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Magnitude of Adverse Birth outcome and its Associated Factors Among Anemic And Non-Anemic Mothers Delivered in Mariestopes International Ethiopiamchcenters A Comparative Cross-Sectional Study

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MAGNITUDE OF ADVERSE BIRTH OUTCOME AND ITS ASSOCIATED FACTORS AMONG ANEMIC AND NON-ANEMIC MOTHERS DELIVERED IN MARIESTOPES INTERNATIONAL ETHIOPIAMCHCENTERS

A COMPARATIVE CROSS-SECTIONAL STUDY

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MAGNITUDE OF ADVERSE BIRTH OUTCOME AND ITS ASSOCIATED FACTORS AMONG ANEMIC AND NON-ANEMIC MOTHERS DELIVERED IN MARIESTOPES INTERNATIONAL ETHIOPIA MCH CENTERS

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Acronyms and Abbreviations

ABO ---Adverse Birth Outcome

ANC ----Antenatal Care

APGAR---Appearance Pulse Grimace Activity Respiration

APH---Ante Partum hemorrhage

AOR---Adjusted Odds Ratio

CI---Confidence Interval

CS---Caesarian Section

EDHS ---Ethiopian Demographic Health Survey

EHR --- Electronics Health Records

GDM---Gestational diabetes mellitus

Hgb ---Hemoglobin

HIV --- Human Immune Virus

PIH --- Pregnancy Induced Hypertension

IDA---Iron Deficiency Anemia

IUGR---Intra Uterine Growth Retardation

LBW---Low Birth Weight

MCH---Maternal and Child Health

MIS---Management Information System

MSIE ---Marie stops international Ethiopia

OR---Odds Ratio

PNC---Post natal Care

PROM--- Premature Rupture of Membrane

SRH---Sexual Reproductive Health service

SVD ---Spontaneous Vaginal Delivery

WHO---World Health Organization

ABSTRACT

Background:Adverse birth outcomes- such as birth defect, prematurity, low birth weight and still birth are closely associated with increased fetal and neonatal mortality, morbidity, and impaired growth and cognitive developmentin both developing and developed countries. Though, there is insufficient information to conclusively assess the magnitude of adverse birth outcome and its associated factors among anemic and non-anemic mothers.

Objective: To assessthe magnitude of adverse birth outcome and its associated factors among anemic and non-anemicmothers delivered in Marie stopes International Ethiopia.

Methods: Facility-based comparative cross-sectional study was employed by reviewing electronic health record data of 1320 mothers that delivered at Marie stopes International Ethiopia MCHcenters from November 2016 to December 2017. Data was collected from randomly selected 440 lab confirmed anemic and 880 non-anemic mothers from April 25 -May 5, 2018.Descriptive statistics like frequency, percentage, mean and standard deviation was calculated.Logistic regression analysis was employed to identify factors associated with adverse birth outcomes. Those factors that had P-value <0.2 in bivariable analysis were entered into multivariable logistic regression analysis and investigate independent predictors by controlling for possible confounders; significance of statistical association was tested using 95% CI.

Findings: In this study, 440anemic and 880non-anemic delivered mothers were involved. The magnitude of adverse birth outcome among anemic mothers was higher than the non-anemic mothers (20.9%, 13.6%) respectively.Motherswho hadlabor duration>24 hours were 2.405 times more likely to have adverse birth outcome than those which had labor duration <=24 hours(AOR 2.405, 95% CI: 1.389, 4.163) and multi- parous mothers were 1.608 times more likely to have adverse birth outcome as compared with primi-parous mothers. (AOR 1.608,95% CI:1.168, 2.213).

Conclusions: The magnitude of adverse birth outcome among anemic mothers was higher than the non-anemic mothers 20.9% [95CI17-25] and 13.6% [95CI11.4-15.9] respectively which shows that the magnitude is high. Hemoglobin level <11 g/dl, multi-Parity and labor duration greater than 24 hours were significantly associated with adverse birth outcome. Therefore, early detection and treatment of anemia, to strengthen health education on family planning to prevent repeated pregnancy and to manage long duration of labor is vital.

1. INTRODUCTION

1.1 Background of the study

Adverse birth outcomes- such as still birth, prematurity, low birth weight and birth defects- represent significant problems in both developing and developed countries. Each year, about 15 million babies in the world, more than one in 10 births, are born too prematurely. More than one million of those babies die shortly after birth; countless others suffer from lifelong physical, neurological, social or educational disabilities, often at great cost to families and societies(1).Complications of preterm birth are the leading direct causes of neonatal mortality which account for an estimated 27% of neonatal deaths. This comes to almost four million neonatal deaths every year(2).From a global standpoint, the prevalence of preterm birth varies from 47.5 to 137 per 1000 live births (3-5).

Globally, stillbirth rate has declined by 14%, from 22.1 stillbirths per 1000 births in 1995 to 18.9 stillbirths per 1000 births. But in the African region, there was only an annual decline of less than 1%. The stillbirth rate for developed countries is estimated between 4.2 and 6.8 per 1000 births, whereas for the developing world, the estimate ranges from 20 to 32 per 1000 births. Two-thirds of all stillbirths occur in just two regions: South-East Asia and Africa(6, 7). In sub-Saharan Africa, an estimated 900,000 babies die as stillbirths. It is estimated that babies who die before the onset of labor, or ante partum stillbirths, account for two-thirds of all stillbirths in countries where the mortality rate is greater than 22 per 1,000 births(8).

Low birth weight (LBW) is closely associated with increased fetal and neonatal mortality, morbidity, and impaired growth and cognitive development. It also leads to chronic diseases later in life. Worldwide, more than twenty million infants (representing 15.5% of all births, 95.6% of whom in developing countries) are born LBW(9).

Anemia in pregnancy is defined as a hemoglobin concentration less than 11 g/dl and classified as mild (10.0–10.9g/dl), moderate (7-9.9g/dl) and severe <7g/ dl(10).While untreated anemia may itself lead to adverse outcomes, its negative effects may be aggravated by the presence of other risk factors such as infections during pregnancy (malaria, urinary tract infection, helminthic infections)(11).Maternal anemia during pregnancy is associated with low birth weight, still birth, premature delivery, birth defect and other adverse birth outcomes(12).

A study done on association between maternal anemia and pregnancy outcomes in Assam, India put prevalence of low birth weight 27%, small for gestational age 42% and still birth 2.8%(13).

A study done on determinants of adverse birth outcome in Gamo-gofa zone, southern Ethiopia resulted that prevalence of adverse birth outcome was 37.6%(14). Another study done on adverse birth outcome and associated factors in Dessie, North East Ethiopia showed the prevalence of adverse birth outcome was 32.5%; out of which 16.7% was low birth weight,15.2% was preterm birth, 8.2 % was still birth and 11% was birth defect(15).

Despite this, there is limited information on themagnitude of adverse birth outcome and its associated factors among anemic and non-anemic delivering mothers. The objective of this study is therefore toassess the magnitude ofadverse birth outcome and its associated factors among anemic and non-anemic mothers delivered in Mariestopes International Ethiopia MCH centers.

1.2 Statement of the problem

Anemia in pregnant women is associated with different maternal and prenatal outcome. It may leads to reduction in women productivity, place an economic burden on the families, communities and the societies and can have lifelong consequences for development, quality of life and health care costs(16, 17).It is an important contributor to maternal mortality or morbidity as well as to preterm delivery, stillbirth, IUGR, birth asphyxia and low birth weight which in turn contribute to increased percentage of infant and child mortality(16).Low birth weight infants may suffer the risk of developing many complications which includes respiratory distress, sleep apnea, heart problems, jaundice, anemia, chronic lung disorders, and infections are some of the problems associated with low birth weight babies(15).

Complications of preterm birth also outrank all other causes as the world's number one killer of young children. Complications from preterm birth caused nearly 1.1 million of the 6.3 million deaths of children under age 5 in 2013. Throughout the world, approximately 210 million women become pregnant and over 135 million of them deliver live born infants, while 75 million pregnancies end in still birth, preterm or spontaneous or induced abortion. Globally in 2015, there were 2·6 million still births, affecting women and their families in all settings. 98% were in low-income and middle income countries, over two-thirds were in sub-Saharan Africa and southern Asia(15). Birth outcomes are measures of health at birth. Birth outcomes have improved dramatically worldwide in the past 40 years. Yet there is still a large gap between the outcomes in developing and developed countries. Adverse birth outcomes such as stillbirth, low birth weight and preterm birth constituted the highest rates of all the adverse pregnancy outcomes and are common in developing countries(15). The birth-weight of an infant is the single most important determinant of newborn survival; Neonatal illness in general is closely related to low birth-weight. Some epidemiological observations revealed that infants born under-weight (less than 2500 gram) are approximately 20 times more likely to die than heavier babies(15).

Stillbirth rate is an important indicator of access to and quality of antenatal and delivery care. Over 2.6 million stillbirth's $\geq$ 28 weeks of gestation or 1000 g occur each year worldwide. 98% were in low-income and middle-income countries, of which over two-thirds were in sub-Saharan Africa and southern Asia(15).

