with first pregnancy, severe anemia, renal disease, absence of antenatal care (ANC), and urinary tract infections are at high risk to develop PE (24). The risk of having PE in a subsequent pregnancy is also found to be dependent on the history of the disease in the first pregnancy (25, 26).

Several studies have been conducted to determine risk factors for PE at global level and the country as well. However, those studies did not come up with conclusive findings on the effect of short duration of cohabitation (SDCH) (10, 11, 15, 27, 28), previous abortion (9, 29) and other obstetrics and behavioral factors on PE (27, 30, 31). In addition to the existing controversies, to the best of our knowledge, no study has been conducted about the influence of duration of cohabitation on PE including other risk factors such as obstetrics and gynecologic, behavioral and nutritional factors among nulliparous women in Ethiopia. Hence, the finding of this study could fill this gap by identifying SDCH, obstetrics and gynecologic, behavioral and nutritional factor for PE among nulliparous women.

### 1.3 Significance of the Study

Ethiopia is implementing Maternal, Newborn, and Child Health (MNCH) programs as a priority health agenda to reduce maternal and child morbidity and mortality (17, 18). To achieve MNCH programs, identifying modifiable risk factors and the group of a population at risk is imperative (32). Therefore, the finding of this study could be important for health programmers, health professionals and future researchers in prevention and management of PE.

For health programmers, the finding of this study is important to design evidence-based intervention strategies for the prevention of maternal and perinatal morbidity and mortality related to PE. Similarly, the finding is also key for health professionals to provide evidence-based counseling and interventions related to modifiable and non-modifiable risk factors for the disease. Identifying modifiable risk factors is important to prevent PE, whereas determining non-modifiable risk factors is helpful for early diagnosis and timely intervention to reduce maternal and perinatal complications. The finding of the study could also be a baseline for future studies since PE is a multifactorial disease with unclear etiology.

## 2. Literature Review

According to different studies, socioeconomic and demographic factors, obstetrics and gynecologic, behavioral and nutritional, and medical characteristics are factors found to affect PE (10, 23). Therefore, the reviewed literature are organized based on these factors.

### 2.1 Socioeconomic and Demographic Factors

Studies indicated that duration of cohabitation, maternal age, marital status, level of education, and economic status are socioeconomic and demographic factors that predispose to PE (10, 33-35).

The risk of PE was found to be high among women who have limited sexual exposure with their partner. On the other hand, Low risk of PE was observed among nulliparous women who had long pre-pregnancy cohabitation. On the contrary, higher risk of PE was observed among women who changed partners though birth interval was mentioned as an explanation for the discrepancy (36, 37). However, partner change could be explained by SDCH before conception since those women who changed partner mostly entered into pregnancy shortly than controls (33).

Being unmarried and advanced maternal age are socio-demographic variables found to be significantly associated with the risk of acquiring PE. As indicated by facility based cross-sectional study in Dessie referral hospital, the risk of developing PE was found to be (AOR: 3.03, 95%, CI: 1.12, 8.2) and (AOR: 4.5, 95%, CI: 1.56, 12.8) times higher among unmarried women and women with age of 35 plus years respectively (34). According to other studies, low socioeconomic status was found to be a significant risk factor for PE (10, 30, 38, 39). For instance, a case control study in India has indicated that women with low socioeconomic status had 6.81 times higher (OR : 95%, CI: 3.81, 12.01) risk of developing PE compared with women in high economic status (10).

Studies indicated that the mean age of women with PE was found to be less than the mean age of women without PE (10, 30). A prospective cohort study conducted in Norway indicated that there was variation in the mean age of the study subjects which found to be  $29.3 \pm 4.4$  years and  $30.2 \pm 4.4$  years among women with and without PE respectively (30). Similarly, the study in India revealed that the mean age of women with PE was found to be less than the mean age of women without PE. The study has also shown that women who were under 20 years of age had an odd of 3.87 times higher risk to develop PE (OR: 95%, CI: 2.32, 6.44) compared with counterparts (10).

On the other hand, a case control study conducted in public health facilities of Bahir Dar has revealed that the odds of developing PE was found to be 4.79 times higher among older women (adjusted OR=4.79, 95%, CI: 1.031, 22.18) compared to the younger one. It specifically showed that the mean age of women with PE and without PE was found to be  $29.7 \pm 6.28$  years and  $24.6 \pm 5.36$  years respectively (31).

With regards to education, studies indicated that level of education is significantly associated with PE. As education level increases, the risk of experiencing PE was found to be decreasing (30, 38). Attending higher educational level was associated with reduced risk of PE. Women with more than 14 years of education had 70% (95%, CI, 20%, 90%) lower risk of acquiring PE compared to women with an education of less than 9 years (30). Another case control study in Iran has also shown that the risk of PE was 4 times higher among illiterate women (OR: 4.05, 95%, CI: 1.18, 13.86) compared to women with some education. The explanation is that education is usually associated with more awareness that enhances health-seeking behavior and better economic status (38).

Regarding duration of cohabitation, SDCH was found to be common among women with PE compared with counterparts which results limited exposure to paternal antigen (10, 27, 40). A case-control study conducted in Iran found that 45% of cases and 29.2% controls had a duration of cohabitation of less than six months. The study indicated that the odds of having PE was found to be 2.4 times higher (adjusted OR: 2.4 , 95% ,CI: 1.35, 4.32) among women with a duration of cohabitation of less than six months compared with controls (27). Another case-control study conducted among 220 women with mixed parity in South Africa revealed that short duration of cohabitation was a significant predictor of PE among multiparous women (unadjusted OR: 3.9, , 95%, CI: 1.2, 13.4) compared to counterparts (37). Similar finding was reported in a case control study conducted in India, which found women who had their first conception within one year of their marriage to be more than 10 times at risk of developing PE (OR: 10.28, 95%, CI: 5.76, 18.35) compared to those who had their first conception after one year of marriage (10).

On the other hand, a cohort study conducted in United States of America indicated that duration of cohabitation was not found to be associated with PE. The study did not support the immune maladaptive theory of PE which states limited exposure to sperm and barrier contraceptive use mostly common among women with PE compared with women without PE (28). Another cohort study conducted in Ibadan, Nigeria, revealed a significant association was not found between PE and duration of cohabitation though there was a decrease in the risk of developing gestational hypertension (9). Similarly, the length of sexual cohabitation before conception was not found to be associated with the frequency of PE among primigravida and multigravida women in a case-control study conducted in Durban, South Africa (11). The study in South Africa has also revealed that significant association was not found between SDCH and PE among nulliparous women, though a significant association was reported among multiparous women (37).

Generally, there was disagreement among reviewed studies about the influence of duration of cohabitation on PE. Some studies revealed that there is a significantly higher risk of PE among women with short duration of cohabitation (15, 33). On the other hand, other studies revealed that there is no significant association between SDCH and PE (9, 41). Some studies recommend further studies to be done related to the duration of sexual cohabitation, contraception and PE (10, 28).

## 2.2 Obstetrics and Gynecologic Factors

PE is considered as the disease of nulliparous women. A cohort study conducted in Jerusalem indicated that the odds of developing PE was found to be 2.58 times higher among women with a first pregnancy (Adjusted OR: 2.58, 95%, CI: 2.23, 2.97) compared to multiparous women (39). Similarly, the case control study in Egypt revealed that the odds of PE was found to be 2.16 times higher among nulliparous women (OR: 2.16, 95%, CI: 1.18, 3.96) compared with multiparous women (15).

The risk of PE during a subsequent pregnancy is also found to be dependent on the history of the disease in the first pregnancy (25, 26). A systematic review of observational studies revealed that women with a previous history of PE had 7.19 times higher risk of PE (unadjusted OR: 7.19 , 95%, CI: 5.85 , 8.83) compared with counterparts (42). Likewise, a cohort study of Swedish birth register indicated that the risk of developing PE in second pregnancy was 14.7% and 1.1% for women with and without PE in their first pregnancy respectively (25).

A similar finding was reported in a case-control study conducted in selected facilities of Addis Ababa; which found the risk of acquiring PE to be 4.28 times higher (AOR: 4.28, 95%, CI: 1.61, 11.43) among women with PE in previous pregnancy compared with women without PE (26).

Age of menarche is found to be a determinant factor for PE. A study conducted in India revealed that the risk of having PE was found to be 13.17 times higher among women with age of menarche less than 12 years (OR: 13.17: 95%, CI: 7.11, 24.39) compared to counterparts (10). A significantly higher proportion of cases had a family history of PE (adjusted OR: 18.57, 95%, CI: 1.93, 178.16) compared with controls (23). Similarly, having multiple pregnancies (15, 23, 42), being nulliparous (42, 43) and female sex fetuses (44) were found to be significant risk factors for PE.

Regarding gravidity and parity, those women who had previous births and abortions had a low risk of acquiring PE compared with primigravida. According to mother and child cohort study of Norway, one previous history of induced abortion reduces the risk of PE moderately (OR 0.84, 95%, CI: 0.69–1.02). Women with two or more induced abortions had a significantly lower risk of PE (OR: 0.36, 95%, CI: 0.18–0.73) compared with women without abortion. The mechanism is related to immunological changes induced by normal pregnancies interrupted in early pregnancy periods which results in reduced risk of PE in subsequent pregnancies (45). A similar finding was reported in an international multicounty prospective cohort study which found low risk of PE among women who had history of one same partner miscarriage compared to counterparts (29). However, a study conducted in Nigeria revealed that there was no difference in risk of PE among women who had history of one previous miscarriage and those women who had no history of miscarriage. Gestational age was mentioned as a reason for non-association between previous abortion and PE since the majority of induced abortions in the study population were performed in early first trimester (9).

With regards to the use of family planning, women who use different methods of contraceptives had a different risk of developing PE. Women who used oral hormonal contraceptives had a reduced risk of PE compared with those who did not use or who use barrier method of contraceptives (30, 46). Individuals who used oral contraceptive before pregnancy had 50% low risk of PE compared with never or former users (adjusted OR:0.6, 95%, CI: 0.3, 1.0).

The mechanism of how oral hormonal contraceptive pills act to reduce PE is not clear. But, it is presumed to be a vascular adaptation to estrogen and progesterone among previous oral contraceptive users. PE is related to an adverse vascular reaction to the increased level of progesterone and estrogen levels. Former users of oral hormonal contraceptive pills had vascular adaptation to the increased estrogen and progesterone hormones which leads to reduced risk of PE (30). Besides the above reasoning, low risk of PE among oral contraceptive users compared to non-contraceptive users might be related to contraceptive effectiveness which leads to a long duration of cohabitation.

On the other hand, women who use barrier contraceptives as family planning methods had significantly higher risk of PE ( $P=0.007$ ) compared with non-users (47). The explanation for the increased risk of PE among barrier contraceptive users is presumed to be related to lack of exposure to paternal sperm especially among nulliparous women and those who change partners. The immunologic theory explains that PE is the result of abnormal placentation associated with an immunologic reaction of the maternal antibody to fetal and placental antigens. Prolonged maternal exposure to paternal antigen before pregnancy is required to develop adaptation to fetal and placental antigens. However, women who use barrier contraceptives and those who change partner have short periods of exposure to the paternal antigen which results in an immunologic reaction leading to PE (27, 46, 47).

Though the majority of reviewed literature agreed on preventive effects of induced abortion on PE, the influence of one previous abortion, different partner abortions, means of termination and the gestations at which abortion happened has not been clearly understood (29, 45, 48).

### 2.3 Behavioral and Nutritional Factors

Alcohol drinking, cigarette smoking, coffee intake, inadequate exercise, high BMI, fruit, and vegetable intake are behavioral and nutrition related factors which are associated with acquiring of PE (2, 31, 35, 49, 50). A case control study in Bahir Dar revealed that the odds of developing PE was found to be 1.78 times higher among women who drank coffee on daily basis (adjusted OR: 1.78; 95% CI: 1.20, 3.05) compared to those who did not take (35).

On the other hand, cigarette smoking and alcohol intake among pregnant women with and without PE were reported to be 1.18% and 12% respectively in a facility based cross-sectional study conducted in Arba Minch, Southern Ethiopia. Those women who found to drink alcohol had 8.06 times higher risk of acquiring PE (adjusted OR: 8.060, 95%, CI: 2.28, 18.51) compared with those who did not drink alcohol (49). Studies indicated that women with a history of smoking had a low risk of developing PE compared with women who did not smoke. Though the mechanism is not fully understood, exposure to nicotine and carbon monoxide results stimulation of nitric oxide production, lowering of anti-angiogenic factors and a decreased immune response have been reported as possible explanations for the preventive effect (50). Nevertheless, smoking was not found to be associated with PE in a large prospective cohort study conducted in North America (43, 51).

The case control study in Egypt revealed that the odds of experiencing PE was found to be 2 times higher among women who took much salty diet (OR: 1.99, 95%, CI: 1.02-3.91), high fat intake (OR: 1.83, 95%, CI: 1.01-3.34) and no adequate fruits and vegetable intake (OR: 1.85, 95%, CI: 1.01-3.39) compared to counterparts (15). Similarly, those women who reported as having eaten organic vegetable mostly had reduced risk of PE compared with those who take sometimes or rarely in another study (52).

With regards to anthropometry, a high BMI or MUAC (Mid-Upper Arm Circumference) are found to be significantly associated with the risk of developing PE. The case control study in New Delhi, India revealed that those women who had  $BMI \geq 25\text{kg/m}^2$  were found to be 5.86 times at a higher risk of experiencing PE (adjusted OR: 5.86, 95%, CI: 2.48-13.8) compared to women with counterparts (23). Likewise, the odds of having PE was found to be 2.47 times higher (unadjusted OR: 2.47, 95%, CI: 1.66, 3.67) among women with  $BMI \geq 25\text{kg/m}^2$  compared with counterparts (42). The mechanism of how high body weight predispose to PE is related to increase pro-inflammatory factors which results in an exaggerated inflammatory response (53). The hypothesis of high body weight as a risk factor for PE was also supported by a study conducted in Bahir Dar city which revealed the odds of developing PE to be 3.33 times higher among women with MUAC of  $\geq 25\text{cm}$  (35).

Studies revealed that poor physical activity during pregnancy is significantly associated with risk of acquiring PE (23, 54). Women with poor physical activity had 2.92 times high risk of having PE (OR: 2.92,95%, CI: 1.02-8.7) compared with women who had adequate physical activity (23). Generally quantification of behavioral factors has not been done in previous studies other than assessing frequency (26, 35, 49).

#### 2.4 Medical Risk Factors

Medical conditions such as diabetes mellitus (DM), chronic hypertension (CHTN), anemia and urinary tract infection (UTIs) are medical factors which play a significant role in the risk of PE (15, 55, 56).

A case control study in Egypt indicated that UTI, vaginosis, asymptomatic bacteriuria, DM, and stress as a significant risk factors for PE (15). Likewise, subclinical infection is also found to be a significant risk factor for PE in another study. The mechanism why infection is found to be a risk factor for PE is related to increased production of cytokine which affects vascular endothelial functions (55). Anemia during pregnancy is found to be a significant risk factor for PE. A study in eastern Sudan revealed that the odds of acquiring PE was 3.6 times higher among women with severe anemia (OR = 3.6, 95% CI: 1.4-9.1) compared with counterparts (56).The increased risk of PE among women with severe anemia might be related to low ANC attendance, low socioeconomic condition and poor health seeking behavior.

Studies indicated that family history of CHTN and DM were found to be a significant risk factor for PE (31, 34). The study conducted in conducted at Dessie hospital revealed that the odds of having PE was 7.19 (95%, CI: 3.4, 15.2) and 2.4 (95%, CI: 1.09, 5.6) times higher among women who had family history of CHTN and DM respectively compared to counterparts (34). The study in Bahir Dar also indicated that the risk of acquiring PE was found to be 11.16 (AOR; 95%, CI: 5.41, 41.43) and 6.17 (AOR ;95%, CI: 2.11, 20.33), times higher among women who had a family history of CHTN and DM respectively (31). Similarly, case control studies in India revealed that women who had past history of CHTN and DM were found to be at high risk to develop PE compared with those who did not have such medical problems (10, 23).

Table 1: Summary of reviewed literatures and identified gaps

S/No	Study design and population	Sample size	Finding	Gaps	Remark
1	-Cohort study (9) -Nulliparous women	Not mentioned	Cohabitation was not significantly associated with PE Hazard ratio (1.07, 95%, CI: 0.99–1.15 )	-Nutritional related factors were not considered	
2	-Case control study -Women coming for delivery (mixed parity )(26)	291 (97, 194)	Nulliparity as significant risk factor for PE (AOR: 2.68, 95% CI: 1.38, 5.22)	-Quantification of behavioral factors was not done -Unmatched design	Modest control of confounding factors
3	-Case control -Mixed parity Parity controlled (10)	300 (100, 200)	Odds of PE was 10 times higher among cohabitation < 12 months 10.28 (95%, CI: 5.76, 18.35)	-Age was not matched -influence of nutritional factors not considered	Further study recommended by controlling FP and birth interval
4	-Case control study -Nulliparous women (27)	240 (120, 120)	Cohabitation of < 6 months was common among women with PE (adjOR 2.64 , 95% CI: 1.24, 5.79)	Unmatched design and limited sample size.	
5	Case control study Matched on parity (37)	220 (110,110)	Short cohabitation found to be significant risk factor for PE among multiparous women but not among nulliparous.	-Influence of nutrition not considered -Age was not matched	Modest control of confounding factors
6	-Case control study -Mixed parity Among ANC and delivery service users (31)	453 (151, 302)	Medical histories and multiple pregnancy were found to be significant risk factors for PE.	-Done among mixed parity -Different study population	

Further studies were recommended about PE to be done among nulliparous women (10, 57). The purpose of this study was to answer such issues by applying age-matched case-control study and restricting study population to nulliparous women. Restricting parity could also help to avoid major confounding factors such as parity, new paternity as well as birth interval.

