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# DETERMINANTS OF ADVERSE BIRTH OUTCOME IN THE WEST SHEWA ZONE, OROMIA, REGIONAL STATE, ETHIOPIA: UNMATCHED CASE-CONTROL STUDY

Daniel Belema Fekene[1]*, Gizachew Abdissa Bulto[1], Benyam Seifu Woldeyes[1], Gurmesa Daba Dina[1], Kassa Mamo Negash[1]

[1]Department of Midwifery, College of Medicine and Health Sciences, Ambo University, Ambo, Ethiopia

**Abstract**

**Introduction:** Adverse birth outcome (ABO) can lead to higher rates of poor health and infection for newborns, as well as long-term neurological and health problems. Hence, the aim is to identify determinants of ABOs among mothers who gave birth in hospitals in West Shewa zone, Ethiopia.
**Material and methods:** A hospital-based, unmatched, case-control study was conducted from March 5 to July 29, 2020, among 591 mothers (171 cases and 420 controls) who had given birth in hospitals found in West Shewa zone. The questionnaire was collected using census and survey processing system (CS-Pro) version 7.1. The data were entered into Epi-data version 3.1 and analyzed by SPSS software version 23. Descriptive statistics, bivariate analysis, and multivariate logistic regression analysis were performed. Finally, P-value <0.05 was used to declare and include variables with statistically significant in predicting the outcome variable.
**Result:** On multivariate analysis, urban residence (AOR=0.65, 95%, CI=0.43–0.98), lack of family support during child bearing (AOR =5.24, 95% CI=3.16–8.71), pregnancy type (AOR = 4.02, 95% CI: 2.47–6.52), short inter-pregnancy interval (AOR = 1.43,95% CI= 1.23–4.48), less than four antenatal care (ANC) visits (AOR =1.80,95%CI: 1.17–2.78), and  having current obstetric complication (AOR=2.07, 95% CI =1.18–3.61) were significantly associated with adverse birth outcomes.
**Conclusions:** Residence, lack of family support during childbearing, pregnancy type, short inter-pregnancy interval, having current obstetric complications, and number of ANC visits were identified as determinants of adverse birth outcome. Therefore, improving family support, increasing inter-pregnancy interval through family planning counselling and provision, and having the recommended ANC follow-up were recommended.

**Keywords**

## Background

An adverse birth outcome (ABO), which includes preterm births (PTB) and low birth weight (LBW), are major drivers of morbidity and mortality in neonates and infants [1-3]. ABO is also an important contributor to serious, short- and long-term, physical and mental disabilities, including perinatal and infant death; chronic health problems later in life, such as hypertension, ischemic heart disease, metabolic syndrome, stroke, diabetes, malignancies, osteoarthritis, and dementia; learning difficulties; and hearing and visual impairments [4-7]. *Preterm* is defined as a baby born alive before 37 weeks of

pregnancy are completed [8]. Low birth weight is defined by the World Health Organization (WHO) as a weight of less than 2,500 grams for a live-born infant at birth [8].The majority of severe adverse outcomes during pregnancy and chldbirth result in the death of the mother or her offspring [9,10]. Globally in 2019, 2.4 million children died in the first month of life and about 6,700 neonatal deaths occurred every day; the first 28 days of life were the most vulnerable time for children under age 5 [11]. Regionally, the neonatal mortality rate is highest in Sub-Saharan Africa, followed by Central and Southern Asia. A child born in Sub-Saharan Africa is 10 times more likely to die in the first month of life than a child

born in a high-income country and 12 times more likely to die than a child born in Australia or New Zealand [11]. ABOs are influenced by a different of biological, psychosocial, and environmental factors [12-14]. Different studies indicated that socioeconomic status, maternal education, marital status, pregnancy desire and teenage pregnancy, maternal co-morbidities, and genetic vulnerabilities are also linked to poor pregnancy outcomes. Moreover, low pre-pregnancy body mass index (BMI), inadequate weight gain, and poor prenatal care utilization, female foetus, and self-reported cigarette smoking history are related to poor birth outcomes [15-17]. A high level of anxiety and depressive symptoms during childbirth and pregnancy have been related to a higher risk of adverse birth outcomes [10,14].