Although the prevalence of anemia and its associated factors were studied in different parts of Ethiopia, there is limited research on the magnitude of adverse birth outcome (preterm birth, low birth weight, birth defectand still birth) and associated factors among anemic and non-anemic mothers.Lots of antenatal care services and deliveries have been attended in Mariestopes International Ethiopia MCH specialty clinics. However, apart from the maternal health services provided there is no any empirical evidence indicating the magnitude of adverse birth outcomes and its associated factors among anemic and non-anemic mothers. So that this study tried to reveal the reality on the magnitude of adverse birth outcome and its associated factors among anemic and non-anemic mothers andfinallyput forward suggestions. It will give an insight to the MCH centers where to focus to reduce adverse birth outcome and thereby neonatal and child mortality and will be practical evidence for decision makers to give due attention on adverse birth outcome.It will also fill in the data shortage on the magnitude of adverse birth outcome and its associated factors among anemic and non-anemic mothersandwill serve as a base for further studies.

1.3 Significance of the study

Different studies in different part of the globe indicate that maternal anemic condition has a direct impact on the birth outcome. Anemia in pregnancy leads to problem which is manifested by different birth outcomes. However, the prevalence of adverse birth outcome and its associated factors among anemic and non-anemic mothers had not been well investigated in Ethiopia.

So that this study will provide an insightto health service providers where to focus to reduce adverse birth outcome and will fill in the data shortage on the magnitude of adverse birth outcomes and its associated factors comparing the anemic and non-anemic mothers. It will be also a practical evidence for decision makers to give due attention on adverse birth outcomeand willserve as a base for further studies.

2. LITERATURE REVIEW

Adverse birth outcomes- such as birth defect, prematurity, low birth weight and still birth- represent significant problems in both developing and developed countries. Low birth weight (LBW) is closely associated with increased fetal and neonatal mortality, morbidity, and impaired growth and cognitive development. Worldwide, more than twenty million infants are born LBW.Stillbirth rate is an important indicator of access and quality of antenatal and delivery care.Over 2.6 million stillbirths occur each year worldwide. Each year, about 15 million babies in the world, more than one in 10 births, are born too prematurely. More than one million of those babies die shortly after birth; countless others suffer from lifelong physical, neurological, social or educational disabilities, often at great cost to families, societies and the nation(1).

2.1 Prevalence of anemia in pregnant women and associated factors

Globally,1.62 billion people affected by anemia but Africa and Asia bears the greatest burden(2).In Africa and South East Asia, the prevalence was estimated to 61.3% and 52.5% respectively. This high rate of anemia especially in South Asia, central West Africa and East Africa attributed to poverty, nutritional deficiency, economic and environmental factors; this is two times as common as in America and Europe where prevalence is estimated at 24.1% and 25.1% compared with central West Africa and East Africa where prevalence is 56% and 36% respectively . Sub Saharan Africa bears the major burden of disease(18).

In different Arabic regions, cross sectional studies conducted on pregnant women in the age of 16-40 years showed that the lowest prevalence was observed in the capital Amman 41.4% and become higher in the Eastern(54.0%) , Southern(63.4%) and Western(67.9%).(19).

A cross-sectional study conducted on 395 pregnant mothers who live in Addis Ababa and were attending antenatal care at TikurAnbessa specialized hospital from November 23, 2012- March8, 2013 resulted the overall prevalence of anemia 21.3% using a cut off level of hemoglobin <11 g/dl (<33%hematocrit) (20).

A cross-sectional study conducted on pregnant women living in three districts around Gilgel Gibe dam area in South West Ethiopia revealed that 53.9% pregnant women were anemic(21).The

magnitude of anemia among pregnant womenattending antenatal care in Nekemte health center is high thatreached 52 % (22).

A study done on the prevalence of anemia and associated factors among pregnant women in Eastern part of Ethiopia, Gode resulted that 56.8% of study participants were anemic(16).A facility based cross-sectional study conducted in WolayitaSoddoOtona hospital amongpregnant women attending antenatal care clinic reviled that the prevalence of anemia was 39.94%(23).A facility based cross-sectional study conducted in North Western zone of Tigray to identify the prevalence of anemia and associated factors among pregnant women resulted the prevalence of anemia was 36.1%(24).Another cross- sectional study conducted on the prevalence and predictors of maternal anemia during pregnancy on pregnant women who attended antenatal careat Gondar university hospital resulted the prevalence of maternal anemia during pregnancywas 16.6%although it is lower than other studies prevalence(25).

2.2 Maternal anemias and adverse birth outcome

Existing evidence revealed that low hemoglobin levels during pregnancy lead to reduced iron stores that will cause infantile anemia ,due to reduce supply of oxygen to the fetus and it can also adversely affect the immune system of the mother which there by increase her susceptibility to genital tract infections that will leading to poor pregnancy outcome. Ontop, these evidences added that maternal anemia during pregnancy is associated with low birth weight, still birth, premature delivery, birth defect and other adverse birth outcomes(12).

Study conducted in Iran to determine ferritin concentration and birth outcome shows a positive correlation between the mother's ferritin concentration and the baby's birth weight ($r = 0.434$, $N = 120$, $p < .001$) and birth length ($r = 0.396$, $N = 120$, $p < .001$). In the study,a linear correlation between maternal serum ferritin concentration and birthweight and birth length was found when the effect of other variables like maternal weight was eliminated(26).

A study conducted in Iran to determine the relationship between maternal hemoglobin concentration and neonatal birth weight also showed that maternal Hgb< 10 g/dl is associated with an increased risk of low birth weight(< 2500 g)(27).

A study conducted on women divided in to three groups based on level of their anima to determine the iron status of babies born from iron deficient anemic mothersin Mottahary hospital showed that babies of iron-deficient anemic mothers had significantly lower levels of serum ferritin, 115.3ng/mL, compared to the non-anemic non-iron deficient group, 204.8 ng/mL(P= 0.014)(28).

A study conducted in Bolivia showed thatmaternal anemia was associated with lower infant Apgar scores at both 1 and 5 minutes after birth. The stronger relationship was observed in the effects of anemia on low Apgar scores at 1(P = 0.006), versus at 5 minutes(P = 0.039). Also birth complications were more prevalent in anemic women than in non-anemic women(29).

An association between maternal anemia and lower infant Apgar scores was reported also in other studies.Study done in Indian women showed that, higher maternal hemoglobin concentrations were correlated with better Apgar scores and with a lower risk of birth asphyxia in the first stage of labor (30). A study conducted in Bangladesh teaching hospital on effect of maternal anemia on fetal outcome showed that maternal Hgb has a significant correlation with placental weight, birth weight, lowApgar score, low gestational age($r=0.40$; $p<0.001$), birth weight ($r=0.35$; $p<0.001$), low APGAR score($r=0.52$; $p<0.001$), low gestational age($r=0.61$; $p<0.001$) and birth asphyxia(31).

A case control study on anemic (Hgb< 10g/dl) and non- anemic (Hgb>10g/dl) laboring mothers in Birendra Hospital, Kathmandu, Nepal was conducted to determine the relationship between maternal hemoglobin and fetal weight. According tothe result of the study, anemic women had LBW < 2.5 kg compared to the non-anemic.This difference was statistically significant ($p< 0.0001$). The risk of low birth weight baby was 6.8 times higher among anemic mothers as compared to non-anemic mothers($p=0.0001$)(32).A case control study conducted in Fuji to determine the effect of maternal anemia on birth weight revealed that the number of low birth weight infants (64%) was statistically significantin the anemic group of mothers than the non-anemic group($p<0.001$) (33).Women who are anemic and harboring infections such as malaria during pregnancy are at greater risk of delivering LBW babies(18).

In an analysis of deliveries in Singapore, women who were anemic at the time of delivery had a higher incidence of preterm delivery than those who were not anemic, but there wasn’t any other difference observed in either pregnancy complications or neonatal outcomes (34). Similar relations

were observed in women of rural Nepal, in whom iron deficiency anemia in the first or second trimester was associated with a 1.87 fold higher risk of preterm birth, but it was not because of anemia alone (30).

A study done in Ghana showed that women with >5 births had an increased risk of an adverse outcome compared with women with single deliveries(35). A study done in GamoGofa zone, Southern Ethiopia on determinants of adverse birth outcome shows that those pregnant women with multigravida were 7 times more likely to have adverse birth outcome as compared to prim gravida mothers. Similarly, those who had three or more births in the last five years have twice the risk as those who had none (17).

A study conducted in Ethiopia to study the correlation between maternal and neonatal hemoglobin profile and Iron status by classifying mothers in Iron deficient anemia(IDA) and non-Iron(NA) deficient based on their hemoglobin level resulted that newborn of IDA mothers had significantly lower levels of serum ferritin ($P = 0.017$) and hemoglobin concentration ($P = 0.024$). Additionally, newborns' ferritin and hemoglobin levels showed significant correlation with maternal hemoglobin ($P = 0.018$; $P = 0.039$) and ferritin ($P = 0.000$; $P = 0.008$) levels(36).

