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Original Research Article

Sociodemographic, obstetric and referral determinants of adverse foetal and perinatal outcomes in obstetric emergencies: evidence from referral hospitals in Benin city, Nigeria

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ABSTRACT

Background: Perinatal mortality remains unacceptably high in many low-resource settings, with a substantial proportion of these deaths occurring among women presenting with obstetric emergencies. This study assessed the sociodemographic, obstetric and referral predictors of adverse foetal and perinatal outcomes among women managed for obstetric emergencies in Benin City, Edo State, Nigeria.
Methods: This cross-sectional study was conducted across the four largest referral hospitals in Benin City using clinical data obtained from women who received EmONC services. Binary logistic regression was applied to assess associations between patient characteristics and outcome. Multivariable logistic regression models were fitted to estimate adjusted odds ratios (AOR) with 95% CIs for the association between explanatory variables and adverse foetal outcomes. To assess potential effect modification, interaction terms were specified between key maternal risk factors (booking status and referral status) and selected EmONC interventions.
Results: Among 526 women presenting with obstetric emergencies, 171 (32.6%) experienced adverse perinatal outcomes. The most frequently provided EmONC interventions were caesarean section (70.0%), parenteral antibiotics (66.4%), and uterotonics (41.4%). After controlling for potential confounders, referral status (AOR 2.11; 95% CI: 1.39–3.20) and booking status (AOR 0.25; 95% CI: 0.15–0.44) were strongly associated with adverse outcomes. Interaction analyses assessing modification of the associations between referral or booking status and adverse foetal and perinatal outcomes, showed no significant effects across any of the interventions evaluated.
Conclusions: Strengthening antenatal care utilisation and improving the efficiency and coordination of referral pathways for women requiring EmONC are essential for improving perinatal survival.

Keywords: Obstetric emergency, Foetal outcome, Perinatal outcome, Determinants, Nigeria

INTRODUCTION

Globally, an estimated 2.6 million stillbirths and 2.9 million neonatal deaths occur each year, with a disproportionate burden on low- and middle-income countries. The global stillbirth rate is 13.9 stillbirths per 1,000 total births, with regional rates ranging from 22.8 stillbirths per 1,000 total births in West and Central

Africa compared with 2.9 per 1,000 total births in Western Europe.[1] Neonatal mortality follows a similar pattern, with sub-Saharan Africa recording 27 deaths per 1,000 live births compared with 2 per 1,000 in Europe.[2] Most of these deaths in low- and middle-income countries are preventable.[3] In Nigeria, Africa's most populous nation with some of the highest perinatal losses, the perinatal mortality rate is 52 per 1,000 total births in pregnancies reaching 28 weeks or more and the neonatal mortality rate is 41 per 1,000 live births.[4] These figures underscore the persistent burden of preventable perinatal and neonatal deaths and highlight the urgent need to understand the determinants of adverse outcomes, particularly within the context of obstetric emergencies in referral-level facilities.

Obstetric emergencies, including severe pre-eclampsia, eclampsia, antepartum haemorrhage, obstructed labour, sepsis, and complications arising from unsafe abortion, significantly contribute to poor foetal and neonatal outcomes. The outcomes of obstetric emergencies can be significantly influenced by the timeliness and quality of care provided, beginning at the community level and extending through the entire referral pathway to tertiary facilities.[5] Delays in receiving definitive treatment and poor referral networks also contribute to adverse foetal and neonatal outcomes.

Also, the availability and quality of emergency obstetric and newborn care (EmONC) are critical factors influencing survival.[6] Socio-demographic characteristics such as level of education, socioeconomic status, and marital support have been shown to influence access to EmONC, thereby having an indirect effect on foetal and neonatal outcomes.[7] Maternal age and parity and obstetric factors, including booking status, gestational age at presentation, mode of delivery, and previous pregnancy outcomes, have also been linked to variations in perinatal survival.[8]

The Edo State Government has made notable investments in maternal and newborn health, including the expansion of skilled birth attendance and the strengthening of referral pathways.[9] Despite these efforts, foetal and perinatal mortality among women referred for emergency obstetric and newborn care remains unacceptably high, indicating persistent gaps in the quality, timeliness, and continuity of care provided at referral facilities. Despite over 90% of deliveries occurring in health facilities in Edo State, institutional maternal mortality ratio across these referral facilities ranges from 395 to 674 maternal deaths per 100,000 live births.[4,10,12,13] Understanding the determinants of adverse foetal and neonatal outcomes in the context of obstetric emergencies is therefore essential for designing targeted improvements in service delivery.

