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Elective versus non-elective caesarean sections: A multinomial regression analysis of predictors and foetal outcome in a Tertiary Health Facility in Southwestern Nigeria

Elective versus non-elective caesarean section

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Abstract
Objective: This study assessed the demographic and obstetric predictors of elective and non-elective caesarean section (CS) and the fetal outcomes at Babcock University Teaching Hospital (BUTH).
Methods: A cross-sectional study of 447 pregnant women who delivered between August 2020 and February 2022 at BUTH. Statistical analysis was done using IBM-SPSS version 23.0. Multinomial logistic regression analysis was used to identify specific predictors of both elective and non-elective caesarean sections.
Results: We found that being aged 30 years and older (AOR 2.5 CI 1.3-5.0; p: 0.007), having low birth order [(order 1, AOR 3.4 CI 1.4-8.3; p: 0.008), (order 2, AOR 2.5 CI 1.1-5.8; p: 0.027)], history of CS (AOR 200.8 CI 56.3-716.9; p: <0.001) and non-cephalic foetal presentation (AOR 61.9 CI 7.2-529.7; p: <0.001) predicted elective CS delivery while low birth order (order 1, AOR 3.6 CI 1.8-7.1; p: <0.001), gestational age between 37 and 40 weeks (AOR 3.7 CI 1.6-8.4; p: 0.002) and history of CS (AOR 22.3 CI 6.0-82.1; p: <0.001) predicted non-elective CS. Foetal morbidities such as birth asphyxia, prematurity and low birth weight were significantly higher in women who had non-elective CS.
Conclusion: This study has demonstrated that advanced maternal age, low birth order, history of CS and non-cephalic presentation predicted elective CS while low birth order, history of CS and gestational age 37-40 weeks predicted non-elective CS. Advocacy for early commencement of family and having well-justified indications for the first CS may be useful strategies for optimizing caesarean delivery at the facility level in Nigeria.

Keywords: Caesarean section, Determinants, Elective, Emergency, Predictors

Plain English Summary

Caesarean section rates have been on the increase and there is a cry for its reduction even though its safety has improved over time. This study attempted to find out those factors that put a pregnant woman at risk of having a caesarean section to see if a modification of these factors could help reduce the rate of caesarean section. The study looked at the records of women who delivered in Babcock University Teaching Hospital between August 2020 and February 2022. The study found out that being older than 30 years, having most likely your first or second pregnancy and having had a previous caesarean section

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would put you at increased risk of having a caesarean section. Also, the babies of those having 'emergency' caesarean section have a higher risk of prematurity, respiratory problems at birth and lower birth weights.

Background

Caesarean section (CS) is a common surgical procedure performed worldwide. While CS can be a lifesaving intervention when medically indicated, it can also have adverse health effects for women and newborns (1). The rising rates of CS are a major public health concern, leading to calls for policy interventions to reverse this trend (2). It is noteworthy however that both very high and very low CS rates are undesirable (3).

Lucas *et al*. proposed a 4-grade classification system based on the urgency of CS: emergency CS (done whenever there is an immediate threat to the life of women or the foetus); urgent CS (done when there is a maternal or foetal compromise which is not immediately life-threatening); scheduled CS (done for women needing early delivery but no maternal or foetal compromise) and elective CS (done at a time to suit the patient and maternity team) (4). Although the World Health Organization (WHO) currently advocates the use of the Robson 10-group classification system for assessing, monitoring, and comparing CS rates, the Lucas classification system is still believed to be useful and reliable in clinical practice, especially for audit, training and risk-management purposes (4, 5). In conventional practice, however, planned CS is often classified as "elective" while all other (non-elective) cases are labelled as emergencies (6).

Several factors have been associated with caesarean sections. These include demographic factors (maternal age, education level, religious belief, ethnicity, place of residence, region of residence) and obstetric factors (parity, number of antenatal visits (7). Additionally, community-level factors such as health insurance coverage, the availability of support or alternative options, as well as the prevalence of private health facilities in the community, can influence the likelihood of caesarean section (8, 9).