## **Conceptual Framework**

The conceptual framework is organized based on reviewed literature. Risk factors which affect PE are organized into four major categories; socioeconomic and demographic factors, obstetrics and gynecologic factors, medical, behavioral and nutritional factors. As it can be observed, PE is at the center of the conceptual framework and all arrows from the four major factors are pointing towards the center to indicate the direct influences on PE.

Socioeconomic and demographic factors which affect PE includes the age of mother, place of residence, economic status, marital status, duration of cohabitation, level of education and occupation. The majority of socio-demographic variables correlate with other variables such as obstetrics and gynecologic, medical, behavioral and nutritional factors.

Obstetrics and gynecologic factors which affect PE comprises age of menarche, previous abortion, parity, antenatal care, iron intake, multiple pregnancies, family history of PE and contraceptive use. On the other hand, medical factors which affect PE include diabetes mellitus, chronic hypertension, urinary tract infections, and anemia. The broken arrow between obstetrics and gynecologic factors and medical factors is to indicate that medical factors such as anemia, CHTN, and UTIs affect pregnancy outcomes (56). The broken arrows are used to indicate that the relationship is either indirect or weak evidence.

Like wise, behavioral and nutritional factors include alcohol intake, smoking, coffee intake, body weight assessed by MUAC, vegetable, and fruit intake. As indicated by the broken arrow, behavioral and nutritional factors such as alcohol use, smoking, vegetable intake and status of physical activity can affect medical conditions such as DM, and CHTN (58).

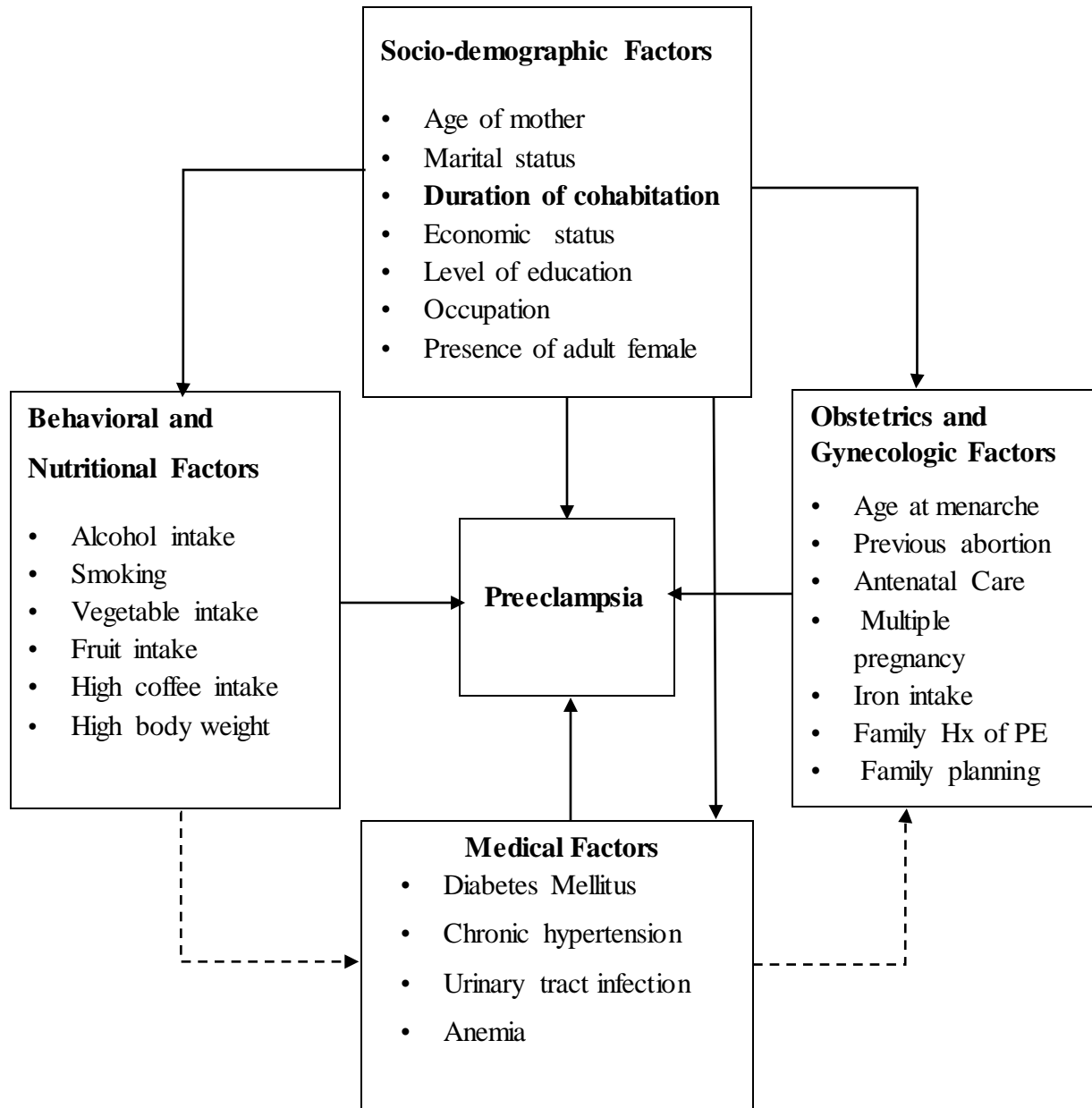


Figure 1: Conceptual frame-work revealing the relationship between preeclampsia and its determinant factors among nulliparous women

## **Research Questions and Hypothesis**

### Research Questions

1. Does short duration of cohabitation play a role for the increased risk of preeclampsia among nulliparous women?
2. How do obstetrics and gynecologic risk factors influence preeclampsia among nulliparous women?
3. Does overweight predispose to increased risk of preeclampsia among nulliparous women?

### Hypothesis

1. Ho: Short duration of cohabitation is not a risk factor for preeclampsia among nulliparous women
2. Ho: Previous abortion is not associated with reduced risk of preeclampsia among nulliparous women
3. Ho: High body weight during pregnancy not is associated with increased risk of preeclampsia among nulliparous women

### **3. Objectives**

#### 3.1 General Objective

To assess the effect of duration of cohabitation, obstetrics and gynecologic, behavioral and nutritional risk factors on preeclampsia among nulliparous women in selected public hospitals of West Amhara Zones, Ethiopia

#### 3.2 Specific Objectives

1. To determine the association between duration of sexual cohabitation and preeclampsia among nulliparous women
2. To determine obstetrics and gynecologic risk factors associated with preeclampsia among nulliparous women
3. To determine behavioral and nutritional factors associated with preeclampsia among nulliparous women

## **4. Methods and Materials**

### **4.1 Study Area**

The study was conducted in Amhara region. Amhara region is broadly divided in to two sub regions western and Eastern Amhara region. The population of the region was estimated to be more than 28 million in the mid-2018 (59). According to the 2018 report of Amhara Regional Health Bureau, there were 76 hospitals, 906 health centers and 3,849 health posts in the region. Of the total 76 hospitals, 62, 9 and 5 hospitals were primary, general, and referral general hospitals respectively (60). The maternal and child health (MCH) service coverage of Amhara region is similar to the national average but much lower than both developed agrarian and urban regions of the country though the region has the highest contraceptive prevalence (47%) in the country following Addis Ababa. The ANC and delivery service coverage of the region were found to be 67% and 27% respectively as per 2016 EDHS report. The region has the highest perinatal mortality (44 per 1000 births) in the country (19).

Public hospitals of Bahir Dar and Debre Tabor towns were selected which are found in West Amhara Zone. Bahir Dar town was purposively selected since there are two public hospitals; one large referral/teaching hospital which provides a service for more than five million population annually. On the other hand, Debre Tabor hospital was selected since there were relatively high (more than 3000) institutional delivery services per annum. Inpatient and outpatient MCH services are provided in the selected hospitals (60).

Bahir Dar which is the capital of Amhara National Regional state is one of the largest cities in Ethiopia which is 565 km far from the capital Addis Ababa. According to Atlas of major cities in Ethiopia, the population of Bahir Dar town is reported to be 348, 429 in 2017 (61). There are two public hospitals (one referral and one district hospitals) and 11 health centers in the town. Felege Hiwot Referral Hospital (FHRH) is a tertiary referral center which provides curative and rehabilitative services for the population of the region and neighboring areas. Whereas, Addis Alem Hospital (AAH) is a district hospital which provides preventive, curative and rehabilitative health services for the population of the town and neighboring areas.

On the other hand, Debre Tabor is the capital town of South Gondar Zone Administration which is about 97 km east of the regional capital Bahir Dar and 666 km from the capital, Addis Ababa. According to reports, the population of the town was estimated to be more than 195, 000 in 2018. There are 3 health centers and one general hospital in the town. Debre Tabor General Hospital (DTGH) is a public hospital which serves the population of the town and surrounding districts. Though the hospital is a general hospital, it serves as a referral center for the surrounding district hospitals (62). A hospital setting was selected for the study since most deliveries of PE patients are conducted in the hospital level. Unless it is emergency, delivery of women with PE is recommended to be managed at hospital level due to the difficulty of managing complications related to the disease.

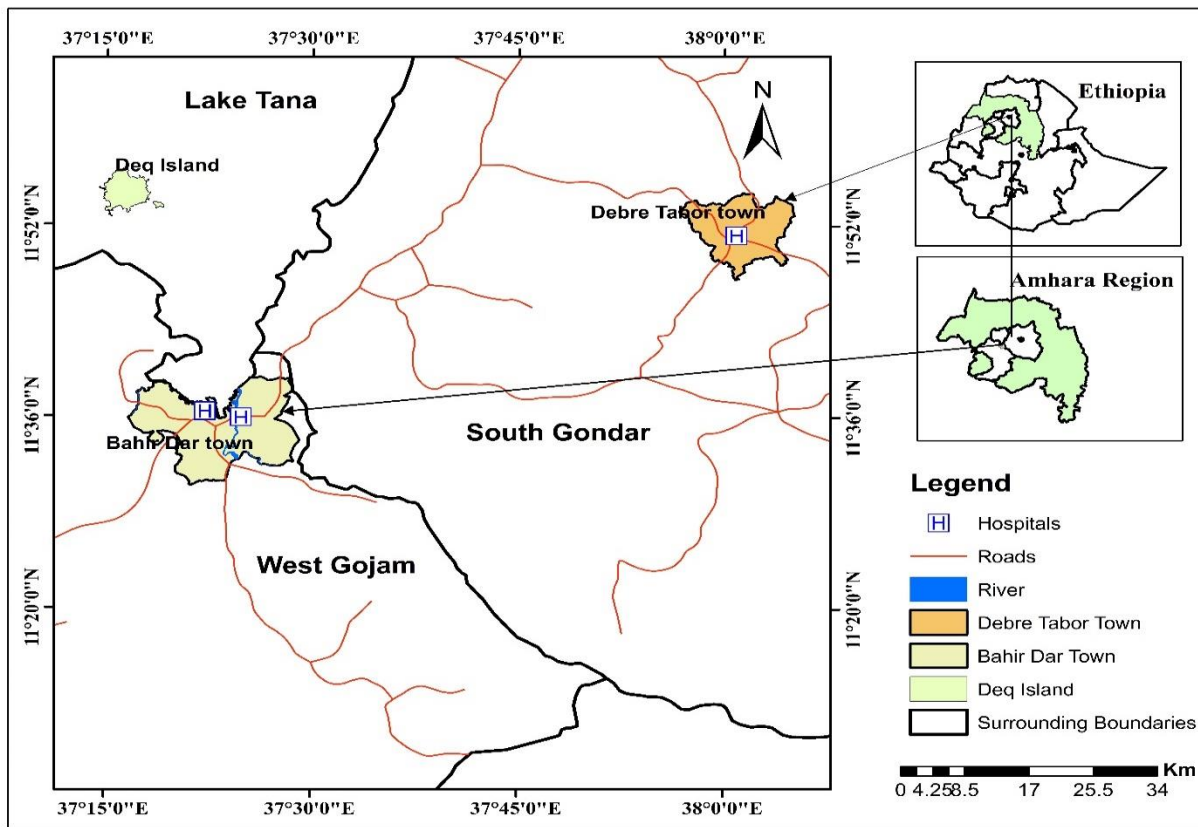


Figure 2 : Map of the study areas

#### 4.2 Study Period

The data collection was undertaken for three months from January 24 to April 24, 2018 in obstetrics wards of the selected hospitals.

### 4.3 Study Design

An age-matched case-control study design was employed on nulliparous women with and without PE who attended delivery services at FHRH, AAH, and DTGH. Age was matching variable in our study since there is variation in the risk of having PE between different age groups. Studies indicated that women who found in extreme age are at risk to develop PE compared to other age groups (10, 15, 39). With regards to matching criteria, cases and controls must be in the same five year age groups.

Cases: - Those nulliparous women who were diagnosed as having increased BP with protein urea irrespective of the severity of the diseases were considered as cases. BP  $\geq$  140/90 mmHg on two separate readings taken at least four hours apart or a single BP measurement of  $\geq$  160/110 mmHg and a proteinuria  $\geq$  300mg per 24-hour urine collection or dipstick reading of 1+ occurred after 20 weeks of gestation among previously normotensive women (5) was the diagnostic criteria used to recruit cases .

Controls: - Were age matched normotensive nulliparous women who came for delivery services at the three hospitals. Controls were made to be similar with cases by age in a five year age group. The selection of controls was made at each hospital from which cases are selected to control the influence of context variation.

### 4.4 Source Population

All nulliparous pregnant women who were seeking delivery services at FHRH, AAH, and DTGH.

### 4.5 Study Population

Selected pregnant nulliparous women with and without PE coming for delivery services at the selected three hospitals during the study period were the study population.

#### 4.5.1 Study Unit

Individual pregnant nulliparous women with and without PE who received delivery services at the selected three hospitals.

#### 4.5.2 Inclusion Criteria

Those women who come for delivery of their first child; diagnosed with PE and those age-matched controls were included. Since the study is conducted among nulliparous women, those women who have had previous abortions were also included in the study. Women who fulfill the ACOG diagnostic criteria of PE (5) after confirmed by a physician were included.

Women with sign of impaired liver function as indicated by abnormally elevated blood concentrations of liver enzymes were also considered as cases irrespective of the presence of proteinuria after confirmed by laboratory investigations.

#### 4.5.3 Exclusion Criteria

Those nulliparous women with known chronic hypertension history and severely ill to the extent unable to respond to questions were excluded in the study.

#### 4.6 Variables

##### 4.6.1 Dependent Variable

PE is the outcome variable to be studied. It is diagnosed when there is increased BP and protein urea occurred after 20 weeks of gestation irrespective of the severity of the disease after confirmed by a physician.

##### 4.6.2 Independent Variables

Duration of cohabitation, obstetrics and gynecologic, behavioral and nutritional factors are major independent variables which affect PE in our study.

Duration of cohabitation is the period of sexual relationship with a partner before conception. The variable was measured by history taking from the participants using last normal menstrual period (LNMP) as a reference and counting back to the time of sexual initiation /marriage. For nulliparous women who had a sexual relationship with physiologic father the current pregnancy before marriage, the time of sexual initiation was used instead of marriage. For those women who did not remember their LNMP, the start date of pregnancy was estimated by subtracting 280 days from the date of delivery (63). Taking the calculated date as the start of pregnancy and counting back to know the duration of sexual cohabitation.

Likewise, obstetrics and gynecologic characteristics are related to pregnancy, abortion, and family planning. Obstetrics and gynecologic factors include; age at menarche, previous abortion, antenatal care, multiple pregnancy, iron intake, family history of PE, and family planning methods. Information about obstetrics and gynecologic variables was collected through interview using structured questionnaires and review of client medical folders as confirmation mechanism. For those participants who had no record about gestation of terminated pregnancy, participants self-report was used to decide the gestational age of abortion.

Studies indicated that those who had one abortion and those who had two or more had different risk of PE. thus number of abortion is dichotomized as < 2 abortion and  $\geq 2$  abortions (45). Information about family planning methods was characterized by type (hormonal and barrier methods of contraceptives).

Behavioral and nutritional risk factors are lifestyle variables which affect the health of an individual. Smoking, alcohol intake, coffee intake, physical exercise, body weight measured by MUAC, vegetable and fruit intake are behavioral and nutritional factors. Information about behavioral and nutrition variables was collected by interview using questionnaires. Adequate vegetable and fruit intake was considered for women who reported as they take vegetable and fruit during pregnancy in a daily basis. Thus, vegetable and fruit intake was dichotomized as daily and not daily (64). A minimum of at least one serving per week is considered as vegetable and fruit intake in our study. Data about alcohol consumption was collected through an interview about the type and the amount in milliliter by estimation of the materials used. Then the finding of alcohol in milliliter was converted into standard unit based on the alcohol content of the drink. Alcohol consumption of more than 1-2 standard units from 1-2 times a week is considered as high intake for a pregnant woman which results in pregnancy complication (58). Taking the lower limit those who consume more than 1 standard unit alcohol per week were considered as at risk of complications developed from alcohol consumption during pregnancy. The formula used to change ml of alcohol to a standard unit is presented below.

Standard unit =  $\frac{n \text{ ml} * AV \text{ alcohol } \%}{1000}$ , where n is the amount of alcohol drink in ml, AV is average alcohol volume in percent.

