Research article

Predictors of adverse pregnancy outcome at Hospitals in South Gondar Zone, North-central Ethiopia: A multicenter facility-based unmatched case-control study

Dagne Addisu [a,*], Shimeles Biru [a], Maru Mekie [a], Binyam Minuye [b], Minale Bezie [a], Wubet Alebachew [b], Solomon Demis [b], Enyew Dagnew [a], Abenezer Melkie [a]

[a] Department of Midwifery, College of Health Sciences, Debre Tabor University, Debre Tabor, Ethiopia
[b] Department of Pediatrics, College of Health Sciences, Debre Tabor University, Debre Tabor, Ethiopia

A B S T R A C T

Background: Adverse pregnancy outcomes are the most significant public health problem which leads to serious short and long-term health consequences to the mother and the newborn baby. Adverse pregnancy outcomes, especially prematurity and low birth weights are the major cause of neonatal morbidity and mortality in Ethiopia, particularly in the study area. Therefore, this study was aimed to determine predictors of adverse pregnancy outcome among mothers who gave birth at Hospitals in South Gondar zone, North-central Ethiopia.
Methods: Hospital-based unmatched case-control study was conducted. A total of 441 study participants with 147 cases and 294 controls were included. The study participants were selected by multi-stage sampling technique. A combination of chart review and interview were used. Data entry and analysis were done by using Epi data version 3.1 and SPSS version 23 respectively. Descriptive & analytical statistics were computed. In the binary logistic regression, both bivariable and multivariable analysis was computed. Statistical significance was considered at $P < 0.05$ and the strength of association were assessed by using the adjusted odds ratio with their 95%confidence interval.
Result: A total of 147 cases and 294 controls were included. The mean age ($\pm$SD) of study participants was 26.8 $\pm$ 5.5 years. History of adverse birth outcome (AOR = 6.39, 95%CI = 2.55, 15.99), did not receive dietary counseling during pregnancy (AOR = 5.17, 95%CI = 2.09, 12.84), pregnancy induced hypertension (AOR = 3.74, 95% CI = 1.20, 11.62), history of hyperemesis gravidarum in the recent pregnancy (AOR = 4.01, 95%CI = 1.58, 10.21) and inter-pregnancy interval less than 24 months (AOR = 2.02, 95%CI = 1.04, 3.91) were significantly associated with adverse pregnancy outcome.
Conclusion: This study showed that history of adverse pregnancy outcome, pregnancy induced hypertension, did not receive dietary counseling, history of hyperemesis gravidarum, and inter-pregnancy interval less than 24 months were significantly associated with adverse pregnancy outcome. This study implies the need to improve dietary counseling for pregnant mothers during antenatal care visits. Beside to this, counseling on birth spacing should be given to improve inter-pregnancy intervals.

1. Introduction

Worldwide, women and children are among the most vulnerable group in terms of negative influences in the environment including inadequate nutrition, insufficient health care, and poor education. Pregnancy brings those factors as high risk for women and their fetus [1, 2].

Adverse pregnancy outcomes indicates those birth outcomes other than normal pregnancy outcome (normal live birth) which mainly include low birth weight(LBW), stillbirth and preterm birth [3, 4]. Adverse pregnancy outcomes are the most important vital statistics which is used to evaluate maternal and child health program and design-evidence based interventions. They are an indicator of the quality of Antenatal Care (ANC), medical services, and general health services to the mother and the children [5, 6, 7, 8, 9].

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* Corresponding author.
E-mail address: addisudagne7@gmail.com (D. Addisu).

Various factors increased the risk of adverse pregnancy outcomes. Some of those factors were grand multiparty, previous history of preterm birth, abortion history, younger maternal age, inadequacy of prenatal care, pregnancy-induced hypertension, antepartum hemorrhage, premature rupture of fetal membranes and induced labor [10, 11].

