BMC Pregnancy and Childbirth

RESEARCH

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Predictors of stillbirth at Tema General Hospital: a registry–based retrospective study

Grace Eddy Amewu[1,4], Charles Lwanga Noora[1*], Yaw Karikari Asamoah[1], Samuel Atuahene-Antwi[2], Chris Opoku Fofie[4], John B. K. Yabani[2], Peter Kofi Doe Amuzu[5], George Kwame Amewu[3] and John Kuumuori Ganle[1]

Abstract

Background In 2015, the global incidence of stillbirths reached 2.6 million, equating to more than 7,178 deaths daily. The stillbirth rate in Ghana during this period was recorded at 22.7 per 1,000 births. While extensive research has been undertaken in high-income countries to document stillbirth rates and elucidate the associated risk factors, there is a notable paucity of similar studies in Ghana. This study therefore determined the predictors of stillbirth in a Ghanaian referral hospital.

Methods We conducted a facility-based 1:1 unmatched case–control study comparing data of women who had stillbirths to those who had live births at the Tema General Hospital in 2019. Data were obtained from the hospital records using a data extraction form that was specifically designed for this purpose. We extracted and entered data into Microsoft Excel 2013, cleaned, and analyzed using STATA 15. Frequency and percentage distributions were used to describe the characteristics of respondents. Bivariate and logistic regression analyses were carried out to examine predictors of stillbirth.

Results Of 552 mothers included in the study, the mean age of mothers with and without stillbirths was 31.4 (SD ± 6.1) years, and 28.8 (SD ± 6.0) years respectively. We identified Mothers aged 40 years and older [aOR = 5.5; (95% CI 1.1–26.9)], Maternal employment [aOR = 2.5; (95% CI = 1.2—5.3)], Caesarean section [aOR = 1.9; (95% CI = 1.2—2.9)], Infants with low birth weight [aOR = 8.7; (95% CI = 5.2- 14.7)], Hypertensive mothers [aOR = 1.9; (95% CI = 1.2—2.8)] to significantly increased likelihood of stillbirth. Primary education [aOR = 0.4; (95% CI = 0.2–0.8)], Tertiary education [aOR = 0.2; (95% CI = 0.1–0.5)], Mothers who attended four or more antenatal care (ANC) [aOR = 0.6; (95% CI = 0.3—0.9)] significantly lower odds of experiencing stillbirth.

Conclusion A combination of socio-demographic, maternal, and foetal variables predicted stillbirth at Tema General Hospital in 2019. Recommendations for improving birth outcomes at the hospital entail persistent community awareness initiatives targeting the impact of pivotal risk factors, timely stratification of pregnancies based on risk assessment, and the establishment of specialized Antenatal Care (ANC) services tailored for high-risk cohorts.

Keywords Stillbirth, Retrospective study, Tema General Hospital, Ghana

*Correspondence:
Charles Lwanga Noora
cnoora@ug.edu.gh; nooralwanga@gmail.com
Full list of author information is available at the end of the article

Background

Stillbirth refers to the birth of a baby who has no signs of life at or after 28 weeks of gestation with a birth weight of ≥ 1000 g or a body length of ≥ 35 cm [14]. Stillbirth rate is an indicator that reflects the inadequacies of antenatal and intrapartum care in an institution, region, or nation [1, 2]. The major causes of stillbirth include birth complications, post-term pregnancy, fetal growth restriction, congenital anomalies, maternal infections in pregnancy such as malaria, syphilis, and HIV, and maternal disorders such as hypertension and diabetes [13].

In 2019, an estimated 2 million babies were stillborn at 28 weeks or more of gestation globally, with a global stillbirth rate of 13.9 stillbirths per 1,000 total births. Stillbirth rates in 2019 varied widely across regions, from 22.8 stillbirths per 1,000 total births in West and Central Africa to 2.9 in Western Europe. Majority of stillbirths occur in low-income countries where stillbirth rate is 29 deaths per 1000 births compared to 3 deaths per 1000 in high-income countries [13]. Three-quarters of all cases of stillbirths occur in South Asia and Sub-Saharan Africa [13]. In Ghana, the stillbirth rate as of 2015 was 22.7 deaths per 1000 births [11]. Regional variations in stillbirth rates and fluctuations exist in the country, however. Some of the regional stillbirth rates 2017 were as follows: Volta (14.7 per 1000 births), Upper East (13.4 per 1000 births), Central (14.2 per 1000 births) and Greater Accra region (15.3 per 1000 births) [4].

