

## Research



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## Predictors of cesarean delivery in public referral hospitals in Botswana: a case control study

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## Abstract

**Introduction:** globally there is concern of rising cesarean delivery trend over the decades from a world average of 6.7% in 1990 to a high of 19.1% in 2014. Similarly, predictors of the cesarean delivery have been documented in other parts of the world, but there is paucity of evidence of those in Botswana. This study therefore aims to determine socio-demographic, obstetrics predictors as well as common indications for cesarean delivery in public referral hospitals in Botswana. **Methods:** a case control study was conducted that involved retrospective review of 672 (112 cases: 223 for each facility) patient's medical records, hospital delivery registers and theater records from 01/01/2018 to 31/12/2018.

*Multivariate logistic regression modelling was applied using SPSS 24 to determine association between independent predictors and cesarean section. **Results:** logistic regression analysis found out the following; women who were referred from other facilities (AOR=2.551; C.I=1.686 - 3.861), history of previous cesarean delivery (AOR=15.840; C.I 8.826 - 28.430), delivered with fetal birth weight of over 4000 grams (AOR=4.420; C.I 1.303 - 14.997), attended antenatal clinics less than four times during the index pregnancy (AOR=2.584; C.I 1.708 - 3.908), unemployed (AOR=1.619; C.I.1.066 - 2.458) as well as those whose moment of delivery was at night (AOR=1.511; C.I 1.004 - 2.275). There was no statistically significant association between HIV serostatus and cesarean delivery. The most common indication for cesarean delivery was the previous cesarean delivery at 29.5%. **Conclusion:** predictors of cesarean delivery were identified as birth weight over 4000 grams, history of previous cesarean delivery, unemployed status as well referral cases from other facilities.*

## Introduction

Cesarean delivery is a major abdominal surgical procedure where the fetus is delivered through a uterine incision following laparotomy [1]. It is one of the most common surgical operations in the world [1,2]. Cesarean delivery when dully indicated improves maternal and neonatal outcomes in both developed and developing countries [3-5]. Predictors of cesarean delivery have been widely documented globally [6,7]; so far, the patterns, predictors, and indications for cesarean deliveries are yet to be determined in Botswana. The proportion of cesarean delivery is an indicator that measures access to and use of this common obstetric intervention used for preventing neonatal and maternal complications [8]. There is a general lack of consensus on the 'ideal' cesarean delivery rate. Hence, since 1985, the WHO has recommended that the acceptable rate must not exceed 10-15% [4,8]. As a principle, the 15% threshold is not to be perceived as a target to be achieved but

rather a threshold not to be exceeded, and all mothers who need cesarean section should be able to access it [8]. The increase in the rate of cesarean delivery deliveries has potentially important direct maternal, perinatal health implications as well as economic implications [9]. Ecological evidence shows that cesarean delivery of over 10% at the population level does not add any more benefit to reducing maternal and infant mortality rate [10].

Several studies have already shown factors associated with cesarean delivery [6,11], the most commonly cited being demographic and obstetrics factors. Increasingly non-obstetrics factors such as a maternal request for are being noted in other settings [12,13]. Clinical factors such as maternal HIV positive serostatus, and maternal conditions such as hypertension and diabetes mellitus have also been shown to contribute to cesarean delivery [14]. The study setting is in Botswana, which has one of the world's highest HIV prevalence rates [15]. Elective cesarean delivery is a proven method of preventing mother-to-child-transmission of HIV, but recent evidence shows that in virally-suppressed mothers, vaginal delivery is safe [16]. This study will assess the contribution of HIV serostatus to cesarean delivery in this high HIV burden setting. The continuing rise of cesarean delivery has been attributed to many factors, including an increasing number of women with a scarred uterus, macrosomia, increasing prevalence of chronic conditions in pregnancy like hypertensive disorders and diabetes mellitus, maternal age extremes, cephalopelvic disproportion, socioeconomic status, maternal weight and height [6,7]. Maternal request for cesarean delivery is also increasingly being cited as a significant driver for the dramatic rise in CRDs globally [17]. Indications for cesarean section is varied across different countries. Previous cesarean delivery is a dominant indication [2,18]. With the clear trend of increasing cesarean delivery globally [2,19], the expectation is that the previous cesarean delivery will continue to be the most common cesarean delivery indication in the

world. Knowledge of the most common indications and predictors of CS in Botswana will help with targeted interventions for the identified clinical indications and predictors. This study therefore aims to determine socio-demographic obstetrics predictors as well as common indications for cesarean delivery in public referral.