This study investigates the socio-demographic, obstetric, and referral factors associated with foetal and neonatal outcomes among women managed for obstetric emergencies in referral hospitals across Benin City, Nigeria. The insights generated are expected to guide policy reforms, strengthen clinical practice, and support progress towards the maternal and newborn health targets of the Sustainable Development Goals.

METHODS

Study design and setting

We conducted a cross-sectional study across four referral hospitals in Benin City, Edo State, Nigeria. Benin City, the capital of Edo State, is a large urban centre with both public and private facilities that provide basic and comprehensive EmONC.[9] Benin City has an estimated population of 2,044,650 in 2025.[14]

The study sites comprised one tertiary hospital (University of Benin Teaching Hospital-UBTH), two public secondary facilities (Edo Specialist Hospital-ESH and Central Hospital, Benin City-CHB), and one private secondary facility (St. Philomena Catholic Hospital), all which function as referral centres for obstetric emergencies in the city. These four hospitals collectively conduct about 6,000 deliveries annually with women referred for EmONC constituting about 20% of these deliveries.

Study population

Eligible obstetric emergency cases were those involving women who presented with obstetric complications and delivered at one of the four study hospitals during the study period. Cases were included whether the women were referred from another facility or self-presented. On the other hand, cases involving uncomplicated deliveries or cases of women who remained pregnant at discharge were excluded.

Data collection

Data were collected prospectively from July 2024 to March 2025. Clinical research assistants, trained on the study objectives, required variables, and standardised operating procedures, captured relevant information as women presented with obstetric emergencies. Clinical and obstetric data were first documented in real time within the patients' case records during routine care. These data were subsequently transferred into a structured proforma developed in Google Forms (Google LLC, Mountain View, Thousand Oaks, CA) to ensure uniformity and completeness of variables across the study sites.

The research team conducted periodic monitoring visits to retrieve completed proformas, assess data quality, and address inconsistencies. Where specific variables were missing, additional information was obtained from clinical notes recorded at the time of care. All completed proformas were uploaded into a secure, password-

protected online database accessible only to authorised members of the research team.

Study variables

The primary outcome was a composite of adverse foetal and perinatal outcomes, comprising early pregnancy loss, stillbirth (fresh or macerated), and birth asphyxia in live births, defined by an Apgar score <7 at five minutes.

Explanatory variables

Explanatory variables comprised sociodemographic factors, obstetric factors, and referral factors. Sociodemographic variables included maternal age, marital status, educational attainment, and employment status. Obstetric characteristics included parity, gestational age in weeks, booking status, and history of previous major direct obstetric complications. Gestational age was determined using the last menstrual period, ultrasound findings, or clinician's assessment. A woman was classified as booked if she had registered for antenatal care (ANC) and received at least one formal antenatal consultation with a skilled health provider before the onset of labour, regardless of the facility where care was obtained.[15]

Regarding referral status, a woman was classified as referred if she presented to the study hospital from another health facility, either with a referral note or through verbal referral, having initially sought care elsewhere during the index pregnancy or emergency.[16] Other variables of interest included the primary diagnosis. This included diagnoses such as antepartum haemorrhage, abnormal lie, prolonged obstructed labour, ectopic pregnancy, foetal distress, hypertensive disorders of pregnancy, intrauterine foetal death, miscarriage, premature rupture of membranes, and postpartum haemorrhage. The primary diagnosis was established based on the attending physician's history taking, clinical examination, and, where available, diagnostic investigations.