Stillbirth causes grief, stigmatization and even a sense of guilt, which affects families. In some parts of the world, mothers are not openly allowed to express this grief or openly mourn these dead children [1]. Studies have shown that stillbirth can cause short- and long-term psychological effects on parents and family members, including depression and post-traumatic stress disorder [5].

While stillbirth is an important public health issue in many low-income settings, it has not been given the attention it deserves in the development of health programmes and policies. For instance, the Millennium Development Goals (MDGs) failed to set targets to lower stillbirth rates. Although the Sustainable Development Goals (SDGs) have set targets for neonatal and under-5 mortality rates, stillbirth rate is not mentioned. Only the '*Every New Born Action Plan*' (ENAP), which was launched in 2014 to end preventable deaths in neonates has clearly stated that one of its goals is to reduce stillbirths to a target of 12 per 1000 births or less by 2030 [12]. As the stillbirth rates both in Ghana and globally remain high, it is important to study the predictors of stillbirth. While extensive research has been undertaken in high-income countries to document stillbirth rates and elucidate the associated risk factors, there is a notable paucity of similar studies in Ghana. It is important in the case of Ghana to identify the factors that contribute to institutional stillbirth to aid in planning, developing and implementing effective strategies and programs to reduce stillbirths. This study therefore determined the predictors of stillbirth in a Ghanaian referral hospital.

Methods

Study design

We conducted a health facility-based secondary data analysis on women who delivered at the Tema General Hospital in 2019 from health facility delivery registers and maternal health records. We compared data of women who had stillbirths to those who had live births.

Study area

We conducted the study at the Tema General Hospital, in Community 12 within the Tema Metropolitan area of the Greater Accra Region. As the largest public health facility in this metropolitan area, Tema General Hospital is a primary referral center for numerous clinics and hospitals in its catchment area. The hospital has a bed capacity of 399. It caters to populations from Teshie, Nungua, Tema Newtown, Kpone, Ashaiman, Afienya, Appolonia, Dawhenya, Prampram, Klagon, Lashibi, Sakumono, and Community 25. Tema General Hospital was selected for this study due to its role as a major referral center, handling an annual average of not less than 5,500 deliveries. Regarding stillbirth rates at this hospital, the rates were 40.7 per 1000 births in 2015, 47.9 in 2016, 44.8 [4], and 46.2 in 2018. The hospital is equipped with a neonatal intensive care unit (NICU) comprising over eight incubators.

Study population

The study population comprised all births that occurred and were recorded in the delivery register of the Tema General Hospital from January to December 2019. To be included in the study, the birth must be captured in the delivery register. The delivery register is used to record sociodemographic, maternal medical, obstetric, and fetal data on all births at the hospital. Information contained in the delivery register included the age of the mother, educational level of the mother, parity, occupation of mother and father, marital status, religion, gravidity, number of antenatal visits, whether there were any complications during delivery, haemoglobin level, gestational age at delivery, the birth weight at delivery, Apgar score, and syphilis status. Excluded from this study were multiple births. Multiple births refer to births involving twins, triplets, or more. These were excluded because existing literature suggests that multiple births are disproportionately affected when it comes to stillbirths [6]. There is

also a counting problem. For instance, if one pf the babies dies, and the others survive. Including multiple births could thus potentially introduce bias into the study.

Sample size and sampling

The sample size was determined using EPI-Info 7 statistical software. The assumptions for the sample size calculation were: proportion of non-educated mothers among controls, minimum detectable odds ratio of 1.67, confidence level of 95%, power of 80%, a case to control ratio of 1:1 and non-response rate of 5%. The total sample size was 552 (276 cases and 276 controls). From the public hospitals that provide institutional delivery services in Greater Accra region, Tema general hospital was selected randomly. Considering the number of mothers who gave birth at the selected hospital in one year prior to the data collection time, the average number of mothers expected to give birth per month in Tema General hospital was estimated.

A total sample of 552 was selected from the combined population of 5,435 live births and 276 stillbirths reported at the Tema General Hospital for the year 2019. As a comparative study, equal samples from both the live and stillbirth populations were sampled to ensure a fair representation.

A two-stage sampling approach was used. Firstly, all the 276 stillbirth cases, having satisfied the inclusion criteria, were accordingly selected because of the small size of the population. Secondly, from the larger livebirth population, an equal sample of 276 was selected using a sampling interval of 20, which was arrived at by dividing the eligible population (i.e. 5406) that met the inclusion criteria by the 276 samples required. This means that after randomly selecting the first live birth record, we selected the 20th, 40th, 60th, and 80th in that order until the 276 records were obtained.