## Methods

**Study design:** hospital based unmatched case control study was conducted that involved retrospective review of charts to assess predictors of cesarean section.

**Study setting:** Nyangabwe Referral hospital (NRH) and Princess Marina Referral Hospital (PMH) were the study sites for this study. These sites had the highest number of deliveries in the country among public hospitals [20]. Princess Marina Referral Hospital is the largest referral hospital in Botswana, with 530 in-patient beds. It is a government-funded hospital and the main referral center for the southern region of Botswana. The hospital is in the capital city Gaborone, which has the most substantial proportion of the country's population at about 231,592 [21]. Nyangabwe Referral hospital is the main referral center for the northern region of Botswana, it has 550 beds. During the 12 months' reference period (01/01/2018-31/12/2018), there were a total of 6289 deliveries in PMH from which 1851 were deliveries by cesarean delivery resulting in cesarean delivery in PMH of 29.4%. In the same study period, there were 5333 total deliveries in NRH, with 1545 being cesarean delivery deliveries. Nyangabwe Referral Hospital had a cesarean delivery of 28.97%. Botswana's total fertility rate (TFR) has continued to show a downward trend from highs of 6.6 children per women in 1981 to estimates of 2.8 children per women in 2011 [22].

**Study population:** this study included all women who delivered live births by cesarean delivery and vaginal delivery in the two study sites during the period 01/01/2018 to 31/12/2018.

**Variables:** variables that were analysed were, maternal age, parity, marital status, employment status, education and obstetrics factors and clinical factors to be considered were, gestational age, fetomaternal outcome, indication of cesarean delivery, maternal weight, HIV serostatus. Cases were all women who presented and delivered by cesarean delivery in the two study sites between 1 January 2018 and 31 December 2018 whereas controls were those that presented and delivered by vaginal delivery between 1 January 2018 and 31 December 2018 in the 2 study sites. Using the patient registers available at maternity wards of the study sites, all women who delivered by cesarean delivery between 01 January 2018 to December 2018 were identified. The first case was randomly selected and followed by the two immediate/successive controls. This was repeated until the sample size is reached. Two controls per case were selected (1 case: 2 controls).

**Sampling and sample size determination:** the sample size will be calculated by using the Schlesselman formula [23]. Using online Epi Info StatCalc, the sample size was calculated to be 112 cases and 224 controls, giving a sample size of 336 for each of the two study sites. The admission list from the maternity unit formed the sampling frame in the two facilities. From this list, the first case that met the inclusion criteria was selected, followed by the recruitment of two controls on the same day. After the identification of the first case, the third case in the list was recruited. Subsequently, probability proportionate to sample size was used to distribute the sample size among the 12 months of the year, so that each month was represented in the sampled participants. This process continued until the required sample size was achieved.

**Inclusion criteria:** all cesarean delivery and vaginal deliveries conducted at the two study sites within the study period; all cesarean delivery and vaginal deliveries after 24 weeks of gestation.

**Exclusion criteria:** all cesarean delivery and vaginal deliveries conducted in other hospitals and sent for a referral to the study sites.

**Data processing and analysis:** data were entered and analysed on SPSS version 24, computer software. Descriptive statistics (percentage and mean) on the important qualitative clinical variables were performed, and results and findings presented as graphs, frequencies as well as charts. Bivariate logistic regression modelling was performed to explore the relationship between outcome (caesarean delivery) and selected exposure variables. Variables were considered for inclusion into the multivariate logistic regression model if they were significant ( $P < 0.2$ ) in bivariate analyses. Covariates from the literature review, shown to be associated with cesarean delivery, were also included in the logistic regression model. A multivariate logistic regression model was run using a backward conditional model to control for confounding of the independent predictive covariates. P-value was conventionally set at  $\leq 0.05$  to indicate the presence of statistical significance at a 95% confidence interval. For each covariate: Coefficient (B), standard error of B, Wald statistic, unadjusted odds ratio (exp. (B)), and confidence interval of exp. (B) were determined. Model quality was assessed by applying the Hosmer and Lemeshow's goodness of fit test. Hosmer and Lemeshow's test was insignificant ( $\chi^2 = 6.23$ ; DF = 8;  $P = 0.62$ ); the model was able to describe 42% of the predictors of cesarean delivery ( $0.001 > \text{Nagelkerke}$ ;  $R^2 = 0.415$ ;  $P < 0.001$ ).