2.3 Adverse birth out come and socio demographic factors

The preterm birth rate varies depending on the age of the mother. Women aged 20 to 39 years have the lowest rate of preterm birth compared with women under 20 years and women of 40 years and above. The rates of preterm birth for women 20 to 39 years and for women 40 years and above showed an increasing trend between 1993 and 2008; however, the increment for 20 to 39 years women was smaller(34).

A study done in Dessie resulted that mothers who lived in rural areas encountered poor birth outcomes more than two times than mothers who lived in urban areas of Wollo(16). Another study done in GamoGofa zone, Southern Ethiopia on determinants of adverse birth outcome also revealed that the odds of pregnant women with rural resident have adverse birth outcome three times higher compared to women who lived in urban residents. Compared with the highest income quintile, mothers from the lowest quintile were at increased risk of having small for gestational age neonates, low birth weight, preterm birth, low Apgar score (<7) at 5 minute and still birth. The

study also reviled that income of mother and maternal education are also associated with poor birth out comes(18).

2.4 Adverse birth outcome and obstetric conditions

Mothers with obstetric complication in recent pregnancies have higher odds of experiencing adverse birth outcomes (preterm births, low birth weight, still birth and visible birth defect) than those without obstetric complications. Women with duration of labor greater than 24 hours were more likely to have adverse birth outcome ascompared with women that had duration of labor less than 24 hours(15). Ante partum hemorrhage (APH), hypertension, obstructed labor, and lack of antenatal care follow up were also significantly associated with still birth(18).

2.5 Adverse birth outcome and medical illnesses

A study conducted in Dessie on adverse birth outcome and associated factors showed that participants who had chronic medical illness were three times more likely to result in an adverse birth outcome than those who hadn't chronic medical illnesses (15).

2.6 Adverse birth outcome and environmental factors

Studies examined that exposure to environmental contaminants may play lead role in the causation of preterm birth and low birth weight. The evidence is strong for environmental tobacco smoke (ETS) and lead. Exposure to elevated particulate matter (PM), sulfur dioxide (SO2), nitrogen dioxide (NO2), and carbon monoxide (CO) is linked to outcomes such as decreased fetal growth, low birth weight, and preterm birth.In addition to air pollutants, several other environmental chemicals have been studied for possible roles of contributing an adverse birth outcome. Exposure to phthalates andpolychlorinated biphenyls (PCBs), may lead to preterm birth, low birth weight or restricted fetal growth (40).

2.7 Conceptual frame workon factors of anemia and adverse birthoutcomes

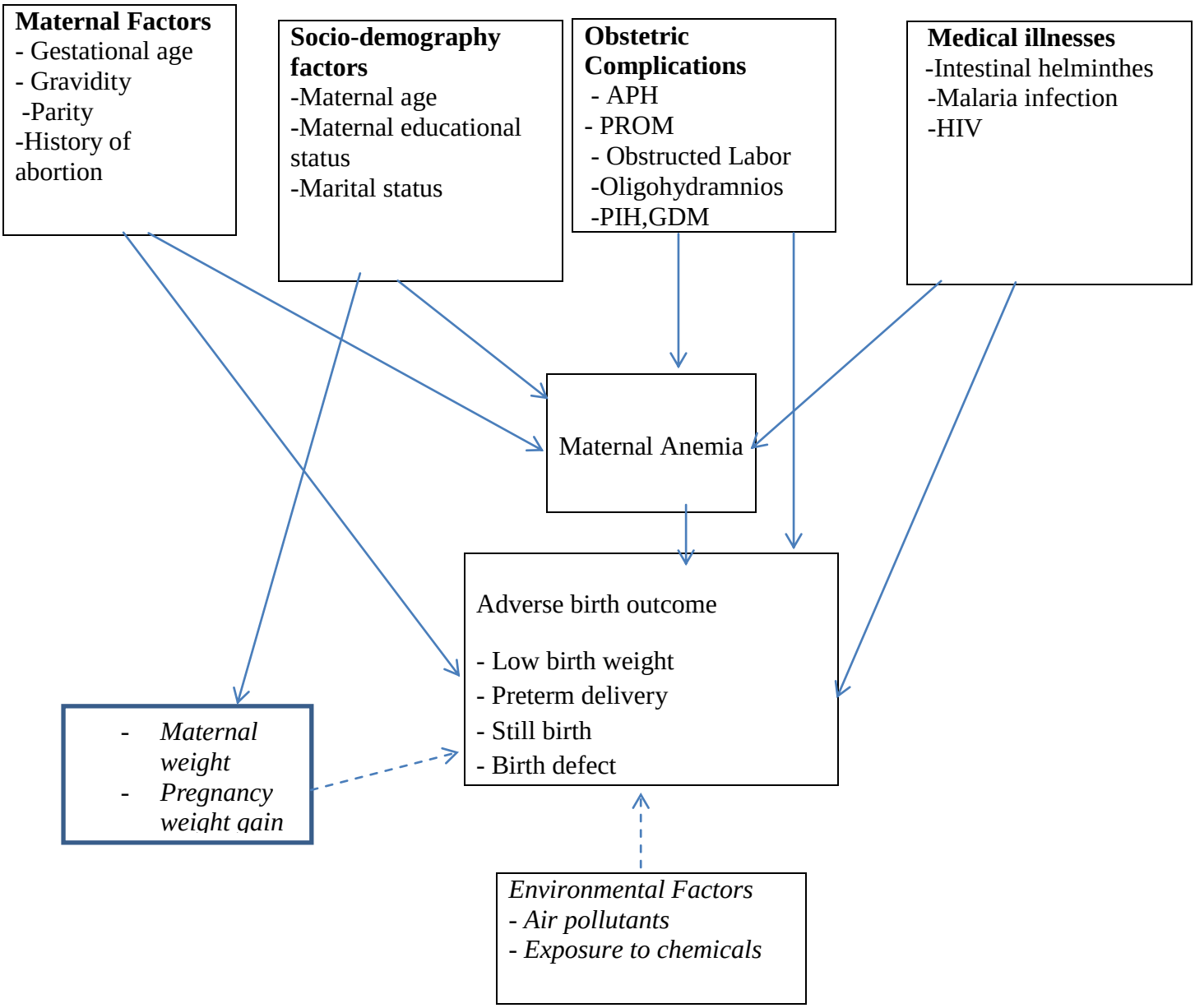

Figure 1: Conceptual frame work on factors that affect maternal anemia and adverse birth outcome adopted from different literatures.

3. OBJECTIVES OF THE STUDY

3.1 General objective

- ✓ Toassessmagnitude of adverse birth outcomesand itsassociated factors among anemic and non-anemic mothers who delivered in Marie stopes International Ethiopia from November 2016 to December 2017.

3.2 Specific objectives

- ✓ To assess the magnitudeof adverse birth outcome among anemic mothers.
- ✓ To assess the magnitude of adverse birth outcome among non- anemic mothers
- ✓ To identify factors associated with adverse birth outcome.

4. RESEARCH METHODS AND MATERIALS

4.1 Study design

A facility- based comparative cross-sectional study design was employed among mothers delivered in MSIE centers during November 2016- December 2017.

4.2 Study area and period

The study was conducted from April 25 to May 5, 2018 in Marie stopes International Ethiopia(MSIE)MCH centers.Marie Stopes International was established in 1976 by Dr. Tim Black and his wife Jean. The wider vision of the founders was to make family planning services available to women and men around the world. They envision a world in which every birth is wanted. Marie Stopes International's program became operational in Ethiopia following a bilateral agreement signed with the Ministry of Health in May 17-1990.Marie stopes International Ethiopia is a nonprofit making organization which works on sexual and reproductive health. In 2017, 19% of the clients served were clients living with poverty whose daily income is less than 1.25 USD. On top of this, the organization had free ANC and delivery service for those who can't afford the price and for some project areas (Addis Ababa and Gonjikolelawereda).The rest of clients served were those who can afford the price. Even though most of the clients served were from urban sites, there were few clients who were coming from rural.

MSIE have four centers,which are Gotera and Arada branches in Addis Abab, Bahir dar and Adama. The main function of these centers focused on maternal and Child health Services like all family planning methods, ANC, delivery, PNC, male circumcision, Vaccination, safe abortion and other SRH services. All together serves more than 600 labor and delivery per month. All of the MCH centers currently operate fully electronic system(EHR) which is a paperless service provision. However, the startup phase was not at the same period. Gotera started onNovember 2014GC. While,Adama started on August 2016, Bahir Dar on November 2016 and Arada on June 2017. Among 8231 total deliveries conducted in the study area during November 2016- December 2017, 4113(49.97%) deliveries were conducted in Gotera MCH, 1761(21.4%) were from Bahir Dar and the rest 2402(28.63%) were from Adama.Aradawas not included because of latestart up(June 2017) as the study considers EHR data of November 2016- December2017.

4.3 Source population

All motherswho delivered in study centersduring from November 2016- December 2017.

4.4 Study population

Allmothers delivered at the study centersfrom November 2016- December 2017who hadhemoglobin test result taken at the time of labor (both anemic and non-anemic groups).

4.5 Study unit

All anemic and non-anemic mothersdelivered in the study centersfrom November 2016- December 2017.