Data collection methods and tools

Relevant data were extracted from delivery registers and other medical records such as antenatal records onto a purposively designed data extraction instrument. The data extraction tool was designed using an Excel spreadsheet, with columns created to capture relevant data on each of the variables of interest. Key components of the tools included socio-demographic characteristics such as age, educational level, and occupation; obstetric characteristics including parity, number of ANC visits, and mode of delivery; Maternal medical characteristics including syphilis, diabetes, hypertension, and obesity; and foetal characteristics such as birth weight, fetal growth, and congenital defects.

Quality assurance measures

We employed research assistants to undertake the data extraction. The research assistants were trained on data abstraction techniques, how to record the data onto the spreadsheet, and the ethics of research. To determine the reliability of the data extraction sheet, it was pretested using 2018 birth records (30 records) at the Tema General Hospital. All necessary modifications were made before the tool was used to collect the final data. The research assistants were closely supervised by the first author throughout to ensure the data collected were of good quality and fit for purpose. Additionally, random data checking was done by the principal investigator to validate the data collected.

Data processing and management

After extracting the data into the Excel spreadsheet, the records were checked for outliers and data inconsistencies. The data validation function in Microsoft Excel was used to determine if values or entries made were within the accepted parameters or not. The validated data were then exported to Stata version 15 for analysis.

Variables

Dependent variable

The dependent variable in this study was birth outcome. This refers to whether the woman had a stillbirth or a live birth. Stillbirth for this study was defined as a baby having no signs of life at or after 28 weeks of gestation with a birth weight of $\geq$ 1000 g, or a body length of $\geq$ 35 cm. It is a binary categorical variable that was coded as "0" for babies born alive and "1" for babies born still.

Independent Variable

The independent variables in this study encompassed socio-demographic, obstetric, maternal medical, and fetal factors. Socio-demographic factors included the age, educational level, and employment status of both mothers and fathers, categorized into specific groups and coded numerically. Obstetric factors covered gravidity, parity, number of antenatal care visits, gestational age, condition of the perineum, and mode of delivery, all categorized and coded accordingly. Maternal medical factors involved clinical diagnoses of syphilis, diabetes, hypertension, obesity, and the use of prevention measures for mother-to-child transmission of HIV, with binary coding. Foetal factors included birthweight, fetal growth, and congenital defects, categorized and coded to facilitate analysis.

Data analysis

We analyzed the data using STATA statistical software version 15. Descriptive statistical analyses, which included frequencies and percentage distributions, were done to describe the characteristics of study respondents. Where there was skewness in the distribution of data for any variable, medians with interquartile ranges were used.

Chi-square tests of associations were used to compare differences in categorical variables between stillbirths and live births. Where expected cell frequencies were too low (< 5), Fisher's exact tests were used. T-tests were also used to compare means between still and livebirths for continuous variables where the normality of sample distribution was satisfactory, otherwise, Mann–Whitney U-tests were used to compare the distribution of those variables (number of ANC visits, Gravidity and Parity) between the two groups. Significant variables from these preliminary analyses were then pulled into a multivariable logistic regression model to estimate the relative odds of stillbirth while controlling for potential confounders. A confidence level of 95% was set, and a *p*-value of less than 0.05 ($p < 0.05$) was used to determine statistical significance.

Results

Characteristics of participants

Table 1 shows the socio-demographic characteristics of the parents of the births studied. The average age of mothers with stillbirths was 31.4 (± 6.1) years, and this

Table 1 Parental sociodemographic characteristics

Characteristic	N (%)		
	Live births (*N* = 276)	Still births (*N* = 276)	*P*-value
Mother's age (years)			**< 0.001**
< 20	22 (8.0)	8 (2.9)	
20–29	127 (46.0)	110 (39.9)	
30–39	118 (42.8)	131 (47.5)	
40 +	9 (3.3)	27 (9.8)	
Mean (± SD)	28.8 (± 6.0)	31.4 (± 6.1)	**< 0.001**
Mother's educational level			**< 0.001**
None	23 (8.3)	59 (21.4)	
Primary	38 (13.8)	44 (15.9)	
JHS/Middle School	93 (33.7)	87 (31.5)	
SHS/O&A Level	76 (27.5)	61 (22.1)	
Tertiary	46 (16.7)	25 (9.1)	
Mother's employment			**0.03**
Unemployed	44 (15.9)	24 (8.7)	
Employed (Formal)	167 (60.5)	168 (60.9)	
Employed (Informal)	65 (23.6)	84 (30.4)	
Father's age (years)			**0.03**
20–29	43 (15.6)	29 (10.5)	
30–39	153 (55.4)	140 (50.7)	
40 +	80 (29.0)	107 (38.8)	
Mean (± SD)	35.2 (± 6.6)	37.2 (± 6.8)	**< 0.001**
Father's educational level			0.06
None	0 (0.0)	1 (0.4)	
Primary	16 (5.8)	28 (10.1)	
JHS/Middle School	57 (20.7)	73 (26.5)	
SHS/O&A Level	132 (47.8)	115 (41.7)	
Tertiary	71 (25.7)	59 (21.4)	
Father's employment			0.81
Unemployed	8 (2.9)	6 (2.2)	
Employed (Formal)	130 (47.1)	135 (48.9)	
Employed (Informal)	138 (50.0)	135 (48.9)	