**Ethical clearance:** ethical clearance was sought from the University of Botswana Institutional Review Board and from Health Research Development Committee. Further approval was obtained from the respective study sites, Princes Marina Hospital and Nyangabwe Referral Hospital to access patient data.

## Results

**Socio-demographic factors:** the mean age of the study participants was  $25.68 \pm 6.2$  years. The mean age of the cases in PMH was 27.8 (5.4) years and 27.9 (6.3) years in NRH. The mean age of controls in PMH was 24.9 (6.3) years and 24.2 (5.8) years in NRH. The average cesarean delivery rate in the two referral hospitals was 29.2%. Most of the women who gave birth in this study were in the age group 20 - 34 years, in both the cases and the controls; 179 (79.0%) and 317 (70.8%), respectively (Table 1).

**Obstetrics factors:** most of the births in this study were in the gestational age group 38 - 41 weeks, with 138 cases (61.6%) and 272 (60.7%) among the controls. The gestational age group of  $> 42$  weeks had the least proportion of births in both cases and controls, with proportions of 4.0% and 5.1%, respectively (Table 2). History of third trimester bleeding was observed in 22 (3.3%) of the study participants. Cases had a significantly higher proportion of previous cesarean delivery compared to the controls (44.2% vs. 4.7%). Macrosomia was relatively rare in this study, with 17 cases observed with a birth weight of  $> 4000$  grams and only four controls having a birth weight of 4000 grams or more. Most of the participants delivered babies in the weight range of 2500 - 3999 grams (Table 2). The overall prevalence of HIV among pregnant women in this study was 20.5% in the two referral facilities in 2018. The proportion of women with HIV was higher in cases compared to the controls, 23.7% vs. 19.2%. Bivariate analysis of predictive variables showed that among socio-demographic factors maternal age was significantly associated with cesarean delivery ( $P < 0.000$ ), other demographic factors that were found to be substantially associated with cesarean delivery were parity ( $P < 0.000$ ), marital status ( $P < 0.018$ ), employment status ( $P < 0.005$ ). Educational level was among the socio-demographic factors this study found not to be significantly associated with cesarean delivery ( $P < 0.478$ ) (Table 3). Analysis of obstetric factors that

were found to be associated with cesarean delivery was the fetal birth weight ( $P < 0.001$ ), a birth weight of  $> 4000$  grams. Maternal weight, with weight  $>90$  kg increasing the risk of cesarean delivery by 65%, women who attended antenatal clinic less than four times were found to be two times to deliver by cesarean delivery as compared to women who attended ten or more antenatal clinics. Other obstetrics factors that were found to be significantly associated with cesarean delivery included the history of cesarean delivery and the history of women bleeding during pregnancy ( $P < 0.001$ ). HIV was found not to be a predictive factor for a woman to undergo cesareans delivery (Table 3).

The variables of interest that were included in the multiple logistic regression model were maternal age, parity, employment status, maternal weight, birth weight, history of bleeding during pregnancy, history of comorbidity, referral status, number of antenatal clinic visits during the index pregnancy, moment of delivery as well as day of delivery. Multiple logistic regression analysis (Table 4) found that the significant predictive factors for cesarean delivery were those who were referred from other facilities (AOR=2.551; C.I 1.686 - 3.861), history of previous cesarean delivery (AOR=15.840; C.I 8.826 - 28.430), fetal birth weight of over 4000 grams (AOR=4.420; C.I 1.303 - 14.997), fetal weight of less than 1599 grams (AOR=3.286; C.I 1.387 - 7.786); those that attended antenatal clinics less than four times during the index pregnancy (AOR=2.584; C.I 1.708 - 3.908), Unemployed (AOR=1.619; C.I 1.066 - 2.458) as well as those whose moment of delivery was at night AOR=1.511; C.I 1.004 - 2.275).

