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Research Article

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Factors Associated with Potentially Life-Threatening Maternal Conditions in Two Large Hospitals in Ghana: A Case Control Study

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Abstract

Background

Ghana's estimated maternal mortality ratio of 391 per 100,000 live births is one of the highest in the world. Therefore, the country has made efforts to reduce it. To achieve a significant reduction in maternal mortality, there is a need to give serious consideration to the risk factors of potentially life-threatening conditions (PLTC), as some may lead to death. We therefore determined factors contributing to potentially life-threatening maternal conditions in Suntreso and Kumasi South Government hospitals in the Ashanti region of Ghana.

Methods

A facility-based case control study was conducted at the Suntreso and Kumasi South Government Hospitals of Ghana between January 2015 and June 2015. Cases were recruited consecutively as they presented, whereas controls were selected randomly around a case. Cases were women admitted to hospitals during pregnancy, delivery, or within 42 days of termination of pregnancy and fulfilled WHO criteria PLTC, while controls were women admitted and gave birth by normal vaginal delivery. The interviewer-administered structured questionnaire and data abstraction tool were used to collect data, with data entry and analysis done with Epi Info 7. Univariate analyses of categorical variables were expressed as frequencies and proportions. Factors independently associated with PLTC were determined by multivariable analysis at a significance level of 5%.

Results

Among 2,238 pregnant women, 71 (3.2%) with potentially life-threatening conditions (PTLC) were identified. The most diagnosed potentially life-threatening condition was postpartum hemorrhage (57.7%). Risk factors for potentially life-threatening conditions identified were preterm delivery (<37 weeks) [aOR = 7.8, 95% CI: (3.0–20.2)], caesarean section in current pregnancy [aOR = 9.7, 95% CI: (3.1–30.2)], and anaemia during the current pregnancy [aOR = 8.1, 95% CI: (2.9–22.2)].

Conclusion

Factors associated with PLTC were preterm delivery, caesarean section in current delivery, and anaemia in current pregnancy. The hospitals should use factors identified in categorising high- and low risk patients and put in interventions to reduce the risk identified, which will subsequently help reduce maternal mortality.

Abbreviations

ANC : Antenatal Clinic
GDHS : Ghana Demographic and Health Survey
LLINs : Long-Lasting Insecticidal Nets
MMR : Maternal Mortality Ratio
PLTC : Potentially Life-Threatening Conditions

Keywords: Maternal Health and Morbidity, Potentially Life-Threatening Condition, Risk Factors, Ghana

1. Background

Maternal morbidity is defined by the Maternal Morbidity Working Group (MMWG) of the World Health Organisation (WHO) as ill health in a woman who has been pregnant (regardless of the site or duration of pregnancy) from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. Maternal morbidity can be conceptualised as a spectrum ranging, from mild to severe, with the most severe form being a life-threatening condition considered a maternal near miss. Severe maternal morbidity can be classified as life-threatening conditions (maternal near-miss) and potentially life-threatening conditions (PLTC) [1]. Cases of potentially life-threatening conditions (PLTC) occur in larger numbers than maternal mortality [2,3]. Globally, maternal morbidity affects about nine million pregnant women every year [3,4]. The burden of maternal morbidity is estimated to be highest in low- and middle-income countries, including Ghana, especially among the poorest women [5]. In Ghana, approximately 73% of births occur in health facilities [6]. In Ghana's capital, an estimated incidence of potentially life-threatening conditions was 157 cases per 1000 live births, and maternal near-miss was 3 cases per 1000 live births [7]. Pregnant women experience preventable acute or chronic morbidity that undermines their normal functioning and can affect women's physical, mental, social, and economic status [8].

