Risk factors for stillbirth and early neonatal death: A case-control study in tertiary hospitals in Addis Ababa, Ethiopia

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Abstract

Background: Globally, Ethiopia is ranked seventh in the absolute number of stillbirths. Attempts to decrease this number have been obstructed by an inadequate understanding of the risk factors leading to stillbirth and early neonatal death in Ethiopia. This study was conducted in two tertiary hospitals in Addis Ababa, Ethiopia, to identify the risk factors for stillbirth and neonatal death in this setting.

Methods: This case-control study was conducted between October 2016 and May 2017 at Tikur Anbessa Hospital (TAH) and Gandhi Memorial Hospital (GMH). All enrolled women who had a stillbirth or early neonatal death during this period were included as cases and a random sample of women delivering at the hospital was selected to enroll as controls for a 2:1 ratio of controls to cases. Data on potential risk factors were retrieved from medical records including health passports, delivery records, and treatment charts. Statistical differences in background and social characteristics of cases and controls were determined by t-test and chi-squared (or fisher's exact test) for quantitative and categorical variables, respectively. Binary logistic regression analysis was completed to determine any associations between risk factors and stillbirth/early neonatal death.

Results: During the study period, 366 women delivering at the hospitals were enrolled as cases and 711 women delivering at the hospitals were enrolled as controls. During the study period, hospital records indicated that the estimated stillbirth and neonatal death rates were 30.7 per 1000. Neonatal causes (43.4%) were the most common, followed by antepartum (32.5%) and intrapartum (24.5%). Risk factors for stillbirths and early neonatal death were maternal education (aOR 1.747, 95%CI 1.098-2.780), parity (aOR 1.114, 95%CI .058- 2.484), previous stillbirth (aOR 9.447, 95%CI 6.245-14.289), previous preterm birth (aOR 3.620, 95%CI 2.363-5.546), and previous child with congenital abnormality (aOR 2.190, 95% 1.228-3.905), and antepartum hemorrhage during pregnancy (aOR 3.273, 95% 1.523-7.031).

Conclusion: Antepartum hemorrhaging is the only risk factor in our study amenable for direct intervention. Efforts should be maximized to improve patient education and antenatal and obstetric services, particularly for women who have a history of obstetric complications identified as risk factors.

Background

The World Health Organization (WHO) defines stillbirth as a fetus born dead at 28 weeks of gestation or more, with a birth weight of $\geq 1000$ g, or a body length of $\geq 35$ cm (1). In 2015, there was an estimated 2.6 million third trimester stillbirth worldwide (2). Ten countries (India, Pakistan, Nigeria, China, Bangladesh, the Democratic Republic of the Congo, Ethiopia, Indonesia, Tanzania, and Afghanistan) carry the burden of over 65% of total stillbirths (3). Progress in reducing the stillbirth rate has been much slower than that of maternal mortality and children under 5 mortalities. (2)

Children face the highest risk of dying during the neonatal period or the first 28 days of life. Every year, nearly 41% of all under-five child deaths are among newborn infants during this period (4). Between 1990 and 2017, the global neonatal mortality rate has decreased by 51% from 36.6 deaths per 1000 live births
in 1990 to 18.0 deaths per 1000 live births (5). While annual NMRs varied widely, South Asia and Central Africa had the highest NMRs in 2017 (5). The 2008 global estimation for the major causes of neonatal deaths was preterm birth (29%), infections (25%), and complications of asphyxia (22%) (6). However, in Sub Saharan Africa, the leading cause of neonatal mortality was asphyxia, which was in turn the consequence of poor obstetric care (7). Improving neonatal mortality is an essential aspect of reducing under-five mortality; thus, reducing neonatal mortality has been a target of the Millennium Development Goals, the Global Strategy for Women’s and Children’s Health, the Every Newborn Act, and several other initiatives.

Early neonatal death is defined as the death of a resident newborn less than seven days of age (8). Stillbirth and early neonatal death together comprise perinatal death. Thus because perinatal mortality accounts for deaths to live births as well as to stillborn and is a comprehensive measure of mortality around the time of delivery and postpartum (8). According to the World Health Organization’s estimation, the perinatal mortality (PM) rate is 57 per 1000 births in the world (8). This rate is below 10 per 1000 births in developed countries, but it rises to 80–100 per 1000 births in African countries (8). Because of the high magnitude of the problem and its direct linkage with the quality of health service during pregnancy, the neonatal mortality rate (NMR) and perinatal mortality rate (PMR) are used as important indicators of the health status of a country (8). Overall, neonatal mortality has decreased, while stillbirth rates have remained steady or increased (9).