was higher than those with live births, 28.8 (±6.0) years. Most of the mothers also had some form of education, with 21.4% of mothers with stillbirths having no formal education compared to 8.3% (23/276) of the mothers with live births. Even though majority of the mothers of both live 60.5% and still 60.9% births were employed in the formal sector, the percentage of unemployed live birth mothers 15.2% was higher than the stillbirth 8.7% counterpart.

Fathers of the babies who were stillborn had a higher mean age of 37.2 (±6.8) compared to those with livebirths of 35.2 (±6.6). Almost all the fathers have had some formal education except for only one of the fathers of the stillborn babies. The level of unemployment among fathers was generally very low in both groups.

Mothers' obstetric characteristics

Table 2 also shows the obstetric characteristics of mothers. Whilst majority 62.5% of all the mothers had three or more pregnancies, the stillbirth mothers 66.3% were slightly more compared to those with live births 58.7%. Table 2 indicates that the number of pregnancies ever carried, and children ever born by all the mothers seems to be generally evenly distributed. For gravidity, 22.5%, 18.8%, and 58.7% of live birth mothers compared to 16.7%, 17.0% and 66.3% of stillbirth mothers ever had one, two three, and more pregnancies respectively.

In terms of parity, the percentage of livebirth mothers who had no child, one child, two children, three and more was 27.9%, 24.6%, 27.5%, and 19.9% respectively while the corresponding percentage for stillbirth mothers was 27.2%, 22.8%, 28.3%, and 21.7%.

Although both groups had an average ANC attendance higher than that of the previously recommended 4 visits, ANC visits were higher among women with livebirths (85.5%) compared to those with stillbirths (73.9%). In both groups, gestational age at birth was within the 3rd trimester for over 90% of respondents, with almost all the livebirths (99.3%) happening within the 3rd trimester compared to that of stillbirths (90.9%).

As regards mother's perineum tear during birth, as much as 83.3% of those with livebirths compared with only 39.9% of those with stillbirths had it intact, with majority (54.3%) not reported in the medical records for those with stillbirths. There was not much difference in the proportion of vaginal (48.9%) and

Table 2 Mothers' obstetric characteristics

	N (%)		
Characteristic	**Live births (*N* = 276)**	**Still births (*N* = 276)**	***P*-value**
Gravidity			0.11
1	0.0162 (22.5)	46 (16.7)	
2	52 (18.8)	47 (17.0)	
3 +	162 (58.7)	183 (66.3)	
Mean (± SD)	3.1 (± 1.7)	3.5 (± 1.9)	0.01
Parity			0.93
0	0.4977 (27.9)	75 (27.2)	
1	68 (24.6)	63 (22.8)	
2	76 (27.5)	78 (28.3)	
3 +	55 (19.9)	60 (21.7)	
Median (IQR)	1.0 (2.0)	1.5 (2.0)	0.49
Number of ANC visits			< 0.001
< 4	< 0.00140 (14.5)	72 (26.1)	
4 +	236 (85.5)	204 (73.9)	
Mean (± SD)	7.0 (± 3.0)	5.8 (± 3.2)	< 0.001
Gestational age at birth			< 0.001
2nd trimester	2 (0.7)	25 (9.1)	
3rd trimester	274 (99.3)	251 (90.9)	
Median (IQR)	39.0 (3.0)	37.0 (7.0)	< 0.001
Mode of delivery			< 0.001
Vaginal	183 (66.3)	135 (48.9)	
Caesarean Section	92 (33.3)	141 (51.1)	
Vacuum	1 (0.4)	0 (0.0)	
Total	276 (100.0)	276 (100.0)	

caesarean (51.1%) section modes of delivery for those with stillbirths, whereas, for those with livebirths, majority delivered through vaginal (66.3%) delivery as seen in Table 2.