With regards to coffee drink, intake of more than (300 mg) or > 4 four cups of coffee per drink is a risk for pregnancy complications than frequency of drink (65). MUAC was used to assess obesity /overweight as an alternative to BMI due to its better accuracy of indicating actual body fat and its stability during pregnancy, unlike BMI. MUAC is independent of pregnancy or lactation status and therefore can be used as an effective indicator of women's nutritional status throughout the reproductive years (66). It is measured by a standard tape meter in the midway between the olecranon of the elbow and the acromion process of the shoulder of the non-dominant arm.

The MUAC cutoff point for obesity, overweight and underweight is found to be >31 cm, >27cm and < 23cm respectively (67, 68). However, the cutoff point can be different for different countries. A MUAC cutoff point of < 23cm, 23-24.99cm, and  $\geq$  25cm for underweight, normal weight, and overweight/obesity respectively were used in our study (35).

On the other hand, socio-demographic and medical factors were treated as confounding factors in this study. Socio-demographic variables include maternal age, marital status, place of residence, economic status, level of education, and occupation. Information about socio-demographic variables was collected by interview of participants using questionnaires. Marriage in under 20 years of age is found to be a risk factor for PE and is used as cutoff point in our study (10). Similarly, medical factors include CHTN, anemia, UTIs, and DM. Clients' medical chart was reviewed using prepared checklist in addition to interview to get information about medical conditions of the study participants. Data about economic status was collected through an interview about the monthly household income of the study participants.

#### 4.7 Sample Size Determination

Double population proportion formula was used to calculate the sample size.

$$\text{Sample size (n)} = \frac{(r+1) (p^* (1- p^*) (Z_B + Z_{\alpha/2})^2}{r(p_1-p_2)^2}$$

Where r =is ratio of control to cases, p\*, average proportion of exposure among cases and controls, p<sub>1</sub>, the proportion among cases, p<sub>2</sub>, the proportion among controls, Z<sub>B</sub>, standard normal variate power, and Z<sub>α/2</sub>, level of significance taken at 95% confidence interval and 80% power (69). To boost the power of the study, sample size was calculated for 11 variables which found to be significantly associated with PE from previous studies.

Proportions among cases and controls were used to predict sample size and the minimum odds ratio to be detected by the study. The variable which gave the largest sample size was taken as a final sample size by adding 10% non-response rate. Open-Epi software was used to calculate sample size at 95% confidence interval and 80% power. A 2:1 control to case ratio was used to increase the power of the study.

Table 2: Variables used for sample size calculation from previous studies

Variables	Authors	Proportion of cases	Proportion of controls	Sample size	Minimum odds ratio	Total sample + 10% NRR
1. Short duration of cohabitation	(27)	45.6%	29.2%	300	2.03	330
2. Vegetable intake	(26)	15.8%	5.8%	294	3.05	324
3. Obesity	(70)	34%	19%	294	2.2	324
4. Coffee intake	(71)	82%	65%	242	2.45	266
5. Multiple pregnancy	(26)	17.9%	4.7%	186	4.24	205
6. Alcohol use	(26)	34.74%	11.05%	104	4.29	115
7. No ANC follow up	(26)	40%	12.6%	84	4.62	94
8. Age < 20 years	(10)	55%	24%	84	3.87	93
9. Previous abortion	(45)	1.2%	23%	83	0.04	92
10. Family history of HTN	(31)	34.4%	5.3%	59	9.37	65
11. Age of menarche < 12 Yrs	(10)	84%	28.5%	26	13.17	29

Thus, the final sample size after adding 10% non-response rate was 330 participants; 220 controls and 110 cases.

#### 4.8 Sampling Procedures

The calculated sample size was proportionally allocated to study hospitals based on delivery caseload. Since PE is a rare disease and there was time constraint to get adequate sample size, all cases of PE among nulliparous women who fulfill the inclusion criteria were included in the study. Consecutive sampling technique was applied to select cases at the study facilities. For each PE cases, two controls in the same five-year age group were selected. According to the 2016/17 report, the total annual deliveries of the selected three hospitals were reported to be 10, 512. At institution level, the annual number of deliveries reported were 5662, 1650 and 3200 at FHRH, AAH, and DTGH respectively. Hence, the calculated sample 330 was proportionally allocated to the three hospitals based on the number of deliveries reported at each facility by taking 10,512 as denominator. Based on this calculation, the allocated sample was 177, 51 and 102 for FHRH, AAH, and DTGH respectively.

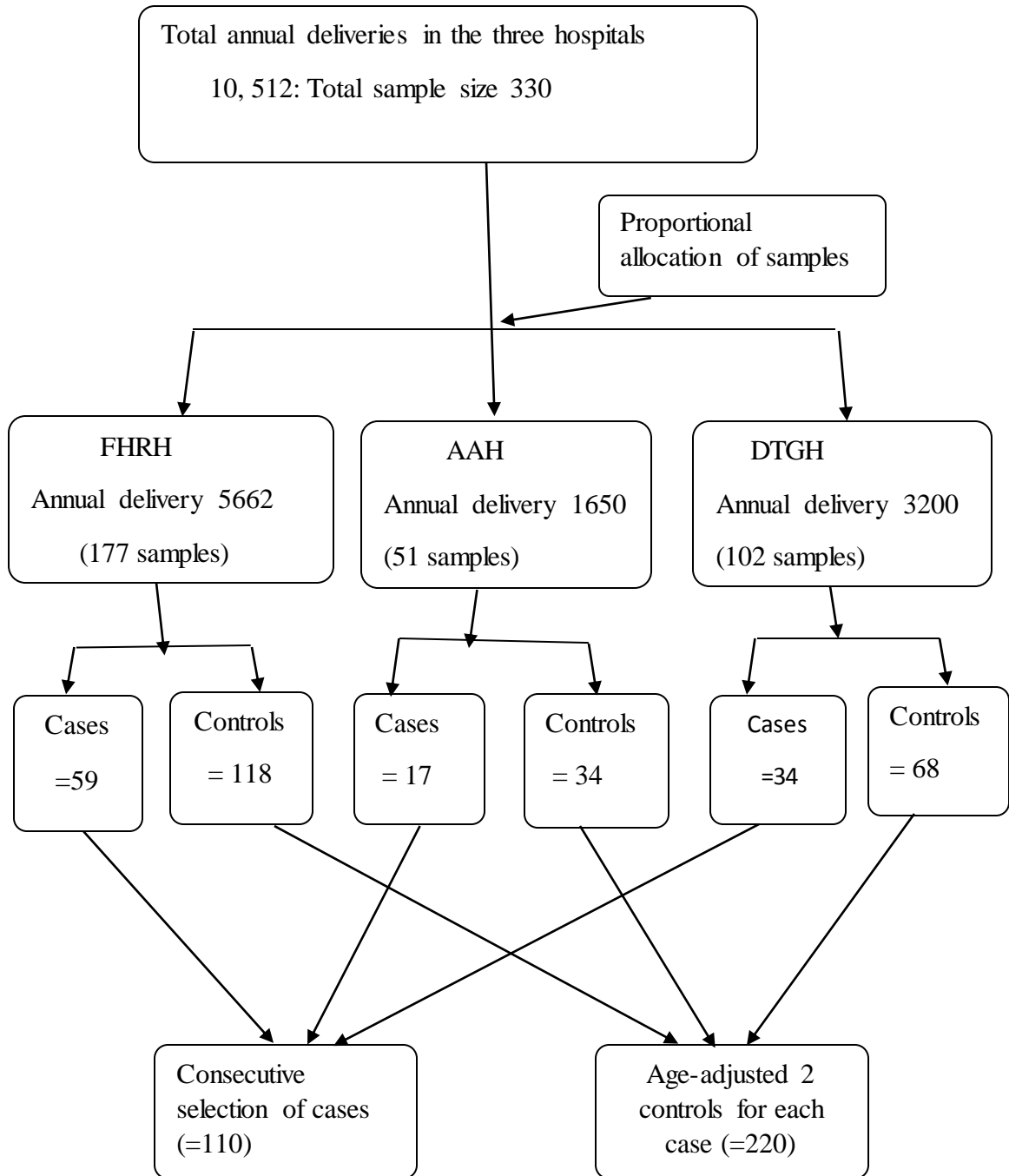


Figure 3: Schematic presentation of sampling procedures

#### 4.9 Data Collection Procedures and Tools

Information about study variables was collected through face to face interview using structured questionnaires and prepared checklist. With regards to anthropometry, MUAC of the participant was taken at the end of each interview session. Data collection was conducted by five BSc midwives and supervision of data collection process was managed by two MSc clinical midwives. Since the study has no professional related bias, midwives who were working in the delivery wards of selected facilities were recruited for data collection to manage logistics related issues. The Ethiopian demographic and health survey (EDHS) questionnaires were adapted to measure socioeconomic and demographic, obstetrics and gynecologic, and behavioral characteristics of the study participants. Some components were added to measure the influence of duration of cohabitation and abortion-related variables which have been validated by studies conducted in different countries (9, 10). The study tool was translated to Amharic language and then translated back to the English language to check consistency.

The interview was conducted six hours after delivery to ensure stabilization of the women following birth. Moreover, those women without any complication are usually discharged six hours following birth. Thus, in order to get appropriate age-matched controls for each case of PE, the interview was conducted after six hours of birth for both cases and controls. Clients' medical chart was reviewed to confirm the diagnosis, previous medical, and gynecologic conditions of the study participants by the prepared checklist.

#### 4.10 Data Quality Assurance

To ascertain data quality, a standard questionnaire was used by adapting tools from EDHS. Data collection and supervision was undertaken by midwives who have experience in data collection and supervision of a research project. To minimize measurement bias, two days training was given to data collectors and supervisors; about how to fill the questionnaires & checklist, clarifications of the whole study tools, variables, research ethics, field data management, and supervision. Pretesting was conducted on 5% of the study sample and necessary corrections and modifications were conducted on the study tools (as example frequency of substance use per week has changed to per drink since there were women who drink less frequently). Since there is no risk of contamination at a facility level, pretesting was conducted at the hospitals which were selected for the study.

Both cases and controls were selected in the same facility to minimize context variations. For the sake of controlling age as confounding factor, an age-matched case-control study design was employed. To further increase the power of the study, two age matched controls were selected for each PE cases. Furthermore, continuous monitoring and follow up at time of data collection was conducted by the principal investigator in addition to field data cleaning and editing. Regards to MUAC measurement, inter and intra-rater measurement error was assessed before and at the middle of data collection period. The value of relative technical error of measurement (relative TEM) of MUAC was within the acceptable range 1.01% and 1.27% respectively for intra and inter-rater measurement errors. Standard operating procedures (SOP) was prepared and used for MUAC measurement.

#### 4.11 Data Management and Analysis

The data was entered in a template prepared on Epi-Data version 3.1. An internal consistency check was prepared on the template to minimize errors during data entry. Data cleaning was done by running frequencies and cross-tabulating with the main outcome variables. The magnitude of system missing and missing values during data collection was checked before initiation of further analysis. Missing values were checked against hard copies of the collected data to correct it accordingly. The data was exported to SPSS version 20 for analysis. The frequency of main dependent and independent variables was run and appropriate recoding was done to ease presentation. Descriptive statistics was used to explore the data in relation to relevant variables. Tables and figures were used to present the frequency distribution of cases and controls by various characteristics of study participants. Moreover, chi-square test was used to show significance difference in PE across different characteristics of study participants. A threshold p value of less  $\leq 0.05$  was used to declare significance association between PE and its predictors in the chi-square test. Since the study is matched case control study design, matched analysis (conditional logistic regression analysis) was used. Hence, variables which were found to be associated with PE were included in the conditional binary logistic regression. Furthermore, different variables including duration of cohabitation, obstetric and gynecologic, behavioral, and nutritional factors were included in the conditional multivariable logistic regression to single out the effect of each covariate with PE. Multi-collinearity between independent variables was checked. The Hosmer-Lemeshow goodness of fit test was used to assess the fitness of the final model. The model was fit well with  $X^2 = 10.05$  and P value of 0.262.

Both crude and adjusted ORs were used in order to measure the strength and direction of association of duration of cohabitation, obstetrics and gynecologic, behavioral, and nutritional risk factors with PE among nulliparous women. A 95% confidence interval for crude and adjusted ORs and a threshold p-value of  $\leq 0.05$  was used to decide significance of association.

#### 4.12 Operational Definitions

Duration of cohabitation: - A period from marriage to the first conception with unprotected sexual exposure with biological father of current pregnancy. The duration was calculated from the time of sexual exposure to LNMP (last normal menstrual period).

Long duration of cohabitation: - Sexual exposure for  $\geq 12$  months prior to conception. On the other hand, short duration of cohabitation is sexual exposure of less than 12 months prior to conception (10).

Preeclampsia:- The standard ACOG definition was used which define PE as BP  $\geq 140/90$  mmHg on two separate readings taken at least four hours apart or a single BP measurement of  $\geq 160/110$  mmHg and a proteinuria  $\geq 300$ mg per 24-hour urine collection or dipstick reading of 1+ occurred after 20 weeks of gestation among previously normotensive women (1). Since eclampsia is the complication of PE, women diagnosed with eclampsia were also considered as PE in this study.

Nulliparous women: - women who never give viable fetus. For this particular study, women who had previous abortion/s irrespective of the means of termination were also considered.

Abortion: - Termination of pregnancy before 28 weeks of gestation was considered as abortion in this study. Dichotomized as  $\geq 2$  abortions and  $< 2$  abortion (45).

Behavioral factors: - Factors related to exercise, and substance use such as smoking, alcohol, and coffee intake.

Obesity:- Measured by MUAC of the pregnant women and MUAC of  $\geq 25$  cm was taken as cutoff point for obesity in our study (35).

High alcohol drink:- High alcohol drink was considered if pregnant women take  $\geq 1$  standard unit per week during pregnancy (58).

High caffeine intake:- Was considered if pregnant women reported of taking more than 300 mg caffeine which is equivalent to  $> 4$  cups of coffee per day (72).

Healthy diet:- Healthy diet was defined as taking foods of mainly plant based foods such as vegetables and fruits (64).

Vegetable and fruit intake:- Vegetable and fruit intake is recommended to be taken daily as per WHO recommendation. Thus vegetable and fruit intake was dichotomized as daily intake and no daily intake (64).

Low hemoglobin level:- Low Hgb is defined as a pregnancy Hgb level of  $< 11$  mg/dl which indicates anemia during pregnancy (73).

#### 4.13 Ethical Considerations

Ethical clearance and letter of approval were obtained from the School of Public Health (SPH), Research Ethics Committee (REC), College of Health Sciences (CHS), Addis Ababa University (AAU). Similarly, letter of permission was obtained from Amhara National Regional State Health Bureau and administrative bodies of the selected hospitals. The purpose of the study was described and informed consent was obtained from each study participant prior to the commencement of data collection. Confidentiality of information received from the study participants was maintained by using codes rather than the name of participants during data collection procedures. Participants were informed that participation is fully voluntary and so that they can terminate the participation at any stage of the interview if they do not want to continue. Post interview health information was provided for participants who were practicing unhealthy behaviors. The study did not inflict on study participants except disturbing mothers after the trauma of delivery.

## 5. Result

### 5.1 Descriptive Analysis

#### **Socio-demographic Characteristics of the Study Participants**

From the total of 330 nulliparous women who came for delivery services at FHRH, AAH, and DTGH, 9 participants, were excluded in the study (3 cases and 6 controls) due to failure to get age-matched controls. Thus, a total of 321 age-matched nulliparous women (107 cases and 214 controls) were enrolled in the study giving a response rate of 97.27% for both cases and controls.

Age was the matching variable in our study and five year age group was used for matching. The median age of the study participant was 23 years. The proportion of ages 15-19, 20-24, 25-29, 30-34 years were found to be 31.3%, 29.4%, 30.0% and 9.3% respectively.

With respects to age at marriage, more than half, 57 (53.3%) of cases and 94 (43.9%) controls were engaged into marriage under 20 years of age. With regards to place of residents, more cases 44 (41.1%) than controls 66 (30.8%) were rural residents. The majority, 94 (87.9%) cases, and 200 (93.5%) controls were in union. Whereas, the rest 13 (12.2%) cases and 14 (6.5%) controls were not in union; either never married, widowed or separated.

Of the total study participants, a high proportion of cases 55 (51.4%) had a duration of sexual cohabitation less than 12 months compared to controls 36 (16.8%). High variability in duration of cohabitation has been observed among cases and controls. The median duration of cohabitation among cases and controls were found to be 11 months and 20 months respectively. Interquartile range of duration of cohabitation was found to be 18 months and 12.25 months among cases and controls respectively.

With regards to education, 45 (42.1%) of cases and 46 (21.5%) controls never attended any education. On the other hand, 28 (26.2%) and 99 (46.3%) of cases and controls respectively had attended secondary education or above. The median monthly household income of the study participants was 3000 ETB. More than half, 60 (56.1%) of cases and 98 (45.8%) controls had a monthly household income of less than the median income. The detail of the socio-demographic characteristics of the study participants is presented in the following table.

