ORIGINAL ARTICLE

Determinants of stillbirth in the Five General Hospitals of Lusaka, Zambia: A Case-Control study

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ABSTRACT

Objective*:* We aimed to assess determinants of stillbirths among women who delivered from the five general hospitals of Lusaka city, Zambia.

Methods*:* We conducted an unmatched case-control study. Cases were consecutively enrolled, and controls were randomly selected within 24 hours of occurrence of a case. A structured questionnaire was used to collect data, and multiple regression was used to assess determinants of stillbirths. A p-value of <0.05 was considered sufficient evidence of an association between stillbirth and independent variables.

Results*:* A total of 58 cases and 232 controls were included in the analysis. Compared with women who delivered babies with birth weight <2500 grams, the risk of stillbirth for women who had babies with birth weight 2500 was higher (AOR= 4.49; 95% CI: 2.84 – 8.99); antepartum haemorrhage (AOR = 3.18; 95% CI: 1.21 – 8.09); previous experience of stillbirth (AOR=3.99; 95% CI: 1.73 – 6.73) compared with their counterparts without. Additionally, women with parity > 2 (AOR = 3.02; 95% CI: 1.07 – 7.54) had higher odds of stillbirth compared to those with parity 2.

Conclusion: Birth weight 2.5 kg, antepartum haemorrhage, previous stillbirth were determinants of stillbirth. Program implementers should consider strategies that can mitigate these determinants to reduce stillbirth.

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INTRODUCTION

Stillbirth is the occurrence of foetal demise with a birth weight of 1000g or 28 completed weeks of gestation . Globally, an estimated 2.6 million stillbirths are reported every year since 2000. Recent data suggests that there has been a 25.5% decline from 24.7 to 18.4 per 1000 live births worldwide. Despite this reduction, sub-Saharan Africa (SSA) still recorded the slowest decline, with an estimated stillbirth rate of 28.7 per 1000 live births. Approximately 98% of stillbirths were notably in low- and middle-income countries (LMIC), where south Asia and SSA accounted for 77% of the reported cases.

Stillbirth is associated with several social and economic consequences. Pregnancy comes with the expectation of a baby, not only by the immediate family, but also by society. When a pregnancy suddenly results in a tragic and painful outcome, the negative impact is at many levels. Not only on the family but also on obstetrics care services. There are challenges in family relationships, especially in African settings where stillbirth is stigmatized and affects the psychological well-being of the affected families. Stillbirth has negative social constructs that are deeply rooted in many African societies. As a result, they end up being missed in national vital statistics, especially when it occurs outside a health facility resulting in an underestimation of the magnitude of the problem. Stillbirth is estimated to be more than double the financial cost of a live birth.

The determinants of stillbirths are multifactorial, and a significant proportion have unknown aetiology. This can be attributed to limited comprehensive population based surveys regarding the definite cause of stillbirth. Literature suggests various interlinked determinants of stillbirth are common across most LMICs and may reflect the quality of obstetrics care available during pregnancy and childbirth. Stillbirths occur due to the complex interaction of socio-demographic, behavioural and obstetrics factors. In high-income countries (HIC),

literature shows that some of determinants of stillbirths include placental conditions, foetal/placental pathologies, and antepartum haemorrhage (APH) and a higher proportion are unexplained. Whereas determinants in LMIC include maternal age (less than 20 and above 35 years of age), high birth weight, low education level, increased parity, and poor antenatal care, history preterm birth, APH, and history of stillbirth. Stillbirth varies across countries and its magnitude fluctuates from time to time. Also, the determinants of stillbirth maybe context-specific, especially in developing countries.

In Zambia, evidence from anecdotal data suggests that stillbirth is a public health challenge with high incidence and prevalence rate. For example, a study conducted in selected health facilities of Lusaka urban more than a decade ago showed that the prevalence of stillbirth was 21 per 1000 live births . It showed that determinants of stillbirth were prior history of stillbirth, APH, extremes of birthweight (<2500g or >4000g), increased maternal age, caesarean and breech deliveries. More recent data estimated 30.5 stillbirths per 1000 live births in certain parts of the country. However, the last Zambia Demographic Health Survey (ZDHS) only reported the perinatal mortality rate for the previous 5-year period under review of 33 per 1000 live births but not specifically stillbirth rate . In response to the challenges in the provision of quality health services and care, the Zambian government established five general hospitals in the year 2018 in Lusaka urban which are equipped with basic obstetric delivery services to improve maternal and perinatal outcomes. One of the priorities set in the Zambia National Health Strategic Plan for 2017 – 2021 is to reduce stillbirth to less than 12 deaths per 1000 live births by 2030 in keeping with WHO target. It is important that the Zambian program implementers prioritized health services that are deemed effective to improve maternal and perinatal outcomes. To reduce stillbirth, assessment of its determinants is

key to generate program data that can be utilized for decision-making to fill the gaps in the provision of maternal and perinatal health services and care. Therefore, we aimed to assess the determinants of stillbirths in the five selected general hospitals in Lusaka, Zambia.