Adverse pregnancy outcomes are the major public health challenges in both developed and resource limited countries [12]. Internationally, around 60–80% of neonatal deaths occurred among LBW infants and more than 2 million babies (around 18.9 stillbirths per 1000 births) died every year before they are born. The impact of preterm birth on early neonatal morbidity and neonatal deaths were expected to be 61% and 75%, respectively [8, 13]. In sub-Saharan Africa, LBW account for around 15% whereas stillbirth accounts for about one-third (35.4 %) of the global burden of stillbirths [13, 14].

Adverse pregnancy outcomes especially LBW and preterm births are at greater risk for mortality, morbidity and several short and long term physical, developmental and psychological problems. Adverse pregnancy outcome also leads significant direct and indirect emotional and economic effects on the infant's family and the societies [4, 15].

In Ethiopia, the majority of the newborns admitted in neonatal wards were secondary to adverse pregnancy outcomes, particularly due to preterm birth and LBW. The world health statistics 2013 showed that the rate of stillbirth in Ethiopia was 26 per 1000 deliveries that make it the third maximum rate in the East African countries next to Djibouti and Somalia (with stillbirth rate accounts around 34 and 30 per 1000 birth respectively [16]. According to Ethiopian Demographic and Health Survey (EDHS) 2016, the stillbirth rate in Ethiopia was 12 per 1000 pregnancies [17].

Ethiopia has implemented different strategies to decrease fetal, neonatal, and infant mortality. Some of these approaches were improving ANC follow up, early detection and treatment of complications and existing diseases during pregnancy, and improving institutional delivery. However, the adverse pregnancy outcome is still significantly higher in Ethiopia due to poor understanding of determinant factors for adverse pregnancy outcomes and inadequate prevention strategies [5,14]. Therefore, this study was aimed to identify predictors of adverse pregnancy outcome among mothers who gave birth at hospitals in the South Gondar Zone, North central Ethiopia. The findings of this study may help decision/policymakers as well as clinicians at different levels for designing empirical and evidence-based prevention strategies for adverse pregnancy outcomes.

2. Methods

2.1. Study design and period

A hospital-based unmatched case-control study was conducted at selected hospitals in the south Gondar zone from September 21, 2019 to January 21, 2020 G. South Gondar Zone is found in Amhara region. It is located around 664 km North-central of Ethiopia.

South Gondar Zone has 1 general hospital, 7 primary hospitals, 97 health centers, and 394 health posts. Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia, this zone had a total population of 2,051,738, of whom 1,041,061 were men and 1,010,677 were women.

2.2. Study population

All women who gave birth at hospitals in the South Gondar Zone were the source population. All women who gave normal live birth at selected hospitals in the South Gondar Zone during data collection periods were the study population for controls, whereas all women who gave least one adverse birth outcome from the following (preterm birth, stillbirth, or LBW) at selected hospitals in South Gondar Zone during data collection periods were the study population for cases. All women who gave birth at selected hospitals in the South Gondar Zone with unknown gestational

age were excluded. Beside to this, mothers who died, critically ill and referred to other health institutions immediately following delivery were excluded.

2.3. Sample size

The required sample size was determined by using factors for adverse birth outcomes(lack of ANC follow up) from the previous study conducted in Jima university specialized hospital [3] and calculated by using open Epi info version 7 statistical software packages. The following assumptions were applied to calculate the sample; 95% CI, 80% of power, control to case ratio of 2, 39.28% of controls in the exposed group, and 60.72% of cases in the exposed group. Accordingly, the sample size was 210. After adding 10% non -response rate and a design effect of 2, the final sample size was 441(cases = 147 and controls = 294).