Some women opt for elective CS for non-medical reasons such as avoiding labour pain, traumatizing past experiences with vaginal delivery and the perception that CS was safer for their babies (10). Other conditions such as abnormal foetal lie, malpresentations, and foetal macrosomia may necessitate elective CS (6). Medical disorders complicating pregnancy such as preeclampsia or foetal conditions like intrauterine growth restriction may necessitate urgent CS. However, acute fetal hypoxia or mechanical difficulties during labour such as cervical dystocia, cephalopelvic disproportion, obstructed labour or incoordinate uterine action usually result in emergency or urgent caesarean sections (11). Since elective CS are performed at predetermined times, it can be hypothesized that the factors that are associated with this class of CS will be different from factors associated with non-elective CS which are often performed for indications suggesting actual or potential maternal or foetal compromise.

Routine monitoring of clinical indications for CS in both public and private facilities is necessary to ensure rational use of the procedure. Moreover, an understanding of the trends of elective and non-elective CSs and the potential predictors will enhance the planning and provision of effective strategies for optimizing caesarean deliveries at the facility level in Nigeria. Hence, this study aims to identify the demographic and obstetric predictors of elective and non-elective CS and the foetal outcome among patients attending a tertiary health facility in Nigeria.

Methods

Study setting

The study was carried out in Babcock University Teaching Hospital (BUTH), a Seventh Day Adventist tertiary health institution in Ilishan, Ikenne local government area of Ogun State, Southwest Nigeria. The hospital has a fully functional maternity unit manned by consultant obstetricians, resident doctors undergoing specialist training, nurses and midwives. There are 24 obstetric beds in the health facility, and the average annual delivery is approximately 350 births. BUTH has two fully functional obstetrics theatre suites, a neonatal ward and a well-equipped haematology department which provides blood bank services.

Study design and population

This cross-sectional study was carried out using the records of all pregnant women who gave birth at the obstetric unit of BUTH from August 2020 to February 2022. A total of 447 women were recruited, their case files retrieved and relevant information extracted using a data capture sheet specifically designed for this study. Information extracted included maternal characteristics (age, educational level); obstetric parameters (gestational age, parity, foetal presentation, number of fetuses, previous CS scar); and fetal outcome (live or stillbirth, birth weights and APGAR scores of babies).

Outcome variable

The main outcome variable of interest in the study was the mode of delivery which had three outcomes coded as '0'= vaginal delivery, '1'= Elective CS and '2'= Non-elective CS.

Explanatory variables

The explanatory variables chosen for this study were guided by the existing literature and clinical experience of the authors. These variables were categorized as follows: maternal age (< 30 years, ≥ 30 years); birth order (1, 2, ≥ 3); gestational age (<37weeks, 37-40 weeks, >40 weeks); previous CS (No, Yes), presentation (cephalic, non-cephalic), birth weight (<2.5kg, 2.5- 4.0kg, >4.0kg); Number of gestation (singleton, multiple); first and fifth minute APGAR scores (<7, ≥7). Low birth weight babies were defined as birth weight less than 2.5kg, macrosomia was defined as birth weight >4.0kg, while birth asphyxia was defined as 5th minute APGAR score less than 7 (12).

Data Analysis

The data were subjected to analysis with the aid of IBM-SPSS Windows version 23.0 (IBM Corp., Armonk, NY, USA). Categorical variables were summarized using frequencies and percentages. The normality of the distribution of continuous variables was tested by the Kolmogorov-Smirnov test. The Mann-Whitney U test was used to compare the differences between the elective and non-elective CS groups in relation to foetal outcomes. Bivariate analysis was performed using Pearson's Chi-square test to establish the association between maternal characteristics and mode of delivery. Variables that were significantly associated with the mode of delivery were included in a multinomial logistic regression model to control potential confounders and determine the factors that influenced both elective and non-elective CS using vaginal delivery as reference category. The results of multinomial logistic regression analyses were presented as adjusted odds ratios (AOR) along with the respective 95% confidence intervals (CIs). A p-value less than 0.05 was considered statistically significant.