METHODS

Study design and study sites

This was a facility based unmatched case-control study conducted between April to June 2022 among women of reproductive age group (15 – 49 years) who gave birth in five general hospitals namely; Kanyama, Chipata, Chawama, Matero and Chilenje in Lusaka urban of Lusaka province. Lusaka city is the capital city of Zambia and is locate in the south central of the country and has eight constituencies with a population of about 1,264 440 million people (312, 255 women of reproductive age group). At the time of data collection, the total number of annual deliveries in the five general hospitals was 120, 000.

Study population

For this study, the stillbirth cases were consecutively enrolled from the five aforementioned general hospitals. The controls were selected from the same hospitals where the cases came from in the ratio one to four (1 case: 4 controls). Cases were from women of child-bearing age (15-49 years), fresh or macerated stillbirth, singleton births, birth weight of 1000 grams and above, or gestation age of 28 completed weeks. Controls were women with the reproductive age group who delivered with 24 hours of stillbirth at the same facility. Four controls were randomly selected from the sampling frame per case. We excluded those who did not sign written informed consent, delivered outside the facility and were too sick to respond to the questionnaire (Figure 1).

Figure 1: Selection of study participants
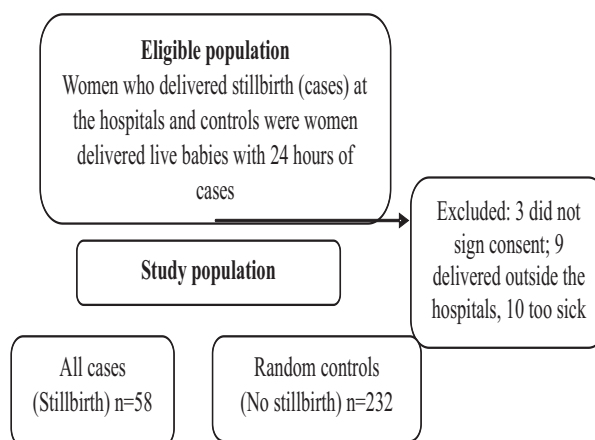
Sample size

For the sample size calculation, A G*Power software for power analysis was used.based on the following assumptions: four controls for per case, power of the study 80% (type II error 20%), 95% confidence interval with 5% type I error, proportional of risk factors in the control participants of 0.33% and cases with potential risk factors to stillbirth of two and half times as likely to be exposed to stillbirth compared to controls (odds ratio = 2.5). Therefore, the calculated sample size was 58 cases and 232 controls.

Sampling technique

Sample from each hospital was based on probability proportion to size after considering the annual stillbirth reports for each facility in the most recent calendar year (January to December 2021). Matero General Hospital 10 cases and 40 controls, Kanyama General Hospital 13 cases and 52 controls, Chilenje General Hospital two cases and eight controls, Chawama General Hospital 21 cases and 84 controls and Chipata General Hospital 13 cases and 52 controls. Cases were consecutively enrolled but controls were randomly sampled within 24 hours of a stillbirth from a sampling frame that

was made before women were discharged in each hospital.

Study variables

The outcome variable was stillbirth coded (1=stillbirth, 0=livebirth), socio-demographic characteristics were age (19, 20 – 34, 35 years), education level (no education/primary, secondary, tertiary), marital status (married, single), employment status (employed , not employed), Christian denomination (Catholic, Pentecostal, Protestant, other); behavioural characteristics were alcohol (yes, no) smoker (yes, no), Obstetrics characteristic such as time taken to reach the facility, mode of transport (walking, public transport, owner transport) sex of the baby (male, female), mode of delivery (vaginal, caesarean section), parity (2, >2) antepartum haemorrhage (yes, no) birth weight (2500, >2500) history of pregnancy loss (yes, no), preeclampsia (yes, no), hypertension (yes, no) HIV status (positive, negative), history of preterm (yes, no), antenatal booking (12 weeks, >12 weeks) and history of stillbirth (yes, no).