2.4. Sampling and sampling procedure

Multi-stage sampling techniques were applied to identify study subjects. At the first stage, out of the 8 hospitals, four hospitals (Addis zemen, Debre Tabor, M/yesus and Nefas Mewucha hospitals) were selected using a simple random sampling technique. Then, study subjects were allocated proportionally to each selected hospital by using the previous number of deliveries in each hospital as a reference. Accordingly, 216 sample sizes were allocated for Debre tabor hospital, 81 for Addis Zemen hospital, 75 for Mekane Eyesus hospital, and 69 samples for Nifas Mewucha hospital. Then, a systematic sampling method was used to select controls from each selected hospital. Regarding case selection, a consecutive sampling technique was applied. Accordingly, every mother who had an adverse birth outcome was taken as a case until the required number of the case was achieved in each selected hospitals.

2.5. Operational definition

Obstetric emergencies were considered when the pregnant women had at least one obstetric problem from the following (Antepartum

Table 1. Sociodemographic characteristics of study participants at Governmental Hospitals in South Gondar Zone, North central Ethiopia, 2020 (n = 515).

Characteristics	Controls N (%)	Cases N (%)
Age (in years)		
≤18	3(1%)	16(10.9%)
19-34	261(88.8%)	102(69.4%)
≥35	30(10.2%)	29(19.7%)
Residency		
Rural	115(39.1%)	70(47.6%)
Urban	179(60.9%)	77(52.4%)
Educational status		
Non-formal education	82(27.9%)	53(36.1%)
Primary	82(27.9%)	54(36.7%)
Secondary	75(25.5%)	26(16.7%)
College and above	55(18.7%)	14(9.5%)
Occupational status		
Housewife	52(17.7%)	23(15.6%)
Civil servant	157(53.4%)	87(59.2%)
Merchant	59(20.1%)	21(14.3%)
Others(private worker, student, daily laborer)	26(8.8%)	16(10.9%)
Marital status		
Married	269(91.5%)	2(1.4%)
Unmarried	17(5.8%)	141(95.9%)
Others(divorced and windowed)	8(2.7%)	4(2.7%)

hemorrhage, cord prolapse, eclampsia, non-reassuring fetal heart rate pattern(NRFHRP) and shoulder dystocia) [3].

Adverse pregnancy outcome were considered when a pregnancy ends with at least one of the following pregnancy outcomes (preterm birth, LBW, and stillbirth).

Stillbirth: In Ethiopia, stillbirth was considered when a fetus was delivered without fetal heart rate or respirator rate at or after 28 weeks of gestational age [12].

Low birth weight(LBW) was considered when fetal weight was less than 2,500 gm within the first hour of life following birth [6].

Gestational age was estimated using either 1st trimester or 2nd trimester ultrasound report (up to 24weeks) or last normal menstrual period.

2.6. Data collection instruments and procedure

A combination of chart review and interviewer-administered questionnaires were used for data collection. A structured interviewer-administered data collection format was adopted and modified from previous literature [3,11]. Questionnaires were prepared first in English then translated to local language (Amharic) for data collection. Before the actual data collection, the questionnaire was pretested on 5% of mothers at Addis Alem primary hospital; thereby adjustment was made to the tool. Data were collected by 8 trained Bachelor midwives.

2.7. Data processing and analysis

Data entry and analysis were done by using EPI data version 3.1 and SPSS version 23 respectively. Descriptive statistics such as frequency and percentage were used to summarize and present the information. Bivariable logistic regression was used to select candidate variables for multiple logistic regressions. Variables with a p-value < 0.2 in the bivariable analysis were selected as candidate variables for multiple logistic regressions. Finally, multiple logistic regressions were conducted to identify significant variables. In multivariable logistic regression, statistical significance was considered at $P < 0.05$. Adjusted Odds Ratio (AOR) and their 95% Confidence Interval (CI) were used to measure the strength of association.

2.8. Ethical consideration

The data collection was carried out after getting approval for the project proposal from the ethical review committee of Debre Tabor University. An official letter was obtained from Debre Tabor University and permission from each selected hospital medical director and respective department heads. Informed written consent was obtained from individual participants. Confidentiality was maintained throughout the process. To ensure confidentiality, a code number was given to every participant and the questionnaire was administered anonymously.