Results

Out of the 447 women who gave birth during the study period, 218 women (48.8%) had vaginal deliveries, 127 women (28.4%) had elective CS and 102 women (22.8%) had non-elective CS. Majority of the 229 CSs were elective (127; 55.4%). Almost all the participants were between the ages of 21- 40 years (95%) and had at least secondary education (99.8%). The majority of the births were singleton (95.5%) with cephalic presentation (95.5%) and at term (81%). More than three-quarters of the newborns weighed ≥ 2.5kg (382; 85.5%). (Table 1)

Table 1: Characteristics of study participants

Variable	N	%
Maternal age (years)		
≤20	6	1.3
21-30	217	48.5
31-40	209	46.8
≥40	15	3.4
Educational level		
Primary	1	0.2
Secondary	53	11.9
Tertiary	393	87.9
Birth order		
1	155	34.7
2	142	31.8
3	90	20.1
≥4	60	13.4
Gestational age (weeks)		
<37	85	19.0
≥37	362	81.0
Presentation		
Cephalic	427	95.5
Non-Cephalic	20	4.5
Number of gestations		
Singleton	427	95.5
Multiple	20	4.5

Newborn Birth weight(kg)		
<2.5	65	14.5
≥2.5	382	85.5

The association between some obstetric characteristics and mode of delivery are depicted in Table 2. Ninety-five (74.8%) of women who had elective CS were aged 30 years or more, compared to 57 (55.9%) for those who had non-elective CS and 108 (49.5%) for those who had vaginal delivery. Regarding birth order, 24 (18.9%) of women who had elective CS had a birth order of one compared to 51(50%) recorded in women who had non-elective CS. Thirty-four women (33.3%) of those who had non-elective CS had preterm deliveries compared to 20 (15.7%) in women who had elective CS and 31(14.2%) in women who had vaginal delivery. Eighty-two women (64.6%) of those who had elective CS had a history of at least one previous CS compared to 16 (15.7%) in women who had non-elective CS and 3 (1.4%) of those who had a vaginal delivery. There was a significant association between the age category of women and their mode of delivery (*P* <0.001). Similarly, the birth order (*P* <0.001), gestational age in weeks (P = 0.001), history of previous CS (*P* <0.001) and foetal presentation (*P* <0.001) were all significantly associated with the mode of delivery. However, the number of gestations was not significantly associated with the mode of delivery (*P*=0.378).

Table 2: Association between obstetric characteristics and mode of delivery

Variable	Elective CS (127) n (%)	Non-elective CS (102) n (%)	Vaginal delivery (218) n (%)	χ^2	P value
Maternal age (years)					
< 30	32 (25.2)	45 (44.1)	110 (50.5)	21.329	<0.001*
≥ 30	95 (74.8)	57 (55.9)	108 (49.5)		
Birth order					
1	24 (18.9)	51 (50.0)	80 (36.7)	28.318	<0.001*
2	57 (44.9)	24 (23.5)	61 (28.0)		
≥3	46 (36.2)	27 (26.5)	77 (35.3)		
Educational level					
Primary	1 (0.8)	0 (0.0)	0 (0.0)	3.836	0.429
Secondary	17 (13.4)	14 (13.7)	22 (10.1)		
Tertiary	109 (85.8)	88 (86.3)	196 (89.9)		
Gestational age (weeks)					
<37	20 (15.7)	34 (33.3)	31 (14.2)	18.180	0.001*
37-40	98 (77.2)	61 (59.8)	173 (79.4)		
>40	9 (7.1)	7 (6.9)	14 (6.4)		
Previous CS					
No	45 (35.4)	86 (84.3)	215 (98.6)	186.824	<0.001*
Yes	82 (64.6)	16 (15.7)	3 (1.4)		
Presentation					
Cephalic	111 (87.4)	99 (97.1)	217 (99.5)	28.397	<0.001*
Non-Cephalic	16 (12.6)	3 (2.9)	1 (0.5)		
Number of gestations					
Singleton	123 (96.9)	95 (93.1)	209 (95.9)	1.944	0.378
Multiple	4 (3.1)	7 (6.9)	9 (4.1)		