Table 3: Socio-demographic characteristics of nulliparous women attended delivery services in selected hospitals of West Amhara Zones, Ethiopia, 2018

Variables	Cases	Controls	Chi-square( $X^2$ )	P- value
	Number (%)	Numbers (%)		
Residence:				
Urban	63(58.9)	148(69.2)	3.347	0.067
Rural	44(41.1)	66(30.8)		
Marital status				
Currently in union	94 (87.9)	200 (93.5)	2.912	0.088
Not in union	13 (12.1)	14 (6.5)		
Age at marriage				
< 20 years old	57(53.3)	94(43.9)	2.501	0.114
≥20 years old	50(46.7)	120(56.1)		
Cohabitation				
<12 months	55 (51.4)	36 (16.8)	41.992	0.000
≥ 12 months	52 (48.6)	178 (83.2)		
Education attended				
No education	45 (42.1)	46 (21.5)	16.330	0.001
Primary/informal	30 (28.0)	69 (32.2)		
Secondary	15 (14.0)	55 (25.7)		
Higher Education.	17 (15.9)	44 (20.6)		
Main Occupation				
Housewife	27(25.2)	52(24.3)	9.902	0.078
Student	5(4.7)	8(3.7)		
Private business	16(15.0)	56(26.2)		
Farmer	39(36.4)	49(22.9)		
Handcraft work	5(4.7)	9(4.20)		
Employed	15(14.0)	40(18.7)		
Adult female in a family				
Yes	16 (15.0)	46(21.5)	1.959	0.162
No	91 (85.0)	168 (78.5)		
Education attended				
No education	33 (30.8)	41 (19.2)	7.396	0.06
Primary/informal	28 (26.2)	50 (23.4)		
Secondary	26 (24.3)	66 (30.8)		
Higher Education.	20 (18.7)	57 (26.6)		
Monthly income				
<3000 ETB	60 (56.1)	98 (45.8)	3.016	0.082
≥3000ETB	47 (43.9)	116 (54.2)		

## **Obstetrics and Gynecologic Characteristics of the Study Participants**

Women who had planned pregnancy had better health-seeking behavior and better pregnancy outcomes. Of the total study participants, high proportions of cases 32 (29.9%) had unplanned pregnancy compared to controls 21 (9.8%). With regards to ANC follow up, 72 (67.3%) cases and 188 (88.0%) of controls had at least one ANC visit during the recent pregnancy. Only 15 (20.8%) of cases and 63 (33.5%) of controls had four or more visits during pregnancy.

A high proportion of cases and controls had a birth of a male baby which was reported among 52 (53.1%) of cases and 110 (52.6%) of controls. While, female births were registered among 46 (46.9%) cases and 99 (47.4%) controls.

Based on participants' self-report, a high number of women with PE 28 (38.9%) did not receive counseling about nutrition during ANC follow up compared with women without PE, 25 (13.3%). A high proportion, 59 (81.9%) of cases and 169 (89.9%) of controls have reported as they take iron folate during pregnancy. On the other hand, about 17 (15.9%) cases and 20 (9.3%) controls had age of menarche less than 12 years.

Overall previous history of abortion was found to be comparable among cases and controls. Sixteen (15.0%) cases and 38 (17.8%) controls had a history of abortion in previous pregnancies. Variation among cases and controls has been observed related to the type and paternity of the abortion.

Of the total study participants, 142 (66.4%) controls, and 59 (55.1%) cases have reported as they use any modern contraceptive in the last two years prior to recent pregnancy.

Table 4: Obstetrics and Gynecologic characteristics of nulliparous women attending delivery services in selected hospitals of West Amhara Zones, Ethiopia, 2018

Variables	Cases	Controls	Chi-square (x <sup>2</sup> )	P value
	Number (%)	Number (%)		
Planned pregnancy				
Yes by then	65 (60.7)	169 (79.0)	20.929	0.000
Yes latter	10 (9.3)	24 (11.2)		
No	32 (29.9)	21 (9.8)		
No of ANC visits				
1-3	57 (79.2)	119 (63.3)	5.995	0.014
≥ 4 visits	15 (20.8)	69 (36.7)		
Iron intake : Yes	59 (81.9)	169 (89.9)	3.048	0.081
No	13 (18.1)	19 (10.1)		
Iron intake				
< 3months	46 (80.7)	119 (70.4)	2.289	0.130
≥3 months	11 (19.3)	50 (29.6)		
Advise at ANC				
Yes	44 (61.1)	163 (86.7)	21.008	0.000
No	28 (38.9)	25 (13.3)		
Multiple pregnancy				
Yes	9 (8.4)	5 (2.3)	6.311	0.012
No	98 (91.6)	209 (97.7)		
Sex of child in singleton birth				
Male	52 (53.1)	110 (52.6)	0.005	0.944
Female	46 (46.9)	99 (47.4)		
Abortion history				
Yes	16 (15.0)	38 (17.8)	.401	0.527
No	91 (85.0)	176 (82.2)		
Age at menarche				
< 12 years	17 (15.9)	20 (9.3)	2.994	0.084
≥ 12 years	90 (84.1)	194 (90.7)		
Abortion Number				
< 2 abortion	11 (68.8)	33 (86.8)	2.442	0.118
≥ 2 abortions	5 (31.2)	5 (13.2)		
FP methods used				
Non users	41 (38.3)	78 (36.4)	11.295	0.004
Hormonal methods	50 (46.7)	126 (58.9)		
Condom	16 (15.0)	10 (4.7)		

There was significant variation among cases and controls with regards to having ANC visits in 95% confidence bar graph.

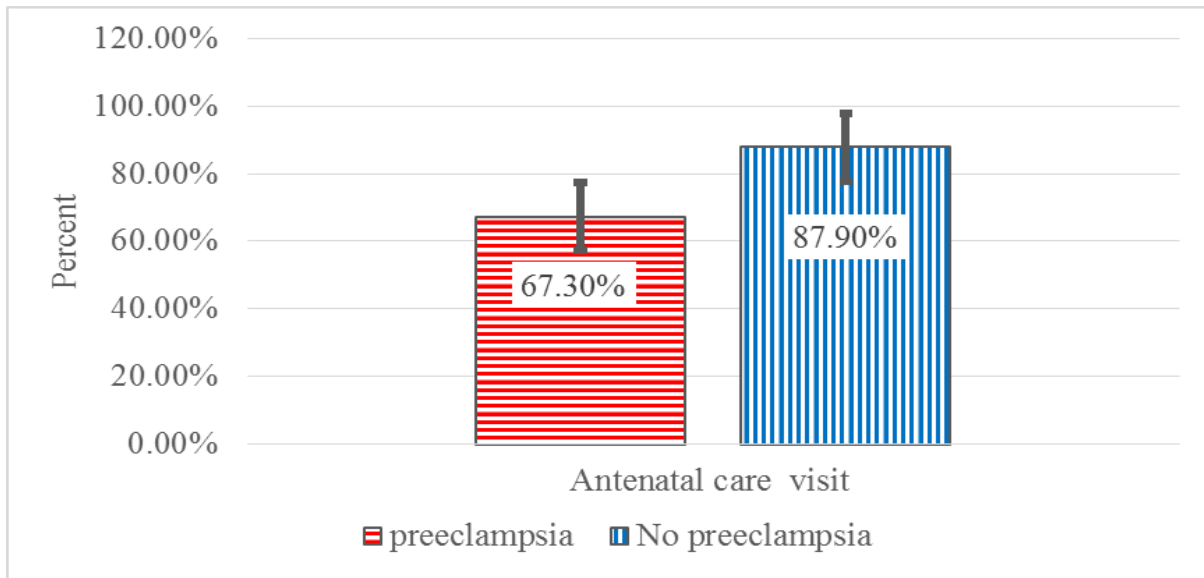


Figure 4: Antenatal care visits among nulliparous women who received delivery services in selected hospitals of West Amhara Zones, Ethiopia, 2018

With regards to ANC follow-up, 67.3% of cases and 87.9% of controls were reported as they have ANC follow-up during the recent pregnancy.

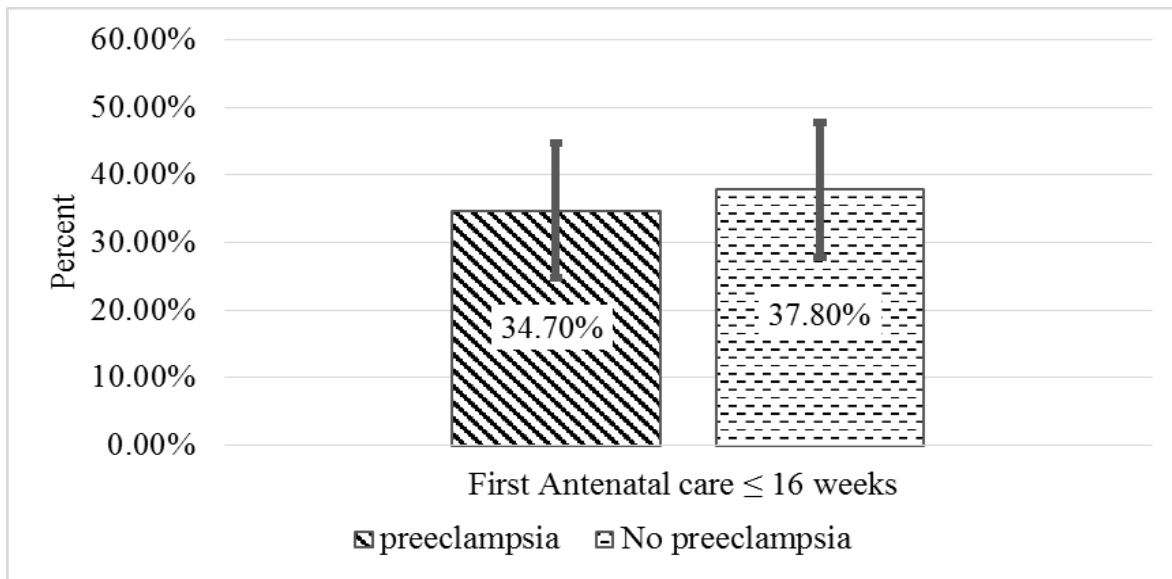


Figure 5: Timing of first antenatal care among nulliparous women who came for delivery services at selected hospitals of West Amhara Zones, Ethiopia, 2018

There was no significant variation among cases and controls on the timing of first antenatal care. Only, 25 (34.7%) and 71 (37.8%) of cases and controls respectively had a first antenatal contact at or before 16 weeks of pregnancy.

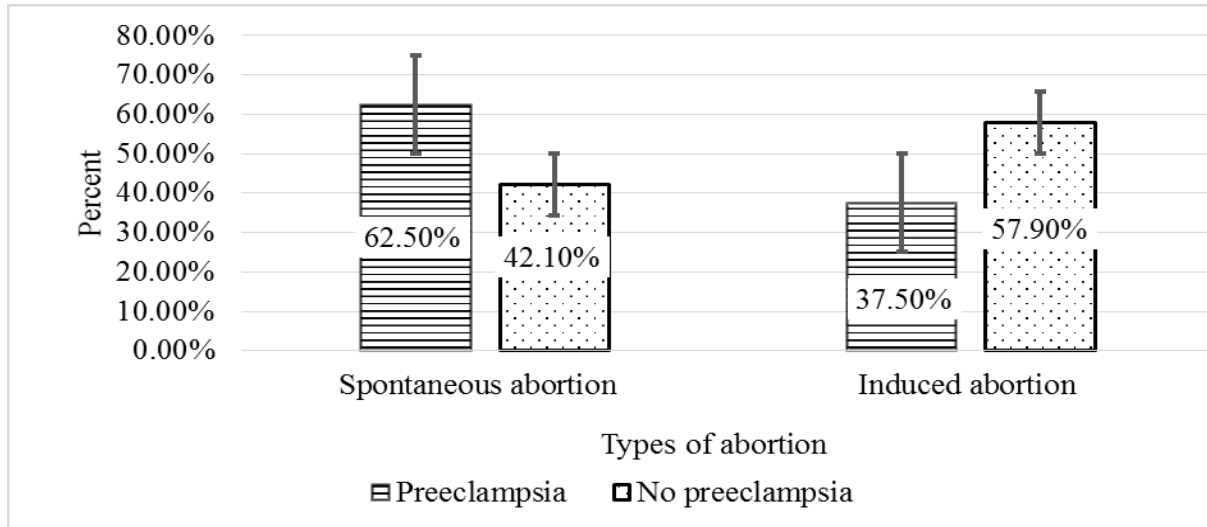


Figure 6: Abortion with type among nulliparous women who attended delivery services in selected hospitals of West Amhara Zones, Ethiopia, 2018

Among participants who have had a history of previous abortions, more than half, 10 (62.5%) of the abortions among cases were spontaneous abortions compared with controls 16 (42.1%). Whereas, induced abortion was reported to be 6 (37.5%) and 22(57.9%) among cases and controls respectively.

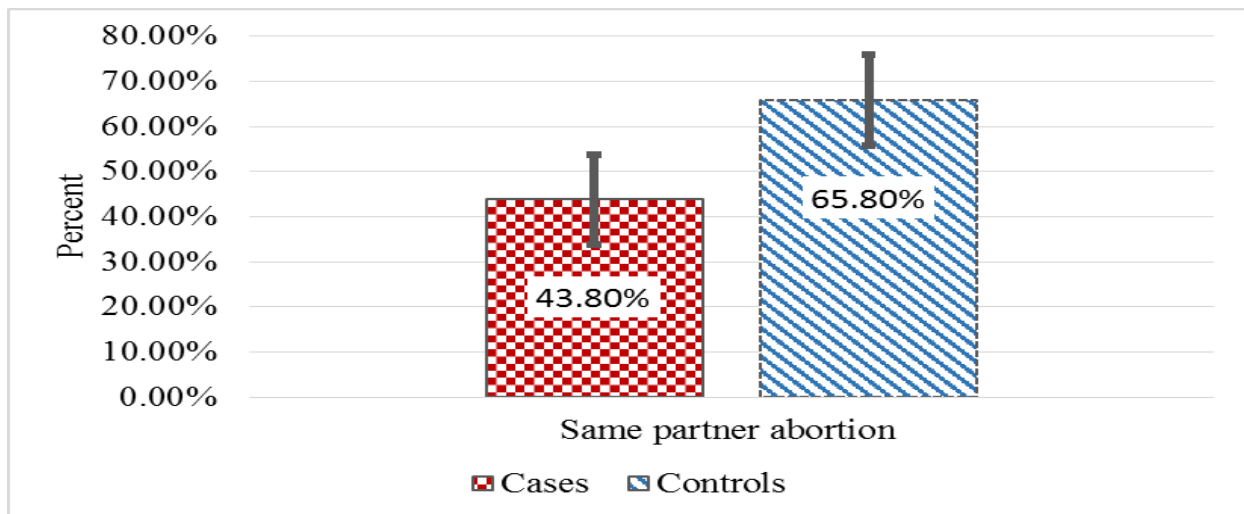


Figure 7: Same partner abortion among nulliparous women who received delivery services in selected hospitals of West Amhara Zones, Ethiopia, 2018

Same partner abortion was found to be low among cases compared with controls. Of the total respondents who had previous abortions, 7 (43.8%) and 25 (65.8%) were same partner abortions among cases and controls respectively.

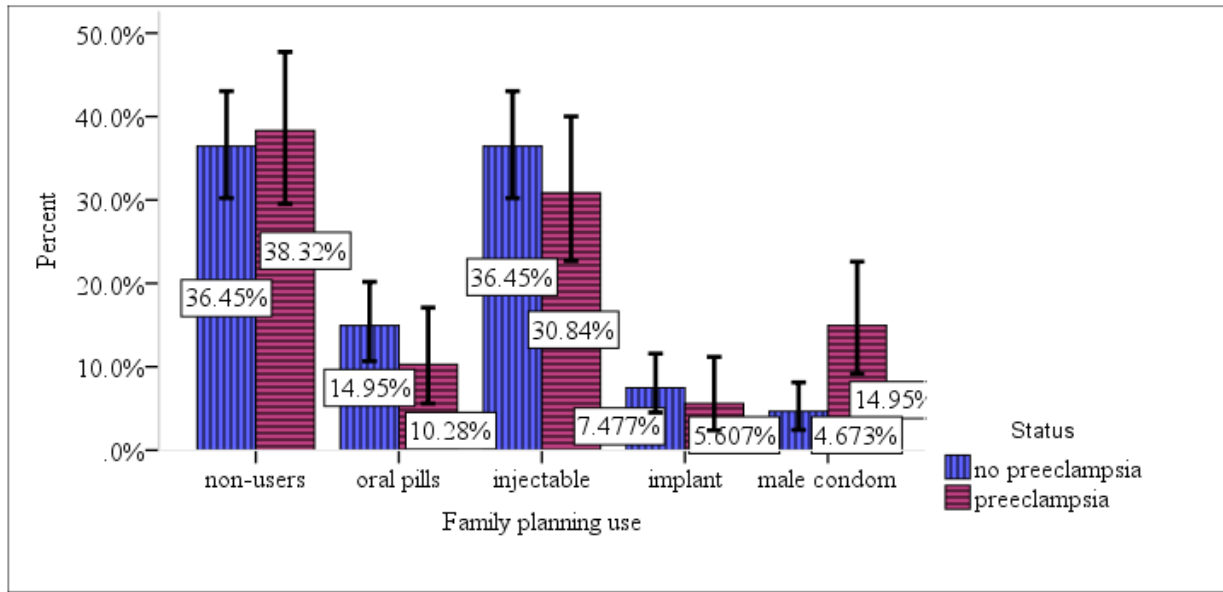


Figure 8: Methods of family planning used among nulliparous women who received delivery services in selected hospitals of West Amhara Zones, Ethiopia, 2018

There was no significant difference between cases and controls with respect to utilization of family planning methods. Forty-one (38.32%) cases and 78 (36.45%) controls did not use any modern contraceptives in the last two years prior to the recent pregnancy. The majority, 33 (30.84%) cases and 78 (36.45%) of controls were reported as they use an injectable method of family planning. On the other hand, 16 (14.95%) of cases and 10 (4.67%) of controls used condom as a method of family planning.

