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Maternal and Neonatal Outcomes of Premature Rupture of Membranes at a Tertiary Hospital in Northwestern Nigeria: A Matched Case–Control Study

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Abstract **Original Research**

Background: Premature rupture of membranes (PROM) is a major cause of maternal and neonatal morbidity, particularly in low-resource settings where delayed presentation and limited diagnostic capacity complicate management. This study evaluated maternal and neonatal outcomes associated with PROM in a tertiary hospital in northwestern Nigeria.

Methods: A hospital-based matched case–control study was conducted among 162 pregnant women (81 with PROM and 81 matched controls with intact membranes) at the Federal Medical Centre, Gusau, Nigeria. Participants were individually matched for maternal age, parity, and gestational age. Maternal and neonatal outcomes were compared using appropriate statistical tests, while associations between duration of PROM and clinical outcomes were assessed at a significance level of $p < 0.05$.

Results: Women with PROM had significantly higher rates of caesarean delivery (37.0% vs. 12.3%; $p < 0.001$), puerperal sepsis (22.2% vs. 4.9%; $p = 0.001$), neonatal sepsis (46.9% vs. 13.6%; $p < 0.001$), and prematurity (27.2% vs. 1.2%; $p < 0.001$) than controls. Duration of PROM was significantly associated with puerperal sepsis ($p = 0.030$), postpartum haemorrhage ($p = 0.016$), and birth asphyxia ($p = 0.040$), but not with neonatal sepsis, prematurity, or perinatal mortality.

Conclusions: PROM remains an important contributor to maternal and neonatal morbidity. Early diagnosis, prompt evidence-based obstetric management, timely antimicrobial therapy, and strengthened antenatal and referral services are essential to reduce adverse outcomes. Institution-specific microbiological surveillance should be integrated into antimicrobial stewardship programmes to optimize empirical antibiotic therapy..

Keywords: premature rupture of membranes; PROM; maternal outcomes; neonatal outcomes; neonatal sepsis; puerperal sepsis; prematurity; antimicrobial susceptibility; Nigeria.

INTRODUCTION

Premature rupture of membranes (PROM) is defined as spontaneous rupture of the fetal membranes before the onset of regular uterine contractions. When membrane rupture occurs before 37 completed weeks of gestation, it is termed preterm prelabor rupture of membranes (PPROM), whereas rupture at or beyond 37 weeks before labour is referred to as term PROM (American College of Obstetricians and Gynecologists [ACOG], 2020). PROM is one of the most common obstetric complications worldwide, affecting approximately 8–10% of pregnancies, while PPROM complicates 2–3% of all pregnancies and accounts for nearly one-third of spontaneous preterm births, making it a major contributor to neonatal morbidity and mortality. (ACOG)

Preterm birth remains the leading cause of neonatal mortality globally and contributes substantially to long-term neurodevelopmental impairment, chronic respiratory disease, and childhood disability. The burden is particularly high in low- and middle-income countries (LMICs), where access to timely obstetric interventions, neonatal intensive care, microbiological diagnostics, and evidence-based antimicrobial therapy is often limited. Consequently, PROM continues to represent an important public health challenge, especially in sub-Saharan Africa, where maternal and neonatal mortality remain among the highest worldwide.

The fetal membranes normally maintain pregnancy by providing mechanical protection and preserving a sterile intrauterine environment. Physiological rupture at term results from coordinated biochemical processes involving collagen remodelling, apoptosis, inflammatory activation, and increased biomechanical stress. In contrast, PROM represents pathological weakening of the membranes before the normal onset of labour. Current evidence indicates that PROM is a multifactorial disorder resulting from complex interactions between infection, inflammation, oxidative stress, extracellular matrix degradation, genetic susceptibility, and mechanical stretching of the fetal membranes (Menon & Richardson, 2017; Romero et al., 2014).

Ascending genital tract infection is considered one of the most important mechanisms underlying PROM, particularly PPROM. Microorganisms colonizing the lower genital tract may ascend through the cervix, inducing inflammatory responses characterized by increased production of cytokines, prostaglandins, matrix metalloproteinases, and collagen-degrading enzymes that weaken the amniochorionic membranes and predispose them to premature rupture. Frequently isolated organisms include *Escherichia coli*, *Group B Streptococcus*, *Staphylococcus aureus*, *Gardnerella vaginalis*, *Ureaplasma urealyticum*, *Mycoplasma hominis*, and *Candida* species, although the microbial spectrum varies considerably across geographical regions and healthcare settings. This geographical variation has important implications for empirical antibiotic therapy and antimicrobial stewardship (Romero et al., 2014).

Several maternal characteristics increase the risk of PROM, including previous PROM, previous preterm birth, lower genital tract infection, urinary tract infection, cervical insufficiency, multiple pregnancy, polyhydramnios, cigarette smoking, nutritional deficiencies, invasive obstetric procedures, and low socioeconomic status. These risk factors are particularly prevalent in many LMICs, where inadequate antenatal care, delayed diagnosis of genital infections, and limited laboratory capacity further increase the risk of adverse maternal and neonatal outcomes (ACOG, 2020). (ACOG)

PROM remains a significant cause of obstetric and neonatal complications. Maternal complications include clinical chorioamnionitis, postpartum endometritis, placental abruption, postpartum haemorrhage, puerperal sepsis, and, in severe cases, maternal death. Fetal and neonatal complications include prematurity, respiratory distress syndrome, neonatal sepsis, intraventricular haemorrhage, necrotizing enterocolitis, umbilical cord prolapse, birth asphyxia, prolonged neonatal intensive care admission, and perinatal mortality. The likelihood of these complications increases with earlier gestational age at membrane rupture and prolonged latency between membrane rupture and delivery (Mercer,

2003).