Maternal medical conditions

Mothers with stillbirths had a much higher prevalence of hypertension (61.6%) compared to those who had livebirths (39.1%) and a higher level of syphilis (8.7%) compared to those with livebirths (4.7%) as seen in Table 3. Meanwhile, Hepatitis B prevalence was higher in mothers with livebirths (8.3%) than their counterparts with stillbirths (6.2%). Prevention of Mother-to-Child Transmission (PMTCT) of HIV/AIDS was the same across both groups with anaemia being slightly higher among the stillbirth mothers (46.4%) compared to those with live births (43.1%). Most of the births in both groups occurred to mothers with blood group O positive, followed by those with B positive and those with A positive blood group.

Foetal characteristics at birth

Majority of the children born to all the mothers were female (51.4%), with most of those stillborn being underweight (49.3%) and having a lower mean weight of 2.50 kg (± 0.99) compared to underweight live births (10.1%) who had a mean birth weight of 3.14 kg (± 0.63) as seen in Table 4. The stillborn babies also had a shorter median length compared to those who were born alive. The median head circumferences were the same for both groups although only 112 of the stillborn babies had such information reported. The prevalence of abnormalities was extremely low at 1.4% for live births and 1.1% for stillbirths. With regard to the lie and presentation of the foetus before birth, majority (50.4%) were in the longitudinal and/or cephalic position (44.4%) with only 2.2% being breeched among the stillbirths compared to 8.3% of the livebirths. Eighty-five percent 85% of the live babies were breathing or cried at birth compared to 39.5% of the stillbirths although 11.6% of such records were not reported for the live births compared to 23.2% for the stillbirths. Resuscitation was provided for majority of the livebirths (65.9%) with 11.6% of such information not provided

Table 3 Maternal medical conditions

Characteristic	N (%)		*P*-value
	Live births (*N* = 276)	Still births (*N* = 276)	
Mothers' blood pressure			**< 0.001**
Normotensive (< 140/90 mmHg)	168 (60.9)	106 (38.4)	
Hypertensive (≥ 140/90 mmHg)	108 (39.1)	170 (61.6)	
Syphilis status			0.07
Negative	257 (93.1)	250 (90.6)	
Positive	13 (4.7)	24 (8.7)	
Hepatitis B status			0.34
Negative	253 (91.7)	259 (93.8)	
Positive	23 (8.3)	17 (6.2)	
PMTCT			1.00
No	266 (96.4)	266 (96.4)	
Yes	10 (3.6)	10 (3.6)	
Mother's Haemoglobin			0.44
Not anaemic (≥ 11 g/dl)	157 (56.9)	148 (53.6)	
Anaemic (< 11 g/dl)	119 (43.1)	128 (46.4)	
Blood group			**0.03**
O + ve	116 (42.0)	120 (43.5)	
O –ve	8 (2.9)	20 (7.2)	
A + ve	46 (16.7)	36 (13.0)	
A –ve	5 (1.8)	4 (1.4)	
B + ve	80 (29.0)	76 (27.5)	
B –ve	6 (2.2)	0 (0.0)	
AB + ve	15 (5.4)	20 (7.2)	
Total	276 (100.0)	276 (100.0)	

NB: P < 0.05 indicates a significant association

Table 4 Foetal characteristics and birth

Characteristic	N (%)		*P*-value
	Live births (*N* = 276)	Still births (*N* = 276)	
Sex of baby			0.73
Female	140 (50.7)	144 (52.2)	
Male	136 (49.3)	132 (47.8)	
Birth weight			**< 0.001**
Normal (≥ 2.5 kg)	248 (89.9)	140 (50.7)	
Underweight (< 2.5 kg)	28 (10.1)	136 (49.3)	
Mean (± SD)	3.14 (± 0.63)	2.50 (± 0.99)	**< 0.001**
Baby's length (cm), Median (IQR)	50.0 (4.0)	44.0 (12.5)	**< 0.001**
Baby's head circumference (cm)	*N* = 252	*N* = 112	
Median (IQR)	33.0 (3.0)	33.0 (3.5)	0.57
Baby had abnormalities			1.00
No	272 (98.6)	273 (98.9)	
Yes	4 (1.4)	3 (1.1)	
Lie and presentation of foetus[a]			**< 0.001**
Longitudinal	193 (69.9)	85 (30.8)	
Cephalic	60 (21.8)	185 (67.0)	
Breech	23 (8.3)	6 (2.2)	
Estimated blood loss (ml)	*N* = 257	*N* = 208	0.88
Median (IQR)	300.0 (150.0)	300.0 (150.0)	

[a] Multiple responses set, totals may exceed 276 (100%) for each group

whereas with the stillbirths, resuscitation was provided in only 1.1% of them and the data was not recorded for 23.2% of the babies (Table 4).