In Ethiopia, different studies have shown that the prevalence of ABOs is within the range of 13.9% to 37.6% [18-24]. Antenatal care (ANC) follow-up, rural residency, pregnancy-induced hypertension, advanced maternal age, current pregnancy complications, anaemia, and twin pregnancy were factors associated with ABOs [18-25]. Though a few earlier studies were conducted in Ethiopia, those studies were cross-sectional and therefore weak in identifying those factors; those studies were also mainly conducted in single town or district [21,24,26-28]. Additionally, no other study has been conducted on determinants of ABOs in the study area. Therefore, the current study aimed at identifying determinants of adverse birth outcomes in the West Shewa zone, Oromia, regional state, Ethiopia, by using unmatched case-control study design.

## Material and methods

### Study area and period
The study was conducted in hospitals found in West Shewa, Oromia, region, Ethiopia, from March 5 to July 29, 2020. Ambo town is the capital city of the West Shewa zone, which is located 114 kilometres to the west of Addis Ababa. West Shewa zone has 8 public hospitals, 96 government health centres, 526 health posts, and 77 private clinics. The total population in the zone is 2,058,676, of whom 1,030,175 were females.

### Study design and population
A hospital-based, unmatched, case-control study was conducted. All mothers who gave birth in hospitals in the zone were our source population. Cases were mothers with adverse birth outcome, including preterm birth, low birth weight, or stillbirth; controls were mothers with live births whose infants had birth weights greater than 2,500 grams at birth and were born at term.

### Sample size determination and sampling procedure
The sample size was calculated by Epi info stat calc software. The proportion of mothers having complications during childbirth among controls was used to determine the sample size from the study conducted in Jimma [29]. The assumptions for the sample size calculation were as follows: The proportion of mothers having complications during childbirth among controls 19.6%, odds ratio of 2.9, 95% CI, power level of 80%, and a case-to-control ratio of 1:2. The maximum sample size was 591, of which 171 were cases and 420 were controls. All government hospitals providing 24 hours delivery services in the West Shewa zone were included in the study. The number of cases and controls were proportionally allocated to each hospital based on their last quarter institutional delivery performance report prior to data collection time. Finally, the eligible case was selected consecutively, and three controls were selected consecutively until the required sample size was achieved.

### Data collection tool, quality control, and measurements
A structured interview questionnaire in English was prepared and translated into the local language, Afan Oromo, by the translator; it was then translated back into English by a third person to check for consistency. The questionnaire gathers information on sociodemographic characteristics, past obstetric and gynaecologic experiences, the current obstetric experience, and the characteristics of the newborn at birth; it was adapted from the EDHS (Ethiopian Demographic and Health Survey) and other reviewed literature and modified according to the local context [9,18,20-25,30]. The data were collected from the mothers, and measurements were taken from the neonates. The questionnaire template was coded using open-source software for Computer Assisted Personal Interviewing and census and survey processing system (CS-Pro) version 7.1 and was deployed to census and survey entry (CS-Entry) android application. Eight nurses were recruited as data collectors and four assistant professors were hired as supervisors. In addition, the data collectors were trained for two days on the techniques of data collection and the purpose of the study for study participants. Pretesting was done on 5% of the total study participants, and necessary adjustments were made to specific word use and sequencing of questions. The weight of the newborns was measured to the nearest 100 grams using a baby measuring weight scale within 15 minutes after delivery.

### Data processing and analysis
The data were collected using CS-Entry for the android version and exported to SPSS version 23 for analysis. Binary logistic regression analysis was done to evaluate the association of ABOs with each independent variable separately. Variables with a p-value <0.2 were entered into the multivariable logistic regression models. Model fitness was tested with Hosmer-

Lemeshow goodness of fit test. Furthermore, multicollinearity was checked between the independent variables and (VIF), and tolerance to test multicollinearity and VIF (variance inflation factors) was less than 10 and tolerance >0. Finally, the strength of association was measured by both crude and adjusted odds ratios, with a 95% CI for exposure variables and ABOs. The statistical significance level was declared at p-value < 0.05.