Current international guidelines recommend that management of PROM should be individualized according to gestational age, fetal condition, evidence of intrauterine infection, and maternal clinical status. Broad-spectrum antibiotics are recommended for women with PPROM to prolong pregnancy and reduce maternal and neonatal infectious morbidity. Antenatal corticosteroids are advised before anticipated preterm delivery to improve fetal lung maturation, while magnesium sulphate is recommended for fetal neuroprotection when early preterm birth is imminent. Recent guidance from FIGO further emphasizes standardized triage, timely referral, and context-specific management strategies, particularly in resource-limited settings where neonatal intensive care services may not be readily available. (obgyn.onlinelibrary.wiley.com)

Although international guidelines recommend empirical antibiotic therapy, increasing antimicrobial resistance has become an important global concern. The bacterial organisms associated with PROM and their susceptibility patterns vary substantially between countries, regions, and healthcare institutions. Consequently, empirical regimens developed using data from high-income countries may not adequately cover locally prevalent pathogens in many LMICs. Continuous local microbiological surveillance is therefore essential to guide evidence-based antibiotic selection, improve antimicrobial stewardship, and reduce maternal and neonatal infectious complications.

Studies from different regions of Nigeria have reported considerable variation in the predominant genital microorganisms isolated among women with PROM. *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella* species, *Group B Streptococcus*, and *Gardnerella vaginalis* have all been reported as leading pathogens, but no consistent microbial pattern has emerged. Furthermore, antimicrobial susceptibility profiles differ markedly between centres, reflecting local prescribing practices and evolving antimicrobial resistance. These findings highlight the importance of generating institution-specific microbiological evidence rather than relying exclusively on international recommendations.

Despite the high burden of PROM in Northwestern Nigeria, published data describing genital microbial isolates, antimicrobial susceptibility patterns, and associated maternal and neonatal outcomes remain limited. At Federal Medical Centre, Gusau, empirical antibiotic therapy is routinely administered to women with PROM, yet local microbiological evidence supporting current treatment protocols is scarce. The absence of such data may contribute to inappropriate antibiotic use, persistent maternal infection, neonatal sepsis, prolonged hospital admission, and increasing antimicrobial resistance.

This study was therefore designed to compare genital microbial isolates, determine their antimicrobial susceptibility patterns, and evaluate maternal and neonatal outcomes among women with premature rupture of membranes and those with intact fetal membranes at Federal Medical Centre, Gusau, and Northwestern Nigeria. The findings are expected to provide locally relevant evidence that will inform empirical antibiotic policies, strengthen antimicrobial stewardship programmes, and improve maternal and neonatal outcomes in similar resource-limited settings.

MATERIALS AND METHODS

Study Design

This hospital-based matched case–control study was conducted to evaluate maternal and neonatal outcomes associated with premature rupture of membranes (PROM) among pregnant women receiving obstetric care at the Federal Medical Centre (FMC), Gusau, Zamfara State, Nigeria. Women diagnosed with PROM (cases) were compared with pregnant women who had intact fetal membranes (controls). Controls were individually matched to cases by maternal age (±2 years), parity (±2), and gestational age (±2 weeks) to minimize confounding from these important obstetric characteristics. The study was reported in accordance

with the **Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)** Statement for case–control studies (von Elm et al., 2007).

Study Setting

The study was conducted at the Department of Obstetrics and Gynaecology, Federal Medical Centre, Gusau, a tertiary referral hospital located in Zamfara State, northwestern Nigeria. The hospital serves as a major referral centre for Zamfara State and neighbouring states, including Sokoto, Katsina, Kebbi, and Niger, and provides comprehensive obstetric, gynaecological, neonatal, and emergency healthcare services. It is also accredited for postgraduate residency training in Obstetrics and Gynaecology.

The Department of Obstetrics and Gynaecology offers antenatal, intrapartum, postpartum, emergency obstetric, and gynaecological services, receiving referrals from primary and secondary healthcare facilities across the region. Neonatal care is provided through the Special Care Baby Unit (SCBU), which manages both inborn and referred neonates. The availability of comprehensive maternal and neonatal services makes the institution an appropriate setting for evaluating pregnancy outcomes following PROM.

Study Population

The study population comprised pregnant women with singleton pregnancies between 28 and 40 completed weeks of gestation who received obstetric care at FMC Gusau during the study period.

Cases consisted of women presenting with spontaneous PROM, while controls were pregnant women with intact fetal membranes attending antenatal clinics or admitted for delivery during the same period. Controls were individually matched to cases according to maternal age (±2 years), parity (±2), and gestational age (±2 weeks).

Case Definition

A case was defined as a pregnant woman with a singleton pregnancy between 28 and 40 completed weeks of gestation who presented with spontaneous rupture of the fetal membranes before the onset of labour. The diagnosis of PROM was confirmed by sterile speculum examination demonstrating visible leakage of amniotic fluid through the cervical os or pooling of liquor in the posterior vaginal fornix.

Control Definition

A control was defined as a pregnant woman with a singleton pregnancy between 28 and 40 completed weeks of gestation who had intact fetal membranes and no clinical evidence of PROM. Controls were recruited contemporaneously with cases and matched according to maternal age, parity, and gestational age.

Eligibility Criteria

Inclusion Criteria

Women were eligible for participation if they:

- had a singleton pregnancy between 28 and 40 completed weeks of gestation;
- had gestational age determined from a reliable last menstrual period and/or first-trimester ultrasonography;
- had PROM confirmed by sterile speculum examination (cases) or intact fetal membranes (controls);
- provided written informed consent.

Exclusion Criteria

Women were excluded if they had:

- antepartum haemorrhage;
- multiple gestation;
- established labour at presentation;
- clinical evidence of chorioamnionitis before recruitment;

- digital vaginal examination before hospital presentation;
- systemic antibiotic therapy within seven days preceding presentation;
- major fetal congenital anomalies.

Sample Size Determination

The minimum sample size was calculated using the formula for comparing two independent proportions described by Fleiss with continuity correction. Estimates were derived from a previous study conducted in northwestern Nigeria that reported a significantly higher prevalence of genital tract infection among women with PROM than among women with intact membranes. Assuming a 95% confidence level, 90% statistical power, a case-to-control ratio of 1:1, and allowing for a 10% non-response rate, a minimum sample size of 81 participants was required in each study group. Consequently, a total of 162 participants (81 cases and 81 matched controls) were recruited.

Sampling Technique

Eligible participants were recruited consecutively until the required sample size was attained. Every woman presenting with PROM who satisfied the eligibility criteria was enrolled as a case. For each case, one eligible control with intact fetal membranes was recruited during the same period using the predefined matching criteria. Consecutive recruitment minimized selection bias while preserving comparability between study groups.