WHO recommended monitoring and analysis of maternal morbidity to improve maternal health and reduce maternal mortality [9]. This recommendation is because, in analysing the factors contributing to maternal morbidity, data is obtained directly from the woman herself, making it more likely to be accurate compared with data on maternal mortality, which is obtained from a surrogate. Recent research in Ghana indicated that maternal morbidity is a continuum and that if the underlying causes of poor maternal health outcomes are addressed, it is likely to improve health outcomes across the continuum of maternal morbidity [7]. To achieve a significant reduction in maternal morbidity and its associated consequences, exploring the risk factors of maternal morbidity to improve maternal health outcomes is imperative. This study was conducted in 2015 to determine factors contributing to PLTC in Suntreso and Kumasi South Government hospitals in Ghana.

2. Method

2.1 Study Design

All pregnant women admitted for delivery and women with pregnancy-related complications from January 26th, 2015, to June 7th, 2015, were included in the study. A case-control study was used to identify risk factors associated with PLTC.

2.2 Study Area

The research was conducted from January 26th, 2015, to June 7th, 2015, in the Suntreso Government Hospital and Kumasi South Government Hospital in Kumasi Metropolis of the Ashanti Region of Ghana. In the Ashanti region, 86% of deliveries are done in health facilities [6]. The metropolis has a population of 1,976,936, of which 30.3% is in Asokwa, where Kumasi South government hospital is located, and 24.2% in Bantama, where Suntreso government hospital is located. Expected births for 2015 in Asokwa and Bantama were estimated at 23,960 and 19,137, respectively [10]. Kumasi South and Suntreso Government Hospitals were purposefully selected because of the high number of deliveries per month in each facility and the availability of obstetrics and gynaecology specialists to manage the PLTC cases. Each hospital has an average monthly delivery of 250. Teams of obstetricians, paediatricians, and well-trained anaesthetists are always available at both hospitals, equipped with a blood bank, intensive care units, and surgical units. Komfo-Anokye Teaching Hospital (KATH), the only tertiary facility in the region, receives referrals from the lower facilities for a few complicated cases beyond their capacity.

2.3 Study Population

All pregnant women in the two hospitals from January 26 to June 7 were studied to determine PLTC per WHO criteria [2].

A case of PLTC was defined as women who had PLTC while pregnant or in labour, either arriving at the facility with it or developing it during their stay at the health-care facility, and were admitted and discharged during the study period. The PLTC are severe postpartum haemorrhage, severe pre-eclampsia, eclampsia, sepsis or severe systemic infection, ruptured uterus, and severe complications of abortion [2].

Controls were defined as women without any complications during delivery admitted to the health facility during the study period.

2.4 Sample size Calculation

In the sample size calculation using Epi Info 7, a Z of 1.96 as the standard score for the confidence interval of 95% was used, with an allowable error of 5%, a power of 80%, and a case-to-control ratio of 1:2. Using the proportion of cases exposed as approximately 50% and the proportion of controls exposed as approximately 30%, a minimum of 70 cases and 140 controls were required for the study [7].

2.5 Sampling Method

The study included all admitted patients who fulfilled the criteria for PLTC according to the WHO-Working Group on Maternal Mortality and Morbidity. The study only included patients once, regardless of their multiple admissions during the study period. Two groups were selected according to the definition criteria and defined as the PLTC group and the control group. Cases were selected consecutively upon admission or while on admission in the hospital during the study period. We randomly selected two controls for each case. When a case is identified, all patients who were eligible to be controls (patient admitted within 24 hours before or after the case was identified) are listed and numbered, and two numbers are selected at random from a covered box.

2.6 Data Collection Techniques and Tools

Data collection tools (checklist and questionnaire) adapted from a modified WHO maternal near-miss surveillance and assessment questionnaire were used to collect quantitative data [2].

Data was collected on socio-demographic and clinical characteristics. Both cases and controls were interviewed using a questionnaire. The data was collected by the following methods:

1. Record review: The checklist was completed weekly from the maternity records and patient folders. This was to record the number of live births (PLTC) using the WHO classification.

2. Case Search: After obtaining written consent from patients, trained midwives and the principal investigator undertook a search of cases in both hospitals to identify eligible PLTC patients in the study period.