*p<0.05 statistically significant

Table 3 shows the foetal outcome of women who had caesarean delivery. Women who had non-elective CS had a higher proportion of low-birth-weight babies than those who had elective CS (24.5% versus 7.9%). Similarly, women who had non-elective CS had a higher proportion of premature babies than those who had elective CS (33.3% versus 15.7%). Women who had elective CS had a higher proportion of macrosomic babies (9.4%) than women who had non-elective CS (2.0%). A higher proportion of asphyxiated babies were recorded in women who had non-elective CS. Three stillbirths were recorded among women who had non-elective CS, and none in women who had

elective CS. The birth weight of babies and prematurity were both significantly associated with the type of caesarean delivery (*P* < 0.001, *P= 0.003* respectively). The first and fifth-minute APGAR scores of babies were also significantly associated with the type of caesarean delivery (*P*=0.002 and *P* < 0.001 respectively). The birth outcome was however not significantly associated with the type of caesarean delivery (*P= 0.087*).

The first-minute APGAR scores in the non-elective CS group were significantly lower than the elective CS group (U=4306.5, *P<0.001*). Similarly, the fifth-minute APGAR scores in the non-elective CS group were significantly lower than the elective CS group (U=4979.5, *P<0.001*).

Table 3: Foetal outcome in women who had caesarean delivery

Variable	Elective CS (127) n (%)	Non-elective CS (102) n (%)	χ^2	P value
Birth weight (kg)				
<2.5	10 (7.9)	25 (24.5)	16.0333	<0.001*
2.5-4.0	105 (82.7)	75 (73.5)		
>4.0	12 (9.4)	2 (2.0)		
Prematurity				
Yes	20 (15.7)	34 (33.3)	8.7562	0.003*
No	107 (84.3)	68 (66.7)		
First-minute APGAR Score				
<7	13 (10.2)	27 (26.5)	9.2462	0.002*
≥7	114 (89.8)	75 (73.5)		
Fifth minute APGAR Score				
<7	1 (0.8)	14 (13.7)	13.428	<0.001*
≥7	126 (99.2)	88 (86.3)		
Birth outcome				
Live birth	127 (100.0)	99 (97.1)	3.785	0.087
Stillbirth	0 (0.0)	3 (2.9)		

*p<0.05 statistically significant

A multinomial regression analysis was done to explore the potential predictors of both elective and non-elective caesarean sections using vaginal delivery as reference category (Table 4). Women who were 30 years and older had a two-and-a-half times increased odds of undergoing elective caesarean section when compared to younger women (AOR 2.5 CI 1.3-5.0). Women with a birth order of one (AOR 3.4 CI 1.4-8.3) and birth order of two (AOR 2.5 CI 1.1-5.8) had increased odds of undergoing elective CS when compared with women with higher birth orders. History of previous CS (AOR 200.8 CI 56.3-716.9) and non-cephalic foetal presentation (AOR 61.9 CI 7.2-529.7) also increased the odds of elective CS significantly.

Table 4: Multinomial logistic regression analysis exploring the predictors of caesarean section types

Variable	Elective CS		Non-elective CS	
	AOR (95% CI)	P value	AOR (95% CI)	P value
Maternal age (years)				
< 30	Reference		Reference	
≥ 30	2.5 (1.3-5.0)	0.007*	1.4 (0.8 -2.5)	0.144
Birth order				
1	3.4 (1.4-8.3)	0.008*	3.6 (1.8-7.1)	<0.001*
2	2.5 (1.1- 5.8)	0.027*	1.5 (0.7-3.0)	0.309
≥3	Reference		Reference	
Gestational age (weeks)				
<37	1.9 (0.7-5.6)	0.216	3.7 (1.6-8.4)	0.002*
37-40	Reference		Reference	