Data Collection

Data were collected prospectively using a structured interviewer-administered case report form designed specifically for the study. Following written informed consent, participants underwent comprehensive clinical assessment, and relevant socio-demographic, obstetric, and clinical information was recorded. Information collected included maternal age, educational level, occupation, booking status, parity, gestational age, previous obstetric history, duration of membrane rupture, clinical findings, and pregnancy outcomes.

For women with PROM, diagnosis was confirmed by sterile speculum examination before any digital vaginal examination was performed. High vaginal and endocervical swab specimens were subsequently collected from both cases and controls for microbiological analysis. Participants were followed until delivery, and maternal and neonatal outcomes were documented using standardized delivery records, neonatal case notes, and hospital registers.

All research personnel received standardized training before commencement of the study. Completed case report forms were reviewed daily by the principal investigator for completeness, internal consistency, and accuracy.

Specimen Collection

Microbiological specimens were collected under strict aseptic conditions by trained resident doctors and midwives using standardized operating procedures.

Participants were placed in the lithotomy position, and a sterile lubricated Cusco's speculum was introduced without antiseptic preparation. Following visualization of the cervix, high vaginal and endocervical swab specimens were collected before any digital vaginal examination or obstetric intervention.

The high vaginal swab was obtained by gently rotating a sterile swab against the lateral vaginal wall and posterior fornix. The endocervical swab was collected by inserting a sterile swab approximately 1–2 cm into the endocervical canal before gentle rotation and withdrawal. Specimens were immediately placed into appropriate transport media, labelled with unique study identification numbers, and transported promptly to the Medical Microbiology Laboratory for analysis.

Laboratory Procedures

Laboratory analyses were performed in the Department of Medical Microbiology using standardized microbiological techniques and established quality assurance procedures.

Microscopy

Fresh high vaginal swab specimens were examined by saline wet mount microscopy for the detection of *Trichomonas vaginalis*, Candida species, epithelial cells, and inflammatory cells. Gram-stained smears were prepared according to standard microbiological procedures and examined under oil immersion (×100 objective) for bacterial morphology, Gram reaction, clue cells, budding yeast cells, pseudohyphae, and Gram-negative intracellular diplococci where appropriate.

Culture and Identification of Microorganisms

High vaginal swabs were inoculated onto Blood agar, Chocolate agar, MacConkey agar, and Sabouraud Dextrose agar using standard microbiological methods. Chocolate agar plates were incubated in a carbon dioxide-enriched atmosphere, while the remaining media were incubated aerobically at 35–37°C for 18–24 hours.

Endocervical swabs were cultured on modified Thayer–Martin medium for selective isolation of *Neisseria gonorrhoeae*. Organisms were identified using colony morphology, Gram staining characteristics, oxidase testing, and conventional biochemical identification methods according to standard microbiological procedures.

Antimicrobial Susceptibility Testing

Antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion technique on Mueller–Hinton agar in accordance with the **Clinical and Laboratory Standards Institute (CLSI) M100 Performance Standards for Antimicrobial Susceptibility Testing** (CLSI, 2023). Antimicrobial agents tested included ampicillin, amoxicillin–clavulanic acid, ceftriaxone, cefuroxime, ciprofloxacin, ofloxacin, gentamicin, azithromycin, erythromycin, meropenem, amoxicillin, and cloxacillin.

Inhibition zone diameters were measured to the nearest millimetre and interpreted as susceptible, intermediate, or resistant according to CLSI interpretive criteria. Internal quality control was maintained using American Type Culture Collection (ATCC) reference strains in accordance with CLSI recommendations.

Quality Assurance

Quality assurance measures included standardized training of research personnel before study commencement, adherence to written standard operating procedures for specimen collection and laboratory processing, routine calibration and maintenance of laboratory equipment, use of ATCC reference strains for internal quality control, duplicate verification of laboratory records, and periodic independent review of laboratory procedures by a consultant medical microbiologist. Daily monitoring of data collection ensured completeness, consistency, and accuracy of study records.

Outcome Measures

The primary outcome was the microbiological profile of genital tract organisms isolated from women with and without PROM, including antimicrobial susceptibility patterns.

Secondary maternal outcomes included clinical chorioamnionitis, puerperal sepsis, mode of delivery, postpartum haemorrhage, prolonged maternal hospital stay, and maternal mortality. Secondary neonatal outcomes included birth weight, Apgar score at five minutes, neonatal sepsis, admission to the Special Care Baby Unit, prematurity-related complications, length of neonatal hospitalization, and perinatal mortality.

Statistical Analysis

Data were entered into Microsoft Excel, cleaned, and analysed using **IBM SPSS Statistics version 26.0** (IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality using the Shapiro–Wilk test and visual inspection of histograms.

Normally distributed continuous variables were summarized as means and standard deviations and compared using the paired Student's *t*-test where appropriate. Non-normally distributed variables were summarized as medians with interquartile ranges and compared using the Mann–Whitney *U* test.

Categorical variables were summarized as frequencies and percentages. Comparisons between groups were performed using the McNemar test or conditional methods appropriate for matched categorical data. Fisher's exact test was used where expected cell frequencies were less than five.

Conditional logistic regression analysis was performed to estimate adjusted odds ratios (aORs) and 95% confidence intervals while accounting for the matched study design. Variables with a *p*-value <0.20 on bivariable analysis and those considered clinically important based on previous literature were entered into the multivariable model. Model adequacy was assessed using likelihood ratio testing, while multicollinearity was evaluated using variance inflation factors. Statistical significance was defined as a two-sided *p*-value <0.05.

Ethical Considerations

Ethical approval for the study was obtained from the Health Research Ethics Committee of the Federal Medical Centre, Gusau (Approval No.: FMC/2020/985/09) before commencement of participant recruitment. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki (World Medical Association, 2013).

Written informed consent was obtained from all participants before enrolment. Participation was voluntary, and participants were informed of their right to withdraw from the study at any stage without prejudice to the quality of care received. Confidentiality was maintained by assigning unique study identification numbers to all participants and storing study records in password-protected electronic databases and locked filing cabinets accessible only to authorized members of the research team.