The indications were physician-documented, and in case of more than one indications, the 'primary indication' was noted. Table 5 shows that the four most common indications for cesarean delivery in this study were; 1) previous cesarean delivery (29.5%); 2) previous cesarean delivery and another indication (13.4%); 3) hypertensive disorders (12.5%); 4) foetal distress (10.7%) in PMH and the top 4 common indications from NRH were; 1)

previous cesarean delivery and another indication (17.9%); 2) previous cesarean delivery (16.0%); 3) foetal distress (14.3%); 4) poor progress & CPD (13.4%). Previous cesarean delivery and previous cesarean delivery and another indication contributed significantly with a combined proportion of 42.9% and 33.9% in PMH and NRH, respectively.

## Discussion

The average cesarean delivery rate in the two facilities was 29.2%. This is significantly higher than the WHO recommendation [5]. The high rates at referral hospitals could pose big health system and logistical challenge to those facilities in terms of availability of theatre space, preoperative and post-operative care and availability of skilled surgeons to carry out those operations. If unchecked this would have huge ramifications for quality of care provided at those facilities as resources will be stretched to the limit. Many African studies in tertiary facilities have similar findings [7,11,24-26]. One of the significant reported drivers of increasing cesarean delivery is low rates of vaginal birth after cesarean (VBAC) and subsequent increasing trends of previous cesarean delivery as an indication for cesarean delivery [11,24]. This study found out that previous cesarean delivery was the most frequent indication for cesarean delivery in the two referral hospitals in 2018. The high primary cesarean delivery rate is another driver of the increasing cesarean delivery. During the study period, the primary cesarean delivery proportion was 56.3% and 53.6% in PHM and NRH, respectively. Maternal age was found to be a significant predictor of cesarean delivery in the bivariate analysis, but this association was lost in the multivariate regression model. Pregnant women in the age group  $< 19$  years was found to have a 29% less odds of undergoing cesarean delivery compared to the reference group of age group 20 - 34 years (Table 5). The age group of over 35 years was found to have a 14% increased risk for a woman to have cesarean delivery (UOR=1.14; 95%

C.I = [0.869 - 2.362). However, this association was not statistically significant. These findings are exciting because many other studies have found that advancing maternal age is a determinant of cesarean delivery [27-30]. In the logistic regression analysis, maternal age was associated with cesarean delivery. Parity and marital status were also not associated with cesarean delivery in this study, a finding consistent with evidence from other studies [7,11,26]. Unemployment was found to be a predictor of cesarean delivery in the two referral hospitals (AOR=1.619; C. I 1.066 - 2.458). This could be explained by the probability that most unemployed, pregnant mothers are likely to present to the public referral hospitals, whereas the employed pregnant mothers more likely to use the private hospital for maternity services.

Most of the predictors of cesarean delivery in this study were obstetric factors. History of having a previous cesarean delivery was found to be associated with cesarean delivery (AOR=15.460; C.I= (8.612 - 27.756). This is similar to the findings of many other studies [6,7,11,24-26,31]. Women with a history of cesarean delivery were found to be more than 15 times more likely to deliver by cesarean delivery in subsequent pregnancies in this study. This is because once a woman is 'cut,' most clinicians classify that woman as a 'high risk' pregnancy; hence the threshold for cesarean delivery is low in subsequent pregnancies. In the context of a high primary cesarean rate, more women are likely to undergo cesarean delivery in their subsequent pregnancies. There is, therefore, a need to reduce the primary cesarean delivery rate to minimize the cesarean delivery. Birth weight of over 4000 grams was associated with cesarean delivery AOR=4.67; C.I=(1.368 - 16.129); these findings are similar to results from regional studies [6,7]. Macrosomia is an established clinical risk factor for cesarean delivery. The importance of this finding is that it will help health care professionals in timely decision making whenever pregnant women present with macrosomia, especially when they are in labor. This study found that women who present with macrosomia are