# Result

## Sociodemographic characteristics of mother

A total of 591 mothers (171 cases and 420 controls) were included, with a response rate of 100%. Concerning the educational status of mothers, 56 (32.7%) of the cases are unable to read and write, and 88 (21.0%) of the controls have college or above educations. Of the controls, 118 (28.1%) were farmers 60 (35.1%) of the cases stated their occupations as housewife or mother. The majority of the cases (62.6%) and the controls (58.7%) were Protestant by religion. Ninety (52.6%) of the cases and 164 (28.8%) of the controls were lived in rural areas. (Table 1)

## Past obstetric and gynaecologic characteristics of participants

The result of this study shows that 12.3% of cases and 6.0% of the control had a record of pre-existing medical illness, with 35 (20.5) cases experiencing anaemia. Forty-nine (11.7%) of the control and 23 (13.5%) of the cases had histories of abortion in their past pregnancies. Concerning family planning, 117 (68.4%) of cases and 275 (65.5%) of controls cases use family planning for birth spacing (Table 2)

**Table 1.** Sociodemographic characteristics of mothers who gave birth in public hospitals, West Shewa zone, Ethiopia, 2020

| Variables | Categories | Case | | Control | | Statistics ($X^2$), p-value |
|---|---|---|---|---|---|---|
| | | Frequency | Percentages % | Frequency | Percentages % | |
| Age | <= 23 | 51 | 29.8 | 118 | 28.1 | $X^2$=8.45, p=0.04 |
| | 24-26 | 33 | 19.3 | 110 | 26.2 | |
| | 27-30 | 60 | 35.1 | 105 | 25.0 | |
| | 31+ | 27 | 15.8 | 87 | 20.7 | |
| Religion | Orthodox | 53 | 31.0 | 138 | 32.9 | $X^2$=1.16, p=0.56 |
| | Muslim | 11 | 6.4 | 36 | 8.6 | |
| | Protestant | 107 | 62.6 | 246 | 58.7 | |
| Ethnicity | Oromo | 162 | 94.7 | 393 | 93.6 | $X^2$=0.29, p=0.59 |
| | Amhara | 9 | 5.3 | 27 | 6.4 | |
| Residence | Rural | 90 | 52.6 | 164 | 39.0 | $X^2$=9.15, p=0.00 |
| | Urban | 81 | 47.4 | 256 | 61.0 | |
| Mother's education | No formal education | 56 | 32.7 | 140 | 33.3 | $X^2$=7.27, p=0.06 |
| | Primary education (1-8) | 60 | 35.1 | 105 | 25.0 | |
| | Secondary education (9-12) | 27 | 15.8 | 87 | 20.7 | |
| | Collage and above | 28 | 16.4 | 88 | 21.0 | |
| Father's education | No formal education | 41 | 24.0 | 99 | 23.6 | $X^2$=8.62, p=0.04 |
| | Primary education (1-8) | 56 | 32.7 | 93 | 22.1 | |
| | Secondary education (9-12) | 36 | 21.1 | 102 | 24.3 | |
| | Collage and above | 38 | 22.2 | 126 | 30.0 | |
| Occupation of mother | Government employee | 19 | 11.1 | 54 | 12.9 | $X^2$=2.64, p=0.65 |
| | Private employee | 13 | 7.6 | 37 | 8.8 | |
| | Farmer | 54 | 31.6 | 118 | 28.1 | |
| | Merchant | 25 | 14.6 | 48 | 11.4 | |
| | Housewife | 60 | 35.1 | 163 | 38.8 | |
| Occupation of father | Government employee | 40 | 23.4 | 133 | 31.7 | $X^2$=5.81, p=0.12 |
| | Private employee | 19 | 11.1 | 56 | 13.3 | |
| | Farmer | 81 | 47.4 | 162 | 38.6 | |
| | Merchant | 31 | 18.1 | 69 | 16.4 | |
| Monthly income | <= 1000 | 99 | 57.9 | 148 | 35.2 | $X^2$=7.14, p=0.68 |
| | 1,001-3,000 | 42 | 24.6 | 133 | 31.7 | |
| | 3,001+ | 30 | 17.5 | 139 | 33.1 | |