## **Behavioral Characteristics of the Study Participants**

With regards to behavioral characteristics, 47 (43.9%) of cases and 58 (27.1%) controls have reported as they drink alcohol during pregnancy. Of the total study participants who drank alcohol, 38 (80.9%) of cases and 42 (72.4%) controls reported as they drink alcohol at least on a weekly basis. Similarly, 41 (87.2%) those cases and 49 (84.5%) controls drank more than one standard unit of alcohol per drink.

Coffee was found to be the most commonly utilized substance during pregnancy in our study. Based on self-report of the study participants, 88 (82.2%) of cases and 159 (74.3%) of controls have reported that they drink coffee during pregnancy. With regards to frequency of drink, 27 (30.7%) cases and 33 (20.8%) controls drank coffee on daily bases. Moreover, 17 (19.3%) and 10 (6.3%) cases and controls respectively reported as they drink four or more cups of coffee per drink.

About 73 (68.2%) of cases and 184 (86.0%) of controls have reported that they took vegetable during pregnancy. Similarly, 50 (46.7%) cases and 138 (64.5%) controls were using fruits during pregnancy. Only small proportion of cases and controls reported as they include vegetables and fruits in their diet on daily basis. With regards to physical exercise, 35 (32.7%) cases and 93 (43.5%) controls reported as they perform physical exercise.

With respects to anthropometry, a high proportion of cases 52 (48.6%) had MUAC  $\geq$  25cm compared with counterparts 23 (10.7%).

Table 5: Behavioral and Nutritional characteristics of nulliparous women attending delivery services in selected hospitals of West Amhara Zones, Ethiopia, 2018

Variables	Cases	Controls	Chi-square (x <sup>2</sup> )	P value
	Numbers (%)	Numbers (%)		
Alcohol drink				
Yes	47 (43.9)	58 (27.1)	9.171	0.002
No	60 (56.1)	156 (72.9)		
Frequency of alcohol use				
< once a week	9 (19.1)	16 (27.6)	1.019	0.313
1-7 days a week	38 (80.9)	42 (72.4)		
Quantity of Alcohol used				
< 1 stand. unit	6 (12.8)	9 (15.5)	.160	0.689
≥ 1 stand. Unit	41 (87.2)	49 (84.5)		
Coffee intake				
Yes	88 (82.2)	159 (74.3)	2.538	0.111
No	19 (17.8)	55 (25.7)		
Coffee drink per week				
Not daily	61 (69.3)	126 (79.2)	3.035	0.081
Daily	27 (30.7)	33 (20.8)		
Average coffee per drink				
≤ 4 cups	71(80.7)	149 (93.7)	9.877	0.002
> 4 cups	17 (19.3)	10 (6.3)		
Vegetable intake				
Yes	73 (68.2)	184 (86.0)	14.091	0.000
No	34 (31.8)	30 (14.0)		
Vegetable/week				
Not daily	64 (87.7)	159 (86.4)	.072	0.788
Daily	9 (12.3)	25 (13.6)		
Fruit intake				
Yes	50 (46.7)	138 (64.5)	9.269	0.002
No	57 (53.3)	76 (35.5)		
Fruit /week				
Not daily	45 (90.0)	124 (89.9)	.001	0.977
Daily	5 (10.0)	14 (10.1)		
Exercise				
Yes	35 (32.7)	93 (43.5)	3.437	0.064
No	72 (67.3)	121 (56.5)		
Frequency of exercise				
Not daily	28 (80.0)	73 (78.5)	.035	0.852
Daily	7 (20.0)	20 (21.5)		
MUAC				
< 25 cm	55 (51.4)	191 (89.3)	57.075	0.000
≥ 25cm	52 (48.6)	23 (10.7)		

## Medical Characteristics of Study Participants

With regards to medical characteristics of the study participants, 20 (18.7%) of cases and 7 (3.3%) of controls had family history of HTN. Similarly, 5 (4.7%) of cases and 6 (2.8%) of controls have reported as they have family history of PE. High proportion of cases, 18 (16.8%) had history of UTI during the recent pregnancy compared with controls, 10 (4.7%). The detail is presented in the table below.

Table 6: Medical conditions among nulliparous women who came for delivery services in selected hospitals of West Amhara Zones, Ethiopia, 2018

Variables	Cases	Controls	Chi-square (x <sup>2</sup> )	P value
	Numbers (%)	Numbers (%)		
Family history of HTN			22.019	0.000
Yes	20 (18.7)	7 (3.3)		
No	87 (81.3)	207 (96.7)		
Family history of PE			0.753	0.386
Yes	5 (4.7)	6 (2.8)		
No	102 (95.3)	208 (97.2)		
Family history of DM			3.669	0.055
Yes	11 (10.3)	10 (4.7)		
No	96 (89.7)	204 (95.3)		
UTI in recent pregnancy			13.225	0.000
Yes	18 (16.8)	10 (4.7)		
No	89 (83.2)	204 (95.3)		
Hgb level			0.165	0.684
< 11 mg/dl	11 (10.3)	19 (8.9)		
≥11 mg/dl	96 (89.7)	195 (91.1)		

## 5.2 Association of different Characteristics of women with preeclampsia

First of all, a comparison was done on socio-demographic, obstetrics and gynecologic, behavioral, and nutritional factors among cases and controls. Difference between cases and controls were analyzed by using chi-square test. Then variables which found to be statistically significant with PE in the chi-square test were entered in the conditional bivariable and multivariable logistic regression analysis to identify the independent predictors of PE among the study participants.

Variables such as short duration of cohabitation, unplanned pregnancy, education status, number of ANC, nutritional counseling during pregnancy, multiple pregnancy, barrier contraceptive use, alcohol drink, coffee intake of more than 4 cups per drink, vegetable intake, fruit intake, high MUAC, family history of HTN, and UTIs were found to be significantly associated with PE in the conditional binary logistic regression analysis. Such variables were included in the final model.

Participants who had a short duration of cohabitation were at high risk to develop PE. The conditional multivariable analysis indicated that nulliparous women who had a duration of cohabitation of less than 12 months were 2 times at risk to develop PE compared with women with duration of cohabitation  $\geq 12$  months (AOR: 2.13, 95% CI: 1.10, 4.11).

With respects to educational status of the study participants, having no education was found to be a statistically significant risk factor for PE. The conditional bivariable analysis indicated that the odds of developing PE was found to be 1.84 times higher among women with no education compared with women with some education (COR: 1.84, 95%, CI: 1.03, 3.29). However, the association is vanished when adjusted for confounders.

Nulliparous women who had unplanned pregnancy were found to be at risk to develop PE compared with those who had planned pregnancy by then or sometimes later. The odds of developing PE was found to be 2.4 times higher among women had unplanned pregnancy compared with counterparts (AOR: 2.35, 95% CI: 1.01, 5.52). Similarly, obstetrics related characteristics such as the number of ANC, nutritional counseling during ANC visits, and multiple pregnancy were found to be statistically significant with PE. The conditional bivariable analysis indicated that women who had frequent ANC visit had a low risk of experiencing PE compared with control counterparts (COR: 0.51, 95%, CI: 0.29, 0.92) even though the significance of association does not persist in the conditional multiple logistic regression analysis.

Receiving nutritional counseling during ANC follow-up was found to be independently associated with PE in the conditional multiple logistic regression. The odds of developing PE was found to be lower among women who receive ANC counseling compared to those who did not receive counseling (AOR: 0.52, 95%, CI: 0.29, 0.96). Similarly, participants who had multiple pregnancy were found to be at high risk to develop PE in the conditional bivariable analysis (COR: 1.97, 95%, CI: 1.03, 3.78). However, the association disappeared when adjusted for confounders. Users of hormonal family planning methods are less likely to develop PE compared to non-users or users of barrier methods. The conditional binary logistic regression analysis indicated that women who reported to use barrier methods of family planning prior to pregnancy were at risk to experience PE compared to hormonal contraceptive users or non-users of family planning (COR: 1.82, 95%, CI: 1.00, 3.33)

With regards to behavioral and nutritional characteristics, the conditional bivariable analysis identified that, alcohol drinking and taking more than 4 cups of coffee per drink as significant risk factors to develop PE (COR: 1.65, 95%, CI: 1.12, 2.43) and (COR: 1.96, 95%, CI: 1.14, 3.37) respectively. However, both factors were not found to be statistically significant when adjusted for confounders. On the other hand, vegetable and fruit intake during pregnancy were found to be significantly associated with PE. The conditional multiple logistic regression analysis identified that nulliparous women who include vegetables and fruits in their diet had low risk of acquiring PE compared with those who did not (AOR: 0.42, 95%, CI: 0.22, 0.82) and (AOR: 0.45, 95%, CI: 0.24, 0.87) respectively.

With regards to anthropometry, the conditional multiple logistic regression analysis revealed that nulliparous women who had MUAC  $\geq 25$  cm were at high risk to develop PE compared with counterparts. The odds of acquiring PE was found to be 2 times higher among women with MUAC of  $\geq 25$  cm compared with women who had MUAC  $< 25$ cm (AOR: 2.00, 95%, CI: 1.10, 3.63).

A family history of HTN and UTIs were medical factors found to be significantly associated with PE in the crude analysis in our study (COR: 2.18, 95%, CI: 1.29, 3.68) and (COR: 2.12, 95%, CI: 1.28, 3.52) respectively. Nevertheless, the association did not persist in both medical factors when adjusted for confounders.

Table 7: Conditional multivariable logistic regression analysis of risk factors on preeclampsia among nulliparous women who attended delivery services in selected hospitals of West Amhara Zones, Ethiopia, 2018

Variables	Cases	Controls	COR at 95%, CI	AOR 95%, CI
Cohabitation:				
<12months	55 (51.4)	36 (16.8)	2.80 (1.90 ,4.13)	2.13 (1.10, 4.11)*
≥ 12 months	52 (48.6)	178 (83.2)	1	1
Education				
No education	45 (42.1)	46 (21.5)	1.84 (1.03, 3.29)	1.05 (0.50, 2.23 )
Primary/informal	30 (28.0)	69 (32.2)	1.11 (0.60, 2.05)	1.02 (0.38, 2.74)
Secondary	15 (14.0)	55 (25.7)	0.79 (0.39, 1.60)	1.31 (0.48, 3.56)
Higher Education.	17 (15.9)	44 (20.6)	1	1
Planned pregnancy				
Yes by then	65 (60.7)	169 (79.0)	1	1
Yes latter	10 (9.3)	24 (11.2)	1.13 (0.57, 2.24)	1.560 (0.56 ,4.39)
No	32 (29.9)	21 (9.8)	2.31 (1.48, 3.60)	2.354 (1.01, 5.52)*
No of ANC : 1-3 visits	57 (79.2)	119 (63.3)	1	1
≥ 4 visits	15 (20.8)	69 (36.7)	0.51 (0.29, 0.92)	0.59 (0.26, 1.31)
Nutritional counseling				
Yes	44 (61.1)	163 (86.7)	0.45 (0.27, 0.73)	0.52 (0.29, 0.96)*
No	28 (38.9)	25 (13.3)	1	1
Multiple Px.				
Yes	9 (8.4)	5 (2.3)	2.02 (1.02, 4.01)	1.11 (0.36, 3.39)
No	98 (91.6)	209 (97.7)	1	1
Family planning				
Non users	41 (38.3)	78 (36.4)	1	1
Hormonal users	50 (46.7)	126 (58.9)	0.82 (0.53, 1.26)	0.74 (0.35, 1.58)
Barrier users	16 (15.0)	10 (4.7)	1.82 (1.00, 3.33)	1.34 (0.41, 3.15)
Alcohol drink:				
Yes	47 (43.9)	58 (27.1)	1.65 (1.12, 2.43)	1.29 (0.72, 2.34)
No	60 (56.1)	156 (72.9)	1	1
Coffee per drink				
≤ 4 cups	71(80.7)	149 (93.7)	1	1
> 4 cups	17 (19.3)	10 (6.3)	1.96 (1,14, 3.37)	1.67 (0.69, 4.05)
Vegetable intake :				
Yes	73 (68.2)	184 (86.0)	0.53 (0.35, 0.80)	0.42 (0.22, 0.82)*
No	34 (31.8)	30 (14.0)	1	1
Fruit intake :				
Yes	50 (46.7)	138 (64.5)	0.62 (0.42, 0.91)	0.45 (0.24, 0.87)*
No	57 (53.3)	76 (35.5)	1	1
MUAC:				
< 25 cm	55 (51.4)	191 (89.3)	1	1
≥ 25cm	52 (48.6)	23 (10.7)	3.10 (2.12, 4.53)	2.00(1.10, 3.63)*
Family history of HTN				
Yes	20 (18.7)	7 (3.3)	2.18 (1.29, 3.68)	2.10 (0.96, 4.61)
No	87 (81.3)	207 (96.7)	1	1
UTIs :				
Yes	18 (16.8)	10 (4.7)	2.12 (1.28, 3.52)	1.34 (0.40, 3.25)
No	89 (83.2)	204 (95.3)	1	1

\* Significant at  $P < 0.05$ , 1 = reference, COR: crude odds ratio, AOR: adjusted odds ratio

## 6. Discussion

This study attempted to assess the effect of duration of cohabitation, obstetrics and gynecologic, behavioral, and nutritional factors on PE among nulliparous women who came for delivery services in the selected hospitals of West Amhara Zones, Ethiopia. We found that short duration of cohabitation, unplanned pregnancy, and high body weight as a significant risk factor for PE. On the other hand, receiving nutritional counseling during ANC visits, vegetable, and fruit intake were found to be protective factors for PE in the final model.

High proportions of cases had a short duration of cohabitation 55 (51.4%) compared to controls 36 (16.8%). The difference was found to be higher between cases and controls in our study in contrast to the study done Kashan, Iran (27) which found 45.6% and 29.2% among cases and controls respectively. Variation of the sample size could explain the disparity since that study was done among 240 women unlike ours. Sociocultural variation and difference in the level of awareness of the study participants may also explain the discrepancy. The odds of acquiring PE was 2 times higher among women who had a short duration of cohabitation compared to women with long duration of cohabitation (AOR: 2.13, 95% CI: 1.10, 4.11). The justification for this may be attributed to lack of adaptation of maternal antibody to the paternal antigen (8, 74) which results in inflammation, abnormal placentation, and placental hypoxia. Women who had a long duration of cohabitation have a chance to develop immunologic tolerance to the paternal antigen (11). Delaying pregnancy for at least a year may also have health advantage to accumulate wealth, to get ready psychologically and to plan the pregnancy which ensure family stability. The finding is supported by the studies conducted in India (10), Egypt (15) and a multicounty country study conducted in New Zealand, Australia, United Kingdom; and Republic of Ireland (29) which reported a high risk of PE among women with duration of cohabitation less than 12 months compared with counterparts. The justification for the similarity might be related to the similarity of factors assessed and the study setting in which the aforementioned studies were conducted in a hospital setting. However, the finding of our study is not in agreement with other studies conducted in Nigeria (9) and South Africa (11) which found no significant relationship between short duration of cohabitation and the risk of acquiring PE. The justification for the discrepancy might be due to the difference in the study population and study design.

The Nigerian study was a prospective cohort study and relatively small number of participants with PE could explain the variation. Similarly, South African study was a case control study conducted among 200 women with mixed parity unlike our study.

Nutritional counseling during ANC visit was found to be significantly associated with PE in the conditional multivariable logistic regression analysis. Women who receive nutritional counseling during ANC follow-up had nearly half reduced risk of experiencing PE compared with counterparts (AOR: 0.52, 95%, CI: 0.29, 0.96). The possible justification is women who receive nutritional counseling can follow healthy diet compared with those who did not get advice. The finding of our study is in line with the study conducted in selected facilities of Addis Ababa which revealed women who receive nutritional counseling during ANC visits had a low risk of acquiring PE (26). The justification for consistency of the finding may be related to the resemblance of study design and study setting. The study in Addis Ababa was a case-control study and conducted in a hospital setting similar to our study.

Likewise, the odds of experiencing PE was 2.35 times higher among women who had unplanned pregnancy compared with counterparts (AOR: 2.35, 95%, CI: 1.01, 5.52). The high risk of experiencing PE among women with an unplanned pregnancy may be related to poor health-seeking behavior and low decision making power. Those women who had an unplanned pregnancy are usually young women who have no decision making power which leads poor health-seeking behavior. The finding of our study is not supported by the study done in Addis Ababa which found no statistically significant difference on the risk of PE among women with unplanned pregnancy compared with counterparts (26). This could be due to variation in the study population in which the study in Addis Ababa was done among women with mixed parity in contrast to our study. Multiparous women might have better decision making power and experience to delay pregnancy compared to young women. Moreover, the contextual difference among study areas could also explicate the variation in which accessibility of health facilities and level of awareness of people in Addis Ababa may be different compared with regions. Besides reducing the risk of developing PE, encouraging women to plan pregnancy can improve the health of the mother as well as the fetus by reducing the risk of post-partum hemorrhage, LBW, and PTB which are greatly related to PE. Consequently, reducing unplanned pregnancy is important to improve the national new born and child survival strategy by reducing the risks of new born mortality (17).