over four times likely to deliver by cesarean delivery compared to those with a fetal weight of 2500g to 3999g. The other extreme of birth weight of less than 1599g was also found to be statistically significant (AOR=3.286; C. I=(1.387 - 7.786). This could have been because of clinical knowledge that those pregnant women with other comorbidities like hypertensive disorders could have been deemed to put the life of the mothers in danger, hence a need for early delivery. Referral status was shown to be positively associated with cesarean delivery in this study (AOR=2.551; C.I=(1.686 - 3.861), with pregnant women who were referred shown to be 2.5 times more likely to deliver by cesarean delivery; this could be because referred women are more likely to be at higher risk hence their referral to a higher-level health facility. Similar findings were found in another study [7]. It is well known that women who are referred from lower-level facilities are more likely to be sicker and, therefore, possible to present as emergency cases that need urgent attention to deliver. The researcher also wanted to establish the association of cesarean delivery with a moment of delivery (morning vs. night shift), this was found to be a predictive factor (P<0.048) in the multiple logistic regression. Another study found similar findings [32]. This could be because, during night duty, there is a fewer number of health care workers to monitor pregnant women during labor closely.

The most common indication for cesarean delivery was the previous cesarean delivery at 29.5%. These findings are similar to those of many other studies in different parts of the world [18,25,26,33,34]. Fetal distress was also shown to be a significant indication for cesarean delivery in this study. This is consistent with findings from other studies [25,26,34]. The significantly high proportion of previous cesarean delivery as an indication allows these facilities to counter the high cesarean delivery by, among other things introducing a vaginal birth after cesarean delivery (VBAC) policy. vaginal birth after cesarean is widely used in other parts of the world

and has been shown to have a relative success rate [35].

**Strength of this study:** this is the first study to identify predictors of cesarean delivery and the cesarean delivery in Botswana.

**Limitations:** use of retrospective review of chart method was a limitation in that important variables that were not routinely or accurately documented were not analysed e.g. maternal Body Mass Index and residence. Future prospective should include these key demographic variables. As is the case in retrospective review of charts some documentation missed key variables hence the next case/control was enrolled, through (complete-case analysis), where the next case/control with complete set of data in the same day was chosen for analysis.

## Conclusion

Cesarean delivery in the two referral hospitals was high, at 29.5%. This study found significant predictors of cesarean delivery to be; birth weight over 4000 grams, history of previous cesarean delivery, history of bleeding during the index pregnancy, pregnant women who had four or less antenatal clinics, women who were referred from other facilities and women who delivered during the night. Knowledge of these predictive factors will be useful to clinicians during the pre-natal counselling of women. Previous cesarean delivery was the most frequent indication for cesarean delivery in both referral hospitals. It is recommended that the Botswana health system promote guidelines for a safe vaginal birth after cesarean delivery and provides adequate training on it as well as enforce its implementation to help reduce the high cesarean delivery.

## What is known about this topic

- *Birth weight over 4000 grams, history of previous cesarean delivery, history of bleeding during the index pregnancy, pregnant women who had four or less antenatal clinics, women who were referred from other facilities and women who delivered during the night are significant predictors of cesarean section delivery;*
- *HIV positive status is not a significant predictor of cesarean section delivery.*

## What this study adds

- *Cesarean section rates in the main Public referral medical centres in Botswana is high;*
- *Previous cesarean section is a dominant indication for cesarean section delivery in Botswana Referral Hospitals;*
- *Women who delivered during the night are more likely to deliver by cesarean section.*

## Competing interests

The authors declare no competing interests.

## Authors' contributions

Dr. Gotsileene Monamodi was involved primarily in the conceptualized of the research concept. Both Dr. Gotsileene and Dr. Thabo Matlhogonolo Phologolo were involved in data analysis and manuscript writing, editing and reviewing. Both authors read and were in agreement to the final manuscript.