**Table 2.** Past obstetric and gynaecologic characteristics of participants in public hospitals, West Shewa zone, Ethiopia, 2020

| Variables | Categories | Case | | Control | | Statistics (X²), p-value |
|---|---|---|---|---|---|---|
| | | Frequency | Percentages % | Frequency | Percentages% | |
| Abortion history | Yes | 23 | 13.5 | 49 | 11.7 | X²=0.04, p=0.84 |
| | No | 86 | 50.3 | 194 | 46.2 | |
| Reason for abortion | Spontaneous | 20 | 11.7 | 44 | 10.5 | X²=2.33, p=0.31 |
| | Medically induced | 3 | 1.8 | 3 | 0.7 | |
| | Medical and MVA* | 0 | - | 3 | 0.7 | |
| Low birth weight | Yes | 29 | 17.0 | 22 | 5.2 | X²=18.9, p=0.00 |
| | No | 83 | 48.5 | 224 | 53.3 | |
| Stillbirth | Yes | 8 | 4.7 | 27 | 6.4 | X²=1.28, p=0.26 |
| | No | 104 | 60.8 | 219 | 52.1 | |
| Preterm | Yes | 31 | 18.1 | 23 | 5.5 | X²=20.19, p=0.00 |
| | No | 81 | 47.4 | 223 | 53.1 | |
| Ever used family planning method | Yes | 117 | 68.4 | 275 | 65.5 | X²=0.47, p=0.49 |
| | No | 54 | 31.6 | 145 | 34.5 | |
| Type of family planning method used | Oral contraceptives | 12 | 7.0 | 46 | 11.0 | X²=5.23, p=0.26 |
| | Implant | 37 | 21.6 | 74 | 17.6 | |
| | Injection | 60 | 35.1 | 136 | 32.4 | |
| | IUD | 6 | 3.5 | 18 | 4.3 | |
| Medical disorder | Yes | 21 | 12.3 | 25 | 6.0 | X²=6.19, p=0.01 |
| | No | 93 | 54.4 | 225 | 53.6 | |
| Diabetes mellitus | No | 141 | 82.5 | 410 | 97.6 | X²=44.27, p=0.00 |
| | Yes | 30 | 17.5 | 10 | 2.4 | |
| Hypertension | No | 130 | 76.0 | 334 | 79.5 | X²=0.88, p=0.35 |
| | Yes | 41 | 24.0 | 86 | 20.5 | |
| Anaemia | No | 136 | 79.5 | 364 | 86.7 | X²=0.65, p=0.42 |
| | Yes | 35 | 20.5 | 74 | 17.6 | |

MVA=manual vacuum aspiration
IUD=*Intrauterine Device*

**Current obstetric characteristics of participants**

Fifty-nine (34.5%) cases had history of one-time pregnancy, and 113 (26.9%) of controls had four or more pregnancies. In terms of planning, 138 (80.7%) cases and 351 (83.6%) of the controls had planned the current pregnancy. A higher proportion of cases and controls didn't develop complications during the current pregnancy. Fifty-one (29.8%) of the cases and 186 (44.3%) of the controls attended four or more ANC visits. (Table 3)

**Neonatal assessment after birth**

The neonatal assessment results indicated that 57.9% of the cases and 65.7% of the controls were male. The first minute APGAR score showed that 25.1% of neonates among the cases and 23.6% among the controls were severely asphyxiated. While 115 (67.3%) of the cases cried at birth, 56 (32.7%) didn't cry. The percentage of cases receiving skin-to-skin was 82.5%; the percentage of controls receiving such care was 77.9 %. (Table4)

**Determinants of adverse birth outcome**

Bivariate logistic regression analysis was performed using odds ratios (OR) and 95% CI. The predictor variables with

p-value less than 0.2 in the bivariate logistic regression analysis were entered into the multivariable logistic regression analysis model to control the influence of potential confounding variables. The correlation between the independent variables was checked.