Consistent with previous studies (52, 71), consumption of vegetable and fruit during pregnancy were found to be significantly associated with PE in this study. The odds of developing PE was found to be low among women who reported to include vegetable and fruits in their diet (AOR: 0.42, 95%, CI: 0.22, 0.82) and (AOR: 0.45, 95%, CI: 0.24, 0.87) respectively. The possible justification for the similarity with other studies may be due to the similarity of factors assessed and study setting. The studies tried to assess the influence organic foods (organic fruits and vegetables) on PE and were conducted in a hospital setting. Incorporating vegetables and fruits in a daily diet during pregnancy has numerous benefits for the mother as well as the growing fetus. The existence of abundant antioxidants, vitamins, minerals, and dietary fiber in vegetable and fruit is stated to be one of the mechanisms for reduced risk of PE among vegetable and fruit users (71). Pregnancy is a period when most women are highly motivated for dietary advice. Thus, providing counseling on a healthy diet during pregnancy could be more efficient than other periods. Dietary changes have also low cost and low risk compared with medical interventions, and even a moderate increase in intakes of vegetables and fruits may have public health importance (75). Taking healthy diet is important to improve birth outcomes by improving the development the growing fetus in utero and reducing the risk of growth flattening in latter ages (76).

Likewise, high body weight was found to be significantly associated with the risk of acquiring PE. The conditional multiple logistic regression analysis indicated that the odds of developing PE was found to be 2 times higher among nulliparous women with MUAC  $\geq$  25cm compared with counterparts (AOR: 2.00, 95%, CI: 1.10, 3.63). The possible explanation how high body weight predisposes to PE is related to increased pro-inflammatory factors which result in an exaggerated inflammatory response (53). Our study is supported by studies conducted in Bahir Dar, Ethiopia (35) and New Delhi, India (23). The justification for consistency of the finding is related to the similarity of the study setting in which hospital setting was used in those studies. Besides, BMI/MUAC was used to assess obesity like our study. Maintaining appropriate body weight has a dual benefit in reducing the risk of developing chronic medical illnesses such as DM and CHTN in parallel to decreasing the risk of PE. Encouraging preventive strategies of PE and practicing preventive practices is important to achieve the national MNCH strategy which is designed to reduce maternal ,newborn and child morbidity & mortality (18).

Chronic medical illnesses are the growing public health problems in Ethiopia. Hence, maintaining appropriate body weight is also significant to achieve national non-communicable disease control strategy (77).

On the other hand, the frequency of ANC visits, multiple pregnancy, barrier contraceptive use, alcohol drink, coffee intake of more than 4 cups per drink, family history of HTN, and UTIs were variables not found to be statistically significant with PE after adjusted for confounders in this study. Nulliparous women who had frequent ANC visits had a low risk of acquiring PE compared with those who did not have frequent ANC visits in the crude analysis (COR: 0.51, 95%, CI: 0.29, 0.92) even though the association is vanishes when adjusted for confounders. The finding of our study is not supported by the study conducted in Bahir Dar (31). This variation could be explained by the difference in study design and population in which the study in Bahir Dar was unmatched case-control design and done among women who came for ANC visits as well as delivery services in contrast to our study. Similarly, the conditional multivariable analysis showed that statistically significant difference was not found between cases and controls related to multiple pregnancy (AOR: 1.11, 95%, CI, 0.36, 3.39) despite a significant association was found in the crude analysis. The finding is not supported by previous studies (15, 26, 31). The disagreement with previous studies may be related to the difference in the study population and employed analysis methods since the aforementioned studies were conducted among women with mixed parity. Besides the above explanation, small number of observation had multiple pregnancy in our study in contrast to the aforementioned studies.

Users of barrier family planning methods were more likely to develop PE compared with non-users or users of hormonal family planning methods in previous studies conducted in Mashhad, Iran (46) and Tabriz, Iran (47). However, a statistically significant association was not found between barrier family planning use and the risk of PE when adjusted for confounders in our study (AOR: 1.34, 95%, CI, 0.41, 3.15) despite significant association was found in the crude analysis. The reason for the discrepancy may be related to variation in sample size. The study conducted in Mashhad, Iran was conducted among 182 nulliparous women with and without PE. Similarly, the study in Tabriz, Iran was conducted among 200 primigravida women with and without PE in a hospital setting.

Small number of users of barrier family planning method could also explain the difference since only few women reported as they use barrier family planning method in the study done in Tabriz, Iran in contrast to our study. The increased risk of PE among barrier users of family planning is related to the lack of prolonged exposure to a paternal antigen which increases women's immune response to paternal antigen (78). Moreover, high failure rate among users of barrier family planning methods may explain the mechanism compared to users of hormonal methods.

With regards to behavioral factors, the conditional multiple logistic regression analysis revealed that statistically significant association was not found between alcohol drinking and PE (AOR: 1.29, 95%, CI, 0.72, 2.34). The finding of our study is supported by the study in Bahir Dar (31). Alcohol drink during pregnancy is also associated with fetal alcohol syndrome which is the leading cause of congenital disability (79) besides its risk on PE. Nevertheless, the finding of our study is in contrast to the study in Arba Minch (49) which found 8 times high risk of experiencing PE among women who drank alcohol compared with counterparts. The variation could be due to the difference in study design, sociocultural variation and study populations as well. The study in Arba Minch was cross-sectional study and conducted among women with mixed parity.

Likewise, no relationship was observed between PE and coffee consumption of more than 4 cups per drink after adjusted for covariates (AOR: 1.67, 95%, CI, 0.69, 4.05) though statistically significant association was found in the crude analysis. The finding of our study is not supported by the study done in Bahir Dar (35). The variation could be due to the difference in the study population and analysis method since the study in Bahir Dar was done among women with mixed parity. Moreover, young women are less likely to take coffee frequently compared with women with advanced age.

On the contrary, obstetrics and gynecologic characteristics such as timing of first ANC, family history of PE (80), sex of the baby (44), iron intake (71), age at menarche (10), types of abortion (45), and same paternity abortion (29) were not found to be significantly associated with PE in the conditional bivariable analysis. Putting this in mind, such variables were not included in the final model although a significant association was reported in previous studies.

## **7. Strength and Limitation of the Study**

### **7.1 Strength of the Study**

Relatively large sample size was used by calculating sample size for 11 variables. Using matched design is one of the strengths of the study which is important to improve the power of the study and to control major confounding variables. The use of matched design is also vital to avoid empty strata during analysis.

Likewise, restricting study subjects by parity is the strength of our study which is important to avoid confounding variables such as birth interval, parity, and new paternity.

Investigating the effect of multiple risk factors of PE simultaneously could be the strength of the study since it is the first in type to do so.

Cases and controls were recruited at the same facility to control for the context difference in the study participants.

Reliability of MUAC measurement was assessed to check inter and intra-rater technical error of measurement (TEM). Besides, experienced data collectors were recruited and standard operational procedure (SOP) was used for data collection purposes.

To control the influence of using matched design, matched analysis (conditional logistic regression analysis) was employed which is one of the strengths of the study.

### **7.2 Limitation of the study**

The following limitations have to be taken in to account in this study:

Due to retrospective nature of the study design, our data may possibly subject to recall bias. Similarly, participants may not disclose the exact experiences related to sexual and behavioral characteristics due to cultural and social desirability bias.

Subjectivity estimation of amount of substance use such as coffee and alcohol drink may affect the reliability of measurement since it depends based on clients self-report.

Chronic HTN was one of the exclusion criteria, but the diagnosis could be biased especially for those who had no ANC visits or ANC visit after 20 weeks gestation due to the difficulty of identifying whether the HTN is pregnancy induced or not.

Diagnosis of cases was dependent on physician decision which may have individual variation in case diagnosis that leads to bias. The study was done in a hospital setting which might not be generalized to the general population.

Detail nutritional assessment including the quantity and item of nutrient was not done which is difficult to make inference in this regard.

## **8. Conclusion and Recommendation**

### **8.1 Conclusion**

The finding of our study suggests that there are different risk factors and preventive factors for PE among nulliparous women. Having short duration of cohabitation, unplanned pregnancy, and high body weight were found to be a significant risk factor for PE. On the other hand, receiving nutritional counseling during ANC visits, vegetable intake, and fruit intake were preventive factors for PE. Encouraging pregnant women to practice preventive factors is key to prevent PE. Similarly, risk factors could help professionals for early prediction, diagnosis, and management of PE and its complications.

### **8.2 Recommendation**

Risk factors identified in this study can be used as a screening mechanism for PE. The following recommendations are forwarded based on the finding of our study which provides an opportunity for prevention, early diagnosis, and management of PE.

**For the public:** Nulliparous women who plan to have a pregnancy, shall delay pregnancy to prevent the risk of having PE related to short pre-pregnancy period.

**Health care providers:** Health professionals shall counsel women about FP to prevent the risk of PE associated with unplanned pregnancy. Similarly, community-based education shall be given to new spouses to delay pregnancy to prevent PE due to a short pre-pregnancy period with the biological father of the recent pregnancy. The relevance of frequent and timely ANC visits shall be advocated to screen women who are at high risk to PE. Counseling women about healthy diet and appropriate body weight in every ANC visit shall be strengthened.

**Policy makers / Health programmers:** Culture tailored health education and counseling on a healthy diet, appropriate body weight and contraception shall be strengthened.

**Researchers:** Further study shall be done on PE in a well-controlled manner and advanced methodology.

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## 10. Annexes

Addis Ababa University  
College of Health Sciences  
School of Public Health

Annex i: English version

Questionnaires to assess the influence of duration of cohabitation, obstetrics and gynecologic, behavioral and nutritional risk factors on preeclampsia among nulliparous women in selected public hospitals of West Amhara Zones, Ethiopia, 2018

10.1 Information sheet:

Good Morning/ Good afternoon my name is \_\_\_\_\_ I am working as data collector in a study conducted by Maru Mekie, a postgraduate student at Addis Ababa University, College of Health Sciences, School of Public Health, reproductive health department. He is conducting research on the influence of short duration of cohabitation, obstetrics and gynecologic, behavioral and nutritional risk factors on preeclampsia among nulliparous mothers at Felege Hiwot, Addis Alem, and Debre Tabor hospitals. He has got permission to do this research from Addis Ababa University, SPH research ethics Committee and Amhara National Regional State Health Bureau as well as management bodies of the hospitals. You are selected to participate in the study from mothers who deliver at this facility. If you are willing to participate, I will ask you questions with regard to duration of cohabitation, obstetrics and gynecologic, behavioral and nutritional factors. The interview will last no more than 20 minutes and your participation is voluntary. You can stop the participation, ask questions and skip questions at any time you want. Your participation in the study will not have any risk on you, other than your time. There will no financial benefits for you in participating in this research project. However, the information you provide will be very helpful for prevention of the disease in the future. The information you provided will be kept confidential and your name will not be revealed in the study. The collected data will not be used for other purposes other than the study.

Do you have any question?

If you want to ask the principal investigator about the research at any time, you can contact him through: [maru.mekie1@gmail.com](mailto:maru.mekie1@gmail.com)

## 10.2 Consent form

I understand that Mau Mekie, a postgraduate student of reproductive health in School of public health, Addis Ababa University want to assess the influence of duration of cohabitation, obstetrics and gynecologic, behavioral, and nutritional risk factors on preeclampsia. I fully understand that they are going to ask me about socioeconomic and demographic factors, obstetric and gynecologic, behavioral and medical factors in the recent pregnancy. The research will take place at Felege Hiwot, Addis Alem, and Debre Tabor hospitals which will not take more than 20 minutes of my time. I want to take part in the study because I have been told that; I can stop participation at any time, skip any question if I do not like to answer. No one will know my answers other than investigators and the information will not be used for other purposes other than study.

**Are you willing to participate in the study?**

Yes  No  acknowledge and go to the next participants

**Result of the questionnaire (to be confirmed by the supervisor)**

Completely filled

Partially filled (missing)

Interviewer Name: \_\_\_\_\_signature \_\_\_\_\_date \_\_\_\_\_

Supervisor Name: \_\_\_\_\_signature \_\_\_\_\_date \_\_\_\_\_

### 10.3 Questionnaires

<b>Section 1: Identification in particulars</b>			
S/No	Questions	Responses	Skip
101	Name of the town	Bahir Dar.....1 Debre Tabor.....2	
102	Name of the hospital	Felege Hiwot.....1 Addis Alem.....2 Debre Tabor .....3	
103	Status of the participant?	Case .....1 Controls.....0	
104	Identification of the participants	ID.....	
<b>Section 2: Socio-demographic characteristics of the respondents</b>			
201	How old are you in complete years?	.....years	
202	Where is your place of residence?	urban..... 1 rural .....2	
203	What is your ethnicity?	Amhara..... 1 Oromo..... 2 Agew ..... 3 Tigrie ..... 4 Others (specify).....5	
204	What is your religion?	Orthodox.....1 Muslim.....2 Catholic ..... 3 protestant.....4 Others (specify).....5	
205	What is your marital status	Married.....1 Unmarried.....2 → Living together .....3 Divorced.....4 widowed.....5 Separated .....6	207
206	How old were you when you get married/living with your husband?	.....(age in complete years)	

207	How long have you been living with your husband/partner before your recent pregnancy? (Use LNMP as reference and count back )	completed .....weeks .....months .....years	
208	Do you read and write simple sentences with any language you speak with?	Yes.....1 No.....2 →	210
209	What is the highest level of education you have attended?	Grade ..... Informal (X)..... <input type="checkbox"/>	
210	Does your husband can read and write simple sentences with any language he speaks with?	Yes .....1 No .....2 →	212
211	What is the highest level of education your husband/partner has attended?	Grade ----- Informal (X) ----- <input type="checkbox"/>	
212	What is your main Occupation?	Housewife..... 1 Student.....2 daily laborer .....3 Private business.....4 Government employee ...5 Farmer .....6 Hand-craft worker.....7 Others (specify).....8	
213	What is your household monthly income?	.....(Ethiopian Birr)	
214	Who earns the main source(s) of income in the household?	Self/mother herself.....1 Husband .....2 Other( specify).....3	
215	What is the family size you are living with?	.....families	
216	Is there an adult female household member?	yes .....1 No.....2	
<b>Section 3: Obstetrics and gynecologic characteristics of the respondents</b>			
<b>The following questions are about pregnancy and related characteristics.</b>			
301	How long have you been pregnant (in months) during the current pregnancy? (see client folder, change and put it in weeks)	.....(weeks Unknown <input type="checkbox"/>	
302	When you got pregnant with current pregnancy, did you want to get pregnant at that time?	Yes by then.....1 Yes but good if latter ...2	

		No .....3	
303	Do you have regular menstrual cycle before pregnancy?	Yes .....1 No .....2 →	305
304	What is the average length of your menstrual cycle?	Every ..... day	
305	How old were you when you see your first menstruation?(age at first menstruation )	.....(completed years) Don't know <input type="checkbox"/>	
306	Have you ever had history of abortion in the last five years?	Yes .....1 No.....3 →	311
307	How many abortions did you have in the last five years? ( type: induced or spontaneous)	Spontaneous ..... Induced .....	
308	What was/were the gestational age of pregnancy in month when you had the abortion/s? ( underline induced if induced, spontaneous if spontaneous; put in weeks )	Spont./induc.1..... week Spont./induc.2..... week Spont./induc.3..... week Spont./induc.4..... week	
309	Have you ever faced abortion from your current partner?	yes .....1 No.....2 →	311
310	The number of abortion/s (underline spontaneous if spontaneous, induced if interrupted deliberately?)	.....spontaneous/induced	
311	Did you attend antenatal care follow up during your current pregnancy?	Yes .....1 No.....2 →	317
312	How many months pregnant were you when you first received antenatal care for the current pregnancy?	.....months	
313	How many times did you receive antenatal care during the recent pregnancy?	..... visits	
314	Have you received iron folate tablet during your antenatal care follow up?	Yes.....1 No.....2 →	316
315	How long did you take iron tablets during the whole pregnancy?(in weeks)	.....weeks (completed)	
316	Did you receive nutritional advice during your antenatal care follow up?	Yes.....1 No.....2	

317	What is the Blood group of the mother ?(refer the medical chart)	A.....1 B.....2 AB .....3 O.....4	
318	What is the Rh factor of the mother?(see the medical chart)	Positive.....1 Negative.....2	
319	What are the number/s of fetuses in the current pregnancy?	One .....1 More than one.....2	
320	What is the sex/s of the neonate/s?(see/review patient folder, underline sex if more than one pregnancy)	Male (same sex).....1 Female (same sex).....2 Different sex .....3	
321	What is the hemoglobin level of the mother? (refer medical chart)	.....(mg/dl)	
322	Have you ever used any family planning methods?	Yes.....1 No .....2 →	401
323	Were you using any family planning methods in the last two years before the current pregnancy?	Yes.....1 No .....2 →	401
324	What type of family planning methods were used? (more than one answer possible)	Standard days method.....1 Rhythm.....2 Withdrawal method.....3 Emergency pills.....4 Oral contraceptive pills.....5 Injectable.....6 Implants.....7 Male Condom.....8 Female condom.....9 IUCD .....10 Spermicidal jelly.....11 Cervical cap.....12	

**Section 4: Behavioral and nutritional characteristics of the respondents.**

Now I am going to ask you about behavioral and nutritional characteristics during your recent pregnancy