Stillbirth and early neonatal death present detrimental psychological, physical, and social costs to mothers, families, and communities. There are many psychosocial consequences for parents, including anxiety, long-term depression, posttraumatic stress disorder, and stigmatization (10). Grief, suppression, employment difficulties, financial debt, substance use, and diminished quality of life are all factors associated with parents and families experiencing stillbirth (10). Thus, to policymakers, public health professionals, and medical professionals, stillbirth continues to remain a tremendous burden.

Of the ten countries that carry the burden of the majority of stillbirths, Ethiopia was ranked in the seventh position (2, 3). Despite offering universal obstetric services, including prenatal care, the nation has faced systematic obstacles such as shortages and inadequacies in staff, ambulatory transportation, and equipment. Rural and cultural stigma against utilizing certain maternal health services also serve as obstacles. Moreover, some facilities in Ethiopia continue to charge user fees for maternal health services and such facilities can offer better services and amenities (11). Thus, despite sustained efforts to address these issues, several obstacles continue to prevent declines in stillbirth rates.

There is limited literature on stillbirth and early neonatal risk factors and rates in Ethiopia. A recent secondary analysis study on the Ethiopian Demographic Health Surveys found that the stillbirth rate has declined in Ethiopia from 13.3 per 1000 live births in 2005 to 9.2 per 1000 live births in 2016 (12). Moreover, they found that women’s urban place of residence, antenatal care, education, health facility delivery, and cesarean delivery were significant predictors of the decline of stillbirths in Ethiopia (12). However, more information is necessary to understand the risk factors of stillbirth, particularly concerning
obstetric risk factors. This study attempts to help address such gaps by investigating determinants of stillbirth in two tertiary referral hospitals in Ethiopia.

**Methods**

**Study Design**

This study was an unmatched case-control design. For this study, all women with live births during the study period were selected as controls and all antepartum, intrapartum, and early neonatal deaths were selected as cases. Neonates who were born at the hospital but died at home after discharge were excluded from this study. Neonates delivered outside the hospitals and referred to the neonatology ward at the hospital but died during follow-up were excluded from this study. A total of 1077 participants were recruited during the study period: 366 cases and 711 controls.

**Study Setting**

The study was conducted in the labor wards of two government-funded tertiary hospitals: Tikur Anbessa Hospital (TAH) and Gandhi Memorial Hospital (GMH). Both hospitals serve as teaching hospitals that provide a range of obstetric and gynecological services and accept a large number of referrals from Addis Ababa and the surrounding districts. Thus, both hospitals experience a higher rate of delivery than those in their surrounding areas. Women with high-risk pregnancies may be admitted to the maternity ward before labor for planned delivery. After delivery, neonates who need special care are transferred to the neonatology wards at the Neonatal Intensive Care Unit.

**Participants**

All women with stillbirth or early neonatal deaths occurring at Tikur Anbessa Hospital and Gandhi Memorial Hospital during the study period were included as cases. For every woman with stillbirth or early neonatal death, two randomly selected women with live births were included as controls. Any stillbirth or early neonatal deaths that then occurred in the referent population were re-categorized and included in the case population.

**Data Collection**

For data collection, a recruiting team composed of midwives was created under the guidance of the principal investigator. Nine midwives from the labor ward in TAH and GMH were trained as recruiters and data collectors for the study. The midwives tracked all women who had stillbirths or early neonatal deaths in the hospital. Mothers with stillbirth and early neonatal death were given a mourning period followed by a counseling session. After a careful mental, emotional, and physical stability assessment, a midwife-recruiter would approach the mother for the interest and consent of the study. Additionally, the recruiters randomly selected women with live births for the referent population and approached them for consent before discharge. Data for the study were collected using a pre-designed data collection form by trained nurse assistants.
For both case and referent participants, data on potential risk factors were retrieved from medical records including health passports, delivery records, and treatment charts shortly before discharge. The midwives asked for clarification of any incomplete data from the health care worker in charge of the case or the mother herself. Questions were asked of mothers only after they had proper time to mourn, received counseling, and were in a stable emotional, mental, and physical state.