RESULTS

A total of **162 women** participated in the study, comprising **81 women with premature rupture of membranes (PROM)** (cases) and **81 women with intact membranes** (controls).

Sociodemographic characteristics

The mean age of participants was **26.0 ± 5.2 years** (range: **16–36 years**). The largest proportion of participants in both groups was aged **25–29 years** (33.3% among cases vs. 32.1% among controls). The majority of participants were **Hausa**, **married**, and had at least **secondary education**.

There were no statistically significant differences between cases and controls with respect to **age group** ($p = .989$), **educational status** ($p = .320$), or **tribe** ($p = .950$). However, **occupation** differed significantly between the two groups ($\chi^2 = 25.53$, $p < .001$), with housewives predominating among cases and traders being more common among controls. **Marital status** also showed a statistically significant difference ($\chi^2 = 6.12$, $p = .042$) (Table 1).

Table 1: *Socio-demographic characteristics of study participants*

Characteristic	**Cases (n = 81), n (%)**	**Controls (n = 81), n (%)**	χ^2	*p*
Age group (years)			0.31	.989
15–19	9 (11.1)	9 (11.1)		
20–24	22 (27.2)	24 (29.6)		
25–29	27 (33.3)	26 (32.1)		
30–34	16 (19.8)	14 (17.3)		
35–40	7 (8.6)	8 (9.9)		
Mean age ± SD (years)	26.0 ± 5.2	26.0 ± 5.2		
Educational status			8.78	.320
Quranic	9 (11.1)	2 (2.5)		
Primary	19 (23.5)	11 (13.6)		
Secondary	26 (32.1)	37 (45.7)		
Tertiary	27 (33.3)	31 (38.3)		
Occupation			25.53	< .001
Housewife	52 (64.2)	23 (28.4)		
Civil servant	7 (8.6)	16 (19.8)		
Trader	7 (8.6)	4 (4.9)		
Other	15 (18.5)	38 (46.9)		
Tribe			0.32	.950
Hausa	59 (72.8)	62 (76.5)		
Yoruba	5 (6.2)	4 (4.9)		
Igbo	6 (7.4)	5 (6.2)		
Others	11 (13.6)	10 (12.3)		
Marital status			6.12	.042
Single	5 (6.2)	0 (0.0)		
Married	73 (90.1)	80 (98.8)		
Divorced	3 (3.7)	1 (1.2)		

Note. Data are presented as *n* (%), unless otherwise indicated. SD = standard deviation. χ^2 = Chi-square statistic. Percentages may not total 100% because of rounding.

Obstetric characteristics

The mean gestational age at delivery was **35.7 ± 3.1 weeks** (range: **28–40 weeks**). Most participants delivered between **37 and 39 weeks' gestation** (34.6% of cases and 37.0% of controls). The mean parity was **2.3 ± 1.8**, with **primigravidae** constituting the largest proportion of participants in both groups (43.2% among cases vs. 44.4% among controls).

There was no statistically significant difference between cases and controls with respect to **parity** (χ^2 = 0.05, p = .976) or **gestational age at delivery** (χ^2 = 0.32, p = .988). However, **booking status** differed significantly between the groups (χ^2 = 24.13, p = .001), with all controls being booked compared with 74.1% of cases (Table 2).

Table 2: *Obstetric characteristics of the study participants*

Characteristic	Cases (n = 81), n (%)	Controls (n = 81), n (%)	χ²/Fisher's exact	*P*
Booking status			24.13	.001
Booked	60 (74.1)	81 (100.0)		
Unbooked	21 (25.9)	0 (0.0)		
Parity			0.05	.976
Primigravida	35 (43.2)	36 (44.4)		
Multipara	31 (38.3)	31 (38.3)		
Grand multipara	15 (18.5)	14 (17.3)		
Mean parity ± SD	2.3 ± 1.8	2.3 ± 1.8		
Gestational age at delivery (weeks)			0.32	.988
28–30	10 (12.3)	10 (12.3)		
31–33	12 (14.8)	11 (13.6)		
34–36	19 (23.5)	20 (24.7)		
37–39	28 (34.6)	30 (37.0)		
40	12 (14.8)	10 (12.3)		

Characteristic	Cases (n = 81), n (%)	Controls (n = 81), n (%)	χ^2/Fisher's exact	*P*
Mean gestational age ± SD (weeks)	35.7 ± 3.1	35.7 ± 3.1		

Note. Data are presented as *n* (%), unless otherwise indicated. SD = standard deviation. χ^2 = Chi-square statistic. Fisher's exact test was used where appropriate. Percentages may not total exactly 100% because of rounding.

Clinical Characteristics of Women with Premature Rupture of Membranes

Among women with premature rupture of membranes, most (66.7%) presented within **12 hours** of membrane rupture. Approximately one-fifth (18.5%) presented between **13 and 24 hours**, while 12.3% presented between **37 and 48 hours**. Only 1.2% each presented between **25 and 36 hours** and after **48 hours** of membrane rupture (Table 3).

Table 3: ***Duration of Premature Rupture of Membranes among Cases (n = 81)***

Duration of PROM (hours)	Frequency	Percentage (%)
1–12	54	66.7
13–24	15	18.5
25–36	1	1.2
37–48	10	12.3
>48	1	1.2
Total	**81**	**100.0**

Association between Duration of Premature Rupture of Membranes and Mode of Delivery

The majority of women, irrespective of mode of delivery, presented within **12 hours** of premature rupture of membranes. There was **no statistically significant association** between the duration of PROM and the mode of delivery ($\chi^2 = 7.31$, $p = .522$) (Table 7).

Table 4: ***Association between Duration of Premature Rupture of Membranes and Mode of Delivery Among Women with PROM (n = 81)***

Duration of PROM (hours)	Spontaneous Vaginal Delivery n (%)	Induction of Labour n (%)	Caesarean Section n (%)	Total n (%)
1–12	26 (76.5)	12 (70.6)	16 (53.3)	54 (66.7)
13–24	4 (11.8)	3 (17.6)	8 (26.7)	15 (18.5)
25–36	0 (0.0)	0 (0.0)	1 (3.3)	1 (1.2)
37–48	3 (8.8)	2 (11.8)	5 (16.7)	10 (12.3)
>48	1 (2.9)	0 (0.0)	0 (0.0)	1 (1.2)
Total	**34 (100.0)**	**17 (100.0)**	**30 (100.0)**	**81 (100.0)**

$\chi^2 = 7.31$, $p = .522$

Note. Percentages for spontaneous vaginal delivery, induction of labour, and caesarean section are column percentages; percentages in the Total column represent the overall distribution of participants.