4.6 Inclusion criteria

- Mothers who delivered in MSIEcenters and hemoglobin test resulttaken at time of labor.
- Mothers who delivered in MSIE centers and at least one of the birth outcomestatuses (low birth weight or prematurity or still birth or birth defect information) was known.

4.7 Exclusion criteria

- Motherswith known birth outcomethat had missed/incomplete data elements.

4.8 Study variables

4.8.1. Dependent variables

Adverse birth outcome (Yes/no) (low birth weight, preterm delivery, still birth, birth defect)

4.8.2. Independent variables

Maternal demographic characteristics (age, marital status, educational level),Maternal obstetric history (gravidity, parity, abortion, gestational age, duration of labor, mode of delivery, previous still birth, history of abortion), current pregnancy complications like APH,PROM and chronic medical illnesses(PIH, GDM, HIV, Malaria).

4.9 Definition of terms

Anemic: refers the hemoglobin concentration of pregnant/laboring mother < 11g/dl.

Low birth weight: Neonate birth weight less than 2,500 gm.

Intra uterine growth retardation: refers to a condition in which an unborn baby is smaller than it should be because it is not growing at a normal rate inside the womb.

Preterm delivery: refers babies born alive before 37 weeks of pregnancy are completed. (WHO)

Still birth: refers the absence of signs of life at birth.

Birth defect: refers if a baby is born with part of a body that is missing or malformed.

Pre Mature Rupture of Membrane (PROM): refers to rupture of membrane (breakage of the amniotic sac) more than one hour before onset of labor.

Ante Partum Hemorrhage (APH): is bleeding from or into the genital tract occurring from 24 weeks of pregnancy and prior to the birth of the baby.

4.10 Operational definition

Adverse birth outcomes: A mother who had at least one of the following: Still birth or low birth weight or preterm labor or birth defect of the baby**.**

4.11 Sample size

From previous study conducted in Dessie, four variables of adverse birth outcome had known prevalence for anemic and non-anemic delivering mothers.

Adverse birth out come	Prevalence of adverse birth outcome among anemic womenin previous study	Calculated sample size(cases)	Prevalence of adverse birth outcome among non-anemic women in previous study	Calculated sample size(controls)	Total Calculated sample size
Still birth	4	440	1.3	880	1320
LBW	26.7	112	13.3	223	335
Preterm	22.7	156	12	311	467
Birth defect	13.3	255	6.7	509	764

The sample size was calculated by open-Epi Info sample calculator usingthe following assumptions:ratio of 2:1non-Anemic versusAnemic, 95% CI and 80% statistical power; the total sample size calculated to be1320.

4.12. Sampling technique

Stratified random sampling techniquewas used to select both anemic and non-anemicmothers fromGotera, Bahir Dar and AdamaMCH specialty centers because of the geographical difference among centers. Among 8231(716 anemic, 7515 non-anemic) total deliveries conducted in the study area during November 2016- December 2017, 4113(49.97%)deliveries were conducted in Gotera MCH, 1761(21.4%) were from Bahir Dar and the rest 2402(28.63%) were from Adama. Six hundred sixty (660) Samples from Gotera, 378 samples from Adama and 282 samples from Bahir Dar were selected proportionally.**(Figure 2)**

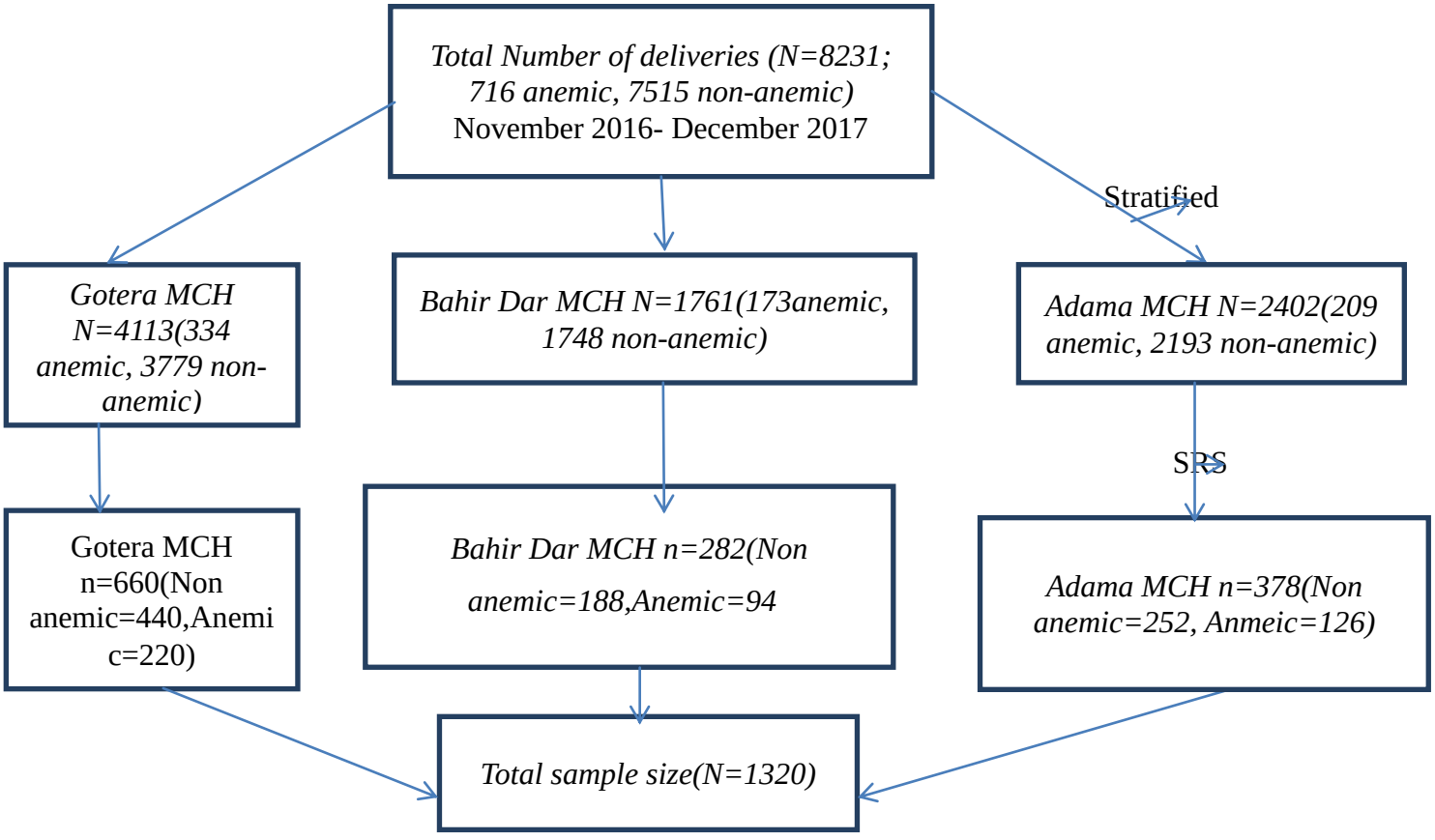

Figure 2: Sampling frame work of study participants

4.13. Sampling procedure and data collection methods

Data was collected from study sites for 2 weeks by review of records of birth registry and observation of laboratory investigations and different examination results from the EHR. Motherswho delivered in the study centers were divided in to two groups based on their Hgb (hemoglobin level). Those with Hgb level < 11g/dl were grouped as anemic (anemic groups were further divided in to mild, moderate and severe based on the Hgb concentration) and those with >=11g/dl were grouped as normal or non-anemic mothers. Electronic health record data of those women who gave birth during the study period in the centers were imported to SPSS.

4.14. Data quality control

To assure the quality of the data, data collection checklist was pretested in Arada MCH center to avoid any ambiguity on the questions prepared and to match with the EHR data capturing template.

4.15. Data management and analysis

The collected data wasentered into Epi info template, cleaned by running simple frequency and cross tabulation and checked for completeness.Variables were coded in to SPSS version 23.0 for advanced statistical analysis. Descriptive statistical methods such as frequencies, percentages, means, standard deviations, cross tabulation and bivariate logistic regression was used to explore the relation between adverse birth outcome and the independent variables using crude odds ratio (COR) with 95% CI. Finally, to determine the independent factors associated with adverse birth outcome, multivariable logistic regression was done. Variables with P-value <0.2 in the bivariate were taken to the multiple regression model. Model fitting was checked using Hosmer Lemeshow goodness of fit test. Finally, variables with P- value <0.05 were considered significant, and presented by Adjusted Odds Ratio (AOR) with 95% CI.

4.16. Ethical approval

Ethical approval letter was obtained from Bahir Dar university research ethical committee and also permission from Marie Stopes International Ethiopia support office,Gotera ,Adama and Bahir Dar MCH centers to access client’s information on birth records and different investigations from their database. Throughout the whole study confidentiality of the client datawas insured.

5. RESULTS

A record of 1320 mothers was involved in the study. This chapter illustrates the characteristics' of the study participants, description of variables and factors associated with adverse birth outcome.