Data collection tool

We developed a questionnaire based on previous studies. One of the principal investigators created an electronic questionnaire with the XLS Form tool and uploaded on ONA server. Data was collected using Open Data Kit (ODK) application which allows collection of data using Android-based tablets in real-time; and ODK Aggregate facilitated data storage. The investigators were constantly conducting data monitoring and management in real-time. At the end of data collection, it was downloaded in excel format and cleaned for analysis.

Data analysis

Data was collected through mobile applications (i.e., Open Data Kit) using tablets and served on ONA server. Data was later downloaded into excel spreadsheet then exported into Stata 16 software (Stata Corp; College Station, Texas, USA) for analysis. Summary proportions and frequencies for cases and controls were obtained from descriptive statistical analyses. Univariate analysis was conducted to obtain the crude association between stillbirth and independent variables. A p-value of 0.2 was used as a cut-off for independent variables to be selected for the multivariable logistic regression model. Evidence of association was determined using $p < 0.05$ for multivariable logistic analyses, in order to assess the independent determinants of stillbirth among the study participants. We utilized a sequential elimination of candidate determinants by checking on the strength and significance of the variable with stillbirth. Also, discrimination and calibration of the model were checked. Variables such as age and birth weight although they were collected as continuous variables were introduced in the model as categorical variables since this is more intuitive from a clinical point of view. To assess the ability of the model to allocate the appropriate risk, we calibrated the model using Hosmer and Lemeshow goodness of fit test. The interpretation of Hosmer and Lemeshow goodness of fit test was considered an accurate prediction when it yielded a non-significant p- value (p>0.05). For model stability, measured by discrimination and differentiated participants with stillbirth from those without, was assessed by using area under the receiving characteristics curve. We considered an area under the curve of more than 0.7 as acceptable. We utilized Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines in reporting this study.

Ethical oversight

Ethical approval for this study was obtained from University of Zambia Biomedical Research Ethics Committee (reference number: 1463-2021) and further permission was obtained from the Zambia National Research Health Authority (reference number: 000050/30/03/2022). Confidentiality and privacy were maintained for the women. Women

were informed that they were free to withdraw from the study at any time without affecting their healthcare.

RESULTS

In this study, there was a total of 290 participants, 58 cases and 232 controls with ratio of one to four respectively. More than three-quarters of the cases (77.6%) and about slightly below three quarters of the controls (74%) belonged to age group 20 – 34 years. Slightly above half in both cases (52.6%) and controls (51.1%) had secondary education as their highest education level. Those who were not employed were 73.7% and 70.7% in the cases and controls respectively. Majority (64.7%) in the cases and 80.6% in the controls were married. More than four-fifth in cases (80.7%) and controls (85.5%)

were not taking alcohol. Slightly below half (48.2%) of the cases and 52.0% of the controls were walking to the facility to access antenatal care. Majority in both cases (82.7%) and controls (92.5%) had vaginal delivery. More than three-quarters of the cases (79.2%) and control (52.4%) had less than or equal to two children. More than one-tenth (14.1%) of the cases and less than one-fifth of the controls experience vaginal bleeding. More than two-thirds of the cases (72.7%) and less than one-third of the controls (28.3%) delivered babies less than or equal to 2500 grams. In both cases and controls, less than one-fifth 17.5% and 10.7% were HIV positive respectively. Almost a quarter (24.1%) in the cases and 12.3% in the controls had history of pregnancy loss (Table 1).

Table 1: Social, behavioural and obstetrics characteristics of cases and controls, Lusaka, Zambia April – June 2022.

Characteristics	Cases (n = 58)		Control (n = 232)		Total (n = 290)	
	n	%	n	%	n	%
Age (years)						
19	8	13.8	27	11.9	35	12.3
20 – 34	45	77.6	168	74.0	213	74.7
35	5	8.6	32	14.1	37	12.9
Education level						
Primary/no education	24	42.1	92	40.5	116	40.9
Secondary	30	52.6	116	51.1	146	51.4
Tertiary	3	5.3	19	8.4	22	7.8
Employment status						
employed	15	26.3	66	29.3	81	28.7
Not employed	42	73.7	159	70.7	201	71.3
Marital status						
Married	37	64.9	183	80.6	220	77.5
Single	20	35.1	44	19.4	64	22.5
Christian denomination						
Catholic	14	24.6	35	15.4	49	17.3
Pentecostal	22	38.6	102	44.9	124	43.7
Protestant	16	28.1	76	33.5	92	32.4
Other	5	8.8	14	6.2	19	6.7
Take alcohol						
Yes	11	19.3	33	14.5	44	15.5
No	46	80.7	194	85.5	240	84.5
Time taken to facility(minutes)						
60	53	94.6	206	92.8	259	93.2
>60	3	5.4	16	7.2	19	6.8
Mode of transport						
Walking	27	48.2	117	52.0	144	51.3
Public	5	8.9	37	16.4	42	14.9
Personal vehicle	24	42.9	71	31.6	95	33.8
Sex of the baby						
Male	29	50.0	114	50.2	143	50.2
Female	29	50.0	113	49.8	142	49.8

Table 1: Socio-demographic, behavioural and obstetrics characteristics of cases and controls Lusaka, Zambia, April – June 2022 conti….