Table 2. Obstetric and fetal related characteristics of study participants at Governmental Hospitals in South Gondar Zone, North Central Ethiopia, 2020 (n = 515).

Characteristics	Controls N (%)	Cases N (%)
Parity		
Primipara	114(38.8%)	71(48.3%)
Multipara	163(55.4%)	67(45.6%)
Grand multipara	17(5.8%)	9(6.1%)
Inter-pregnancy interval		
<24months	98(55.7%)	58(72.5%)
≥24months	78(44.3%)	22(27.5%)
Gestational age		
29–36week	26(8.8%)	59(40.1%)
37–40week	251(85.4%)	77(52.4%)
≥41weeks	17(5.8%)	11(7.5%)
ANC follow up		
No	22(7.5%)	20(13.6%)
Yes	272(92.5%)	127(86.4%)
History of adverse birth outcome		
No	284(96.6%)	120(81.6%)
Yes	10(3.4%)	27(18.4%)
History of abortion		
No	260(88.4%)	120(81.6%)
Yes	34(11.6%)	27(18.4%)
History of hyperemesis gravidarum		
No	271(92.2%)	119(81%)
Yes	23(7.8%)	28(19%)
Obstetric emergency		
No	273(92.9%)	117(79.6%)
Yes	21(7.1%)	30(20.4%)
Congenital anomaly		
No	284(96.6%)	140(95.2%)
Yes	10(3.4%)	7(4.8%)
Sex of the newborn		
Male	123(41.8%)	43(29.3%)
Female	171(58.2%)	104(70.7%)
Weight of the newborn		
<2.5kg	10(3.4%)	68(46.3%)
2.5–4kg	278(94.6%)	77(52.4%)
>4kg	6(2%)	2(1.4%)

Table 3. Nutritional and medical related characteristics of study participants at Governmental Hospitals in South Gondar Zone, North Central Ethiopia, 2020 (n = 515).

Characteristics	Controls N (%)	Cases N (%)
Dietary counseling		
No	281(95.6%)	118(80.3%)
Yes	13(4.4%)	29(19.7%)
Iron sulphate/foliate supplementation		
No	14(4.8%)	21(14.3%)
Yes	280(95.2%)	126(85.7%)
HIV status		
Negative	288(98%)	141(95.9%)
Positive	6(2%)	6(4.1%)
Pregnancy induced hypertension		
No	282(95.9%)	129(87.8%)
Yes	12(4.1%)	18(12.2%)
Hgb(mg/dl)		
<11	21(8.5%)	24(16.3%)
≥11	269(91.5%)	123(83.7%)
GDM		
No	285(96.9%)	143(97.3%)
Yes	9(3.1%)	4(2.7%)
Hepatitis B virus		
Negative	289(98.3%)	142(96.6%)
Positive	5(1.7%)	5(3.4%)
History of Asthma		
No	287(97.6%)	143(97.3%)
Yes	7(2.4%)	4(2.7%)
Malaria		
No	292(99.3%)	141(95.9%)
Yes	2(0.7%)	6(4.1%)

Table 4. Bivariable and multivariable association of adverse pregnancy outcome and independent factors among mothers who gave birth at Governmental Hospitals in South Gondar Zone, North-Central Ethiopia, 2020.