>40	1.3 (0.4- 4.2)	0.663	1.0 (0.4-2.8)	0.942
Previous CS				
Yes	200.8 (56.3- 716.9)	<0.001*	22.3 (6.0-82.1)	<0.001*
No	Reference		Reference	
Presentation				
Non-cephalic	61.9 (7.2- 529.7)	<0.001*	6.2 (0.6-63.3)	0.124
Cephalic	Reference		Reference	
Birth weight (kg)				
<2.5	0.4 (0.1- 1.3)	0.139	0.9 (0.4-2.3)	0.877
2.5-4.0	Reference		Reference	
>4.0	2.1 (0.9-4.6)	0.053	1.7 (0.9-3.3)	0.106

Reference category: Vaginal delivery; *P< 0.05 statistically significant

For non-elective CS, women with a birth order of one had increased odds of this category of CS compared with women with higher birth orders (AOR 3.6 CI 1.8-7.1). Women with preterm pregnancies had increased odds of non-elective CS compared to women delivering at gestational age between 37 and 40 weeks (AOR 3.7 CI 1.6-8.4). Similarly, women with a history of previous CS had significantly increased odds of non-elective CS (AOR 22.3 CI 6.0-82.1).

Discussion

We found that maternal age, birth order, history of CS and foetal presentation predicted elective CS delivery while birth order, history of CS, and gestational age predicted non-elective CS among our study participants. Specifically, being aged 30 years and older, having a low birth order, having a history of CS, and having a non-cephalic presentation at birth were associated with increased odds of elective CS among our study participants. Also, first birth order, preterm delivery and previous history of CS increased participants' risk of undergoing non-elective CS. This study also indicated that foetal morbidities such as birth asphyxia, prematurity and low birth weight were significantly higher in women who had non-elective CS compared to those who had elective CS.

In this study, about three-quarters of women who had elective CS were aged 30 years or more. Moreover, these older women were found to be two and a half times more likely to have elective caesarean delivery than younger women. Many studies suggest a consistent age-related increased risk of cesarean sections (13, 14, 15). Increased maternal age is known to be an independent risk factor for CS (16). Research has also shown that older women may have other risk factors for adverse pregnancy outcomes such as hypertension and diabetes and this may increase their chance of caesarean delivery (14). Moreover, many career women delay pregnancies till when they are at an advanced age, some may have had a history of infertility, while others may have conceived via In-Vitro Fertilization. Maternal preferences together with all the previously outlined factors may have contributed to the increased odds of elective caesarean delivery in older women as reported in this study. It is interesting to note that age did not significantly influence the likelihood of non-elective CS. This may suggest that obstetric factors are more important than demographic factors in predicting non-elective CS.

Many researchers have reported an inverse relationship between birth order and the likelihood of CS and this finding is consistent across all CS types (17, 18, 19). Women with first birth orders had about three times increased risk of elective CS and about four times increased risk of non-elective CS compared to women with birth orders of two or more. Women undertaking their first labours are more prone to labour dystocia and this may account for the higher odds of non-elective CS. Moreover, the majority of the women in this group are usually of low risk and would normally not require elective CS. About half of the women who had non-elective CS were primigravidas compared to approximately 20% of those who had elective CS. Other studies have also reported that emergency CSs are commoner than elective CS in primigravidas while the reverse is often true in multigravidas (20, 21).

A previous caesarean section increases the likelihood of a woman's future caesarean delivery (22). In our study, the history of previous CS predicted both elective and emergency CS. However, the risk of elective CS in a woman with a history of previous CS was about 10 times higher than the risk of non-elective CS. Additionally, about two-thirds of women who had elective CS had a previous history of at least one previous CS. This underscores the fact that previous CS is often the most common indication for elective CS (21, 23). The obvious challenge in many facilities is the need to ensure that the primary CS is always done for

justifiable reasons. This can be enhanced by engaging both clients and providers in an informed decision-making process (17).

Non-cephalic foetal presentation increased the likelihood of having elective CS remarkably. Although external cephalic version and assisted vaginal breech delivery are management options for transverse lie, oblique lie and breech presentations, foetal malpresentation still accounts for a significant proportion of prelabour CS in many parts of the world (15, 24, 25).