After controlling for confounders using multivariable analysis residence, lack of family support during childbearing, pregnancy type, short inter-pregnancy interval, current obstetric complications, and number of ANC visits were identified as determinants of ABOs. (Table 5)

Mothers who live in urban areas are 1.5 times less likely to develop ABOsas compared with women living in rural areas (AOR=0.65, 95%, CI=0.43-0.98). The odds of having adverse birth outcomes increases twofold for mothers whose birth intervals are less than two years, as compared to their respective referent group (AOR=1.43,95% CI=1.23-4.48). Furthermore, mothers who have no family support during childbearing had a five times greater chance to develop ABOs as compared with mothers who had family support (AOR =5.24, 95% CI=3.16-8.71). The number of antenatal care visits was found to be associated with the incidence of ABOs, with mothers who had fewer than four antenatal care visits being twice as likely to experience adverse birth outcomes as

**Table 3.** Current obstetric characteristics of mothers who gave birth in public hospitals in West Shewa zone, Ethiopia, 2020

| Variables | Categories | Case | | Control | | Statistics ($X^2$), p-value |
|---|---|---|---|---|---|---|
| | | Frequency | Percentages % | Frequency | Percentages% | |
| Gravidity | <= 1 | 59 | 34.5 | 174 | 41.4 | $X^2$=2.95, p=0.23 |
| | 2 - 3 | 65 | 38.0 | 133 | 31.7 | |
| | >_4 | 47 | 27.5 | 113 | 26.9 | |
| Antenatal care (ANC) | Yes | 138 | 80.7 | 362 | 86.2 | $X^2$=2.81, p=0.09 |
| | No | 33 | 19.3 | 58 | 13.8 | |
| Number of ANC visits | <4 | 120 | 70.2 | 234 | 55.7 | $X^2$=2.81, p=0.00 |
| | >_4 | 51 | 29.8 | 186 | 44.3 | |
| Current obstetric complication | Yes | 23 | 13.5 | 36 | 8.6 | $X^2$=3.27, p=0.07 |
| | No | 148 | 86.5 | 384 | 91.4 | |
| Vaginal bleeding | No | 165 | 96.5 | 403 | 96.0 | $X^2$=0.09, p=0.76 |
| | Yes | 6 | 3.5 | 17 | 4.0 | |
| Obstructed labour | No | 166 | 97.1 | 411 | 97.9 | $X^2$=0.09, p=0.57 |
| | Yes | 5 | 2.9 | 9 | 2.1 | |
| Anaemia | No | 168 | 98.2 | 410 | 97.6 | $X^2$=0.22, p=0.64 |
| | Yes | 3 | 1.8 | 10 | 2.4 | |
| Foul smelling discharge | No | 168 | 98.8 | 415 | 98.8 | $X^2$=0.29, p=0.59 |
| | Yes | 3 | 1.2 | 5 | 1.2 | |
| Birth interval | < 2 years | 107 | 62.6 | 198 | 47.1 | $X^2$=11.58, p=0.001 |
| | > 2 years | 64 | 37.4 | 222 | 52.9 | |
| Pregnancy planned | Yes | 138 | 80.7 | 351 | 83.6 | $X^2$=0.71, p=0.43 |
| | No | 33 | 19.3 | 69 | 16.4 | |
| Pregnancy supported by husband | Yes | 162 | 94.7 | 402 | 95.7 | $X^2$=0.27, p=0.61 |
| | No | 9 | 5.3 | 18 | 4.3 | |
| Family support during pregnancy | Yes | 105 | 61.4 | 386 | 91.9 | $X^2$=80.42, p=0.00 |
| | No | 66 | 38.6 | 34 | 8.1 | |
| Place of delivery | Home | 11 | 6.4 | 27 | 6.4 | $X^2$=6.64, p=0.08 |
| | Health Centre | 47 | 27.5 | 84 | 20.0 | |
| | Hospital | 113 | 66.1 | 309 | 73.6 | |
| Mode of delivery | SVD | 131 | 76.6 | 303 | 72.1 | $X^2$=1.56, p=0.46 |
| | Assisted vaginal delivery | 7 | 4.1 | 16 | 3.8 | |
| | CS | 33 | 19.3 | 101 | 24.0 | |
| Type of pregnancy | Single | 110 | 18.6 | 372 | 62.9 | $X^2$=47.48, p=0.00 |
| | Twin | 61 | 10.3 | 48 | 8.1 | |
| Labour onset | Spontaneous | 144 | 84.2 | 364 | 86.7 | $X^2$=0.61, p=0.43 |
| | Induced | 27 | 15.8 | 56 | 13.3 | |
| Rhesus factor (Rh) | Positive | 158 | 92.4 | 391 | 93.1 | $X^2$=0.09, p=0.77 |
| | Negative | 13 | 7.6 | 29 | 6.9 | |
| Received tetanus injection | Yes | 98 | 57.3 | 253 | 60.2 | $X^2$=0.43, p=0.51 |
| | No | 73 | 42.7 | 167 | 39.8 | |