3. Interview: The structured questionnaire was administered to the cases and controls to capture socio-demographic and clinical variables.

2.7 Variables

The main dependent variable was PLTC. The independent variables of interest were socio-demographic and clinical factors related to PLTC. Some socio-demographic variables of the pregnant women considered were age, educational level, marital status, occupation, alcohol intake, and smoking. some Clinical variables considered included: previous caesarean section, previous surgery, previous obstetric morbidities, parity, gravidity, sickle cell disease, HIV, hypertension, diabetes, gestational age at delivery, antenatal visits, caesarean section in current delivery, referral status (whether or not the patient was referred to the study site or facility), delays in reaching the hospital, use of herbal preparations in pregnancy, and pregnancy-induced morbidity (hypertension and diabetes). The data collection tools were pre-tested at Nkawie-Toase Government Hospital, which has a similar setting as the chosen hospitals, and the necessary modifications were made after the pre-test.

2.8 Quality Control, Data Processing and Analysis

Trained midwives were used in the data collection and were supervised by the principal investigator, who is a medical officer. To ensure the quality of the data, information collected from medical records was randomly cross-checked by the participants for correctness. Double entry of data into Epi Info software version 7 was done, and discrepancies were resolved by referring to the original data collection tools. Descriptive data analyses were done using frequencies and cross-tabulations. Potential Life-Threatening Condition indicators were expressed in frequencies, proportions, and rates. Categorical variables (marital status, educational level, et cetera) were expressed as frequencies, proportions, means, and standard deviations for age.

Bivariate analysis was done using the odds ratio and the corresponding 95% confidence intervals to assess the association between selected independent variables and PLTC. Logistic regression modelling was used to assess the strength of the association between the factors assessed and PLTC. Variables that were statistically significant in bivariate analysis and those that were known to be associated with PLTC were included in the multiple logistic model. The confidence interval (CI) of 95% and a p-value of <0.05 were considered statistically significant.

3. Results

3.1 Socio-Demographic and Clinical Characteristics of Pregnant Women with Potentially Life-Threatening Conditions

In all, 2,238 pregnant women were seen in the two facilities during the study period. There were 2,178 (97.3%) live births (LB) and 71 (3.2%) women with potentially life-threatening conditions. The age of cases ranged from 15 to 42 years, while that of the controls was 14 to 40 years, with the mean ages (± standard deviation) of the cases and controls being 28.7± 7.9 years and 26.8± 5.4 years, respectively (p-value = 0.04). The majority [151 (70.9%)] of both cases and controls were between the ages of 20 and 34, as illustrated in Table 1. Aside from maternal age (p-value = 0.01), none of the measured socio-demographic variables were significantly associated with severe maternal morbidity (Table 1).

Characteristics	Case n (%)	Control n (%)	Odds ratio(95%CI)	P-value
Maternal age(years)				
<20	15(21.1)	15(10.6)	3.4(1.5-7.7)	0.01
20 – 34	34(47.9)	117(82.4)	1.0	
≥ 35	22(31.0)	10(7.0)	7.6(3.3-17.5)	
Educational status				
None	9(12.7)	15(10.6)	1.0	0.57
Primary	13(18.3)	18(12.7)	1.2(0.4-3.6)	
Junior high	21(29.6)	55(38.7)	0.6(0.2-1.7)	
Senior high	18(25.4)	30(21.1)	1.0(0.4-2.8)	
Tertiary	10(14.1)	24(16.9)	0.7(0.2-2.1)	
Marital status				
Single	22(31.0)	37(26.1)	1.3(0.7-2.4)	0.69