Characteristics	Cases		Control		Total	
	n	%	n	%	n	%
Birth weight (grams)	40	72.7	60	28.3	100	37.4
< 2500	15	27.3	152	71.7	167	62.6
= 2500						
History of pregnancy loss						
Yes	14	24.1	28	12.3	42	14.7
No	44	75.9	199	87.7	243	85.3
Hypertension						
Yes	4	4.9	25	11.1	29	10.2
No	54	93.1	201	88.9	255	89.8
Preeclampsia						
Yes	7	12.1	16	7.2	23	8.2
No	51	87.9	207	92.8	258	91.8
Time s taken fansid ar						
< 5	40	68.9	166	73.1	206	72.3
= 5	18	31.1	61	61.9	79	27.7
HIV status						
Positive	10	17.5	24	10.7	34	12.1
Negative	47	82.5	201	89.3	248	87.9
History of preterm						
Yes	2	3.5	12	5.3	14	4.9
No	55	96.5	214	94.7	269	95.1
History of stillbirth						
Yes	17	29.3	13	5.8	30	10.6
No	41	70.7	213	94.3	254	89.4
Antenatal booking (weeks)						
=12	20	35.1	47	20.9	67	23.8
>12	37	64.9	178	79.1	215	76.2

HIV = Human immunodeficiency virus

Determinants of stillbirth

The association between each independent variable and stillbirth was assessed using binary logistic regression model. The regression showed that marital status, parity, antenatal booking, birth weight, history of pregnancy loss, history of stillbirth and antepartum haemorrhage had enough evidence of association with stillbirth. In multivariable regression model, parity, birth weight, history of pregnancy loss and history of stillbirth had enough evidence of association with stillbirth. Women who had more than two children were 3 times more likely to have stillbirth than those who

had less than two children (AOR = 3.02; 95% CI: 1.07 – 7.54). Women who delivered babies with birth weight equal to or more than 2500 grams were 4.45 times more likely to have stillbirth than their counterparts who had babies less than 2500 grams. (AOR = 95% CI: 2.84 – 8.99) Those who reported a history of stillbirth were 4 times more likely to have stillbirth compared to women who had no history of stillbirth (AOR = 3.99; 95% CI: 1.73 – 9.73). Women who reported experiencing antepartum haemorrhage in the current pregnancy were 3 times more likely to have stillbirth compared to those without antepartum haemorrhage. (AOR = 3.02; 95% CI: 1.18 - 6.46) as shown in Table 2

Table 2: Determinants of stillbirth from the logistic regression model, Lusaka City, Zambia April – June 2022.

Characteristics	COR	P-value	AOR (95% CI)	P-value
Age (years)	Ref			
19	1.10 (0.47 – 2.60)	0.817		
20 – 34	1.89 (0.55 – 2.61)	0.308		
35				
Education				
Primary/no education	Ref			
Secondary	1.01 (0.55 -1.82)	0.978		
Tertiary	1.65 (0.45 – 6.04)	0.448		
Employment status				
Employed	Ref			
Not employed	0.86 (0.44 – 1.65)	0.653		
Marital status				
Married	Ref			
Single	0.44 (0.23 – 0.84)	0.013	0.57 (0.24 – 1.31)	0.184
Christian denomination				
Catholic	Ref			
Pentecostal	1.85 (0.85 – 4.01)	0.117		
Protestant	1.9 (0.83 – 4.31)	0.126		
Other	1.12 (0.33 – 3.69)	0.856		