Statistical analyses

Descriptive statistics using frequencies and percentages were used to summarize participants' socio-demographic, obstetric and referral characteristics. The distribution of EmONC signal functions received was presented graphically, using pie charts. Bivariate analyses were conducted to explore unadjusted associations between explanatory variables and adverse foetal outcomes. Chi-squared tests were applied and crude odds ratios (OR) with 95% confidence intervals (CI) were estimated using simple logistic regression.

Variables with p value≤0.1 in these preliminary analyses were considered for inclusion in the multivariable model. Multivariable logistic regression models were fitted to estimate adjusted odds ratios (AOR) with 95% CIs for the association between explanatory variables and adverse foetal and neonatal outcomes. Statistical significance in this stage was defined as $p<0.05$. Gestational age was not included in the multivariable analysis because components of the composite outcome occur in different gestational risk windows, creating structural zeros and making the adjusted association uninterpretable. To assess potential effect modification, interaction terms were specified between key maternal risk factors (booking status and referral status) and selected EmONC interventions.

These models evaluated whether associations between maternal characteristics and perinatal outcomes differed by exposure to specific life-saving interventions. Interaction effects were reported as AORs with 95% CIs, and joint Wald tests were used to assess significance. All analyses were performed using Stata version 18 (Stata Corp, College Station, TX, USA).

Ethical considerations

Ethical approval for this study was obtained from the Health Research Ethics Committee of the University of Benin Teaching Hospital (ADM/E 22/A/VOL. VII/14830112952) and permission to access clinical records was secured from the hospital management.

RESULTS

A total of 526 women met the inclusion criteria and were analyzed. The median age was 30 years, with 379 of all women included aged 20–34 years (72.1%). Most women were married (n=485; 92.2%), had a parity of 1-4 (334;63.5%), were at term (310;58.9%) and nearly half (49.4%) were referred from another facility, while 448 (85.3%) had been booked for antenatal care (Table 1).

The commonest obstetric complication reported as primary diagnosis amongst the included women was hypertensive disorders of pregnancy (137;26.1%). This was followed by antepartum hemorrhage (65;12.4%), premature rupture of membranes (62;11.8%), prolonged or obstructed labour (57;10.8%), and foetal distress (53;10.1%).

Other diagnosis occurred in less than 10% of the women (Miscarriage (39;7.4%), previous CS (no complications) (38;7.2%), abnormal lie (23;4.4%), post-partum hemorrhage (22;4.2%), intra-uterine foetal death (20;3.8%), and ectopic pregnancy (10;1.9%).

Signal function interventions

The most frequently performed interventions were caesarean section (366 (70%)), parenteral antibiotics (349 (66.4%)), and uterotonic drugs (218 (41.4%)). One-quarter of women received blood transfusion (126 (24.3%)), while 128 (24%) received anticonvulsants. Other interventions performed were abortion services (22

(4.2%)), assisted vaginal delivery (17 (3.2%)), neonatal resuscitation (12 (2.3%)) and manual removal of placenta (10 (1.9%)) (Figure 1).

Table 1: Socio-demographic and obstetric characteristics of women (n=526).

Characteristics	Frequency	Percentage (%)
Age (years)		
<20	9	1.7
20-34	379	72.1
35 and older	138	26.2
Marital status		
Single	41	7.8
Married	485	92.2
Employment status		
Unemployed	39	7.4
Student	16	3.0
Self-employed/petty trader	202	38.4
Self-employed/mid-high business	163	31.0
Employed	106	20.2
Education		
None	7	1.33
Primary	48	9.13
Secondary	250	47.53
Tertiary	221	42.02
Referral status		
Not referred	268	50.95
Referred	258	49.05
Booking status in the health system		
Un-booked	77	14.67
Booked	448	85.33
Previous obstetric complication		
No previous major direct obstetric complication	420	79.85
Previous major direct obstetric complication	106	20.15
Parity		
0	168	31.9
1-4	334	63.5
5 and above	24	4.6
Gestational age (weeks)		
4-12	27	5.1
13-25	23	4.7
26-36	166	31.6
37-42	310	58.9