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## Tables

**Table 1:** sociodemographic characteristics of the study population in public referral hospitals 2018

**Table 2:** obstetric, clinical and non-clinical characteristics of the study population in public referral hospitals 2018

**Table 3:** unadjusted and adjusted odds ratios of predictive variables of cesarean deliveries

**Table 4:** multivariate logistic regression analysis of predictors of cesarean delivery in a public referral hospital in Botswana - 2018

**Table 5:** indications for cesarean delivery

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**Table 1:** sociodemographic characteristics of the study population in public referral hospitals 2018

Variable	Yes n=224 (%)	No N=448 (%)	Total n=672 (%)
<b>Age group</b>			
20 - 34	177 (79.0)	317 (70.8)	494 (73.5)
<19	15 (6.7)	91 (20.3)	106 (15.8)
> 35	32 (14.3)	40 (8.9)	72 (10.7)
<b>Marital status</b>			
Single	196 (87.5)	416 (92.9)	612 (91.1)
Married	28 (12.5)	31 (6.9)	59 (8.8)
Unavailable	0 (0)	1 (0.2)	1 (0.1)
<b>Education level</b>			
None	5 (2.2)	3 (0.7)	8 (1.2)
Primary	5 (2.2)	9 (2.0)	14 (2.1)
Secondary	156 (69.6)	317 (70.8)	473 (70.4)
Tertiary	58 (25.9)	119 (26.6)	117 (26.3)
<b>Employment status</b>			
Employed	98 (43.8)	146 (32.6)	244 (36.3)
Unemployed	125 (55.8)	301 (67.2)	426 (63.4)
Unknown	1 (0.4)	1 (0.2)	2 (0.3)

**Table 2:** obstetric, clinical and non-clinical characteristics of the study population in public referral hospitals 2018

<b>Variable</b>	<b>Yes</b>	<b>No</b>	<b>Total</b>
	n=224 (%)	N=448 (%)	n=672 (%)
<b>Parity</b>			
2 - 4	135 (60.3)	167 (37.3)	302 (44.9)
1	73 (32.6)	263 (58.7)	336 (50.0)
> 5	16 (7.1)	18 (4.0)	34 (5.1)
<b>HIV status</b>			
Negative	171 (76.3)	359 (80.1)	530 (78.9)
Positive	53 (23.7)	86 (19.2)	139 (20.7)
Unavailable	0 (0)	3 (0.7)	3 (0.4)
<b>Gestational age (weeks)</b>			
38 - 41	138 (61.6)	272 (60.7)	410 (61.0)
< 37	74 (33.0)	149 (33.3)	223 (33.2)
> 42	9 (4.0)	23 (5.1)	32 (4.8)
Unknown	3 (1.4)	4 (0.9)	7 (1.0)
<b>Referral status</b>			
Referred	135 (60.3)	151 (33.7)	286 (42.6)
Not referred	89 (39.7)	297 (66.3)	386 (57.4)
<b>Birth weight (grams)</b>			
2500 - 3999	165 (73.7)	365 (81.5)	530 (78.9)
1600 - 2499	29 (12.9)	58 (12.9)	87 (12.9)
< 1599	13 (5.8)	21 (4.7)	34 (5.1)
> 4000	17 (7.6)	4 (0.9)	21 (3.1)
<b>Maternal weight (kg)</b>			
70 - 89.9	92 (41.1)	166 (37.1)	258 (38.4)
< 69.9	80 (35.7)	238 (53.1)	318 (47.3)
> 90	49 (21.9)	37 (8.3)	86 (12.8)
Unknown	3 (1.3)	7 (1.6)	10 (1.5)
<b>ANC attendance</b>			
>10	112 (50.0)	172 (38.4)	284 (42.3)
5 - 9	84 (37.5)	188 (42.0)	272 (40.5)
0 - 4	28 (12.5)	88 (19.6)	116 (17.3)
<b>Fetal sex</b>			
Male	116 (51.8)	243 (54.2)	359 (53.4)
Females	108 (48.2)	205 (45.8)	313 (46.6)
<b>Delivery day of the week</b>			
Weekday	165 (73.7)	301 (67.2)	466 (69.3)
Weekend/holiday	59 (26.3)	147 (32.8)	206 (30.7)
<b>Moment of birth</b>			
Day Duty (07:29 - 16:29)	121 (54.0)	166 (37.1)	287 (42.7)
Night duty(16:30 - 07:28)	103 (46.0)	282 (62.9)	385 (57.3)
<b>Cesarean/delivery history</b>			
Yes	99 (44.2)	21 (4.7)	120 (17.9)
No	125 (55.8)	427 (95.3)	552 (82.1)
<b>History of bleeding</b>			
Yes	15 (6.7)	7 (1.6)	22 (3.3)
NO	209 (93.3)	441 (98.4)	650 (96.7)
<b>Presence of comorbidities</b>			
Yes	88 (39.3)	132 (29.5)	220 (32.7)
No	136 (60.7)	316 (70.5)	