Predictors of stillbirth

Factors that showed significant differences between life and stillbirths were then analyzed using logistic regression models to assess the relative odds of having a stillbirth, first in unadjusted models and then jointly in an adjusted model. Variables that were significant but not well reported (i.e. with 5% or more missing data) were excluded to avoid using a reduced number of records for the logistic regression which could lead to unfair comparisons.

From Table 5, there were not much significant differences across ages of both the mothers and fathers of the children after controlling for the other variables. The results show that mothers aged 40 and more years had significantly higher odds of having stillbirth compared with mothers who were aged below 40 years (cOR = 8.2; 95% CI = 2.7–24.9; $p < 0.001$). Even after adjusting for other variables identified as significant predictors, this difference was still statistically significant (aOR = 5.5; 95% CI = 1.1–26.9; $p = 0.03$).

Additionally, higher levels of mother's education were significantly associated with a reduction in the odds of stillbirth. For example, there was strong evidence of a 78% reduction in the odds of stillbirth among mothers with tertiary education compared to those with no formal education (cOR = 0.2; 95% CI = 0.1–0.4: $p < 0.001$). After adjusting for other variables, this difference was still statistically significant (aOR) = 0.2; 95%CI = 0.1–0.5; $p < 0.001$).

Also, mothers in both formal (cOR = 1.7; 95% CI = 1.1–3.0; $p = 0.04$) and informal (cOR = 2.3; 95% CI = 1.2–4.1; $p < 0.01$) employment had significantly higher odds of stillbirth compared with unemployed mothers. After adjusting for potential confounders, the observed differences were still statistically significant. Thus, for formal employment (aOR = 2.5; 95% CI = 1.2–5.3; $p = 0.01$) and informal (aOR = 2.7; 95% CI = 1.2–5.9; $p = 0.01$).

There was also borderline evidence of about a 43% reduction in the odds of stillbirth among mothers who had at least four ANC visits compared to those who had less than four ANC visits (cOR = 0.5; 95%CI = 0.3–0.7; $p < 0.01$). The differences in the ANC visit remained statistically significant after adjusting for potential confounders (aOR = 0.6; 95%CI = 0.3–0.9; $p = 0.04$).

Moreover, there was strong evidence that the odds of stillbirth among babies delivered through caesarean section was about 1.9 times that among those with vaginal delivery (aOR = 1.9; 95%CI = 1.3–2.9; $p < 0.01$). Similarly, there was strong statistically significant evidence that the odds of stillbirth among hypertensive

Table 5 Logistic regression to assess the relative odds of having a stillbirth

	Crude		Adjusted	
Characteristic	**COR (95% CI)**	***P*-value**	**AOR (95% CI)**	***P*-value**
Mother's age (years)				
< 20	Ref		Ref	
20–29	2.4 (1.1, 5.6)	0.04	2.84 (0.9, 9.2)	0.08
30–39	3.0 (1.3, 7.1)	0.01	2.90 (0.8, 10.5)	0.10
40 +	8.3 (2.7, 24.9)	< 0.001	5.54 (1.1, 26.9)	**0.03**
Mothers educational level				
None	Ref		Ref	
Primary	0.4 (0.2, 0.8)	< 0.01	0.40 (0.2, 0.9)	**0.02**
JHS/Middle School	0.3 (0.2, 0.6)	< 0.001	0.37 (0.2, 0.7)	**< 0.01**
SHS/O&A Level	0.3 (0.2, 0.5)	< 0.001	0.35 (0.2, 0.7)	**< 0.01**
Tertiary	0.2 (0.1, 0.4)	< 0.001	0.22 (0.1, 0.5)	**< 0.001**
Mother's employment				
Unemployed	Ref		Ref	
Employed (Formal)	1.8 (1.1, 3.0)	0.04	2.55 (1.2, 5.3)	**0.01**
Employed (Informal)	2.3 (1.2, 4.1)	< 0.01	2.69 (1.2, 5.8)	**0.01**
Father's age (years)				
20–29	Ref		Ref	
30–39	1.4 (0.8, 2.3)	0.25	0.73 (0.3, 1.6)	0.42
40 +	1.9 (1.1, 3.4)	0.02	0.71 (0.3, 1.8)	0.47
Number of ANC visits				
< 4	Ref		Ref	
4 +	0.5 (0.3, 0.7)	< 0.001	0.57 (0.3, 0.9)	**0.04**
Mode of delivery				
Vaginal	Ref		Ref	
C-Section	2.1 (1.5, 2.9)	< 0.001	1.91 (1.26, 2.89)	**< 0.01**
Mother's blood pressure				
Normotensive (< 140/90 mmHg)	Ref		Ref	**< 0.01**
Hypertensive (≥ 140/90 mmHg)	2.49 (1.8, 3.5)	< 0.001	1.87 (1.2, 2.8)	
Blood group				
O +	Ref		Ref	
O –	2.4 (1.1, 5.6)	0.05	1.9 (0.7, 5.3)	0.21
A +	0.7 (0.4, 1.2)	0.26	0.7 (0.4, 1.2)	0.23
A –	0.8 (0.2, 2.9)	0.69	0.4 (0.1, 2.4)	0.34
B +	0.9 (0.6, 1.4)	0.65	0.8 (0.5, 1.3)	0.47
AB +	1.3 (0.6, 2.6)	0.50	0.9 (0.4, 2.4)	0.94
Birth weight				
Normal (≥ 2.5 kg)	Ref		Ref	
Underweight (< 2.5 kg)	8.6 (5.4, 13.5)	< 0.001	8.7 (5.2, 14.7)	**< 0.001**