Women who had non-elective CS had approximately twice the proportion of preterm deliveries than women who had elective CS. Furthermore, the odds of non-elective CS increased almost 4 folds in women with preterm deliveries compared to term deliveries. In many instances, preterm deliveries are indicated in situations where there is a maternal or foetal compromise, hence the need for emergency CS.

Women who had non-elective CS had poorer foetal outcomes such as low birth weight, prematurity and asphyxia than those who had elective CS. Other studies have indicated that foetal complications were significantly higher in women who had non-elective CS compared to those who had elective CS (21, 26). Our study reported significantly lower APGAR scores in babies delivered through non-elective CS. Moreover, the proportion of asphyxiated babies was about 17 times higher in women who had non-elective CS compared to those who had elective CS. This can be explained by the fact that non-elective CS is often done in situations in which there is foetal or maternal compromise which may have affected oxygen supply between mother and fetus (27). Roth-Kleiner *et al*. however reported that the severity of respiratory morbidity was higher in babies born after elective CS than non-elective CS (28). This disparity may be explained by the development of transient tachypnea in the newborn which is sometimes associated with elective CS. Also, elective CS may be inappropriately timed leading to iatrogenic prematurity with its attendant risk of respiratory distress syndrome (12). This research result does not align with our own findings. Moreover, the majority of our preterm deliveries occurred in women who had non-elective CS.

The results of this study show that the typical woman who is likely to have elective CS is an older woman with a low birth order and a previous history of CS. While age and birth order are non-modifiable risks, measures to prevent the first CS and promote the trial of labour after CS are necessary to reduce elective CS rates. For non-elective CS, measures to reduce medically-indicated preterm births are essential. Although very little reduction is currently possible, some of the proposed interventions include improved maternal nutrition, identification and management of medical disorders; early detection and management of pregnancy complications such as preeclampsia and foetal growth restriction; and appropriate fetal surveillance in high-risk pregnancies (29,30).

Strength and limitations

One major strength of this study was the multinomial regression analysis performed to control for potential confounding variables. There are however some limitations that require consideration. This was a cross-sectional study and its retrospective nature meant that the data used for the study was dependent on the accuracy of the data gathered from the case records. Also, given that the study was conducted at a single tertiary healthcare facility that caters for a substantial load of referred cases, certain findings may not be universally applicable.

Conclusion

This study has demonstrated that advanced maternal age, low birth order, history of CS and non-cephalic presentation predicted elective CS while low birth order, history of CS and gestational age 37-40 weeks predicted non-elective CS. Advocacy for early commencement of family and having well-justified indications for the first CS may be useful strategies for optimizing caesarean delivery at the facility level in Nigeria. This can be achieved by engaging both clients and care providers in an informed decision-making process.

List of Abbreviations

AOR: Adjusted Odds Ratio
BUTH: Babcock University Teaching Hospital
CI: Confidence Interval
CS: Caesarean Section
IBM: International Business Machine
SPSS: Statistical Package for Social Sciences
WHO: World Health Organisation

Declarations

Ethics approval and consent to participate

The study was carried out following the Helsinki Declaration. Due to the retrospective nature of the study, the women whose data were used could not be accessed to provide informed consent. However, consent waiver and ethical approval for the study were obtained from the Babcock University Health Research Ethics Committee (BUHREC 754/21) before the commencement of the study. It was ensured that confidentiality was

not compromised. Moreover, the dataset used did not contain any direct or indirect person identifiers.

Consent for Publication
All the authors gave consent for the publication of the work under the Creative Commons Attribution-Non-Commercial 4.0 license.

Availability of Data
Data for this work are available with the authors and may be provided upon reasonable request.

Conflicts of Interest
The authors have declared no conflict of interest.

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Authors' contributions
AkAA conceptualised and designed the study. AkAA, AdAA GEO, and AOM managed the literature search and gathered data. AkAA analysed the data. AkAA and AdAA wrote the first draft of the manuscript. All authors read and approved the final manuscript.

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