5.1 Socio demographic characteristics of study participants

Among the study participants,390 (88.6%) from the anemicand 779(88.5%) from the non-anemic were in the age group of 15-35, with mean age of 28.83 years being the minimum17 and the maximum 41 years, and standard deviation of 4.517 for anemic mothers and with mean age of 28.87 years being the minimum17 and the maximum 44 years, and standard deviation of 4.448 for non- anemic mothers. Anemic mothers who were married that had adverse birth outcome were 86(20.8%) whereas non-anemic, married mothers who had adverse birth outcome were 113(14%). Regarding their educational status,44(21.2 %) who attended tertiary education and anemic had adverse birth outcomeas compared to 51(12.9%) of their non-anemic counter parts.(**Table1)**

Table 1:Socio-demographic characteristics of study participants among anemic and non-anemic mothers delivered in Marie stopes International Ethiopia MCH centers from November 2016-December 2017

Socio demographic variable	**Adverse birth outcome**		**Adverse birth outcome**	
	Anemic		**Non-anemic**	
	Yes n (%)	**No n (%)**	**Yes n (%)**	**No n (%)**
Age (N=1320)				
15-35 years	83(21.3)	307(78.7)	105(13.5)	674(86.5)
>=35 years	9(18.0)	41(82.0)	15(14.9)	86(85.1)
Total	92(20.9)	348(79.1)	120(13.6)	760(86.4)
Marital status(N=1320)				
Married	86(20.8)	328(79.2)	113(14)	696(86)
Single	4(18.2)	18(81.8)	5(8.2)	56(91.8)
Divorced and widowed	2(50)	2(50)	2(20)	8(80)
Total	92(20.9)	348(79.1)	120(13.6)	760(86.4)

Educational status(N=1320)				
Tertiary	44(21.2)	164(78.8)	51(12.9)	344(87.1)
Secondary	26(21.1)	97(78.9)	43(15.9)	227(84.1)
Primary	13(19.1)	55(80.9)	20(14.9)	114(85.1)
No formal education	9(22%)	32(78)	6(7.4)	75(92.6)
Total	92(20.9%)	348(79.1)	120(13.6)	760(86.4)

5.2 Maternal health condition

Among 1320 study participants, those who are primi-paras and anemic who had adverse birth outcome were63(21.4%) whereas the non-anemic, primi-paras who had adverse birth outcome were 75(10.9%). Around 41(25.2 %) of the anemic and 46(13.1%) of the non-anemic who had previous history of 1-3 abortion had adverse birth outcome**.** There was no finding on history of 3 or more consecutive abortion. Among anemic mothers, 55(22.1%) of moderately anemic and 37(19.4%) of mildly anemic mothers had adverse birth outcome. **(Table 2)**

Table 2: Maternal health condition of study participants among anemic and non-anemic mothers delivered in Marie stopes International Ethiopia MCH centers from November 2016- December 2017

Maternal health related variable	**Adverse birth outcome for Anemic**		**Adverse birth outcome for Non-anemic**	
	Yes n (%)	**No n (%)**	**Yes n (%)**	**No n (%)**
Gravidity (N=1320)				
Primi-Gravida	27(16.5)	137(83.5)	50(12.0)	366(88.0)
Multi-Gravida	65(23.6)	211(76.4)	45 (23.3)	394(84.9)
Total	92(20.9)	348(79.1)	120(13.6)	760(86.4)
Parity(N=1320)				
Primi-para	63(21.4)	231(78.6)	75(10.9)	612(89.1)
Multi-para	29(19.9)	117(80.1)	45(23.3)	148(76.7)
Total	92(20.9)	348(79.1)	120(13.6)	760(86.4)
Mode of				

Delivery(N=1320)				
SVD	50(21.5)	183(78.5)	73(14.2)	441(85.8)
Instrument assisted	13(21.0)	49(79.0)	11(10.3)	96(89.7)
CS	29(20.0)	116(80.0)	36(13.9)	223(86.1)
Total	92(20.9)	348(79.1)	120(13.6)	760(86.4)
History of Abortion(n=520)				
1-3 Abortion	41(25.2)	122(74.8)	46(13.1)	304(86.9)
>3 Abortion	0(0)	1(100)	1(16.7)	5(83.3)
Total	41(25)	123(75)	47(13.2)	309(86.8)
Labor Duration(N=1320)				
<=24 hours	75(18.4)	332(81.6)	116(13.7)	731(86.3)
>24 hours	17(51.5)	16(48.5)	4(12.1)	29(87.9)
Total	92(20.9)	348(79.1)	120(13.6)	760(86.4)
Obstetric Complications(n=21)				
Yes	1(1.09)	5(1.43)	0(0)	15(1.97)
No	91(98.91)	343(98.57)	0(0)	745(98.03)
Total	92(100.0)	348(100)	0(0)	760(100)
Medical Illnesses(n=12)				
Yes	1(1.09)	3(0.86)	2(1.66)	6(0.77)
No	91(98.91)	345(99.14)	118(98.34)	754(99.23)
Total	92(100)	348(100)	120(100)	780(100)
Anemia grade(n=440)				
Moderately anemic(7-9.9mg/dl)	55(22.1)	194(77.9)		
Mild anemic (10-10.9mg/dl)	37(19.4)	154(80.6)		
Total	92(20.9)	348(79.1)		

5.3 Proportion of adverse birth outcomes

The study finding showed that the magnitude of adverse birth outcome among the study participants was 16.1%. Ninety two (20.9%) were from the anemic and 120(13.6%) were from the non-anemic.**(Figure 3)**

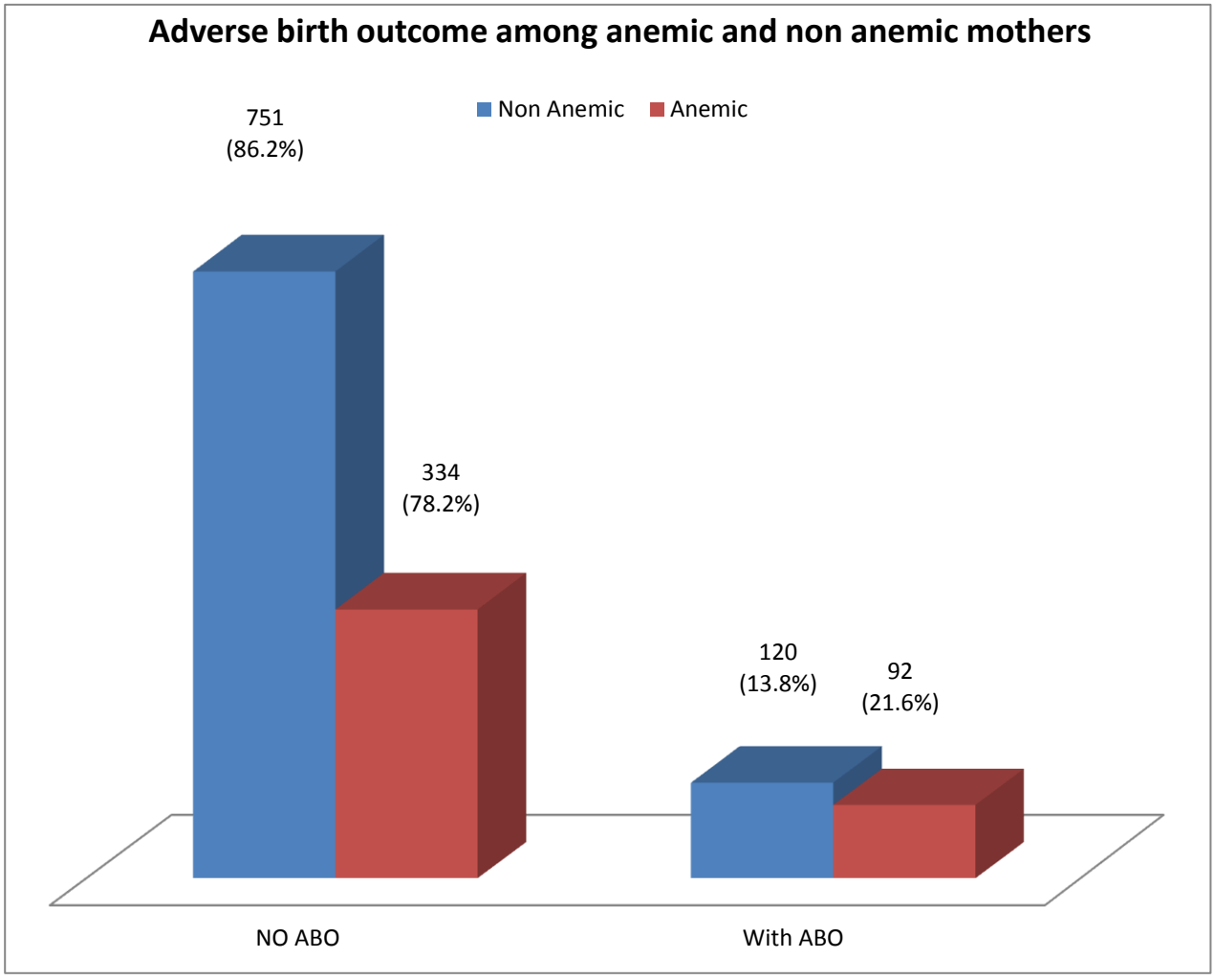

Figure 3:Proportion of adverse birth outcome among mother delivered in MSIE centers from November 2016- December 2017