**Table 3:** unadjusted and adjusted odds ratios of predictive variables of cesarean deliveries

Variables	UOR	CI of OR	P-value	AOR	CI of OR	P-value
<b>Maternal age</b>			0.000*			0.215
20 - 34	1*	-	-	1*	-	-
≤ 19	0.295	0.166 - 0.525	0.000	0.553	0.928 - 3.720	0.080
> 35	1.143	0.869 - 2.362	0.159	1.026	0.459 - 2.040	0.932
<b>Parity</b>			0.000*			0.415
2-4	1*	-	-	1*	-	-
0-1	0.343	0.243 - 0.485	0.000	1.355	0.786 - 2.336	0.274
> 5	1.100	0.540 - 2.238	0.793	1.610	0.573 - 4.523	0.366
<b>Marital status</b>			0.018*			0.674
Single	1*	-	-	1*	-	-
Married	1.917	1.119 - 3.285	0.018	1.176	0.553 - 2.501	0.674
<b>Education level</b>			0.478			0.851
Primary/none	1*	-	-	1*	-	-
Secondary	0.591	0.250 - 1.397	0.230	0.699	0.200 - 2.442	0.574
Tertiary	0.585	0.239 - 1.433	0.241	0.686	0.181 - 2.600	0.580
<b>Employment status</b>			0.005*			0.071
Employed	1*	-	-	1*	-	-
Unemployed	1.609	1.157 - 2.237	0.005	1.508	0.965 - 2.355	0.071
<b>HIV status</b>			0.193			0.833
Negative	1*	-	-	1*	-	-
Positive	1.294	0.878 - 1.907	0.193	1.076	0.546 - 2.121	0.833
<b>Gestational age</b>			0.815			0.210
38-41	1*	-	-	1*	-	-
< 37	1.022	0.723 - 1.444	0.904	1.496	0.853 - 2.624	0.159
> 42	1.297	0.584 - 2.878	0.523	0.623	0.235 - 1.654	0.342
<b>Referral status</b>			0.000*			0.000*
Referred	2.983	2.141 - 4.157	0.000	2.570	1.678 - 3.938	0.000
Not referred	1*	-	-	1*	-	-
<b>Birth weight</b>			0.001*			0.014*
2500-3999	1*	-	-	1*	-	-
1600-2499	1.106	0.683 - 1.791	0.682	1.027	0.497 - 2.122	0.943
< 1599	1.369	0.669 - 2.801	0.389	2.632	1.028 - 6.738	0.044
> 4000	9.402	3.115 - 28.37	0.000	5.126	1.463 - 17.962	0.011
<b>Maternal weight</b>			0.000*			0.110
70-89.9	1*	-	-	1*	-	-
< 69.9	0.607	0.423 - 0.869	0.006	0.784	0.494 - 1.246	0.304
> 90	2.390	1.454 - 3.928	0.001	1.577	0.827 - 3.006	0.167
<b>ANC attendance</b>			0.08			0.001*
>10	1*	-	-	1*	-	-
5-9	1.404	0.854 - 2.308	0.350	1.696	1.040 - 2.766	0.034
0-4	2.047	1.257 - 3.332	0.004	4.325	2.025 - 9.235	0.000
<b>Fetal sex</b>			0.548			0.543
Male	1*	-	-	1*	-	-
Females	1.104	0.800 - 1.522	0.548	1.138	0.751 - 1.724	0.543
<b>Day of week</b>			0.087			0.410
Weekday	1*	-	-	1*	-	-
Weekend/holiday	1.366	0.956 - 1.951	0.087	1.210	0.769 - 1.903	0.410
<b>Moment of birth</b>			0.000*			0.047*
Day duty (07:29-16: 29)	1*	-	-	1*	-	-
Night duty (16:30-07:30)	1.996	1.442 - 2.763	0.000	1.530	1.005 - 2.328	0.047
<b>Cesarean/delivery history</b>			0.000*			0.000*
Yes	16.104	9.658 - 26.85	0.000	16.680	8.576 - 32.442	0.000
No	1*	-	-	1*	-	-
<b>History of bleeding</b>			0.001*			0.069
Yes	4.522	1.816 - 11.25	0.001	2.976	0.920 - 9.628	0.069
No	1*	-	-	1*	-	-
<b>Presence of comobidities</b>			0.011*			0.789
Yes	1.549	1.107 - 2.168	0.011	1.085	0.598 - 1.968	0.789
No	1*	-	-	1*	-	-