Characteristics	COR	P-value	AOR (95% CI)	P-value
Parity category				
2	Ref			
> 2	3.4 (1 75 – 6.91)	<0.001	3.02 (1.07 – 7.54)	0.036
APH				
No	Ref			
Yes	4.46 (1.59 7.99)	0.004	3.18 (1.21 – 8.09)	0.011
Antenatal booking (weeks)				
12	Ref			
> 12	2.04 (1.10 – 3.85)	0.031	1.65 (0.66 – 3.2)	0.353
Birth weight (grams)				
< 2500				
2500	5.52 (2.47 – 9.23)	<0.001	4.49 (2.84 – 8.99)	<0.001
History of pregnancy loss				
No	Ref			
Yes	2.26 (1.10 – 4.23)	0.021	1.98 (0.72 – 3.98)	0.185
Hypertension				
No	Ref			
Yes	0.59 (0.29 – 1.16)	0.355		
Preeclampsia				
No	Ref			
Yes	1.77 (0.69 – 4.54)	0.231		
HIV status				
Negative	Ref			
Positive	1.78 (0.78 – 3.97)	0.199		
History of stillbirth				
No	Ref			
Yes	4.18 (2.01 – 5.97)	<0.001	3.99 (1.73 – 6.73)	0.004

COR = crude odds ratio; AOR = adjusted odds ratio; Ref = reference category

DISCUSSION

This unmatched case-control study focused on the determinants of stillbirths among women who delivered in five general hospitals in Lusaka district, Zambia. The results showed that parity of greater than two, babies with birth weight of above 2500 grams, history of stillbirths and history of antepartum haemorrhage were significant determinants of stillbirth.

In this study the odds of experiencing stillbirth were found to be four and half times higher among women who gave birth to babies with birth weight equal or more than 2500 grams compared to women who gave birth to babies to babies less than 2500 grams. This finding is in keeping with previous studies. Stillbirth among normal birth weight babies is associated with inadequate prenatal care which may result into missed detection of foetal infection during pregnancy especially in resource-poor settings. The increased risk in the latter may be explained by difficulty in delivery of a large or abnormal presentation of the infant, leading to prolonged labour, foetal distress and death.

This study found that presence of antepartum haemorrhage was a determinant factor for stillbirth. This is in agreement with a study from Ethiopia which strengthens the presence of antepartum haemorrhage could be due to placenta praevia and placental abruption which are risk factors for stillbirth. The association of antepartum haemorrhage and stillbirth could reflect poor quality care during childbirth or inadequate maternity services. In addition, bleeding in pregnancy may result in preterm labour and delivery, foetal death due to inadequate blood supply. Therefore, an active heighten and persistent monitoring strategy should be in place to identify women who are likely to experience APH especially that it may occur without warning signs.

Our study showed that history of stillbirth was a risk factor for stillbirth. Previous studies have reported that history of stillbirth is known to increase the recurrence of stillbirth due to potential placental vascular disorders and women with such experience should undergo vigorous prenatal care in succeeding pregnancies.

Evidence suggests that pregnant women, who start antenatal care early, within the first trimester, have reduced odds of experiencing stillbirth than those who start after the first trimester. This was in line with our finding though did not reach statistical significance; probably our study was not powered for this variable. A plausible explanation could be that late antenatal initiation does not offer sufficient time to screen and detect risks and appropriate interventions by health care professionals to prevent stillbirth.

There are several limitations to this study. First, there was no clinical examination of the cases reported. Therefore, the potential risk factors for antepartum stillbirth, such as placental insufficiency could not have been identified and recorded that way. For instance, women with hypertensive disorders during pregnancy are more likely to have placental compromise, and thus a higher risk for foetal death. Secondly, this is a case-control study, which can only show the association between the various risk factors but cannot show a causal relationship. Thirdly, there is a possibility that maternal medical conditions were not thoroughly examined during clinical assessment prior to admission and thus risk factors like hypertensive disorders in pregnancy, diabetes may not have been properly documented. Fourth, this was a hospital-based study, thus, the background characteristics of the women with stillbirths might not be the same at the population level therefore, our study cannot be generalized.

In conclusion, the study suggests that the determinants of stillbirth are birth weight greater than 2500 grams, parity greater than two, antepartum haemorrhage and history of stillbirth. Therefore, it is recommended that active surveillance during antenatal care for women likely to develop antepartum haemorrhage and those with previous

record of stillbirth should be enforced to reduce stillbirth. In addition, women should be encouraged to have fewer children.

Acknowledgments

Conflict of interest

All authors declare no conflict of interest

Authors' contributions

MM: conceptualization of the study, study design, data collection and manuscript writing. WM: supervision, study design, data collection and manuscript writing. TM: study design, data collection and manuscript writing. MC: study design, data collection and manuscript writing. MCM: conceptualization, study design, data collection and manuscript writing. MKL: conceptualization of the study, study design, data collection, monitoring of the data collection process, and manuscript writing. PK: conceptualization of the study, study design, data collection, monitoring of the data collection process, data analysis, supervision and manuscript writing. All authors read and approved the final version of the manuscript.

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