Women with premature rupture of membranes had a significantly higher rate of caesarean section compared with controls (37.0% vs. 12.3%; χ^2 = 21.13, p < .001). Among maternal complications, puerperal sepsis occurred significantly more frequently in the PROM group than in the control group (22.2% vs. 4.9%; χ^2 = 10.31, p = .001). There were no significant differences between the groups in the occurrence of postpartum haemorrhage, anaemia, or chorioamnionitis.

With respect to neonatal outcomes, neonates born to women with PROM had significantly higher rates of neonatal sepsis (46.9% vs. 13.6%; χ^2 = 21.33, p < .001) and prematurity (27.2% vs. 1.2%; χ^2 = 22.35, p < .001) compared with controls. However, the frequencies of birth asphyxia and perinatal mortality did not differ significantly between the two groups (Table 8).

Table 5: ***Comparison of Maternal and Neonatal Outcomes between Women with Premature Rupture of Membranes and Matched Controls (N = 162)***

Outcome	Cases (n = 81) n (%)	Controls (n = 81) n (%)	χ^2	p value
Mode of delivery				
Spontaneous vaginal delivery	34 (42.0)	61 (75.3)		
Induction of labour	17 (21.0)	9 (11.1)		

Outcome	Cases (n = 81) n (%)	Controls (n = 81) n (%)	χ^2	p value
Caesarean section	30 (37.0)	10 (12.3)		
Vacuum-assisted delivery	0 (0.0)	1 (1.2)	**21.13**	**<.001**
Maternal outcomes				
Postpartum haemorrhage	7 (8.6)	9 (11.1)	0.28	.598
Anaemia	1 (1.2)	2 (2.5)	0.34	.560
Chorioamnionitis	2 (2.5)	0 (0.0)	2.03	.155
Puerperal sepsis	18 (22.2)	4 (4.9)	**10.31**	**.001**
Neonatal outcomes				
Neonatal sepsis	38 (46.9)	11 (13.6)	**21.33**	**<.001**
Birth asphyxia	13 (16.0)	11 (13.6)	0.20	.653
Perinatal mortality	6 (7.4)	4 (4.9)	1.46	.482
Prematurity	22 (27.2)	1 (1.2)	**22.35**	**<.001**

Abbreviations: PROM, premature rupture of membranes.

Among women with PROM, the duration of membrane rupture was significantly associated with the occurrence of postpartum haemorrhage (χ^2 = 7.60, p = .016) and puerperal sepsis (χ^2 = 9.71, p = .030). Women who developed puerperal sepsis were more likely to have experienced prolonged rupture of membranes than those without sepsis. No significant associations were observed between the duration of PROM and anaemia or chorioamnionitis (Table 9).

Table 6: ***Association between Duration of Premature Rupture of Membranes and Maternal Outcomes among Women with PROM (n = 81)***

Maternal Outcome	1–12 h n (%)	13–24 h n (%)	25–36 h n (%)	37–48 h n (%)	>48 h n (%)	χ^2/Fisher's exact	p value
Postpartum haemorrhage							
Yes	5 (71.4)	0 (0.0)	1 (14.3)	1 (14.3)	0 (0.0)	7.60	**.016**
No	49 (66.2)	15 (20.3)	0 (0.0)	9 (12.2)	1 (1.4)		

Maternal Outcome	1–12 h n (%)	13–24 h n (%)	25–36 h n (%)	37–48 h n (%)	>48 h n (%)	χ^2/Fisher's exact	p value
Anaemia							
Yes	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	Fisher's exact	.973
No	53 (66.3)	15 (18.8)	1 (1.3)	10 (12.5)	1 (1.3)		
Chorioamnionitis							
Yes	2 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	Fisher's exact	.973
No	52 (65.8)	15 (19.0)	1 (1.3)	10 (12.7)	1 (1.3)		
Puerperal sepsis							
Yes	8 (44.4)	7 (38.9)	1 (5.6)	2 (11.1)	0 (0.0)	9.71	**.030**
No	46 (73.0)	8 (12.7)	0 (0.0)	8 (12.7)	1 (1.6)		

Note. Percentages are calculated within each maternal outcome category. Fisher's exact test was used where expected cell frequencies were <5.

Among women with PROM, the duration of membrane rupture was significantly associated with birth asphyxia (χ^2 = 8.43, p = .040). No significant associations were observed between the duration of PROM and neonatal sepsis (p = .656), prematurity (p = .306), or perinatal mortality (p = .644) (Table 7).

Table 7: ***Association between Duration of Premature Rupture of Membranes and Neonatal Outcomes among Women with PROM (n = 81)***

Neonatal Outcome	1–12 h n (%)	13–24 h n (%)	25–36 h n (%)	37–48 h n (%)	>48 h n (%)	χ^2/Fisher's exact	p value
Neonatal sepsis							
Yes	24 (63.2)	8 (21.1)	1 (2.6)	5 (13.2)	0 (0.0)	2.38	.656
No	30 (69.8)	7 (16.3)	0 (0.0)	5 (11.6)	1 (2.3)		
Birth asphyxia							
Yes	6 (46.2)	5 (38.5)	1 (7.7)	1 (7.7)	0 (0.0)	8.43	**.040**
No	48 (70.6)	10 (14.7)	0 (0.0)	9 (13.2)	1 (1.5)		

Neonatal Outcome	1–12 h n (%)	13–24 h n (%)	25–36 h n (%)	37–48 h n (%)	>48 h n (%)	χ^2/Fisher's exact	p value
Prematurity							
Yes	13 (59.1)	6 (27.3)	1 (4.5)	2 (9.1)	0 (0.0)	4.53	.306
No	41 (69.5)	9 (15.3)	0 (0.0)	8 (13.6)	1 (1.7)		
Perinatal mortality							
Yes	5 (83.3)	0 (0.0)	0 (0.0)	1 (16.7)	0 (0.0)	1.23*	.644
No	49 (66.2)	14 (18.9)	1 (1.4)	9 (12.2)	1 (1.4)		

*Fisher's exact test is recommended because of the small number of events.