NB: P < 0.05 indicates a significant association

mothers (≥ 140/90 mmHg) were about 1.9 times higher than that among normotensive (< 140/90 mmHg) mothers (aOR = 1.8; 95%CI = 1.2–2.8); $p < 0.01$).

Discussion

The purpose of the study was to describe and compare the characteristics of women who had stillbirths to

those who had normal births to determine the predictors of stillbirth at the Tema Hospital in 2019. The three socio-demographic factors that were found to be statistically significant predictors of stillbirth in this study were maternal age, maternal level of education, and maternal employment status. In the case of maternal age, older women (i.e. women in their forties) were more likely to have stillbirths compared to their counterparts with live births. Whilst this is similar to findings from Mexico [8] and Zambia, Kenya, Nagpur, and Belagavi [9], it however contradicts one study in Ghana, which reported more stillbirths among adolescent mothers [2]. We think the findings in this study could be related to maternal experience. For instance, evidence shows that as women gain more childbirth experience, they tend to not adhere to all instructions that healthcare providers may give [8]. Rather, they tend to rely on their previous childbirth experience. This could lead to risk under estimation.

This study also found educational level of the mother to be a significant predictor of stillbirth. Thus, mothers with lower educational levels were more likely to have stillborn babies. This result aligns with previous findings in Nigeria [6] and Canada (Auger et al. [3]). This may be attributed to the fact that higher education might have improved the knowledge and perception of the women in relation to pregnancy risks, enabling them to take more precautions to avoid stillbirth.

Contrary to a study conducted at the War Memorial Hospital in Navrongo to study trends and risk factors for stillbirths [7], our study found maternal employment to play a significant role. Women in employment (either formal or informal) were at a higher risk of having a stillbirth compared to unemployed women. It is not clear to us why employment increases the risk of stillbirth. However, we think this may be related to stress and time constraints. For instance, women who are formally employed in Ghana often do not get maternity leave until they are due for delivery, or they have actually delivered. This potentially increases stress. Work schedules may also result in limited time for rest and leisure, further leading to stress. Additionally, time constraints may also result in the inability of such women to honour all appointments such as ANC attendance, which could lead to non-identification of potential risks including early detection of warning signals, and preventive counseling. This is particularly likely given higher number of ANC attendance seems to reduce the risk of stillbirth in this study.

Among all the obstetric variables examined, only two of them—ANC attendance and mode of delivery—were statistically significant predictors of stillbirth. In relation to ANC attendance, the odds of having stillbirth were reduced for mothers who had 4 or more visits compared to those who did not. This finding confirms findings from the 2017 Ghana Maternal Health Survey [4]. More ANC attendance most likely reduces the risk of stillbirth because women who attend more ANC may benefit from all the interventions that are available during the ANC, including early detection of warning signals, and preventive counseling by appropriate health professionals to reduce the risk of complications ahead of their delivery dates.

As regards mode of delivery, babies delivered through CS were more likely to be born still as compared to vaginal delivery, a finding which is contrary to a similar study carried out in the Asante-Akim South district of Ghana where spontaneous vaginal deliveries were highly associated with fresh stillbirths [2]. This contraction between the two studies may stem from the fact that the Tema General Hospital is a major referral point that accepts and manages complicated delivery referral cases. Most of the time, the women get referred late resulting in emergency CS in an attempt to save the life of the mother and baby as compared to the Asant-Akim South district.