Characteristics	Controls	Cases	COR (95%)	AOR (95%)
Residency				
Rural	115(39.1%)	70(47.6%)	1.41(0.94, 2.11)	1.51(0.81, 2.82)
Urban	179(60.9%)	77(52.4%)	1	1
History of adverse abortion				
No	260(88.4%)	120(81.6%)	1	1
Yes	34(11.6%)	27(18.4%)	1.72(0.99, 2.98)	1.58(0.73, 3.44)
History of adverse birth outcome				
No	284(96.6%)	120(81.6%)	1	1
Yes	10(3.4%)	27(18.4%)	6.39(3.00, 13.61)	6.39(2.55, 15.99)*
Dietary counseling				
No	281(95.6%)	118(80.3%)	5.31(2.66, 10.57)	5.17(2.09, 12.84)*
Yes	13(4.4%)	29(19.7%)	1	1
ANC follow up				
No	22(7.5%)	20(13.6%)	1.94(1.02, 3.69	1.97(0.70, 5.55)
Yes	272(92.5%)	127(86.4%)	1	1
Pregnancy induced hypertension				
No	282(95.9%)	129(87.8%)	1	1
Yes	12(4.1%)	18(12.2%)	3.27(1.53, 7.00)	3.74(1.20, 11.62)*
History of hyperemesis gravidarum				
No	271(92.2%)	119(81%)	1	1
Yes	23(7.8%)	28(19%)	2.77(1.53, 6.01)	4.01(1.58, 10.21)*
Inter pregnancy interval				
<24 months	98(55.7%)	58(72.5%)	1	1
≥24 months	78(44.3%)	22(27.5%)	2.09(1.18, 3.72)	2.02(1.04, 3.91)*

COR: Crude Odd Ratio, AOR: Adjusted Odd Ratio.

* indicates statistically significant variables in multivariable logistic regression.

3. Result

3.1. Sociodemographic characteristics of study participants

A total of 147 mothers who had adverse birth outcomes (cases) and 294 mothers who did not have adverse birth outcome (controls) were included. The mean age (±SD) of study participants was 26.8 ± 5.5 years and ranges from 16 to 40 years. The majority (88.8%) of controls and 102(69.4%) of cases were in the age group of 19–34 years. One hundred seventy-nine (60.9%) of controls and 77(52.4%) of cases were from urban areas. All of the study participants (cases and controls) were Amhara in ethnicity. Regarding occupational status, 157(53.4%) of controls and 87(59.2%) of controls were civil servants. Concerning educational status, 82(27.9%) of controls, and 53(36.1%) cases had non-formal education (Table 1).

3.2. Obstetric and fetal related characteristics of respondents

Regarding parity, 163(55.4%) of controls and 67(45.6%) cases were multipara mothers (Para 2–4). Ninety-eight (55.7%) of controls and 58(72.5%) of cases had an inter-pregnancy interval of less than 24 months. Concerning gestational age (GA); 251(85.4%) of controls, and 77(52.4%) of cases had GA between 37-40 weeks. The majority (92.5%) of controls and 127(86.4%) of cases had ANC follow up. Twenty one (7.1%) of controls and 30(20.4%) of cases had an obstetric emergency during pregnancy. Thirty four (11.6%) of controls and 27(18.4%) of cases had history of abortion in their previous pregnancy (Table 2).

3.3. Nutritional and medical related characteristics of respondents

The majority, 281(95.6%) of controls and 118 (80.3%) of cases received dietary counseling during pregnancy. Six (2%) of controls and 6(4.1%) of cases had HIV. Regarding hepatitis status; 5(1.7%) of controls

and 5(3.4%) of cases had hepatitis B virus. Nine (3.1%) of controls and 4(2.7%) of cases had gestational diabetes mellitus (GDM) (Table 3).

3.4. Determinants of adverse birth outcomes

Both bivariable and multivariable logistic regression was done to identify significant variables for adverse birth outcome. History of adverse pregnancy outcome, pregnancy induced hypertension, did not receive dietary counseling during pregnancy, history of hyperemesis gravidarum, and inter-pregnancy interval less than 24 months were significantly associated with adverse pregnancy outcome (Table 4).

4. Discussion

Adverse pregnancy outcomes are the most significant indicator of the quality of maternal and child health care services, especially antenatal care, medical services, and general health services to the mother and their children. It is influenced by various obstetric, nutritional, and medical-related factors.