**Study Instruments**

Data were collected utilizing a data capture sheet composed of three sections. Section 1 captured data on demographic information, prior obstetric history, antenatal care, and complications of current pregnancy and labor. Section 2 captured data on stillbirth and early neonatal cases. All available information from laboratory tests, other investigations, and autopsies are also recorded in this section. If the cause of death was unknown, an autopsy was requested only if consent was received from the mother. The purpose of Sect. 2 was to utilize all available information to assign a standard primary cause of death to each case based on the Wigglesworth Classification. Section 3 captured data on participants with multiple pregnancies and/or deliveries.

A verbal autopsy instrument modified from the WHO/LSTMH/JHU instrument for the evaluation of stillbirth and early neonatal deaths was used. Its modifications included adjustments for cultural sensitivity and exclusion of irrelevant questions. The final questionnaire was composed of different sections for basic information about the deceased neonate and stillbirth and included both narrative and close-ended questions. The instrument was translated into Amharic language and then re-translated in English to ensure content recording and validity. Pretesting of the instrument was performed to identify potential issues during instrument administration and to drive possible solutions. A senior midwife conducted a verbal autopsy at the hospital. The health care provider who attended the birth did not participate in the interview for the verbal autopsy.

**Statistical Analysis**

The following variable definitions were utilized in this study:

*Live birth* is the complete expulsion or extraction of a fetus from its mother, after 28 weeks of gestation (or weight of greater than 1000 grams), which after expulsion shows any vital signs of life (heartbeat, spontaneous breathing, umbilical cord pulsation, or spontaneous muscle movement).

*Stillbirth*  
late fetal death with $\geq$ 28 completed weeks of gestation

*Antepartum Stillbirth*  
the death of the fetus before initiation of labor after 28 weeks of gestation as diagnosed by the attending physician.
Intrapartum Stillbirth

the death of the fetus after initiation of labor after 28 weeks of gestation as diagnosed by the attending physician.

Early neonatal death

A neonate that born in the hospital but dies before the seventh postnatal day.

Causes of Stillbirth

Stillbirth and early neonatal death were classified according to the method described by Wigglesworth et al., which was utilized to identify a single underlying cause of death. While in most cases, there are several contributing factors of death, the Wigglesworth Extended Classification places events that occurred first in the hierarchy for the cause of death than those occurring later. Available health records and verbal autopsies of cases were reviewed separately by two midwife data collectors. Each was assigned a primary cause of death based on the Wigglesworth classification system. If there was a consensus between the two midwife-data collectors, the cause of death was assigned as such. However, if there was a discrepancy, the principal investigator was consulted and reviewed the case to assign the final cause of death.

Risk Factor Analysis

A comparison of demographic and obstetric characteristics for the case and referent population was done using Pearson's chi-squared and fisher's exact test for categorical variables. Comparisons of the mean for quantitative variables between the two populations were done using a t-test with equal variance not assumed. Univariate logistic regression analysis was performed to test the association between variables and stillbirth. For those variables that showed a significant association in the univariate analysis, multivariate logistic regression was created to adjust for confounders. The variables investigated in the multivariate model were education, marital status, blood type, parity, previous stillbirth, previous preterm birth, previous child with congenital abnormalities, antenatal care for current pregnancy, hypertensive disorder during pregnancy, antepartum hemorrhage during pregnancy, PROM during pregnancy, method of delivery, and multiple births. A data replacement method for missing variables was not utilized because of missing data composed of less than 5% per variable.

Ethical clearance was obtained from the Research and Publication Committee (RPC) of the Department of Gynecology and Obstetrics and Institutional Review Board of the College of Health Sciences, Addis Ababa University. Permission was also obtained from the study facilities to collect data. Participation in the study was completely voluntary and informed consent was acquired from every participant before participation. The study did not involve vulnerable populations. Anonymity and confidentiality of patient personal information were protected through several mechanisms.

Results
During the study period, there were 11,916 deliveries and 366 stillbirths and early neonatal deaths. A total of 1,077 women were enrolled in the study; 711 women were enrolled as controls and 366 were enrolled as cases. Cases were sub-classified as antepartum, intrapartum, and early neonatal mortality (Table 1).

Demographic and social characteristics of both the case and control populations were compared (Table 2). The mean maternal age for the control and case populations was 26.80 and 27.23, respectively. The demographic characteristics of age, religion, residence, and occupation were not statistically significantly different between cases and controls.