Out of 212 adverse birth outcomes,the commonest in this study was preterm delivery 114(53.77%) followed by low birth weight91 (42.9%). Fourteen(14) had stillbirth and five(5) had birth defects. The type of birth defects were two (2) spinal beefed (1 of the anemic and 1 of the non-anemic), down syndrome (1 anemic),club foot (1 anemic) and cleft lip from the non-anemic.**(Figure4)**

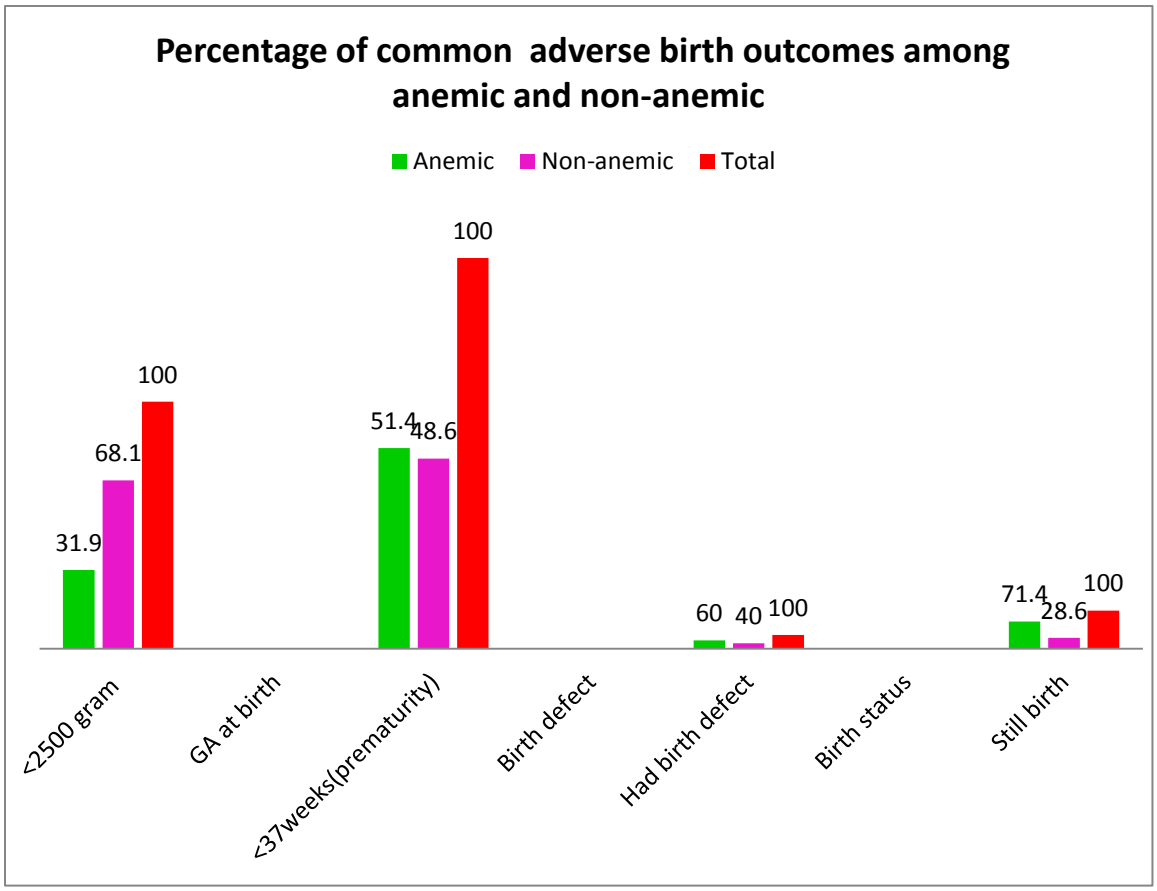

Figure 4:Common adverse birth outcomes among delivered mothers in MSIE MCH centers from November 2016- December 2017

5.4 Factors associated with adverse birth outcome among anemic and non-anemic mothers

Bivariate analysis

In the bivariate logistic analysis, Out of the variables maternal hemoglobin level,gravidity, parity and labor duration had significant association with adverse birth outcome.(Table 3)

Table 3: Bivariate logistic regression model to identify Socio demographic factors associated with adverse birth outcome among anemic and non-anemic mothers delivered in Marie stopes International Ethiopia MCH centers

Socio demographic variable	Adverse birth outcome of anemic women		COR (95%CI)	p-value	Adverse birth outcome of non-anemic		COR (95%CI)	P-Value
	Yes n (%)	No n (%)			Yes n (%)	No n (%)		
Age (n=1320)								
15-35 years	8(21.3)	307(87.7)	1		105 (13.5)	674(86.5)	1	
>=35 years	9(18.0)	41(82.0)	.812 (.38,1.8)	.592	15 (14.9)	86 (85.1)	1.12 (.623,2.0)	.705
Marital status (n=1320)								
Married	86(20.8)	328(79.2)	1		113 (14)	696(86)	1	
Single	4(18.2)	18(81.8)	.848 (.280,2.5)	.770	5 (8.2)	56 (91.8)	.550 (.22,1.41)	.211
Divorced and widowed	2(50)	2(50)	3.814 (.53,27.4)	.180	2 (20)	8 (80)	1.54 (.32,7.34)	.588
Educational status (N=1320)								
Tertiary	44(21.2)	164(78.8)	1		51 (12.9)	344 (87.1)	1	
Secondary	26(21.1)	97(78.9)	.999 (.58,1.73)	.997	43 (15.9)	227 (84.1)	1.278 (.82,1.98)	.274
Primary	13(19.1)	55(80.9)	.881 (.44,1.76)	.719	20 (14.9)	114(85.1)	1.183 (.678,2.0)	.555
Non-formal	9(22)	32(78)	1.048 (.47,2.36)	.909	6 (7.4)	75 (92.6)	.540 (.233,1.3)	.170

Maternal health related variable	Adverse birth outcome of anemic women		COR (95%CI)	p-value	Adverse birth outcome of non-anemic women		COR (95%CI)	P-Value
	Yes n (%)	No n (%)			Yes n (%)	No n (%)		
Gravidity (N=1320)								
Primi-gravida	27 (16.5)	137 (83.5)	1		50 (12.0)	366 (88.0)	1	
Multi-gravida	29 (19.9)	117(80.1))	1.563 (.95,2.57)	.079	70 (15.1)	394 (84.9)	1.301 (.881,1.92)	.186
Parity (N=1320)								
Primi-para	63 (21.4)	231 (78.6)	1		75 (10.9)	612 (89.1)	1	
Multi-para	29 (19.9)	117 (80.1)	.909 (.56,1.49)	.704	45 (23.3)	148 (76.7)	2.488 (1.65,3.74)	.000
History of abortion (N=520)								
1-3 abortions	41 (25.2)	122 (74.8)			46 (13.1)	304 (86.9)	1	
>3 abortions	0 (0.0)	1 (100)			1 (16.7)	5 (83.3)	1.332 (.15,11.58)	.801
Labor duration (n=1320)								
<=24 hours	75 (18.4)	332 (81.6)	1		116 (13.7)	731 (86.3)	1	
>24 hours	17 (51.5)	16 (48.5)	.213 (.103,.44)	.000	4 (12.1)	29 (87.9)	1.15 (.397,3.33)	.796
Hemoglobin level (N=1320)								
>11g/dl					120(13.6)	760(85.4)	1	
<11g/dl	92(20.9%)	348(79.1)					1.674 (1.24,2.26)	.001
Mode of delivery (1320)								
SVD	50 (21.5)	183 (78.5)	1		73 (14.2)	441 (85.8)	1	
Instrument assisted	13 (21.0)	49 (79.0)	.971 (.499,1.9)	.933	11 (10.3)	96 (89.7)	.092 (.354,1.35)	.283
CS	29 (20.0)	116 (80.0)	.915 (.55,1.53)	.734	36 (13.9)	223 (86.1)	.975 (.634,1.50)	.909

5.5 Multi-variable logistic regression analysis of adverse birth out come with other variables

After the bivariate logistic regression was done for each variable, only variables with P-value <=0.2 were taken to the multi variable logistic regression model**.**

Women who had hemoglobin level less than 11 g/dl were found 1.5 times more likely to experience adverse birth outcomes when compared with those with Hgb level greater than 11 g/dl[AOR=1.528: 95% CI 1.125,2.074]. Those participants who had labor duration > 24 hours were 2.405 times more likely to have adverse birth outcome than those which had labor duration < =24 hours [AOR=2.405: 95% CI 1.389,4.163]. Multi- parous mothers were 1.608 times more likely to have adverse birth outcome ascompared withprimi-parous mothers [AOR=1.608: 95%CI 1.168, 2.213].**(Table 5)**

Table 4: Bi-variate and multiple logistic regression analysis of adverse birth outcome with other variables among mothers delivered in Marie stopes International Ethiopia MCH centers from November 2016- December 2017

Variable	**Adverse birth out come**		**COR (95% CI)**	**AOR(95% CI)**	**P-value**
	Yes	**No**			
Anemic status					
>11mg/dl	120(13.6)	760(86.4)	1		
<11mg/dl	92(20.9%)	348(79.1)	1.674(1.24,2.26)	1.528(1.125,2.074)	0.007
L. Duration					
<=24 hours	191(15.2%)	1063(84.8)	1		
>24 hours	21(31.8%)	45(68.2)	2.594(1.513,4.49)	2.405(1.389,4.163)	0.002
Gravidity					
Premi-gravid	164(28.2)	416(71.8)	1		
Mult-gravid	276(37.2)	464(62.8)	1.465(1.081,1.987)	1.141(0.792,1.643)	0.480
Parity					
Premi-para	138(14%)	843(86%)	1	1	
Mult-para	74(21.8%)	265(78.2)	1.706(1.246,2.336)	1.608(1.168,2.213)	0.004

Key: A selection criterion in bivariate logistic regression was at $p \leq 0.2$; the cut point for multivariable logistic regression was at $p \leq 0.05$.