UOR - unadjusted odds ratio, AOR - adjusted odds ratio, 95% C.I - confidence interval

**Table 4:** multivariate logistic regression analysis of predictors of cesarean delivery in a public referral hospital in Botswana - 2108

Variables	B	S.E.	Wald	Sig.	OR	95% C.I for OR
<b>Birth weight (g)</b>			12.690	0.005V		
<b>Birth weight (g) 1600 - 2499</b>	0.297	0.332	0.797	0.372	1.345	0.701 - 2.582
<b>Birth weight (g) &lt; 1599</b>	1.190	0.440	7.307	0.007	3.286	1.387 - 7.786
<b>Birth weight (g) &gt; 4000</b>	1.486	0.623	5.685	0.017	4.420	1.303 - 14.997
<b>Birth weight (g) 2500 - 3999</b>	0.000			-	1*	-
<b>Number of ANC attended</b>			13.422	0.001V		
<b>Number of ANC 5 - 9</b>	-0.447	0.230	3.759	0.053	1.563	0.995 - 2.456
<b>Number of ANC &lt; 4</b>	-1.290	0.358	12.969	0.000	3.631	1.800 - 7.325
<b>Number of ANC attended &gt; 10</b>	0.000			-	1*	-
<b>Maternal weight (kg)</b>			5.224	0.073		
<b>Maternal weight (kg) &lt; 69.9</b>	-0.240	0.226	1.129	0.288	0.786	0.505 - 1.225
<b>Maternal weight (kg) &gt;90</b>	0.482	0.321	2.260	0.133	1.620	0.864 - 3.039
<b>Maternal weight (kg) 70 - 89.9</b>	0.000			-	1*	-
<b>History of cesarean delivery</b>	2.763	0.298	85.705	0.000V	15.840	8.826-28.430
<b>No history of cesarean delivery</b>	0.000			-	1*	-
<b>History of bleeding</b>	1.096	0.579	3.586	0.058	2.993	0.962 - 9.306
<b>No history of bleeding</b>	0.000			-	1*	-
<b>Moment of delivery - night</b>	-0.413	0.209	3.909	0.048V	1.511	1.004-2.275
<b>Moment of delivery - Day</b>	0.000			-	1*	-
<b>Referral status</b>	0.949	0.211	20.214	0.000V	2.584	1.708 - 3.908
<b>Not referred</b>	0.000			-	1*	-
<b>Unemployed</b>	-0.482	0.213	5.110	0.024V	1.619	1.066 - 2.458
<b>Employed</b>	0.000			-	1*	-
<b>Constant</b>	-0.925	0.261	12.540	0.000	0.397	

AOR - adjusted odds ratio, 95% C.I - confidence interval, V - statistically significant

**Table 5:** indications for cesarean delivery

Indications	Nyangabwe Referral Hospital		Princess Marina Hospital	
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
Previous cesarean delivery	33	29.5	18	16.0
Previous cesarean + another indication	15	13.4	20	17.9
Fetal distress	12	10.7	16	14.3
Hypertensive disorder	14	12.5	5	4.5
Fetal macrosomia	9	8.0	10	8.9
Failed induction	2	1.6	6	5.4
PROM	2	1.6	0	0
Oligohydramnios	3	2.7	4	3.6
Mal-presentation & malposition	2	1.6	11	9.8
Ante partum hemorrhage	8	7.1	5	4.5
Poor progress + CPD	6	5.4	15	13.4
Others*	6	5.4	2	1.6
Total	112	100	112	100

\*Hydrocephalus, ruptured uterus, uterine fibroids, cancer of the cervix, schizophrenia, thrombocytopenia, genital wart