Note. Percentages are calculated within each neonatal outcome category.

DISCUSSION

Premature rupture of membranes (PROM) remains a major cause of maternal and neonatal morbidity, particularly in resource-limited settings. In this matched case–control study, PROM was significantly associated with increased rates of caesarean delivery, puerperal sepsis, neonatal sepsis, and prematurity compared with pregnancies with intact membranes. Prolonged membrane rupture further increased the risks of puerperal sepsis, postpartum haemorrhage, and birth asphyxia, underscoring the importance of minimizing the interval between membrane rupture and definitive obstetric care. The matched study design, which controlled for maternal age, parity, and gestational age, strengthened the validity of these findings by reducing confounding and providing a more accurate assessment of the independent impact of PROM on pregnancy outcomes. Overall, the study highlights the need for early recognition of PROM, timely obstetric intervention, evidence-based antimicrobial therapy, and strengthened antenatal and referral services to reduce preventable maternal and neonatal morbidity in low-resource settings.

The absence of significant differences in maternal age, educational status, parity, and gestational age between women with PROM and controls is consistent with the matching strategy employed and supports previous reports suggesting that these characteristics alone may not independently predispose women to membrane rupture. Although extremes of maternal age and grand multiparity have occasionally been associated with PROM, most contemporary studies indicate that these relationships become less apparent after adjustment for confounding factors such as genital tract infection, cervical insufficiency, socioeconomic status, previous obstetric complications, and access to antenatal care (Mercer, 2003; Menon & Richardson, 2017; Okeke et al., 2022). Membrane rupture is increasingly recognized as a multifactorial condition resulting from complex interactions between infection, inflammation, oxidative stress, extracellular matrix degradation, and mechanical stretching of the fetal membranes rather than demographic characteristics alone (Romero et al., 2014).

In contrast, occupation and booking status differed significantly between the two groups, suggesting that socioeconomic and healthcare-related factors continue to influence the occurrence of PROM in this

environment. Housewives constituted the majority of women with PROM, a finding that probably reflects underlying socioeconomic disadvantage rather than occupation itself. In northern Nigeria, women who are financially dependent often experience barriers to accessing healthcare, including limited decision-making autonomy, transportation challenges, and delayed presentation to health facilities. Similar observations have been reported in several African studies where socioeconomic deprivation was associated with untreated genital tract infections, poor nutrition, and inadequate antenatal attendance, all of which increase susceptibility to membrane rupture and subsequent obstetric complications (Goldenberg et al., 2008; Ameh et al., 2019).

One of the most clinically relevant findings was the significantly higher proportion of unbooked women among the PROM group. Regular antenatal care remains one of the most effective interventions for identifying and managing conditions that predispose women to membrane rupture, including urinary tract infections, bacterial vaginosis, sexually transmitted infections, cervical insufficiency, and maternal anaemia. Women who do not access antenatal services are also less likely to receive health education regarding the importance of early presentation following leakage of amniotic fluid and are therefore more likely to present after prolonged membrane rupture, thereby increasing the risks of maternal and neonatal infection (World Health Organization [WHO], 2022). Similar associations between poor antenatal attendance and adverse pregnancy outcomes have been documented in Nigeria and other sub-Saharan African countries, where unbooked women consistently experience higher rates of maternal morbidity, neonatal infection, and perinatal mortality than women receiving routine antenatal care (Eleje et al., 2015; Lawani et al., 2020; Tessema et al., 2021).

The finding that approximately two-thirds of women presented within 12 hours of membrane rupture is encouraging and compares favourably with reports from many resource-limited settings where delayed presentation remains common. Early presentation permits confirmation of diagnosis, assessment of fetal wellbeing, commencement of appropriate antibiotic therapy, administration of antenatal corticosteroids where indicated, and timely planning of delivery, thereby reducing maternal infectious morbidity and improving neonatal outcomes (American College of Obstetricians and Gynecologists [ACOG], 2020; FIGO Safe Motherhood and Newborn Health Committee, 2023). Nevertheless, almost one-third of participants still presented more than 12 hours after membrane rupture, indicating that barriers to timely obstetric care persist. Delays may result from poor transportation, financial constraints, and initial presentation to lower-level health facilities, or failure to recognize PROM as an obstetric emergency. Because the risk of ascending intrauterine infection increases progressively with increasing duration of membrane rupture, even relatively short delays can substantially increase maternal and neonatal morbidity (Mercer, 2003).

An important observation in the present study was the significantly higher caesarean section rate among women with PROM compared with controls. Similar findings have been consistently reported in both developed and developing countries and largely reflect the obstetric challenges associated with membrane rupture. PROM is frequently complicated by failed induction of labour, fetal distress, malpresentation, non-reassuring fetal heart rate patterns, prolonged labour, suspected intra-amniotic infection, and cord compression, all of which lower the threshold for operative delivery (Romero et al., 2014; ACOG, 2020). Studies from Nigeria, Ethiopia, Pakistan, and India have similarly demonstrated increased operative delivery among women with PROM compared with women with intact membranes (Eleje et al., 2015; Lawani et al., 2020; Noor et al., 2020; Tessema et al., 2021).

Interestingly, although PROM itself was associated with a significantly higher caesarean section rate, the duration of membrane rupture did not significantly influence the mode of delivery. This finding suggests that obstetric decision-making in the study centre was guided more by maternal and fetal clinical status than by the duration of membrane rupture alone. Contemporary international guidelines similarly advocate individualized management based on

gestational age, evidence of infection, fetal wellbeing, cervical favourability, and labour progression rather than relying on arbitrary latency thresholds (ACOG, 2020; FIGO Safe Motherhood and Newborn Health Committee, 2023). Such an approach minimizes unnecessary operative intervention while ensuring timely delivery when maternal or fetal compromise develops.