6 DISCUSSION

The purpose of this study is to know the magnitude of adverse birth outcome among anemic and non-anemic mothers including the factors associated with adverse birth outcome. Based on this the magnitude of adverse birth outcome among anemic mothers was 92 (20.9%) [95%CI 17-25]which is in line with the study done from Tanzania (18%), Ghana (19%), Shirie, Tigray, Ethiopia (22.6%)(35, 37, 38)respectively. However, this finding was lower than studies done inDessie referral hospital (32.5%) and a study done in Gamo-gofa zone, SNNPR, Ethiopia (37.6%) (15, 18) respectively. Whereas magnitude of adverse birth outcome among non-anemic mothers was 120 (13.6%)[95%CI 11.4-15.9].This finding was lower than studies done inTanzania (18%), Ghana (19%), Shirie, Tigray, Ethiopia (22.6%) (35, 37, 38) respectively. This finding was also lower than studies done in Dessie referral hospital (32.5%) and Gamo-gofa zone, SNNPR, Ethiopia (37.6%) (15, 18).The variations between the findingsfor both anemic and non-anemic mothers may be attributable to the difference in operational definition of adverse birth outcome. Dessie considered spontaneous abortion and the Gamo-gofa study included IUGR and APGAR score at 1 and 5 minutes additionally.It may be also due to the difference in the quality of maternal health service and the difference in their level of knowledge and utilization of health servicesince the study areas were urban, previous studies were conducted at hospital level where more complicated ones are referred from health centers contributing to higher rates of adverse birth outcomes.69.5% of the study participants of Dessie hospital were women referred from health centers and 21% of them encountered labor complications(15).

The magnitude ofpreterm delivery in this study was 74(5.6%) for the anemic and 70(5.3%) for non-anemic mothers with total magnitude of 144(10.9%) respectively[95CI 9.4-12.6].This figure was consistent with a study done inin Tanzania 12%, Dessie Ethiopia 11%.The finding was higher than a study conducted in Shirie, Ethiopia 8.7%but lower than a study conducted inGondar 14.3%(15, 38). This difference may be due to population variation and socio-economic differences.

The magnitude of low birth weight in this study was 29(2.2%) for anemic mothers and 62(4.7%)for non-anemic mothers with total magnitude of 91(6.9%) respectively [95CI 5.5-8.3]. This was consistent with the previous findings of Tanzania 8%. However,it is lower than a national study inEthiopia 9.8%, Dessie 16.7%, a reported birth weight in Addis Ababa, 11.4% and a study in

Shirie11.5%. The difference might be due to the socio-economic and educational leveldifferences and because of the nutritional determinants, such as pre-gestational weight and weight gain during pregnancy whichinfluence birth weight. Inadequate maternal caloric intake, which may be the result of nutritionally poor diet, leads to lower absorption of essential micronutrients, such as vitamin B12 and iron, for fetal growth (18, 35, 37, 38).

The magnitude of stillbirthin this study was 10(0.7%) for anemic and 4(0.3%) for non-anemic mothers with a total magnitude of 14(1.06% or 10.6/1000births) [95CI 0.5-1.5].It was lowerthan the previous reports from Hosanna, Gondar, Dessie Ethiopia, Tanzania and a systemic review for sub-Saharan African studies where the prevalence of still birth ranged from 2.7-8.2% (27-82/1,000 total births)(8, 15, 37).The variations may be due to the fact that more complicated ones are referred to the referral hospitals contributing to higher rates of still birth.

The magnitude of birth defect in this study was 3(0.23%) for anemic and 2(0.15%) for non-anemic mothers with a total magnitude of 5(0.4%) [95CI 1-8] which was consistent with previous study conducted in referral hospitals of North-West Ethiopia 1.96% and in Mekelle town(39, 40).

In multivariate analysis, Women with hemoglobin level less than 11 g/dl were found 1.5 times more likely to experience adverse birth outcomes when compared with those with Hgb level greater than 11 g/dl. The finding was consistent with studies conducted in Tanzania and d Dessie referralhospital(15). The reason could be linked to the effect of anemia on the oxygen bearing capacity and its transportation to the placental site for the fetus.

In this study, mothers with duration of labor greater than 24 hours were 2.4 times more likely to have adverse birth outcome compared with women who had duration of labor less than 24 hours. The finding was comparable with a study done in Dessie referral hospital(15). This might be due to when the labor prolongs the fetus may be at risk for aspiration and fetal heart beat abnormalities.

In this study,multi-parous mothers were1.6 times more likely to have adverse birth outcome as comparedto primi-parous mothers.This finding was similar with a study done in Ghana which showed that women with >5 births had an increased risk of an adverse outcome compared with women with single deliveries(35). It is also consistent with a study done in Mekelle town which shows that those primi-parous mothers were 21% less likely to develop adverse birth outcome as compared to grand multi-Parous mothers(40). This might be due toblood loss by a rapid sequence of pregnancy. Those who had low hemoglobin levels because of blood loss may stimulate changes in placental angiogenesis and favor fetal hypoxia. A reduction in nutrients and oxygen to the fetus due to deficits in placental transport is resulted from hemoglobin depletion.

7LIMITATIONS OF THE STUDY

It would not be generalized to the whole community as the participants were sampled from MCH centers located in urban areas. It might also lead to underestimation of the prevalence of adverse birth outcomes as majority of mothers who deliver at home and private and governmental lower levels of health facilities were not included in this study.

In this study possible variables were incorporated through review of related literature. However due to the EHR data elements limitation, variables like occupation, family income, family size and number of meal per day were not included. Moreover, obstetric histories like family planning, ANC attendance, iron folate supplementation, history of previous adverse birth outcome other than still birth history weren't included.These factors could contribute to the occurrence of adverse birth outcomes.Maternal adverse birth outcomes like miscarriage and fetal or neonatal adverse birth outcomes like IUGR, macrosomia and post-term delivery, low Apgar score were not also considered in this study.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

The magnitude of adverse birth outcome among anemic mothers was higher thanthe non-anemic mothers(20.9%, 13.6%) respectively which shows that the magnitude is high and from the adverse birth outcomes preterm delivery and low birth weight covers the highest.

Parity and labor duration were significantly associated with adverse birth outcome. Labor duration > 24 hours andmulti- parity were independent predictors of adverse birth outcome.

8.2 RECOMMENDATIONS

Mariestopes International Ethiopia

- Early identification and management of anemia.
- Strengthen health education on family planning with a special focus for multi-parous mothers to prevent repeated pregnancy.
- Should manage women with long duration of labor with other mode of delivery.

For researchers

- Additional investigation should be conducted on magnitude of adverse birth outcome according to anemia severity(grade) on low birth weight, preterm, still birth and birth defect separately to solve over estimation of adverse birth outcomes.

9 REFERENCES

1. Althabe F. Born too soon: the global action report on preterm birth: World Health Organization; 2012.

2. Lawn JE, Gravett MG, Nunes TM, Rubens CE, Stanton C. Global report on preterm birth and stillbirth (1 of 7): definitions, description of the burden and opportunities to improve data. BMC pregnancy and childbirth. 2010;10(1):S1.

3. Liu L, Liu J, Liu Y, Li Z, Ye R, Zheng J, et al. Prevalence of preterm birth among singletons in 10 counties (cities) of China, 1993-2005. Zhonghua liu xing bing xue za zhi= Zhonghua liuxingbingxue zazhi. 2007;28(11):1051-4.

4. Mokuolu OA, Suleiman B, Adesiyun O, Adeniyi A. Prevalence and determinants of pre-term deliveries in the University of Ilorin Teaching Hospital, Ilorin, Nigeria. Pediatric reports. 2010;2(1).

5. Silveira MF, Victora CG, Barros AJ, Santos IS, Matijasevich A, Barros FC. Determinants of preterm birth: Pelotas, Rio Grande do Sul State, Brazil, 2004 birth cohort. Cadernos de Saúde Pública. 2010;26:185-94.