401	Have you ever taken a drink that contains alcohols during your recent pregnancy?(beer, tela, areki, wine etc)	Yes.....1 No.....2 →	405
402	If yes, mention the type of alcohol? (multiple answers possible)	Tela .....1 Areki.....2 Teji.....3 Beer.....4 Wine .....5 Others (specify).....6	
403	How often do you drink alcohol per week?	.....days per week	
404	The average amount of alcohol taken per drink?	.....Milliliters	
405	Did you smoke cigarettes during the current pregnancy?	Yes.....1 No.....2 →	408
406	How often did you smoke per week?	.....days per week	
407	On average, how many cigarettes did you smoke during current pregnancy per day?	-----cigarettes per day	
408	Did you smoke cigars during current pregnancy?( local plant product)	Yes .....1 No .....2 →	411
409	How often did you smoke cigar per week?	.....days per week	
410	On average, how many cigars did you smoke during current pregnancy per day?	.....cigar per day	
411	Have you ever drink coffee during recent pregnancy?	Yes .....1 No.....2 →	414
412	How often did you drink coffee during the recent pregnancy per week?	.....days per week	
413	On average how many cups of coffee did you drink per day	-----cups per day	
414	During the whole pregnancy, did you eat vegetables?	Yes.....1 No.....2 →	416
415	On average, how often did you eat vegetables during the recent pregnancy per week?	.....days per week	

416	During the whole pregnancy, did you eat fruits?	Yes.....1 No.....2 →	418
417	On average, how often did you eat fruits during the recent pregnancy per week?	.....days per week	
418	Were you doing physical exercise in your recent pregnancy?	Yes.....1 No.....2 →	501
419	On average, how often did you perform physical exercise during pregnancy?	.....days per week	
<b>Section 5: Medical condition of respondents and family history of medical illnesses</b>			
In this section, I am going to ask you about personal and family history of medical conditions			
501	Do you have family history of chronic hypertension (anyone in the family?)	Yes.....1 No.....2 →	503
502	If yes, who is affected by hypertension in the family?	Father.....1 Mother.....2 Sister/brother .....3	
503	Do you have family history of preeclampsia (increased blood pressure during pregnancy?)	Yes .....1 No.....2	
504	Do you have family history of diabetes mellitus (anyone in the family?)	Yes .....1 No.....2 →	506
505	If yes, who is affected by diabetes mellitus in the family?	Father.....1 Mother.....2 Sister/brothers.....3	
506	Have you ever been told by physician as you have Diabetes mellitus? (Check record)	Yes.....1 No.....2	
507	Did the woman had urinary tract infection during recent pregnancy? (Confirm on record)	Yes.....1 No.....2	
508	What is the MUAC of the mother?(use standard operational procedure for MUAC)	.....centimeters	

Annex: ii Amharic version

አዲስ አበባ ዩኒቨርሲቲ  
ጤና ሳይንስ ኮሌጅ  
የህብረተሰብ ጤና ትምህርት ቤት

በተመረጡ የምራብ አማራ ዞን የመንግስት ሆስፒታሎች የመጀመሪያ ልጃቸውን ለመውለድ የመጡ እናቶች ላይ ከሙሽርነት እስከ እርግዝና ድረስ የነበረ ጊዜ፣ እርግዝና እና ወሊድ፣ የአኗኗር ዘይቤ እና የአመጋገብ ሁኔታ ፤ በእርግዝና ጊዜ በሚከሰት የደም ግፊት ላይ የሚኖራቸውን ተፅዕኖ ለማጥናት የተዘጋጀ መጠይቅ፤ ኢትዮጵያ፣2018

10.4 የመረጃ ቅጽ

እንደምን አደሩ/ዋሉ፣ ስሜ .....እባላለሁ፤ የመጣሁት በዚህ ሆስፒታል ማሩ መኬ የተባሉት በአዲስ አበባ ዩኒቨርሲቲ፣ ጤና ሳይንስ ኮሌጅ፣ የህብረተሰብ ጤና ትምህርት ቤት፣ የስነ ተዋልዶ ጤና የድህረ ምረቃ ተማሪ፤ ለሁለተኛ ድግሪ መመሪያ በሚሰሩት ጥናት ዕሁፍ መረጃ ለመሰብሰብ ነዉ። ጥናቱ የሚካሄደው ከሙሽርነት እስከ እርግዝና ድረስ የነበረ አጭር ጊዜ፣ እርግዝና እና ወሊድ፣ የአኗኗር ዘይቤ እና የአመጋገብ ሁኔታ ፤ በእርግዝና ጊዜ በሚከሰት የደም ግፊት ላይ የሚኖራቸውን ተፅዕኖ በፈለገ ህይወት ፣ በአዲስ አለም እና በደብረ ታቦር ሆስፒታሎች የመጀመሪያ ልጃቸውን በሚወልዱ እናቶች ነዉ። ይህን መረጃ ለመሰብሰብ ከአዲስ አበባ ዩኒቨርሲቲ የህብረተሰብ ጤና ትምህርት ቤት፣ የጥናትና ምርምር ስነ ምግባር ኮሚቴ እና ከአማራ ክልል ጤና ቢሮ፤ እንዲሁም ከሆስፒታሎቹ ሃላፊዎች ፈቃድ አግኝተዋል። እርስዎም በዚህ ሆስፒታል የመጀመሪያ ልጅዎን ከመውለድዎ ጋር ተያይዞ ተሳታፊ ይሆናሉ። ለመሳትፍ ፈቃደኛ ከሆኑ፤ ስለማህበራዊ ፣ እርግዝና እና ወሊድ፣ የአኗኗር ዘይቤ እና የአመጋገብ ሁኔታ ጋር የተያያዙ መረጃዎችን ከ20 ደቂቃ ያልበለጠ ጊዜ እጠይቀዎታለሁ። በዚህ ጥናት ላይ መሳተፍ፣ በፍቃደኝነት ላይ የተመሰረተ ስለሆነ፤ ስጠይቅዎት በመሃል ጥያቄ መጠየቅ፣ ጥያቄ መዘለል፣ በሎም ማስቆም ይችላሉ። የእርስዎ ጥናቱ ላይ መሳተፍ አሁን ለግልዎ የገንዘብ ጥቅም ባይኖረውም፤ የሚሰጡት መረጃ ግን ወደፊት በእርግዝና ጊዜ የሚከሰት የደም ግፊት በሽታን ለመከላከል ትልቅ ጥቅም ይኖረዋል። እርስዎ በጥናቱ ላይ ስለተሳተፉ ከጊዜዎት በስተቀር የሚደርሱብዎት ምንም ችግር የለም። የሚሰጡት መረጃ ለጥናቱ ብቻ የሚወልድ ሲሆን፤ ሚስጥራዊነቱንም ለመጠበቅ ስምዎት ጥናቱ ላይ አይገለፅም።

**ጥናቱን በተመለከተ ሊብራራልዎት የሚፈልጉት ነገር ካለ መጠየቅ ይችላሉ።**

ለበለጠ መረጃ የጥናቱን ዋና መሪ በሚከተለው አድራሻ ማግኘት ይችላሉ።

**ኢሜል :** [maru.mekiel@gmail.com](mailto:maru.mekiel@gmail.com) **ወይም ሞባይል ስልክ ቁጥር :** 0924-47-37-81

10.5 የስምምነት ቅጽ

በአዲስ አበባ ዩኒቨርሲቲ የስነ ተዋልዶ ጤና የድህረ ምረቃ ተማሪ ማሩ መኬ ፤ ከሙሽርነት እስከ እርግዝና ድረስ የነበረ ጊዜ፣ እርግዝና እና ወሊድ፣ የአኗኗር ዘይቤ እና የአመጋገብ ሁኔታ በእርግዝና ጊዜ በሚከሰት የደም ግፊት ላይ የሚኖራቸውን ተፅዕኖ ለማጥናት መምጣታቸውን ተረድቻለሁ። በመሆኑም ስለማህበራዊ፣ እርግዝና እና ወሊድ ሁኔታዎች ፣ የአኗኗር ዘይቤ እና የአመጋገብ ሁኔታ ጋር የተያያዙ ጥያቄዎችን እንደምጠየቅ ተገዝቤአለሁ ። ጥናቱ የሚካሄደው በፈለገ ህይወት፣ አዲስ አለም እና ደብረ ታቦር ሆስፒታሎች እንደሆነ ፤ መጠይቁም ከ 20 ደቂቃ ያልበለጠ ጊዜ እንደሚወስድ ተነግሮኛል። በተጨማሪም በማንኛውም ጊዜ ጥያቄ መጠየቅ ፣ መዘለል፣ ብሎም ካልፈለግሁ ማስቆም እንደምችል የተነገረኝ ሲሆን፣ መረጃው ለጥናቱ ብቻ የሚወል መሆኑ እና ሚስጥራዊነቱ የተረጋገጠ ስለመሆኑ ግንዛቤ ስለተሰጠኝ ፤ በጥናቱ ላይ ለመሳተፍ ፈቃደኛ ነኝ።

**ጥናቱ ላይ ለመሳተፍ ፈቃደኛ ነዎት?**

አዎ  አይደለሁም  አመስግኖ ወደ ቀጣይ ተሳታፊ መሄድ

**የመጠይቁ ዉጤት ማረጋገጫ ( በጥናቱ ተቆጣጣሪ ባለሙያ መረጋገጥ አለበት )**

ሙሉ በሙሉ የተሞላ   
በከፊል የተሞላ   
የጠያቂው ስም \_\_\_\_\_ ፊርማ \_\_\_\_\_ ቀን \_\_\_\_\_  
የተቆጣጣሪ ስም \_\_\_\_\_ ፊርማ \_\_\_\_\_ ቀን \_\_\_\_\_

10.6 መጠይቆች

ክፍል 1 : የተሳታፊ መለያን የተመለከቱ መረጃዎች			
ተ/ቁ	ጥያቄዎች	አማራጭ መልሶች	ተሻገር
101	የከተማዉ ስም	ባህር ዳር.....1 ደብረ ታቦር.....2	
102	የሆስፒታሉ ስም	ፈለገ ህይወት.....1 አዲስ አለም.....2 ደብረ ታቦር.....3	
103	የተሳታፊ ሁኔታ	ከእርግዝና ጋር የተገናኘ የደም ግፊት ያለባት...1 ከእርግዝና ጋር የተገናኘ የደም ግፊት የሌለባት..0	
104	የተሳታፊ መለያ ቁጥር	መለያ ቁጥር.....	
ክፍል 2 : የ ኢኮኖሚ እና የማህበራዊ ሁኔታን የተመለከቱ ጥያቄዎች			
201	እድሜዎት በሙሉ ዓመት ስንት ነዉ?	.....ዓመት	
202	የመኖሪያ ቦታዎ አይነት ምንድን ነዉ?(ገጠር/ከተማ)	ከተማ.....1 ገጠር.....2	
203	ብሄርዎ ምንድን ነዉ?	አማራ.....1 አሮሞ.....2 አገዉ.....3 ትግሬ.....4 ሌላ (ይገለጽ).....5	
204	የምን ሀይማኖት ተከታይ ነዎት?	ኦርቶዶክስ.....1 ሙስሊም.....2 ካቶሊክ.....3 ፕሮቲስታንት.....4 ሌላ ካለ ይገለጽ.....5	
205	የጋብቻ ሁኔታ ምንድን ነዉ?	አግብቻለሁ.....1 አብረን ነዉ የምንኖረዉ.....2 አላገባሁም.....3 ተፋተናል.....4 ባለቤቴ በህይወት የለም.....5 ተለያይተናል.....6	→ 207
206	መጀመሪያ ትዳር የያዙት፣ በስንት ዓመት እድሜዎ ነዉ?	.....(ሙሉ ዓመት)	
207	ከዚህ እርግዝና በፊት ከባለቤትዎ/ጓደኛዎ ጋር ምን ያህል ጊዜ አንድ ላይ ቆያችሁ? (የመጨረሻ የወር አበባን እንደ መነሻ ተጠቅሞ ወደ ኃላ መቁጠር)	ሙሉ .....ሳምንት .....ወር .....ዓመት	
208	በማንኛዉም በሚናገሩት ቋንቋ፣ ቀላል ዓረፍተ ነገሮችን ማንበብ እና መፃፍ ይችላሉ?	አዎ.....1 አልችልም.....2	→ 210
209	የተከታተሉት ክፍተኛ የትምህርት ደረጃ ስንት ነዉ?	ክፍል..... መደበኛ ያልሆነ (X) ..... <input type="checkbox"/>	

210	ባለቤትዎ በማንኛውም በሚናገሩት ቋንቋ፤ ቀላል ዓረፍተ ነገሮችን ማንበብ እና መጻፍ ይችላሉ?	አዎ.....1 አይችሉም.....2      →	212
211	ባለቤትዎ የተከታተሉት ከፍተኛ የተምህርት ደረጃ ስንት ነው?	ከፍል..... መደበኛ ያልሆነ (X) ..... <input type="checkbox"/>	
212	የእርስዎ ዋና ስራ ምንድን ነው?	የቤት እመቤት.....1 ተማሪ.....2 የቀን ስራተኛ.....3 የግል ንግድ.....4 የግብርና ስራ.....5 የእደገበብ ሙያ.....6 የመንግስት ስራተኛ.....7 ሌላ ከሆነ ይገለጹ.....8	
213	በአማካኝ፣ የቤተሰቡ የወር ገቢ ምን ያህል ነው?	.....ብር	
214	የቤተሰቡን ዋና ገቢ የሚያስገኘው ሰው ማን ነው?	እኔ.....1 ባለቤቴ.....2 ሌላ ካለ ይገለጹ.....3	
215	እርስዎ የሚኖሩበት ቤተሰብ ብዛት ምን ያህል ነው?	.....ቤተሰብ	
216	በቤተሰቡ ውስጥ አዋቂ/ስራ የምታገዝ/ዙ ሴት/ቶች አላች/አሉ?	አዎ.....1 የለም.....2	
<b>ክፍል 3፡ የእርግዝና እና ወሊድን ሁኔታ የተመለከቱ ጥያቄዎች</b>			
<b>ከዚህ ቀጥሎ ከእርግዝና እና ወሊድ ጋር የተያያዙ ጉዳዮችን ያካተቱ ጥያቄዎችን እጠይቀዎታለሁ፤</b>			
301	የአሁኑን እርግዝና ለምን ያህል ወራት አረገዙት?(በሳምንት ተቀይሮ ይቀመጥ)	.....ሳምንታት አይታወቅም <input type="checkbox"/>	
302	አሁን የተወለደውን ህፃን ሲያረግዙ ፤ በወቅቱ እርግዝናዎ ተፈልጎ ነበር ?	አዎ ፈልጎ ነው.....1 አዎ፣ ግን ትንሽ ቢቆይ ጥሩ ነበር ...2 አይደለም.....3	
303	ከእርግዝና በፊት፣ የወር አበባዎ ሁልጊዜ፣ ጊዜውን ጠብቆ ነው የሚመጣው?	አዎ.....1 አይደለም.....2      →	305
304	ከእርግዝና በፊት፣ የወር አበባ የሚያዩት በአማካኝ በየስንት ጊዜ ነበር?	በየ.....ቀን	
305	የመጀመሪያ የወር አበባ ማየት የጀመሩት በስንት ዓመት እድሜዎ ላይ ነው?(ሙሉ ዓመት)	..... ዓመት አላወቅም <input type="checkbox"/>	
306	ባለፉት አምስት ዓመታት ውስጥ የጽንሰ መቋረጥ አጋጥመዎት ያውቃል?	አዎ.....1 አያውቅም.....3      →	311

307	ባለፉት አምስት ዓመታት፣ ስንት የጽንሰ መቋረጥ ትግር ገጠመዎት? (በራሱ ለወረደ እርግዝና = ወ.ር.ጃ፣ ሆን ተብሎ ለወረደ = ማስወረድ ላይ ይሙሉ)	በራሱ የወረደ/ ወ.ር.ጃ..... ሆን ተብሎ/ማስወረድ.....	
308	የጽንሰ መቋረጥ የገጠመዎት በእርግዝናው ስንተኛ ወር ላይ ነው? (በራሱ ለወረደ እርግዝና = ወ.ር.ጃ፣ ሆን ተብሎ ለወረደ = ማስወረድ ላይ ያስምሩ፤ በሳምንት ተቀይሮ ክፍት ቦታው ላይ ይሞላ )	ወ.ር.ጃ /ማስወረድ1.....ሳምንት ወ.ር.ጃ/ማስወረድ 2.....ሳምንት ወ.ር.ጃ /ማስወረድ3.....ሳምንት ወ.ር.ጃ/ማስወረድ 4.....ሳምንት	
309	አሁን ካሉት ባለቤትዎ ጋር የጽንሰ መቋረጥ ገጥመዎት ያወቃል?	አዎ .....1 የለም .....2                      →	311
310	መልስዎ አዎ ከሆነ፣ ምን ያህል የፅንሰ መቋረጥ አጋጠመዎት? (ብዛቱን ይግለፁ፣ በተጨማሪ በራሱ ለወረደ = ወ.ር.ጃ፣ ሆን ተብሎ ለወረደ = ማስወረድ ላይ ያስምሩ)	.....ወ.ር.ጃ/ ማስወረድ	
311	በዚህ እርግዝና ጊዜ የቀድመ ወሊድ ክትትል ነበርዎት?	አዎ ነበረኝ.....1 አልነበረኝም.....2                      →	317
312	በአሁኑ እርግዝና፣ የመጀመሪያ የእርግዝና ክትትል የጀመሩት በእርግዝናው ስንተኛ ወር ላይ ነበር?	.....ወር ላይ	
313	በአሁኑ እርግዝና ወቅት፣ ስንት ጊዜ ነበር ክትትል ያደረጉት?	..... ጊዜ	
314	በክትትልዎ ወቅት የደም ማነስ ክረን /አይረን ፎሌት ይወስዱ ነበር?	አዎ .....1 አልወሰድሁም .....2                      →	316
315	በሙሉ እርግዝና ወቅት፣ የደም ማነስ ክረን /አይረን ፎሌት ለምን ያህል ጊዜ ወስዱ? (በሙሉ ሳምንት ይቀመጥ)	.....ሳምንት/ታት	
316	በእርግዝና ክትትል ጊዜ፣ ስለአመጋገብ ምክር ተሰጥተዎት ነበር?	አዎ .....1 አልተሰጠኝም.....2	
317	የተሳታፊዎ፣ የደም አይነት ምንድን ነው? (ካርዱን አይተው ይሙሉ)	A.....1 B.....2 AB .....3 O.....4	
318	የተሳታፊዎ፣ አር ኤች አይነት ምንድን ነው (Rh factor)? ( ካርዱን አይተው ይሙሉ) ?	ፖዘቲቭ (+ve).....1 ኒጋቲቭ (-ve).....2	
319	በአሁኑ እርግዝና ጊዜ ፤ የተረገዙት ልጆች ስንት ነበሩ?	አንድ.....1 ከአንድ በላይ.....2	
320	የህጻኑ/ናቱ ስታ ምንድን ነው? (አረጋግጠው ይሙሉ)	ወንድ (ተመሳሳይ ስታ).....1 ሴት (ተመሳሳይ ስታ).....2 የተለያዩ ስታዎች.....3	
321	የተሳታፊዎ ቀይ የደም ህዋስ መጠን ስንት? ነው (Hgb)? (ካርድ አይተው ይሙሉ)?	.....(ሚሊ.ግ/ደ.ሊ.)	