Based on verbal autopsy and available health records, the cause of death attributed to each case was classified via the Wigglesworth classification (Table 3). The highest cause of death was related to intrapartum asphyxia, anoxia, or trauma, followed by congenital anomalies, umbilical cord-related complications, and preeclampsia, respectively. Congenital anomalies and preeclampsia are key preventable or manageable causes of death.

Univariate logistic regression analysis showed that the following risk factors: lower maternal education (aOR 1.722, 95% CI 1.033–2.869), marital status (aOR 2.188, 95% CI 1.202–3.982), blood type (aOR 1.405, 95% CI 1.025–1.924; aOR 1.424, .850-2.384), parity (aOR 1.833, 95% CI .279-12.066), previous still birth (aOR 10.023; 95% CI 7.006–14.338), previous preterm birth (aOR 4.584, 95% 3.317–6.335), ever had child w/ congenital abnormalities (aOR 2.442, 95% 1.584–3.765), antenatal care for current pregnancy (aOR 1.956; 95% CI .854 – 4.480), hypertensive disorder during pregnancy (aOR 1.731, 95% CI 1.262–2.374), antepartum hemorrhage in pregnancy (aOR 4.761, 95% CI 2.499–9.072), PROM during pregnancy (aOR .615, 95% .396-.954), method of delivery (aOR .814, 95% .599-1.108), multiple birth (aOR 2.698, 95% 1.663–4.376) (Table 4).

| Case Classification | Total |
|---------------------|-------|
|                     | N = 366 |
|                     | n (%)   |
| Antepartum          | 119 (32.5) |
| Intrapartum         | 75 (24.5)  |
| Early neonatal      | 159 (43.4) |
| Unknown             | 13 (3.6)   |
Table 2
Social and demographic characteristics of cases and controls

| Variable             | Controls N = 711 | Cases N = 366 | p-value |
|----------------------|------------------|---------------|---------|
| Maternal Age in Years| 26.80 +/- 4.421  | 27.23 +/- 4.873 | .060    |
| Religion             |                  |               |         |
| Orthodox             | 480 (67.5)       | 244 (66.7)    | 0.56    |
| Catholic             | 15 (2.1)         | 8 (2.2)       |         |
| Protestant           | 54 (7.6)         | 27 (7.4)      |         |
| Muslim               | 161 (22.6)       | 83 (22.7)     |         |
| Other                | 1 (0.0)          | 4 (1.0)       |         |
| Residence            |                  |               |         |
| Urban                | 629 (88.5)       | 327 (89.3)    | .421    |
| Rural                | 82 (11.5)        | 39 (10.7)     |         |
| Occupation           |                  |               |         |
| Housewife            | 391 (55.0)       | 201 (54.9)    | .061    |
| government-employed  | 123 (17.3)       | 59 (0.16)     |         |
| Private-Employed     | 132 (18.6)       | 70 (19.1)     |         |
| Merchant             | 56 (7.9)         | 26 (0.07)     |         |
| Student              | 6 (0.8)          | 5 (1.4)       |         |
| Other                | 3 (0.4)          | 5 (1.4)       |         |
Table 3
Causes of Stillbirth at Tikur Anbessa Hospital and Gandhi Memorial Hospital

| Cause of Death                              | Total |
|--------------------------------------------|-------|
|                                            | N = 366 n (%) |
| Congenital Anomaly                         | 59 (16.1) |
| Unexplained Antepartum Fetal Death         | 38 (10.4) |
| Death from Intrapartum Asphyxia, Anoxia, Trauma | 148 (40.4) |
| Immaturity/ Prematurity                    | 33 (9.0)  |
| Sepsis                                     | 10 (2.7)  |
| Other Fetal-Related Causes                 | 7 (1.9)   |
| Cord-Related Cause                         | 28 (7.7)  |
| Placenta-Related Cause                     | 3 (0.8)   |
| Uterus-Related Cause                       | 4 (1.1)   |
| Preeclampsia/Eclampsia                     | 24 (6.6)  |
| Unclassified                               | 12 (3.3)  |
Table 4
Univariate logistic regression analysis for the likelihood of Stillbirth