6. Cousens S, Blencowe H, Stanton C, Chou D, Ahmed S, Steinhardt L, et al. National, regional, and worldwide estimates of stillbirth rates in 2009 with trends since 1995: a systematic analysis. The Lancet. 2011;377(9774):1319-30.

7. Smith GC, Fretts RC. Stillbirth. The Lancet. 2007;370(9600):1715-25.

8. Lincetto O, Mothebesoane-Anoh S, Gomez P, Munjanja S. Antenatal care: opportunities for Africa's newborns. New York: World Health Organiation. 2010.

9. Wardlaw TM. Low birthweight: country, regional and global estimates: Unicef; 2004.

10. Benoist B, McLean E, Egli I, Cogswell M. World Prevalence of Anaemia 1993–2005: WHO Global Database on Anaemia. WHO (World Health Organization) and CDC (Centers for Disease Control and Prevention Atlanta). 2008.

11. McClure EM, Goldenberg RL, Dent AE, Meshnick SR. A systematic review of the impact of malaria prevention in pregnancy on low birth weight and maternal anemia. International Journal of Gynecology & Obstetrics. 2013;121(2):103-9.

12. Tsegaye Ababiya, Gabrie T. Prevalence of Anemia among Pregnant Women in Ethiopia and Its Management. 2014.

13. Nair M, Choudhury MK, Choudhury SS, Kakoty SD, Sarma UC, Webster P, et al. Association between maternal anaemia and pregnancy outcomes: a cohort study in Assam, India. BMJ global health. 2016;1(1):e000026.

14. Gebremeskel F, Dibaba Y, Admassu B. Timing of first antenatal care attendance and associated factors among pregnant women in Arba Minch Town and Arba Minch District, Gamo Gofa Zone, South Ethiopia. Journal of environmental and public health. 2015;2015.

15. Cherie N, Mebratu A. Adverse Birth Out Comes and Associated Factors among Delivered Mothers in Dessie Referral Hospital. North East Ethiopia. 2018:1-6.

16. Kefiyalew F, Zemene E, Asres Y, Gedefaw L. Anemia among pregnant women in Southeast Ethiopia: prevalence, severity and associated risk factors. BMC research notes. 2014;7(1):771.

17. Haider BA, Olofin I, Wang M, Spiegelman D, Ezzati M, Fawzi WW. Anaemia, prenatal iron use, and risk of adverse pregnancy outcomes: systematic review and meta-analysis. Bmj. 2013;346:f3443.

18. Gebremeskel F, Gultie T, Kejela G, Hailu D, Workneh Y. Determinants of Adverse Birth Outcome among Mothers who Gave Birth at Hospitals in Gamo Gofa Zone, Southern Ethiopia: A Facility Based Case Control Study. Quality in Primary Care. 2017;25(5):259-66.

19. Salahat MA, Ibrahim AI. Prevalence of anemia among Jordanian pregnant women and the effect of early pregnancy on alkaline phosphatase activity. Jordan Journal of Biological Sciences. 2012;147(617):1-6.

20. Jufar AH, Zewde T. Prevalence of anemia among pregnant women attending antenatal care at tikur anbessa specialized hospital, Addis Ababa Ethiopia. Journal of Hematology & Thromboembolic Diseases. 2014.

21. Getachew M, Yewhalaw D, Tafess K, Getachew Y, Zeynudin A. Anaemia and associated risk factors among pregnant women in Gilgel Gibe dam area, Southwest Ethiopia. Parasites & vectors. 2012;5(1):296.

22. Mihiretie H, Fufa M, Mitiku A, Bacha C, Getahun D, Kejela M, et al. Magnitude of anemia and associated factors among pregnant women attending antenatal care in Nekemte health center, Nekemte, Ethiopia. Journal of Medical Microbiology & Diagnosis. 2015;4(3):1.

23. Gedefaw L, Ayele A, Asres Y, Mossie A. Anaemia and associated factors among pregnant women attending antenatal care clinic in Walayita Sodo town, Southern Ethiopia. Ethiopian journal of health sciences. 2015;25(2):155-64.

24. Gebre A, Mulugeta A. Prevalence of Anemia and associated factors among pregnant women in north western zone of Tigray, northern Ethiopia: a cross-sectional study. Journal of nutrition and metabolism. 2015;2015.

25. Melku M, Addis Z, Alem M, Enawgaw B. Prevalence and predictors of maternal anemia during pregnancy in Gondar, Northwest Ethiopia: an institutional based cross-sectional study. Anemia. 2014;2014.

26. Vazirinejad R, Esmaeili A, Vazirinejad H, Hassanshahi G. Ferritin concentration and pregnancy outcome: linear models for predicting birthweight and birth length. Food and nutrition bulletin. 2007;28(4):419-25.

27. Sekhavat L, Davar R, Hosseinidezoki S. Relationship between maternal hemoglobin concentration and neonatal birth weight. Hematology. 2011;16(6):373-6.

28. Emamghorashi F, Heidari T. Iron status of babies born to iron-deficient anaemic mothers in an Iranian hospital. 2004.

29. Laflamme EM. Maternal hemoglobin concentration and pregnancy outcome: a study of the effects of elevation in El Alto, Bolivia. McGill Journal of Medicine: MJM. 2011;13(1).

30. Akhter S, Momen M, Rahman M, Parveen T, Karim R. Effect of maternal anemia on fetal outcome. Mymensingh medical journal: MMJ. 2010;19(3):391-8.

31. Rana SS, Sharma S, Chand A, Malla R. Relationship between maternal Haemoglobin and fetal weight. Nepal Journal of Obstetrics and Gynaecology. 2013;8(1):37-40.

32. Ahmad MO, Kalsoom U, Sughra U, Hadi U, Imran M. Effect of maternal anaemia on birth weight. Journal of Ayub Medical College Abbottabad. 2011;23(1):77-9.

33. Terefe B, Birhanu A, Nigussie P, Tsegaye A. Effect of maternal iron deficiency anemia on the iron store of newborns in Ethiopia. Anemia. 2015;2015.

34. Agency USEP. America's Children and the Environment, Third Edition. Washington, D.C., . 2013.

35. Hill Z, Kendall C, Arthur P, Kirkwood B, Adjei E. Recognizing childhood illnesses and their traditional explanations: exploring options for care-seeking interventions in the context of the IMCI strategy in rural Ghana. Tropical Medicine & International Health. 2003;8(7):668-76.

36. Zerfu TA, Ayele HT. Micronutrients and pregnancy; effect of supplementation on pregnancy and pregnancy outcomes: a systematic review. Nutrition Journal. 2013;12(1):20.

37. Kidanto HL, Mogren I, van Roosmalen J, Thomas AN, Massawe SN, Nystrom L, et al. Introduction of a qualitative perinatal audit at Muhimbili National Hospital, Dar es Salaam, Tanzania. BMC pregnancy and childbirth. 2009;9(1):45.

38. Adhena T, Haftu A, Gebre G, Dimtsu B. Assessment of Magnitude and Associated Factors of Adverse Birth Outcomes among Deliveries at Suhul Hospital Shire Tigray, Ethiopia from September, 2015 to February, 2016. Research & Reviews: Journal of Medical Science and Technology. 2019;6(1):1-10.

39. Seyoum G, Adane F. Prevalence and associated factors of birth defects among newborns at referral hospitals in Northwest Ethiopia. Ethiopian Journal of Health Development. 2018;32(3).

40. HaftuBerhe, HailemariamBerhe, DemelashZeleke. factors associated with patterns of birth outcome at public hospitalsin mekelle town, tigray region, ethiopia, 2013: a case-control study. 2013.

ANNEXES

Data collection check list

Section 1.Maternal socio demographic characteristics

1	Age at birth	
2	Marital status	1) Married 2) Single 3) Divorced 4) widowed
3	The educational status	1. Tertiary(Above secondary school) 2. Secondary school 3. Primary schools 4. Not educated/illiterate

1.2 Maternal health condition

4	Gravida	
5	Para	
6	History of previous still birth	
7	History of abortion abortions	
8	History of >= 3 consecutive	
9	History of medical illness/ current	

	pregnancy complaint present? (Yes, No), if yes describe	
10	Hgb level of mother at onset of labor	
11	Gestational age on the onset of labor	
12	Duration of labor process	
13	Mode of delivery	1.Spontaneous vaginal delivery 2.Instrument assisted 3. Cesarean section

Section2. Neonate outcome

14	Weight of the newborn in grams	
15	Premature birth? Yes, No	
16	APGAR score of the newborn at 1st minute	
17	APGAR score of the newborn at 5th minute	
17	Hgb level of the newborn	
18	Still birth? Yes, No	
19	Birth defect? Yes, No (if yes describe)	

Declaration form

Declaration I,

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

Principal investigator

Name: Misikir Gebeyehu (BSC)

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Date: _____

Advisors

Name: Anemaw Asrat (MPH)

Signature: _____

Date: _____

Name: Desta Debalkie (MPH)

Signature: _____

Date: _____

Evaluator

Name: Gedefaw (MPH)

Signature: _____

Date: _____