SVD =spontaneous vaginal delivery
CS=Cesarean delivery

**Table 4.** Neonatal assessments at birth in West Shewa zone, Ethiopia, 2020

| Variables | Categories | Case | | Control | | Statistics (X²), p-value |
|---|---|---|---|---|---|---|
| | | Frequency | Percentages % | Frequency | Percentages % | |
| Sex | Male | 99 | 57.9 | 276 | 65.7 | X²=3.23, p=0.07 |
| | Female | 72 | 42.2 | 144 | 34.3 | |
| APGAR score in first minutes | Normal | 55 | 32.2 | 160 | 38.1 | X²=1.88, p=0.39 |
| | Moderate asphyxia | 73 | 42.7 | 161 | 38.3 | |
| | Severe asphyxia | 43 | 25.1 | 99 | 23.6 | |
| APGAR score in fifth minute | Normal | 97 | 56.7 | 253 | 60.2 | X²=1.08, p=0.58 |
| | Moderate asphyxia | 34 | 19.9 | 69 | 16.4 | |
| | Severe asphyxia | 40 | 23.4 | 98 | 23.3 | |
| Gestational age | Preterm | 38 | 6.4 | 83 | 14.0 | X²=0.45, p=0.50 |
| | Term | 133 | 22.5 | 337 | 57.0 | |
| Birth weight | Low birth weight | 61 | 35.7 | 23 | 3.9 | X²=90.87, p=0.00 |
| | Normal birth weight | 110 | 64.3 | 397 | 67.2 | |
| Birth injury | Yes | 2 | 1.2 | 11 | 2.6 | X²=1.17, p=0.28 |
| | No | 169 | 98.8 | 409 | 97.4 | |
| Cry immediately after birth | Yes | 115 | 67.3 | 306 | 72.9 | X²=1.86, p=0.17 |
| | No | 56 | 32.7 | 114 | 27.1 | |
| Skin-to-skin contact | Yes | 131 | 22.2 | 327 | 77.9 | X²=0.10, p=0.74 |
| | No | 30 | 6.8 | 93 | 22.1 | |
| Breastfeeding within one hour | Yes | 62 | 36.3 | 186 | 44.3 | X²=3.25, p=0.07 |
| | No | 109 | 63.7 | 234 | 55.7 | |
| Provided first initial newborn care | No | 70 | 40.9 | 265 | 63.1 | X²=24.30, p=0.00 |
| | Yes | 101 | 59.1 | 155 | 36.9 | |