Divorced/Separated	2(2.8)	3(2.1)	1.5(0.2-9.0)	
Married/Cohabitation	47(66.2)	102(71.8)	1.0	
Tribe				
Ga-adangme	8(11.3)	9(6.3)	1.0	0.32
Ewe	7(9.9)	10(7.0)	0.8(0.2-3.1)	
Akan	49(69.0)	99(69.7)	0.6(0.2-1.5)	
Others	7(9.9)	24(16.9)	0.3(0.1-1.2)	
Occupation				
Farming	3(4.2)	5(3.5)	1.0	0.55
Artisan	3(4.2)	13(9.2)	0.4(0.1-2.6)	
Professionals	11(15.5)	24(16.9)	0.8(0.2-3.8)	
Unemployed	15(21.1)	18(12.7)	1.4(0.3-6.8)	
Others	10(14.1)	19(13.4)	0.9(0.2-4.5)	
Religion				
Christian	64(90.1)	120(84.5)	1.0	0.29
Muslim	7(9.9)	18(12.7)	0.7(0.3-1.8)	
Others	0(0.0)	4(2.8)		
Smoking				
Yes	2(2.8)	3(2.1)	1.3(0.2-8.2)	1.00
No	69(97.2)	139(97.9)		
Alcohol				
Yes	19(26.8)	35(24.6)	1.1(0.6-2.1)	0.74
No	52(73.2)	107(75.4)		

Table 1: Socio-demographic characteristics of cases and controls in Kumasi South and Suntreso Hospitals in Ashanti region, Ghana, January to June 2015.

Close to half of the participants, 94 (44.1%), used herbal medication during the index pregnancy. Only 22 (15.5%) of the controls and 17 (23.9%) of the cases had the index pregnancy as their first ever pregnancy. Twenty-five (41.0%) of the nulliparous women were cases, and the rest were controls. There was no significant association between parity, gravidity of the participants and PLTC [parity (p = 0.32), gravidity (p = 0.17)]. (Table 2a).

Variable	Cases n(%)	Controls n(%)	Odds ratio (95%CI)	P-value
Parity				
0	25(35.2)	36(25.4)	1.0	0.32
1-4	43(60.6)	99(69.7)	0.6(0.3-1.2)	
>4	3(4.2)	7(4.9)	0.6(0.2-2.6)	
Gravidity				
1	17(23.9)	22(15.5)	1.0	0.17
2-4	40(56.4)	98(69.0)	0.5(0.3-1.1)	
>4	14(19.7)	22(15.5)	0.8(0.3-2.1)	
Previous Surgery				
Yes	7(9.9)	3(2.1)	5.1(1.3-20.2)	0.02
No	64(90.1)	139(97.9)		
Antenatal visit				
≤3	34(47.9)	31(21.8)	3.3(1.8-6.1)	<0.001
>3	37(52.1)	111(78.2)		

Herbal use				
Yes	28(39.4)	67(47.2)	0.7(0.4-1.3)	0.31
No	43(60.6)	75(52.8)		
Gestational age(weeks)				
≤36	33(46.5)	13(9.2)	8.6(4.1-18.0)	<0.001
≥ 37	38(53.5)	129(90.8)		
Mode of delivery				
Caesarean section	19(26.8)	7(4.9)	7.1(2.8-17.8)	<0.001
Vaginal delivery	52(73.2)	135(95.1)		
Delivery before arrival				
Yes	13(18.3)	11(7.7)	2.7(1.1-6.1)	0.04
No	58(81.7)	131(92.3)		

Table 2a: Clinical characteristics of cases and controls in the two large hospitals in Ashanti region, Ghana, January to June 2015.

Variable	Cases n (%)	Controls n (%)	Odds ratio(95%CI)	P-value
Referral status				
Referred	9(12.7)	9(6.3)	2.2(0.8-5.7)	0.13
Not referred	62(87.3)	133(93.7)		
Anaemia				
Yes	28(39.4)	10(7.0)	8.6(3.9-19.1)	<0.001
No	43(60.6)	132(93.0)		
HIV				
Reactive	4(5.6)	6(4.2)	1.4(0.4-5.0)	0.73
Not reactive	67(94.4)	136(95.8)		
Prolonged labour				
Yes	1(1.4)	3(2.1)	0.7(0.1-6.5)	1.00
No	70(98.6)	139(97.9)		
Sickle cell anaemia				
Yes	0(0.0)	4(2.8)		0.30
No	71(100)	138(97.2)		

Table 2b: Clinical characteristics of cases and controls in the two large hospitals in the Ashanti region of Ghana, January to June 2015.