| Variable                                      | Crude OR | 95% CI     | p-value |
|------------------------------------------------|----------|------------|---------|
| Education                                     | 1.722    | 1.033–2.869| .006    |
| No Education                                  | 1.819    | 1.263–2.619|         |
| Some Education (Primary-Secondary)            | Ref      |            |         |
| Higher Education/Vocational                   |          |            |         |
| Marriage Status                               | Ref      | 1.202–3.982| .010    |
| Currently Married                             | 2.188    |            |         |
| Not Currently Married                         |          |            |         |
| Employment                                    | Ref      | .821-1.371 | .651    |
| Employed                                      | 1.061    |            |         |
| Unemployed                                    |          |            |         |
| Age                                           | Ref      | .780-1.926 | .152    |
| < 35                                          | 1.226    |            |         |
| ≥ 35                                          |          |            |         |
| Income Quintile                               | 1.112    | .723-1.711 | .202    |
| Poorest                                       | 1.249    | .827-1.886 |         |
| Poorer                                        | .779     | .505-1.201 |         |
| Middle                                        | .823     | .519-1.305 |         |
| Rich                                          | Ref      |            |         |
| Richest                                       |          |            |         |
| BMI                                           | Ref      | .530-3.027 | .528    |
| Normal                                        | 1.267    | .643-1.175 |         |
| Low                                           | .869     |            |         |
| High                                          |          |            |         |
| Variable                                      | Crude OR | 95% CI       | p-value |
|----------------------------------------------|----------|--------------|---------|
| Blood Type                                   | 1.405    | 1.025–1.924  | .043    |
| Type A                                       | .890     | .629–1.258   |         |
| Type B                                       | 1.424    | .850–2.384   |         |
| Type AB                                      | Ref      |              |         |
| Type O                                       | Ref      |              |         |
| Parity                                       | Ref      | .059–.955    | .002    |
| 0                                            | .237     | .279–12.066  |         |
| 1–5                                          | 1.833    |              |         |
| 6 or more                                    |          |              |         |
| Previous Still Birth                         | Ref      | 7.006–14.338 | .000    |
| No                                           | 10.023   |              |         |
| Yes                                          |          |              |         |
| Previous Preterm Birth                       | Ref      | 3.317–6.335  | .000    |
| No                                           | 4.584    |              |         |
| Yes                                          |          |              |         |
| Ever Had Child w/ Congenital Abnormalities   | Ref      | 1.584–3.765  | .000    |
| No                                           | 2.442    |              |         |
| Yes                                          |          |              |         |
| Antenatal Care for Current Pregnancy         | 1.956    | .854–4.480   | .024    |
| No ANC                                       | 1.787    | 1.089–2.934  |         |
| 1–2 visits                                   | Ref      |              |         |
| 3 or more visits                             |          |              |         |
| HIV                                          | Ref      | .781–3.972   | .173    |
| No                                           | 1.761    |              |         |
| Yes                                          | 1.761    |              |         |
| Hypertensive Disorder during Pregnancy       | Ref      | 1.262–2.374  | .001    |
| No                                           | 1.731    |              |         |
| Yes                                          | 1.731    |              |         |
| Variable                                      | Crude OR | 95% CI       | p-value |
|----------------------------------------------|----------|--------------|---------|
| Antepartum Hemorrhage in Pregnancy          | Ref      | 2.499–9.072  | .000    |
| No                                           |          | 4.761        |         |
| Yes                                          |          |              |         |
| Intrauterine Growth Restriction in Pregnancy | Ref      | .864–3.187   | .128    |
| No                                           |          | 1.660        |         |
| Yes                                          |          |              |         |
| PROM during Pregnancy                        | Ref      | .396–.954    | .030    |
| No                                           |          | .615         |         |
| Yes                                          |          |              |         |
| Other Complications in Pregnancy             | Ref      | .849–4.166   | .119    |
| No                                           |          | 1.881        |         |
| Yes                                          |          |              |         |
| Method of Delivery                           | Ref      | .599–1.108   | .018    |
| SVD                                          | .814     | .165–.772    |         |
| Cesarean section                             | .357     |              |         |
| Other                                        |          |              |         |
| Multiple Birth                               | Ref      | 1.663–4.376  | .000    |
| No                                           |          | 2.698        |         |
| Yes                                          |          |              |         |
| Sex of Baby                                  | .947     | .731–1.227   | .680    |
| Male                                         | Ref      |              |         |
| Female                                       |          |              |         |