**Table 5.** Bivariate and multivariate logistic regression analysis of determinants of adverse birth outcome in West Shewa zone, Ethiopia, 2020

| Variables | Adverse birth outcome | | COR95%CI | | P-value |
|---|---|---|---|---|---|
| | Yes | No | | AOR95%CI | |
| **Residence** | | | | | |
| Urban | 81(13.7%) | 256(43.3%) | 0.57 (0.403-0 .83) | 0.65(0.43-0.98)* | 0.040 |
| Rural | 90(15.2%) | 164(27.7%) | 1 | 1 | |
| **Family support during childbearing** | | | | | |
| No | 66(11.2%) | 34(5.8%) | 7.14 (4.47-11.38) | 5.24(3.16-8.71)* | 0.000 |
| Yes | 105 (17.8%) | 386(65.3%) | 1 | 1 | |
| **Pregnancy type** | | | | | |
| Twins | 61(10.3%) | 48(8.1%) | 4.29(2.78-6.63) | 4.02 (2.47-6.52)* | 0.000 |
| Single | 110 (18.6%) | 372 (62.9%) | 1 | 1 | |
| **Birth interval** | | | | | |
| <2 years | 107(18.1%) | 198(33.5%) | 1.87 (1.30-2.69) | 1.43(1.23-4.48)* | 0.0001 |
| >2 years | 64 (10.8%) | 222(37.6%) | 1 | 1 | |
| **Number of antenatal care visits** | | | | | |
| <4 | 120(20.3%) | 234(39.6%) | 1.87(1.28-2.74) | 1.80(1.17-2.78)* | 0.008 |
| >=4 | 51(8.6%) | 186(31.5%) | 1 | 1 | |
| **Current obstetrics complication** | | | | | |
| Yes | 43(7.3%) | 39(6.6%) | 3.28(2.04-5.3) | 2.072(1.18-3.61)* | 0.001 |
| No | 128(21.7%) | 381(64.5%) | 1 | 1 | |

Keys: 1=Reference category

*Statistically significant at p<0.05 in multivariate*

compared to their counterparts with four or more such visits (AOR = 1.80, 95% CI: 1.17-2.78). Mothers who gave birth to twins had a four times greater chance of an ABO than mothers who gave birth to a singleton (AOR = 4.02, 95% CI: 2.47-6.52). Mothers having current obstetric complications were twice as likely to experience adverse birth outcomes as compared to mothers with no current obstetric complications (AOR=2.07, 95% CI: 1.18-3.61).

## Discussion

This study tried to identify determinants of ABOs among mothers who delivered in hospitals in West Shewa zone. Women's place of residence was found to be significantly associated with ABOs. Those women residing in urban areas were 1.5% less likely to develop ABOs than those in rural areas, a result similar to that found in studies reported elsewhere in Ethiopia (in Gamo Gofa zone, Hosana town, and northern Wollo) and in China [22-25]. This could be due to the relative lack of access in rural areas to quality pregnancy-related care, including medical services, health information, and nutritional awareness.

The number of antenatal care (ANC) visits is significantly associated with ABOs: mothers who had fewer than four ANC visits were twice as likely to have ABOs as those who had four or more such visits. This finding is supported by studies conducted in Cameroon, India, Malawi, Addis Ababa, and in Ethiopia, in Tigrai region, Amhara region,and North Shewa zone [31-37]. This might be because mothers who have four or more ANC visits gain access to different or additional health promotion and preventive interventions that enhance the health of both the mother and foetus.

Having a history of current obstetric complications was also found to be significantly associated with ABOs. The chance of developing an abnormal birth outcome among mothers with current histories of child-related abnormal birth outcome was twice as high as the chances of mothers without such complications. A study conducted in Gambia and Nigeria showed that mothers with a current history of child-related abnormal birth outcomes are at greater risk of giving birth to a baby with abnormal outcomes [38,39]. Similar findings were previously reported in Ethiopia [21,23,24]. The link may be explained by the impact on the well-being of the foetus in the uterus  of complications affecting the mother during pregnancy [40].

Mothers who have no support during childbearing had a five times greater chance of developing adverse birth outcomes as compared to mothers who have partner support. This study was in line with a study done in the United States that found that women with a supportive partner were 63% less likely to have low birth weight infants and nearly two times less likely to have a pregnancy loss, as compared to those with no partner support [30]. Those who have paternal support may experience less stress and thus be more likely to enter prenatal care; they may also be more likely to report a desired pregnancy, which may also reduce their risk of poor birth outcomes.