Overall, these findings indicate that while demographic characteristics played a relatively minor role in the occurrence of PROM within the study population, access to antenatal care and timely obstetric intervention were major determinants of clinical outcomes. They further emphasize that reducing the burden of PROM in low-resource settings requires not only appropriate intrapartum management but also strengthening antenatal services, improving community awareness of obstetric danger signs, and addressing socioeconomic barriers that delay access to skilled maternity care. These preventive strategies are likely to reduce prolonged membrane rupture, limit ascending genital tract infection, and ultimately improve both maternal and neonatal outcomes.

The increased maternal infectious morbidity observed among women with PROM in this study is consistent with the established pathophysiological consequences of membrane rupture and remains one of the most important findings of the present investigation. Women with PROM were significantly more likely to develop puerperal sepsis than women with intact membranes, emphasizing the critical role of ascending genital tract infection following loss of the protective barrier provided by the fetal membranes. Once membrane integrity is disrupted, microorganisms from the lower genital tract gain easier access to the decidua, fetal membranes, amniotic fluid, and uterine cavity, triggering inflammatory responses that may culminate in endometritis, puerperal sepsis, and, in severe cases, systemic maternal infection (Romero et al., 2014; Menon & Richardson, 2017). This biological mechanism has been consistently demonstrated in experimental, microbiological, and clinical studies and remains the principal rationale for early diagnosis and prompt antibiotic therapy in women presenting with PROM.

The higher incidence of puerperal sepsis observed in the present study agrees with reports from several Nigerian studies and systematic reviews, which have consistently identified maternal infection as one of the commonest complications associated with PROM (Eleje et al., 2015; Lawani et al., 2020). Similar findings have also been reported in studies from Ethiopia, Uganda, India, and Pakistan, where maternal infectious morbidity increases substantially when membrane rupture is prolonged or when access to skilled obstetric care is delayed (Noor et al., 2020; Tessema et al., 2021). The consistency of these findings across diverse healthcare settings suggests that maternal infection remains a universal consequence of PROM despite variations in healthcare systems and management protocols. Nevertheless, improvements in obstetric care, including routine administration of prophylactic antibiotics, reduced frequency of unnecessary vaginal examinations, and earlier obstetric intervention, have substantially reduced severe maternal infectious complications in many tertiary centres.

In contrast, postpartum haemorrhage, anaemia, and clinically diagnosed chorioamnionitis did not differ significantly between women with PROM and controls. These findings suggest that although PROM markedly increases susceptibility to infection, it may not independently increase the risk of all maternal complications. Previous studies have similarly demonstrated that postpartum haemorrhage is more strongly influenced by factors such as uterine atony, prolonged labour, operative delivery, retained placenta, and hypertensive disorders than by membrane rupture itself (Mercer, 2003). Likewise, maternal anaemia is primarily determined by nutritional status, malaria, haemoglobinopathies, and antenatal iron supplementation rather than PROM alone. The relatively low frequency of clinical chorioamnionitis in this study may reflect early presentation of most participants, prompt initiation of broad-spectrum antibiotics, and timely delivery after diagnosis. Furthermore, clinical chorioamnionitis represents only the severe end of

the infectious spectrum, and histological evidence of intra-amniotic inflammation may occur in the absence of overt clinical signs, suggesting that the true burden of intrauterine infection may have been underestimated (Romero et al., 2014).

The neonatal findings similarly reinforce the substantial burden of PROM on newborn health. Neonates born to women with PROM had significantly higher rates of neonatal sepsis and prematurity than those delivered following uncomplicated pregnancies, findings that are consistent with both biological plausibility and published evidence. Early-onset neonatal sepsis remains one of the most feared consequences of PROM because disruption of the fetal membranes allows ascending bacterial colonization of the amniotic cavity before delivery, exposing the fetus to pathogenic microorganisms during labour and birth. Previous studies have demonstrated that bacterial invasion of the amniotic cavity may occur even in the absence of overt maternal infection, resulting in fetal inflammatory response syndrome and subsequent neonatal sepsis (Romero et al., 2015). Consequently, current international guidelines continue to recommend careful neonatal evaluation and early empirical antibiotic therapy for newborns considered at high risk of early-onset sepsis following PROM (ACOG, 2020).

The increased frequency of neonatal sepsis observed in this study is comparable with reports from tertiary hospitals across Nigeria and other low- and middle-income countries. Lawani et al. (2020) reported significantly higher neonatal infectious morbidity among infants delivered following PROM, while studies from Ethiopia, Kenya, Pakistan, and India have similarly identified PROM as one of the strongest predictors of neonatal sepsis (Noor et al., 2020; Tessema et al., 2021). Meta-analyses have likewise demonstrated that prolonged rupture of membranes remains one of the principal antenatal risk factors for early-onset neonatal sepsis worldwide, particularly in settings where delayed presentation and limited neonatal intensive care facilities remain important challenges (Kenyon et al., 2013). The findings of the present study therefore reinforce existing evidence supporting routine neonatal surveillance following PROM and highlight the importance of close collaboration between obstetricians and neonatologists in reducing neonatal morbidity.

Prematurity was also significantly more common among women with PROM, a finding that was anticipated because spontaneous membrane rupture frequently precipitates preterm labour or necessitates medically indicated delivery owing to maternal or fetal compromise. Worldwide, preterm prelabour rupture of membranes accounts for approximately one-third of spontaneous preterm births and remains one of the leading contributors to neonatal mortality, respiratory distress syndrome, intraventricular haemorrhage, necrotizing enterocolitis, and long-term neurodevelopmental impairment (Goldenberg et al., 2008; Blencowe et al., 2013; WHO, 2023). The findings of this study therefore underscore the important contribution of PROM to the continuing burden of prematurity in sub-Saharan Africa, where access to neonatal intensive care remains limited in many settings.