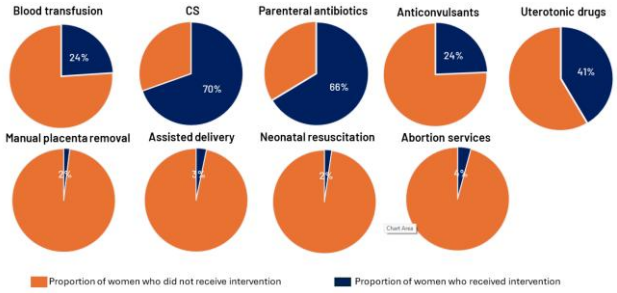

Figure 1: Proportion of women who received specific signal function interventions.

Distribution of adverse foetal outcomes

Adverse foetal and neonatal outcomes were observed in 171 women (32.6%) overall. This included 46 abortus (8.8%), 39 fresh stillbirths (7.2%), and 24 macerated stillbirths (4.6%). In terms of distribution of outcomes by demographic and clinical-obstetric characteristics, we observed adverse foetal and neonatal outcomes in 109 referred women (42.3%) compared with 62 (23.3%) among those not referred. For booking category, 49 un-booked women (63.6%) experienced adverse outcomes compared with 121 booked women (27.1%). Adverse outcomes occurred in 32 women (30.2%) with a previous major obstetric complication and in 139 women (33.2%) without such a history.

Across parity groups, adverse outcomes were recorded in 53 women (31.6%) with no previous birth, 107 (32.1%) among women with one to four births, and 11 (45.8%) among those with five or more births. By gestational age, adverse outcomes were most frequent among women presenting in early pregnancy—26 (96.3%) at 4–12 weeks and 21 (91.3%) at 13–25 weeks—compared with 46 (27.7%) at 26–36 weeks and 78 (25.2%) at term (37-42 weeks) (Table 2). In the bivariate analysis, referral status, booking status, gestational age, parity, marital status, employment status, and education were each associated with adverse foetal outcomes (Table 2).

Predictors of adverse foetal outcomes

Referred women had higher adjusted odds of adverse outcomes compared with those not referred (AOR=2.11, 95% CI:1.39–3.20, p<0.01). Also, women who were booked had lower adjusted odds of adverse outcomes compared with those not booked (AOR=0.25, 95% CI:0.15–0.44, p<0.01) (Table 3).

Effect of EmONC signal functions

Interaction analyses assessing modification of the associations between referral or booking status and adverse foetal and perinatal outcomes, showed no significant effects across any of the interventions evaluated (Table 4).

Table 2: Bivariate analyses of association of demographic and clinical-obstetric characteristics with foetal outcomes.

	Non-adverse foetal outcomes N (%)	Adverse foetal outcomes N (%)	P value
Maternal age-group (years)			
<20	6 (66.67)	3 (33.33)	
20-35	261 (69.05)	117 (30.95)	0.44
35 and higher	87 (63.04)	51 (36.96)	
Marital status			
Single	21 (51.22)	20 (48.78)	0.02
Married	333 (68.8)	151 (31.2)	
Employment status			
Unemployed	22(56.41)	17 (43.59)	
Student	9(56.25)	7 (43.75)	
Self-employed/petty trader	124 (61.69)	77 (38.31)	0.02
Self-employed/mid-high business	121 (74.23)	42 (25.77)	
Employed	78 (73.58)	28 (26.42)	
Education			
None	4 (57.14)	3 (42.86)	
Primary	21(43.75)	27 (56.25)	<0.01
Secondary	168 (67.47)	81 (32.53)	
Tertiary	161 (72.85)	60 (27.155)	
Referral status			
Not referred	205 (76.78)	62 (23.33)	<0.01
Referred	149 (57.75)	109 (42.25)	
Booking status in the health system			
Un-booked	28 (36.36)	49 (63.64)	<0.01
Booked	326 (72.93)	121 (27.07)	
Previous obstetric complication			
No previous major direct obstetric complication	280 (66.83)	139 (33.17)	0.56
Previous major direct obstetric complication	74 (69.81)	32(30.19)	
Parity			
0	115 (68.45)	53 (31.55)	
1-4	226 (67.87)	107 (32.13)	0.36
≥5	13 (54.17)	11 (45.83)	
Gestational age (weeks)			
4-12	1 (3.7)	26 (96.3)	
13-25	2 (8.7)	21 (91.3)	<0.01
26-36	120 (72.29)	46 (27.71)	
37-42	231 (74.76)	78 (25.24)	

Table 3: Predictors of adverse foetal outcomes (multivariable logistic regression (n=526).