322	ከዚህ በፊት በህይወትዎ፣ የቤተሰብ ምጣኔ ተጠቀመዎት ያወቃሉ?	አዎ .....1 የለም .....2 →	401
323	ከዚህ እርግዝና በፊት፣ ባለፉት ሁለት ዓመታት ውስጥ የቤተሰብ ምጣኔ ይጠቀሙ ነበር?	አዎ .....1 አልተጠቀምሁም.....2 →	401
324	መልስዎ አዎ ከሆነ፣ የትኛውን የእርግዝና መከላከያ ዘዴ ነበር የሚጠቀሙት? (ከአንድ በላይ መልስ ይቻላል)	የሰውነት ሙቀት አቆጣጠር ዘዴ...1 ካላንደር/የቀን መቁጠሪያ ዘዴ.....2 የወንድ የዘር ፍሬን ወደወጭ ማፍሰስ...3 የድንገተኛ ክረን.....4 በአፍ የሚወሰድ ክረን.....5 በመርፌ የሚሰጥ.....6 በከንድ ቆዳ የሚቀበር.....7 የወንድ ኮንዶም .....8 የቤት ኮንዶም.....9 ሉፕ/በማህፀን የሚቀመጥ.....10 ፎም/ጀሊ.....11 በማህፀን ጫፍ ላይ የሚቀመጥ...12	
<b>ክፍል 4፡ ከአኗኗር ዘይቤ እና የአመጋገብ ሁኔታ ጋር የተያያዙ ጥያቄዎች</b>			
<b>ከዚህ ቀጥሎ ደግሞ ከአኗኗር ዘይቤ እና የአመጋገብ ሁኔታ ጋር የተያያዙ ጥያቄዎችን እጠይቀዎታለሁ፤</b>			
401	በእርግዝና ጊዜ የሚያስከር/ አልኮልነት ያለው መጠጥ ይጠጡ ነበር? (ቢራ፣ጠላ፣አረቄ ፣ወይን ወዘተ)	አዎ.....1 አልጠቀምም.....2 →	405
402	መልስዎ አዎ ከሆነ፣ አይነቱ የትኛው ነው?	ጠላ.....1 አረቄ.....2 ጠጅ.....3 ቢራ.....4 ወይን.....5 ሌላ ካለ ይገለጹ...6	
403	በሳምንት ለምን ያህል ጊዜ ይጠጡ ነበር?	..... ጊዜ	
404	በአማካኝ፣ በአንድ ጊዜ ምን ያህል አልኮል ይጠጣሉ?(መጠኑ በስሌት ይቀመጥ)	.....ሚሊሊትር	
405	በአሁኑ እርግዝና ጊዜ ሲጋራ ያጨሱ ነበር?	አዎ.....1 አላጨሱም.....2 →	408
406	መልስዎ አዎ ከሆነ፣ በሳምንት ለምን ያህል ጊዜ ያጨሱ ነበር?	ሊ..... ቀን/ናት	
407	በአማካኝ፣ በቀን ምን ያህል ሲጋራ ያጨሱ ነበር?	.....ሲጋራ/ዎች በቀን	
408	በአሁኑ እርግዝና ጊዜ ፣ ባህላዊ ሲጋራ (ሲጋር) ያጨሱ ነበር?	አዎ.....1 አላጨሱም.....2 →	411
409	በየሳምንቱ ለምን ያህል ጊዜ ያጨሱ ነበር	ሊ..... ቀን/ናት	
410	በአማካይ በቀን ምን ያህል ባህላዊ ሲጋራ ያጨሱ ነበር?	.....ሲጋር በቀን	
411	በአሁኑ እርግዝና ወቅት፣ ቡና ይጠጡ ነበር?	አዎ.....1 አልጠጣም.....2 →	414
412	መልስ አዎ ከሆነ፣በሳምንት ምን ያህል ጊዜ ይጠጡ ነበር?	..... ጊዜ	

413	በአማካኝ በየቀኑ፣ ምን ያህል ስኒ ቡና ይጠጡ ነበር?	.....ስኒ	
414	በሙሉ እርግዝና ወቅት፣ የጓሮ አትክልት ይመገቡ ነበር?	አዎ .....1 አልመገብም .....2      →	416
415	መልስዎ አዎ ከሆነ፣ በአማካኝ በሳምንት ለምን ያህል ጊዜ አትክልት ይመገቡ ነበር?	.....ቀን/ናት	
416	በሙሉ የእርግዝና ወራትዎ፣ ፍራፍሬ ይመገቡ ነበር?	አዎ .....1 አልመገብም .....2      →	418
417	መልስዎ አዎ ከሆነ፣ በአማካኝ በሳምንት ለምን ያህል ጊዜ ይመገቡ ነበር?	.....ቀን/ናት	
418	በእርግዝናዎ ጊዜ፣ የአካል ብቃት እንቅስቃሴ ይሰሩ ነበር?(ለገጠር ሰዎች፣ ከቦታ ቦታ ተዘዋወሮ የቤት እና የግብርና ስራ መስራት፣ ለከተማ ስፖርት መስራት )	አዎ .....1 አላደርግም .....2      →	501
419	መልስዎ አዎ ከሆነ፣ በአማካኝ በሳምንት ለምን ያህል ጊዜ ይሰሩ ነበር?	.....ቀን/ናት	
<b>ክፍል 5፡ ከጤና ችግር ጋር የተያያዙ ጥያቄዎች</b>			
<b>ከዚህ ቀጥሎ ከእርስዎ እና ቤተሰብ ጤና ጋር የተያያዙ ጥያቄዎችን እጠይቀዎታለሁ፤</b>			
501	በቤተሰብ ዉስጥ፣ የደም ግፊት በሽታ ያለበት/ የነበረበት ሰዉ አለ?	አዎ .....1 የለም .....2      →	503
502	መልስዎ አዎ ከሆነ፣ ይህ በሽታ ያለው በማን በኩል ነው?	አባት .....1 እናት .....2 ወንድም/እህት .....3	
503	ከቤተሰብ ዉስጥ በሃኪም የተነገረ፣ በእርግዝና የሚከሰት የደም ግፊት የነበረበት ሰዉ ነበር?	አዎ .....1 የለም .....2	
504	በቤተሰብ ዉስጥ፣ የስኳር በሽታ ያለበት ሰዉ አለ/ነበረ?	አዎ .....1 የለም .....2      →	506
505	መልስዎ አዎ ከሆነ ፣ ይህ በሽታ ያለው በማን በኩል ነው?	አባት .....1 እናት .....2 ወንድም/እህት .....3	
506	ከዚህ በፊት የስኳር በሽታ እንዳልዎት በሀኪም ተነግሮዎት ያውቃል? (ካርድ አይተዉ ያረጋግጡ)	አዎ .....1 የለም .....2	
507	በአሁኑ እርግዝና ወቅት ፣ በሃኪም የተረጋገጠ የኩላሊት በሽታ/ኢንፌክሽን እንዳለብዎት ተነግሮዎት ነበር? (ካርድ አይተዉ ይሙሉ)	አዎ .....1 የለም .....2	
508	የተሳታፊዎ / የመልስ ሰጭዎ ፣ የላይኛዉ ክንድ መሃል መጠነ ዙሪያ ስንት ነዉ? (MUAC ይለኩ)	.....ሴንቲ ሜትር	

### Annex iii: Standard operating procedure (SOP)

Changes in body dimensions reflect the overall health and welfare of individuals and populations. Anthropometry is used to assess and predict performance, health and survival of individuals and reflect the economic and social well-being of populations. Anthropometry is a widely used, inexpensive and non-invasive measure of the general nutritional status of an individual or a population group (*Anthropometric Indicators Measurement Guide, FOOD AND NUTRITION TECHNICAL ASSISTANCE (FANTA), 2003*).

Mid upper arm circumference (MUAC) is relatively stable anthropometric measurement during pregnancy. It is the best measure of nutritional status and subcutaneous fat during pregnancy in developing countries. Body mass index (BMI) is much affected by pregnancy unless it is taken before 10 weeks of pregnancy. Getting BMI data before 10 weeks of pregnancy is difficult especially in developing countries. In this regards MUAC is the best and the simplest alternative to BMI for assessing nutritional status for pregnant and laboring mothers.

In our study the MUAC of participants will be taken at the end of interview. Accurate measurement is very important for reasonably good research finding. Accuracy is achieved through training and repeated measurements. The arm circumference is measured on the right arm at the level of the upper arm mid-point mark. The mark should be made on the posterior surface of the arm immediately after measuring the upper arm length (*National Health and Nutrition Examination Survey (NHANES), Anthropometry procedural manual*).

***The same procedures should be applied to every participant to get accurate and precise measurements.*** Standardized data collection methodology, rigorous training and monitoring of data collectors should be done to reduce measurement errors (*Reliability of anthropometric measurements in the WHO Multicenter Growth Reference Study*). Accurate means valid and unbiased measurement; whereas precise means repeatable and reproducible measurement.

### Factors affecting the quality of anthropometric measurements

- ✓ The quality of the instrument, for MUAC this factor cannot be a problem
- ✓ The behavior of the participants, if children are the subjects this factor compromise quality. However, if adults are study subject, behavior of the participants cannot be problematic
- ✓ The characteristics of the measurement environment; is a condition when there is no adequate light in measurement environment and uncomfortable surface for weight scale.
- ✓ The measurement skills of the observers and the behavior of accompanying persons can be sources of error.

**NB: Measurement skill** is the major factor that can compromise the quality of MUAC measurement in adults. To reduce skill related error repeated measurement, selection of experienced measurer, and training should be given.

### Intra observer Technical Error of Measurement (TEM)

Most commonly used measure of imprecision. It is the square root of measurement error variance. Obtained by carrying out a number of repeat measurements on the same subject, either by the same observer, or by two or more observers.

Technical error of measurement (TEM) =  $\sum_{i=1}^N \sqrt{\frac{(Mi_1 - Mi_2)^2}{2 * N}}$  Where, Mi 1 and Mi2 are the duplicate measurements recorded by a given observer for the ith participant, and N is the number of participant measured.

### Relative technical error of measurement (RTEM)

The absolute TEM will be transformed into relative TEM in order to obtain the error expressed as percentage corresponding to the total average of the variable to be analyzed. Relative TEM =  $\frac{TEM}{VAV} * 100$ , relative TEM is expressed in percentage.

Acceptable range of intra observer **relative TEM** is **1.5% for beginner** anthropometrist and **1.0% for skillful** anthropometrist. On the other hand the acceptable inter observer measurement error relative TEM is 2.0% and 1.5 % for beginners and skill full measurers respectively.

### **Coefficient of reliability (R)**

The proportion of the inter-subject variance (total measurement variance) that is not due to measurement error. **R=90% means** 90% of the total variability is true variation and the rest 10% is attributable to measurement error.

$$R = 1 - \frac{(TEM)^2}{(SD)^2}$$

### **Summary table acceptable range of relative TEM for MUAC among and within measurers**

<b>Types of analysis</b>	<b>Beginner measurer</b>	<b>Experienced measurer</b>
Intera-measurer	1.5%	1%
Inter- measurer	2.0%	1.5%
<i>Acceptable Intra-observer variability =&gt; 1%-1.5%</i>		
<i>Acceptable Inter-observer variability=&gt; 1.5%-2.0%</i>		

### **Mechanism to reduce inter and intra observer measurement errors**

Training should be given for data collectors and repeat practice of MUAC measurement will be undertaken. The skill of measurers will be evaluated and appropriate measures will be taken during training. Experienced data collectors shall be recruited for data collection purpose. Data collection shall be proceed if the inter and intra observer variability of MUAC is within the acceptable range (0.5cm). Re-training and demonstration of MUAC measurement shall be given if the variability is not in the acceptable range. Assessment of inter and intra observer measurement error will be checked twice. The first assessment will be provided before the beginning of actual data collection and the second will be around the mid time of data collection.

For the sake of increasing comparability of measurements, pre-defined procedures should be followed in every measurement. The following standard operating procedures are adapted from Great Britain (*National Institute for Health Research (NIHR), Procedure for Measuring Adult Circumferences*).

### **Standard operating procedures (SOP)**

1. Tell the woman about the procedure and ask the mother to remove any clothing that may cover the left arm.
2. Ask the women to be either in a standing / sitting position with her back to the measurer and their arms hanging by their sides.
3. Palpate the tip of the acromion (the point of the shoulder) on the non-dominant side and mark with a cross.
4. Ask the participant to flex their arm to 90 degrees. Palpate the olecranon (tip of the elbow) and mark it with a cross.
5. Put the tape measure on the mark made at the shoulder and drop it down to the tip of the elbow by the side of the arm.
6. Read the exact distance as if you had drawn an imaginary horizontal line from the bottom most point of the elbow to your tape measure.
7. Mark a point on the arm halfway between the acromion and olecranon. This marks the vertical level at which the circumference will be measured. It is important that this measurement is made with the arm flexed.
8. The woman is then asked to relax, with the arm hanging by her side. This is important as a very different reading may be obtained if the arm is not fully relaxed.
9. Place the tape around the upper arm with the tape's upper border on the mark. Ensure tape is horizontal around the arm. Make sure the tape is not pulled too tight. It should rest on the skin, but not indent it.
10. Read the tape to the nearest 0.1cm and beware of digit preference.
11. Make two measurements of mid upper arm circumference.
12. Record all two measurements and take the mean, by adding the values together and dividing by two. (*National Institute for Health Research (NIHR), Southampton Biomedical Research Centre Procedure for Measuring Adult Circumferences, October 2015*)

In addition to taking the average value of two measurements, strict follow up and monitoring will be conducted to improve the accuracy of MUAC measurement after training during the whole data collection periods. *The Largest acceptable differences between repeated measurements of MUAC is 0.5 cm. Any MUAC difference of greater than 0.5 cm between repeated measurements is not acceptable.*

Annex iv: Data collection guide

**How to match age of participants**

Age in years	Matched groups in years	Age in years	Matched age groups
10 11 12 13 14	10-14	30 31 32 33 34	30-34
15 16 17 18 19	15-19	35 36 37 38 39	35-39
20 21 22 23 24	20-24	40 41 42 43 44	40-44
25 26 27 28 29	25-29	45 46 47 48 49	45-49

1. MUAC measurement is taken on non-dominant arm of the participants using standard tap meter. The measurement will be done on the mid way between the olecranon of the elbow and acromion process of the shoulder.
2. When there is twin pregnancy encircle (sex for both) and write 2).
3. If a woman smoke one cigarette a week, the daily number of cigarette will be (1/7daily)
4. The start of pregnancy for those who don't know their LNMP will be calculated by subtracting 280 from date of delivery.
5. Exercise for rural women; if the women actively do household and agricultural works it will be considered as physical exercise. For urban just ask exercise. A minimum of 20-30 minutes activity is considered as exercise.

Annex v: Medical record checklist

- | <b>1. Previous Medical histories</b>                 | <b>mark (X) if condition exist</b> |
|--|------------------------------------|
| 1.1 Family history of hypertension                   | <input type="checkbox"/>           |
| 1.2 Family history of diabetes mellitus              | <input type="checkbox"/>           |
| 1.3 Family history of preeclampsia                   | <input type="checkbox"/>           |
| 1.4 Self-history of diabetes mellitus                | <input type="checkbox"/>           |
| 1.5 Urinary tract infection in recent pregnancy      | <input type="checkbox"/>           |
| <b>2. Previous obstetrics and gynecologic record</b> |                                    |
| 2.1 Gestation at first ANC visit                     | <input type="checkbox"/>           |
| 2.2 Gestational age at current birth                 | <input type="checkbox"/>           |
| 2.3 History of abortion in previous pregnancies      | <input type="checkbox"/>           |
| 2.3.1 Spontaneous abortion                           | <input type="checkbox"/>           |
| 2.3.2 Induced abortion                               | <input type="checkbox"/>           |
| 2.6 Family planning method used before pregnancy     | <input type="checkbox"/>           |
| <b>3. Hematologic information</b>                    |                                    |
| 3.1 Blood group and Rh -----                         |                                    |
| 3.2 Hemoglobin level -----                           |                                    |