Multivariate logistic regression to adjust for the interaction of variables (Table 5).
Table 5
Multivariate logistic regression analysis for the likelihood of Stillbirth

| Variable                          | Adjust OR | 95% CI          | p-value |
|----------------------------------|-----------|-----------------|---------|
| Education                        | 1.293     | .658- 2.563     | .048    |
| No Education                     | 1.747     | 1.098–2.780     | .452    |
| Some Education (Primary-Secondary)| Ref       |                 | .019    |
| Higher Education/Vocational      |           |                 |         |
| Marriage Status                  | Ref       | .643- 3.115     | .388    |
| Currently Married                | 1.415     |                 |         |
| Not Currently Married            |           |                 |         |
| Blood Type                       | 1.375     | .927- 2.037     | .180    |
| Type A                           | .931      | .604- 1.435     |         |
| Type B                           | 1.566     | .830- 2.956     |         |
| Type AB                          | Ref       |                 |         |
| Type O                           |           |                 |         |
| Parity                           | Ref       | .011- 1.899     | .009    |
| 0–1                              | .144      | .058- 21.484    |         |
| 2–5                              | 1.114     |                 |         |
| 6 or more                        |           |                 |         |
| Previous Still Birth             | Ref       | 6.245–14.289    | .000    |
| No                               | 9.447     |                 |         |
| Yes                              |           |                 |         |
| Previous Preterm Birth           | Ref       | 2.363–5.546     | .000    |
| No                               | 3.620     |                 |         |
| Yes                              |           |                 |         |
| Ever Had Child w/ Congenital Abnormalities | Ref     | 1.228–3.905     | .008    |
| No                               | 2.190     |                 |         |
| Yes                              |           |                 |         |
| Variable                                           | Adjust OR | 95% CI       | p-value |
|----------------------------------------------------|-----------|--------------|---------|
| Antenatal Care for Current Pregnancy               | Ref       | .428- 3.955  | .896    |
| No ANC                                             | 1.301     | .517- 1.888  |         |
| 1–2 visits                                         | .988      |              |         |
| 3 or more visits                                   |           |              |         |
| Hypertensive Disorder during Pregnancy             | Ref       | .732 – 1.710 | .605    |
| No                                                 | 1.118     |              |         |
| Yes                                                |           |              |         |
| Antepartum Hemorrhage in Pregnancy                 | Ref       | 1.523–7.031  | .002    |
| No                                                 | 3.273     |              |         |
| Yes                                                |           |              |         |
| PROM during Pregnancy                              | Ref       | .501 – 1.450 | .555    |
| No                                                 | .852      |              |         |
| Yes                                                |           |              |         |
| Method of Delivery                                 | Ref       | .580- 1.283  | .607    |
| SVD                                                | .863      | .291- 1.732  |         |
| Cesarean section                                   | .710      |              |         |
| Other                                              |           |              |         |
| Multiple Birth                                     | Ref       | .945- 3.313  | .075    |
| No                                                 | 1.769     |              |         |
| Yes                                                |           |              |         |

In this analysis, the risk of stillbirth was still increased among women with lower maternal education (aOR 1.747; 95%CI, 1.098–2.780), parity (aOR 1.114, 95%CI .058- 2.484), previous stillbirth (aOR 9.447, 95%CI 6.245–14.289), previous preterm birth (aOR 3.620, 95%CI 2.363–5.546), previous child with congenital abnormality (aOR 2.190, 95% 1.228–3.905), and antepartum hemorrhage during pregnancy (aOR 3.273, 95% 1.523–7.031).

**Discussion**

During our study period, the overall stillbirth and early neonatal death mortality rates at Tikur Anbessa Hospital were 30.1 per 1000 live births. According to the EDHS report, the overall national stillbirth and
early neonatal death rate was 46 per 1000 live births (13). This rate is lower than the WHO estimate of 58 per 1000 births in East African countries (14). This rate is also lower than the rates of stillbirth and early neonatal death in Southern Ethiopia and Nigeria, which were 85 per 1000 live births and 53.9 per 1000 live births, respectively. (15, 16).