	Non-adverse foetal outcome Adverse foetal outcome AOR (95% CI)	P value
Referral status		
Not referred (ref)	1	
Referred	2.11 (1.39-3.20)	<0.01
Booking status in the health system		
Un-booked (ref)	1	
Booked	0.25 (0.15-0.44)	<0.01
Marital status		
Single (ref)	1	
Married	0.933 (0.44-1.96)	0.86

Continued.

	Non-adverse foetal outcome	
Employment status		
Unemployed (ref)	1	
Student	1.23 (0.34-4.44)	0.75
Self-employed/petty trader	0.93 (0.44-1.97)	0.86
Self-employed/mid-high business	0.69 (0.31-1.57)	0.38
Employed	0.72 (0.29-1.78)	0.48
Education		
None (ref)	1	
Primary	1.44 (0.25-8.34)	0.68
Secondary	0.64(0.13-3.22)	0.79
Tertiary	0.92 (0.17-5.09)	0.93

Table 4: Effect modification of EmONC signal functions by referral status and booking status.

	Non-adverse foetal outcome		Non-adverse foetal outcome	
	Adverse foetal outcome		Adverse foetal outcome	
	Referral status		Booking status	
Fully adjusted for covariates*	**AOR (95% CI)**	**P value**	**AOR (95% CI)**	**P value**
Blood transfusion	0.66 (0.24-1.8)	0.42	0.58 (0.17-1.97)	0.38
Caesarean section	1.66 (0.67- 4.09)	0.27	0.54 (0.16-1.77)	0.31
Parenteral antibiotics	1.35 (0.54-3.39)	0.51	1.27 (0.28-4.22)	0.71
Anticonvulsants	1.70 (0.63-4.59)	0.29	1.18 (0.28-5.05)	0.81
Uterotonic drugs	0.76 (0.32-1.8)	0.54	0.52 (0.13-2.00)	0.35
Manual placenta removal	-		7.57 (0.22-25.33)	0.25
Assisted delivery	1.45 (0.12-16.77)	0.76	-	
Neonatal resuscitation	1.93 (0.13-28.33)	0.63	0.53 (0.03-9.46)	0.67
Abortion services	-			

* Each model is fully adjusted for age, marital status, employment, and education.

DISCUSSION

This study investigates the sociodemographic, obstetric and referral factors associated with adverse foetal and perinatal outcomes in obstetric emergencies, in an urban Nigerian setting. Nearly one in three pregnancies ended in foetal loss or severe compromise despite delivery in referral hospitals. Referral was strongly associated with adverse foetal outcomes, while antenatal booking was protective. Further, gestational age was a critical determinant of survival. Irrespective of referral or booking status, the EmNOC intervention that women received was not found to have a statistically significant association with having poor foetal or neonatal outcomes Referral was notably associated with adverse foetal outcomes, highlighting persistent gaps in intra-urban referral systems.