In this study, only women who had hypertensive blood pressure had significantly higher odds of having stillbirths compared to those who were normotensive, similar to findings from studies conducted in Ghana, China [10] and Latvia [15]. This is not surprising because generally, hypertensive mothers tend to have interruption in regular and adequate blood supply to the baby in utero which can result in complications leading to the loss of the baby.

The results also showed that the odds of stillbirth were as high as nine times for babies delivered underweight compared to those with normal weight. This is consistent with findings from earlier research in Navrongo, Ghana, where neonates with lower birth weights were at a higher risk of stillbirth [7]. This may be due to underdevelopment of the foetus, which is sometimes associated with stillborn babies especially in this study where the average length at delivery was significantly lower for the stillborn babies. Malformed foetuses would typically lead to stillbirths, which due to the malformations, will have lower foetal lengths and therefore lower weights. In this study, however, only 1.1% of the stillbirths had any abnormalities compared to 1.5% of the live births which shows that the malformed foetuses in this case would largely have been underdeveloped in size but not necessarily with abnormalities.

The findings of this study should however be interpreted with certain limitations in mind. The study relied on secondary data; any original data entry errors could have been unnoticeably carried through the analysis. The data used covered only a limited set of variables that could be found in the delivery register and for that matter potentially relevant variables such as mothers' estimated

loss of blood, multiple pregnancies, history of pregnancy loss, diabetes status, and anthropometric measures, resuscitation provision could not be examined. Lie and presentation of foetus was a multiple-response question where a baby could have any combination of presentations and each presentation choice had quite a lot of missing data and so even though they were tested for the bivariate they were not added to the regression model. These limitations notwithstanding, the use of actual health facility-level data rather than the perceptions and opinions of respondents to retrospectively analyze the predictors of stillbirth is a strength of this study.

Conclusion

The findings from this study have shown that a combination of modifiable socio-demographic, maternal and foetal factors determined stillbirth. Addressing these factors through targeted interventions could potentially reduce the incidence of stillbirths at the hospital. Continuous sensitisation of pregnant women and community members on key risk factors of stillbirth, early classification of pregnancies into risk groupings and institutionalisation of special ANC for high-risk groups are recommended to improve on birth outcomes at the hospital. Other innovative interventions such as continuous professional development of midwives and community health nurses in the identification, management and timeous referral of high-risk pregnancies and labour are also recommended to help improve maternal and foetal health outcomes.

Abbreviations

SD	Standard deviation
CI	Confidence Interval
ANC	Antenatal Care
aOR	Adjusted Odds Ratio
WHO	World Health Organisation
UNICEF	United Nations International Children's Emergency Fund
MDGs	Millennium Development Goals
SDGs	Sustainable Development Goals
NICU	Neonatal intensive care unit
HIV	Human immunodeficiency virus
CS	Caesarian Section

Acknowledgements

We thank the staff of Tema General Hospital and Health Directorate for providing us with the data. In particular , special thanks go to Dr. Sally Deirdre Quartey, Ms. Joana Ocansey and Dr. Richard Anthony. We are so grateful to Mr. Tony Godi of the University of Ghana, school of Public Health Biostatistics Department for his guidance on the data analysis. We acknowledge Dr. Mercy Abbey of the Ghana Health Service Research and Development Division for your thorough inputs on this manuscript.

Authors' contributions

GEA and JKG Designed implemented the study and wrote the initially draft of the manuscript. GEA, SDQ and GKA were involved in data collection, analysis and project implementation. GEA, YKA and CLN drafted the manuscript. All listed authors reviewed the manuscript and approved the final manuscript.

Funding

This research received no funding support from any organization.

Data availability

All relevant data generated and analyzed are included in this paper.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Ghana Health Service Ethic Review Committee (Protocol Number: GHS-ERC 042/08/20. Data collected were password-protected and kept solely in the possession of the principal investigator. Research assistants were trained on the principles of ethics including confidentiality and data protection. No identifiable individual data were reported and due to the retrospective nature of the study, no consent is needed from the participants. This research was conducted in compliance with the Helsinki Declaration.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]School of Public Health, University of Ghana, Legon, Accra, Ghana. [2]Tema Metropolitan Health Directorate, Ghana Health Service, Tema, Ghana. [3]Tema General Hospital, Ghana Health Service, Tema, Ghana. [4]Family Health Division, Ghana Health Service HQ, Accra, Ghana. [5]Aquinas Senior High School, Accra, Ghana.

Received: 14 August 2024 Accepted: 6 March 2025
Published online: 01 May 2025

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