Regarding demographic characteristics, we found that the risk for stillbirth and early neonatal death was higher among women who had lower maternal education and higher parity in multivariate analysis. High parity and low socio-economic status associations with stillbirth have been reported by several other studies from developing countries, including Ghana and Brazil (17, 18, 19). We found obstetric factors to have the highest odds ratio associations with stillbirth and early neonatal death. This included previous stillbirth, previous preterm birth, and antepartum hemorrhage during pregnancy, and a previous child with congenital abnormalities. Studies done in Ethiopia and Zambia have similarly shown that prior preterm birth was an important risk factor associated with stillbirth/early neonatal death mortality (19, 20). We found that congenital anomalies accounted for 16.1% of stillbirth/early neonatal deaths in our study. This is similar to other reports that congenital anomalies account for 2.1–33.3% of stillbirths (21). Similar results were reported in Nepal, where 18% of stillbirths were due to congenital anomalies in a study that examined medical records (22). Finally, we found that antepartum hemorrhage during pregnancy was strongly associated as a cause of stillbirth in this study (aOR 3.273, 95% 1.523–7.031). A study involving 495 stillbirths in multiple West African countries showed a strong association between vaginal bleeding in late pregnancy and intrapartum bleeding with stillbirths (23).

We also found that the majority (40.4%) of stillbirth and early neonatal deaths in our study were due to asphyxia, anoxia, or trauma. This is in contrast to a few previous studies done in Ethiopia that found that the majority of stillbirth/early neonatal deaths were primarily due to mechanical factors (like obstructed labor, uterine rupture, and malpresentation) (15, 20, 24). Thus, these previous studies found that nearly three-fourths of the cases were at term and the birth weight for more than half of the cases was in the normal range because the causative factor was mechanical-related. This is in stark contrast to developed nations where prematurity and low birth weight were major contributors to stillbirth/early neonatal death (25).

Our study did not find antenatal care to be a significant risk factor in multivariate analysis. While some studies in developing countries have found this to be a significant risk factor, others have not (26). This may be due to expanded access to antenatal services that the country has prioritized in recent years or limitations of the study. Moreover, the demographic characteristics of age, religion, residence, and occupation were not statistically significant in our study, although several other studies have found demographic characteristics to be significant risk factors, particularly those of maternal age (17).

There are several limitations to this study. Most significantly, the causes of stillbirth were assigned based on the clinical assessment of the providing physician. Fetal autopsies would have provided a more accurate cause of death data. Second, there were deficiencies in methods of assessment for certain causes of death, including placental examination and genetic analyses. Lastly, our case-control study
design only demonstrates associations between risk factors and not necessarily causal relationships. Further research must be done to explore the causative relationship between such risk factors and stillbirth/early neonatal death.

Conclusion

Based on our study, efforts should be maximized to improve patient education, prenatal, antenatal, and obstetric services, particularly for women who have a history of obstetric complications identified as risk factors. Antepartum hemorrhaging is the only risk factor in our study amenable for direct intervention. Thus, efforts should be made to improve overall emergency obstetric care to improve pregnancy outcomes. Further studies are necessary to establish the causes of stillbirth and early neonatal death in this patient population. Furthermore, assessments of psychological variables and their impact on subsequent pregnancy must be considered.

List Of Abbreviations

BMI: Body Mass Index; CI: Confidence intervals; EDHS: Ethiopian Demographic Health Survey; GMH: Gandhi Memorial Hospital; NMR: Neonatal Mortality Rate; RPC: Research and Publication Committee; SD: Standard deviation; PM: Perinatal mortality; PROM: Premature Rupture of Membrane; SVD: Spontaneous Vaginal Delivery; TASH: Tikur Anbessa Specialized Hospital; WHO: World Health Organization.

Declarations

Ethics approval and consent to participate:

Ethical clearance was obtained from the Research and Publication Committee (RPC) of the Department of Gynecology and Obstetrics and Institutional Review board of the College of Health Sciences, Addis Ababa University. (Meeting number 008/2016 date 08, September 2016). Permission was also obtained from the study facilities to collect data. Participation in the study was completely voluntary, and informed written consent was acquired from every participant before participation. The study did not involve vulnerable populations.

Consent for publication

Not applicable since data were anonymized and no data on a specific participant are presented.

Availability of Data and Material:

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Competing Interest:
All authors declare that they have no competing interests.

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Author's contributions:

EK designed and implemented the study. This included seeking IRB approval, collecting data, and cleaning data. EK reviewed the reference articles, performed data analysis, and wrote the initial manuscript. MK contributed to data analysis, constructed summary tables, and wrote the final manuscript. All authors have read and approved the manuscript.

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