Short inter-pregnancy interval is also found to be a determinant of ABOs. The odds of having an ABO were 1.43 times greater among mothers with short birth intervals, as compared to mothers having optimal birth spacing. This result is in line with studies in Tanzania; California, Ohio, and elsewhere across the United States; and Bangladesh [41-44], which showed short inter-pregnancy intervals were a risk factor for low birth weight and/or preterm birth. For example, a study conducted in Tanzania found that women who conceived at either shorter (less <24 months) or longer (37 to 59 months or more) inter-pregnancy intervals had a greater risk of preterm birth [41], and studies conducted in California, Ohio, and elsewhere across the United States showed that intervals shorter than 6 months might be associated with increased risk of adverse outcomes in the subsequent pregnancy [42,43]. Study results from Bangladesh showed that a very short birth interval less than 21 months (birth-to-pregnancy of less than 12 months when pregnancy is carried to term) is associated with an increased risk of adverse pregnancy outcomes, but intervals of 24 to 32 months (birth-to-pregnancy interval of 12 to 23 months when pregnancy is carried to term) and 33 to 44 months (birth-to-pregnancy interval of 24 to 35 months) do not appear to be [44]. This could be because short inter-pregnancy interval results in maternal nutrition reduction, which compromises the mother's ability to support foetal growth and development, which in turn increases the risks of preterm birth, growth restriction, and maternal morbidity and mortality in the subsequent pregnancy [40,45].

In this study, mothers having current obstetric complications were three times more likely to develop adverse birth outcomes as compared to mothers with no history of current complications. This result is supported by studies conducted in Gondar, Ethiopia; Hosanna, Ethiopia; and a university and hospital in Nashik, India. [19,23,32].

## Conclusions

The result of this study revealed that residence, lack of family support during childbearing, pregnancy type, short inter-pregnancy interval, current obstetric complications, and a number of ANC visits were determinants of adverse birth outcome. Therefore, improving family support, inter-pregnancy

intervals through family planning counselling and provision, having the recommended ANC visits, were recommended.

## Abbreviations

| ABO | Adverse birth outcome |
|-----|----------------------|
| ANC | Antenatal care |
| AOR | Adjusted odds ratio |
| CI | Confidence interval |
| COR | Crude odds ratio |
| GA | Gestational age |
| LBW | Low birth weight |
| MM | Maternal mortality |
| PTB | Preterm birth |
| SD | Standard deviation |
| WHO | World Health Organization |

## ORCID Identifiers of the Authors

Daniel Belema Fekene 0000-0001-5751-6575 (https://orcid.org/0000-0001-5751-6575)

Gizachew Abdissa Bulto 0000-0003-4390-1418 (https://orcid.org/0000-0003-4390-1418)

Benyam Seifu Woldeyes 0000-0003-3861-0878 (https://orcid.org/0000-0003-3861-0878)

Gurmesa Daba Dina 0000-0002-0520-3814 (https://orcid.org/0000-0002-0520-3814)

Kassa Mamo Negash 0000-0002-4320-923X (https://orcid.org/0000-0002-4320-923X)

## Declaration

### Ethics approval and consent to participate

Ethical clearance and an approval letter to conduct this study were obtained from the Ambo University Institutional Review Board, and a letter of cooperation was taken from the Ambo University Institute of Health to West Shewa Health Bureau. Written consent was obtained from the study participants after explaining the study objectives and procedures and ensuring participants of their right to refuse at any time to continue in the study. For this purpose, a one-page consent letter was attached to the cover page of each questionnaire stating the general objectives of the study and ensuring the participants' confidentiality; data collectors were fully briefed on these points before proceeding with the interview. Confidentiality of the information was ensured by coding and by restricting access to the raw data collected from the field to authorized persons.

### Consent for publication

Not applicable.

### Availability of data and materials

Full data for this research is available through the corresponding author upon request.

### Competing interests

The authors declare that they have no competing interests.

### Authors' contributions

All authors (DB, GA, BS, GD, and KM) contributed to the design of the study and the interpretation of data. DB performed the data analysis and drafted the manuscript. All other authors critically revised the manuscript and approved the final version. All authors read and approved the final manuscript.

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