Only anaemia, out of all the associated conditions measured, showed a significant association with PLTC [odds ratio 8.6; 95% CI (3.9–19.1)]. The other clinical variables measured were not significantly associated with PLTC (Table 2b).

3.2 Multivariate Analysis To Determine Potential Life-Threatening Conditions Risk Factors

In the multivariate logistic regression, caesarean section as a mode of delivery in index pregnancy was significantly associated [aOdds ratio of 9.7; 95%CI (3.1–30.2)]. Anaemia during the index pregnancy increases the odds of PLTC by approximately eight times [aodds ratio of 8.1; 95% CI (.9–22.2)]. All the other variables used in the model were not statistically significant for PLTC (Table 3).

Variable	Crude Odds ratio (95% C I)	Adjusted Odds ratio (95% C I)
Gestational age(weeks)		
(≤36)	8.4(4.0-17.5)	7.8(3.0 – 20.2)
(37-42)		
Antenatal visits		
≤3	3.3(1.8-6.1)	2.1(0.9 – 5.1)
>3		
Maternal age(years)		
<20	3.4(1.5-7.7)	2.6(0.8 – 8.1)
20-34	1.0	1.0
>34	7.6(3.3-17.5)	6.9(0.8-20.3)
Previous surgery		
Yes	5.1(1.3-20.2)	4.6(0.7 – 29.5)
No		
Caesarean section		
Yes	7.1(2.8-17.8)	9.7(3.1-30.2)
No		
Delivery before hospital arrival		
Yes	2.7(1.1-6.1)	2.8(0.8 – 9.4)
No		
Anemia		
Yes	8.6(3.9-19.1)	8.1(2.9 – 22.2)
No		

Table 3: Multivariate logistic regression for risk factor identification of potentially life-threatening conditions among patients at Kumasi South and Suntreso Hospitals in Ashanti Region, Ghana, January to June 2015.

4. Discussion

Cases of PLTC are associated with acute complications, are likely to lead to maternal death, and therefore warrant prompt and better management of care. Therefore, the determination of specific factors involved in PLTC cases can provide evidence to further reduce maternal death. In this study, 3.2% of the women had potentially life-threatening conditions. This falls within the range of a systematic literature review published in 2012 on this subject, which indicated a prevalence ranging from 0.04% to 15% [11]. Preterm delivery, caesarean section in current delivery, and anaemia in current pregnancy were found to be risk factors for PLTC. None of the socio-demographic variables were seen as risk factors. Some previous studies show an association between maternal age and PLTC, while a case-control study in Nigeria showed no association between maternal age and PLTC [12-14]. There is no consistent finding on the association between education, marital status, and PLTC. While some studies suggest no association between PLTC and marital or educational status, others found some association [14-16]. In this study, no significant association ($p > 0.05$) was seen between marital status, educational level, and PTLC, possibly because the population under study has similar socioeconomic characteristics.

Approximately 18% of women had anaemia during their current pregnancy, this was relatively lower compared to a study in Ghana conducted in 2008, which estimated the prevalence at 34% [17]. It is important to note that anaemia in the present population excludes women with sickle cell anaemia. Nutritional intervention and a decrease in malaria in pregnancy through intermittent preventive treatment (IPTp) by women during pregnancy and the use of long-lasting insecticidal nets (LLINs) as part of national efforts in Ghana may have improved the level of anaemia in the study population [18]. Anaemia in pregnancy was identified as a risk factor for PLTC. A case-control study in Sudan and a cross-sectional study in Tanzania demonstrated that anaemia is a risk factor for PLTC [19,20]. Anaemia during pregnancy could have negative maternal and child health effects and increase the risk of maternal and perinatal mortality as oxygen to vital organs in the child and mother could be compromised.