This study found that adverse pregnancy outcome were significantly associated with previous history of adverse birth outcome, pregnancy induced hypertension, lack of dietary counseling during pregnancy, history of hyperemesis gravidarum, and short inter-pregnancy interval.

This study showed that previous history of adverse birth outcomes was significantly associated with adverse pregnancy outcome. Mothers who had history of adverse birth outcome were 6.39 times more likely to have adverse pregnancy outcome as compared to their counterparts (AOR = 6.39, 95%CI = 2.55, 15.99). This finding was supported by a study finding in Hawassa [4], Jimma university medical center [18], and university of Gondar [12]. There is well-established evidence that indicates previous history of abnormal birth outcome is a risk factor to the occurrence of abnormal birth outcome in subsequent pregnancies.

Dietary counseling was significantly associated with adverse pregnancy outcome. The likelihood of developing adverse pregnancy outcome was 5.17 times higher in those mothers who did not receive dietary counseling during ANC as compared to those mothers who received dietary counseling (AOR = 5.17, 95%CI = 2.09, 12.84). This finding was supported by a study finding in Tigray region [19]. This could be due to the direct effect of maternal nutritional status on placental size, strength of the membrane, and fetus.

According to this study, pregnancy induced hypertension was significantly associated with adverse pregnancy outcome. The occurrence of adverse pregnancy outcome was 3.74 times higher in those mothers who had pregnancy induced hypertension as compared to their counterparts (AOR = 3.74, 95%CI = 1.20, 11.62). This finding was supported by a study finding in Suhul Hospital in Shire. This could be due to reduced placental blood flow due to endothelial cell injury and vasoconstriction of blood vessels. This condition affects the exchange of nutrients and oxygen between the mother and fetus, which results in abnormal pregnancy outcomes such as intrauterine growth restriction, low birth weight, preterm birth and stillbirth.

Furthermore, hyperemesis gravidarum was significantly associated with adverse pregnancy outcome. Those mothers who had history of hyperemesis gravidarum in the recent pregnancy were 4.01 times more likely to have adverse pregnancy outcome as compared to their counterparts (AOR = 4.01, 95%CI = 1.58, 10.21). This finding was supported by a study finding in England [20]. The association could due to placental dysfunction, maternal nutritional deficits and electrolyte imbalance during hyperemesis gravidarum.

Finally, this study identified a short inter-pregnancy interval as a risk factor for adverse pregnancy outcome. Mothers who had an inter-pregnancy interval of less than 24 months were 2.02 times more likely to have an adverse pregnancy outcome (AOR = 2.02, 95%CI = 1.04, 3.91). This finding was supported by a study finding in shire Ethiopia [19] and rural Uganda [21]. This could be due to the fact that shorter birth-to-pregnancy intervals result in maternal depletion syndrome which eventually increased the risk of adverse pregnancy outcomes mainly infant, neonatal and perinatal mortality, LBW, and preterm delivery [22].

This study has some limitations. Some variables like previous history of adverse birth outcome and history of abortion were self-reported information. Hence, this study may be prone to recall and social desirability biases. Moreover, some confounders may not be controlled due to the unmatched selection of study subjects.

5. Conclusion

This study showed that history of adverse pregnancy outcome, pregnancy induced hypertension, lack of dietary counseling, history of hyperemesis gravidarum, and inter-pregnancy interval less than 24 months were significantly associated with adverse pregnancy outcome. This study implies the need to improve dietary counseling during ANC visits for pregnant mothers. Beside this, counseling on birth spacing should be given to improve inter-pregnancy intervals. Furthermore, attention should be given to those mothers who had history adverse birth outcomes and hyperemesis gravidarum.

Declarations

Author contribution statement

Dagne Addisu: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Shimeles Biru, Minale Bezie, Wubet Alebachew, and Enyew Dagnew Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Maru Mekie, Binyam Minuye, Solomon Demis and Abenezer Melkie: Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Data availability statement

Data included in article/supplementary material/referenced in article.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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