The observation that referral more than doubled the odds of adverse foetal outcomes is consistent with previous evidence from the city of Lagos, where inter-facility transfers and prolonged travel significantly increased the odds of maternal and perinatal death.[17,18] The paradox of adverse maternal and perinatal outcomes observed even in urban cities with high facility delivery, illustrates that geographical proximity to hospitals may not ensure timely access to definitive care. Referral systems in Nigerian cities remain fragmented, often requiring multiple transfers before women reach a facility capable of providing EmOC.[19] Similar challenges have been reported in other African contexts, where referral delays and weak facility readiness undermine survival despite increased institutional delivery.[20,21]

ANC booking was strongly protective, with un-booked women more than twice as likely to experience adverse foetal outcomes. This aligns with evidence from Nigeria showing that lack of ANC is a major risk factor for adverse foetal outcome and stillbirths.[22,23] Evidence from Imo State demonstrated that un-booked pregnancies were independently associated with antepartum stillbirth but not intrapartum stillbirths, while other reports from Lagos and Rivers States also identified absence or poor use of ANC as a significant contributor to term stillbirths and adverse perinatal outcomes.[24-26] Findings from other parts of sub-Saharan Africa also support the association between ANC attendance and reduced perinatal mortality.[27,28] Systematic reviews of interventions aimed at preventing adverse foetal outcomes have consistently shown that ANC-improving strategies are effective.[29]

Interaction analyses exploring whether referral status or booking status modified the association between maternal characteristics and perinatal outcomes revealed no significant effect modification across any of the EmONC interventions evaluated. This indicates that the influence

of key maternal risk factors on foetal and perinatal outcomes was generally consistent regardless of whether women received specific life-saving interventions or not. This suggests that the intrinsic risk associated with these factors remains substantial even when emergency interventions are provided. The lack of statistically significant interaction further highlights the dominant role of underlying clinical severity at presentation and delays occurring earlier in the care-seeking pathway – factors which may overshadow the potential modifying effect of EmONC procedures once women arrive at referral facilities. These findings underscore the need for upstream interventions that address the first and second delays, particularly improving early antenatal engagement, strengthening primary-level obstetric care, and ensuring timely and efficient referral systems. Importantly, the lack of associations based on binary "availability" EmONC indicators highlights the limitations of this measure, as it does not capture whether interventions are functional, delivered with quality, or accessible in real time during emergencies.[30] Evidence from Ethiopia, Tanzania and Uganda has similarly shown discrepancies between reported availability of EmONC functions and actual service readiness at the point of care.[31] A rethink of EmONC readiness beyond binary availability to incorporate functionality, timeliness, and quality, aligning with the high-quality health systems agenda is desirable.[32]

The study findings have important policy implications. Efforts to reduce foetal and neonatal deaths in urban Nigeria must go beyond expanding facility delivery coverage to strengthening the systems that govern emergency response. Three areas are critical. First, referral pathways should be reorganized into coordinated networks with centralized communication, reliable transport, and mechanisms to minimize inter-facility delays. Second, ANC coverage must be expanded through targeted outreach to socioeconomically vulnerable groups. Third, availability of EmONC signal functions in health facilities is not sufficient to prevent adverse perinatal outcomes. There is need to capture broader health system factors such as functionality and timeliness of interventions, not just nominal availability. Incorporating these approaches into maternal and newborn health strategies could accelerate progress toward the SDGs for maternal and newborn survival.

This study has several strengths. It utilizes a multi-hospital analysis in Benin City to link referral processes and maternal characteristics with foetal and perinatal outcomes. Prospective data collection reduced reliance on incomplete retrospective case notes and allowed for more accurate assessment of clinical and referral pathways. However, the study limitations should be acknowledged. The analysis was restricted to facility deliveries and excluded women who died before arrival, which may underestimate the full burden of referral-related mortality. Although the models were adjusted for key confounders, the possibility of residual confounding remains, especially in analyses involving clinical interventions where the quality of care and service readiness could not be measured. Finally, the composite outcome used to define adverse foetal outcomes encompassed a wide gestational range (4–42 weeks) and combined heterogeneous events, including early foetal losses, stillbirths, and perinatal complications. This aggregation may mask gestation-specific effects and obscure the differential impact of EmONC interventions across the spectrum of foetal risk.

CONCLUSION

Adverse foetal and neonatal outcomes remain unacceptably high in referral hospitals in Benin City despite widespread facility delivery. Referral inefficiencies, inadequate antenatal coverage, and early gestational age during obstetric complications are major contributors. Strengthening referral coordination and expanding ANC to reach vulnerable urban populations are critical for accelerating progress.

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