In this study, preterm delivery was significantly related to PLTC. This was reported in some previous studies, while others did not report a significant association [14,21]. In this study, close to 31% had less than the required minimum number of antenatal visits (4 ANC visits). In 2014, approximately 87% of participants had four or more ANC visits, which is higher than what was seen in this

study (69%) [6]. Having an adequate number (at least 4 visits) of antenatal visits prior to delivery was not significantly associated with PLTC. Other studies involving PLTC cases also found a high proportion of insufficient antenatal visits [12,13]. Antenatal care in Ghana has greatly improved in the past decade, though 3 percent of mothers received no antenatal care for their most recent birth in the five years before the survey [6]. This study reveals a troubling observation: about 5% of the study population never attended antenatal care. To improve maternal outcomes, we need to investigate the reasons behind this non-attendance, a topic beyond the scope of this current study.

This study found that women who underwent vaginal delivery had lower odds of developing postpartum haemorrhage (PLTC) compared to those who underwent caesarean sections. This has been demonstrated in some studies [14,21]. The caesarean section rate in this study was 12%, which is of extreme importance in view of the high and continually rising rates of these interventions [22,23]. Caesarean section as a mode of delivery in the index pregnancy was identified as a risk factor for severe maternal morbidity. This may be because it was employed after the occurrence of a complication and to prevent a woman's conditions from becoming life-threatening. However, it could be that the complications developed after the caesarean section.

There is little evidence to suggest a relationship between the use of herbal medication prior to delivery and severe maternal morbidity. Though this study showed no significant association between herbal medication use and PLTC, as many as 95 (44.6%) pregnant women used some form of herbal preparation during their current pregnancy and prior to delivery. Other studies have reported the increasing trends of herbal preparation use during pregnancy [24,25]. A limitation of the study was possible recall bias due to the case-control study design adopted, as this may have influenced answers to the questions by participants. This, however, was limited due to the short duration of the recall period.

5. Conclusion

In all, 2,238 pregnant women were seen in the two facilities during the study period, with 71 (3.2%) women having potentially life-threatening conditions. The identified risk factors associated with PLTC were preterm delivery, caesarean section in current delivery, and anaemia in current pregnancy. The use of herbal preparations, though not found to be associated with PLTC, was used by almost half of the study participants. The Ministry of Health increases capacity to manage severe maternal morbidity in the lower facilities. Kumasi South and Suntreso Hospitals should use the factors identified as a guide to categorise high- and low-risk patients, and studies should be conducted to ascertain reasons for zero antenatal care prior to the delivery of some clients.

Declarations

Ethics Approval and Consent to Participate

Ethical clearance for this study was obtained from the Ethics Review Committee of the Ghana Health Service with proposal approval identification number GHS-ERC 22/02/2015. The study was in conformity with the guidelines of the 1975 Helsinki Declaration. All participants provided written, informed consent. Permission was obtained from the head of the institution.

Consent to Publish

All participants were informed about the study, and consent was obtained. Participants provided written informed consent that was duly administered and witnessed before data collection. Participants were informed that the findings would be shared with the Ghana Health Service and the wider scientific community.

Availability of Data And Materials

All the data obtained from participants has been fully represented and provided in the tables contained in the results section of the manuscript.

Competing Interests

The authors declare that they have no competing interests. The views expressed in this paper are those of the authors. No official endorsement by the Ministry of Health or the Ghana Health Service is intended or should be inferred.

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Authors' Contributions

NYP, EA, and DA conceptualised the study and coordinated it. NYP carried out the data collection and drafted the first manuscript. All authors participated in the statistical analysis, reviewed, and approved the final manuscript.

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