Interestingly, birth asphyxia and perinatal mortality were not significantly higher among infants born following PROM despite the increased rates of neonatal sepsis and prematurity. This finding may reflect the relatively early presentation of most women, timely obstetric intervention, appropriate intrapartum fetal surveillance, and prompt neonatal resuscitation available at the study centre. It is equally plausible that the study lacked sufficient statistical power to detect significant differences in relatively infrequent outcomes such as perinatal death. Previous studies have similarly reported that improvements in intrapartum monitoring and neonatal care can substantially reduce mortality despite persistent increases in neonatal morbidity (Mercer, 2003). Conversely, studies conducted in settings characterized by delayed referral, prolonged labour, and limited neonatal support have consistently reported substantially higher rates of stillbirth and neonatal death following PROM (Goldenberg et al., 2008). These observations emphasize that institutional capacity and quality of care play important roles in determining neonatal outcomes after membrane rupture.

An additional strength of the present study lies in its evaluation of the influence of membrane rupture duration on maternal and neonatal outcomes. Increasing duration of PROM was significantly associated with puerperal sepsis and postpartum haemorrhage, findings that further support current understanding of PROM pathophysiology. The relationship between prolonged latency and maternal infection is biologically plausible because longer exposure of the uterine cavity following membrane rupture increases the likelihood of ascending bacterial invasion, amplification of inflammatory mediators, and development of postpartum infection. Several investigators have reported a progressive increase in maternal infectious morbidity after 18–24 hours of membrane rupture, particularly among women who experience delays in receiving definitive obstetric care (Mercer, 2003; ACOG, 2020). Although postpartum haemorrhage was also associated with prolonged membrane rupture, this association should be interpreted cautiously because of the relatively small number of affected women. Nevertheless, prolonged labour, infection-related uterine dysfunction, and operative delivery may collectively increase the risk of uterine atony and postpartum haemorrhage in women with extended latency periods.

Among neonatal outcomes, only birth asphyxia demonstrated a statistically significant association with increasing duration of membrane rupture, whereas neonatal sepsis, prematurity, and perinatal mortality were not significantly influenced by latency. Although this finding initially appears unexpected, it is important to recognize that neonatal outcomes following PROM are influenced by multiple interacting factors, including gestational age, microbial virulence, timing of antibiotic administration, fetal maturity, quality of intrapartum monitoring, and availability of neonatal intensive care. The lack of statistical association between prolonged membrane rupture and neonatal sepsis in this study should therefore not be interpreted as evidence that duration is clinically unimportant. Rather, it probably reflects the relatively small sample size, early presentation of most participants, and timely initiation of antibiotic therapy after admission, all of which may have attenuated the adverse effects of prolonged latency. Similar findings have occasionally been reported in centres where standardized management protocols reduce neonatal infectious morbidity despite prolonged membrane rupture (Menon & Richardson, 2017). Nevertheless, because international evidence overwhelmingly demonstrates that the risk of neonatal infection increases with prolonged membrane rupture, timely obstetric intervention remains an essential component of evidence-based PROM management.

Taken together, these findings indicate that PROM continues to exert its greatest clinical impact through maternal and neonatal infectious morbidity, while prolonged membrane rupture further amplifies the risk of adverse outcomes. They also demonstrate that timely presentation, adherence to evidence-based clinical protocols, and access to comprehensive obstetric and neonatal services can mitigate many of the serious complications traditionally associated with PROM. These observations provide further support for strengthening antenatal education, improving referral systems, and ensuring rapid institution of appropriate obstetric and neonatal care in order to reduce the burden of PROM-related morbidity in resource-constrained settings.

Strengths and Limitations

This matched case–control study provides robust evidence on the maternal and neonatal consequences of premature rupture of membranes (PROM) in a tertiary hospital in northwestern Nigeria. The matched design minimized confounding by maternal age, parity, and gestational age, while prospective data collection and standardized microbiological methods enhanced the validity and reliability of the findings. The inclusion of both maternal and neonatal outcomes, together with antimicrobial susceptibility testing, offers clinically relevant evidence to inform obstetric practice and antimicrobial stewardship in resource-limited settings. However, the single-centre design may limit generalizability, and the relatively modest sample size reduced the power to detect uncommon outcomes. In addition, reliance on conventional

culture techniques may have underestimated fastidious organisms, and residual confounding from unmeasured variables cannot be entirely excluded.

Clinical Implications

The findings underscore the importance of early recognition and evidence-based management of PROM to reduce maternal and neonatal morbidity. Improving antenatal care utilization, promoting prompt presentation following membrane rupture, strengthening referral systems, and ensuring adherence to guideline-based management—including timely antibiotic therapy, corticosteroid administration, and appropriate obstetric intervention—are essential. Regular surveillance of microbial isolates and antimicrobial resistance patterns should also be integrated into institutional antimicrobial stewardship programmes to optimize empirical antibiotic therapy and improve clinical outcomes.

Conclusion

Premature rupture of membranes remains a major contributor to maternal and neonatal morbidity in northwestern Nigeria. Women with PROM were at significantly increased risk of caesarean delivery, puerperal sepsis, neonatal sepsis, and prematurity, while prolonged membrane rupture further increased the risks of puerperal sepsis, postpartum haemorrhage, and birth asphyxia. These findings highlight the importance of timely diagnosis, appropriate antimicrobial therapy, and prompt obstetric intervention, supported by improved antenatal care and microbiological surveillance. Further multicentre studies using larger cohorts and molecular diagnostic techniques are needed to better characterize pathogen profiles, antimicrobial resistance, and long-term maternal and neonatal outcomes.

Recommendations

Based on the findings of this study, the following recommendations are proposed:

1. Pregnant women should receive continuous education during antenatal care on recognizing PROM as an obstetric emergency and the importance of immediate presentation to a healthcare facility following leakage of amniotic fluid.
2. Healthcare providers should adhere to evidence-based protocols for the management of PROM, including prompt diagnosis, appropriate antibiotic therapy guided by local antimicrobial susceptibility data, administration of antenatal corticosteroids and magnesium sulphate where indicated, and timely delivery based on maternal and fetal conditions.
3. Health authorities should strengthen antenatal care services and referral systems, particularly in rural and underserved communities, to facilitate early identification and management of women at risk of PROM and its complications.
4. Hospitals should establish regular surveillance programmes to monitor genital tract microorganisms and antimicrobial resistance patterns, thereby supporting antimicrobial stewardship and ensuring the continued effectiveness of empirical treatment protocols.
5. Future research should involve multicentre prospective studies with larger sample sizes and incorporate molecular diagnostic techniques to improve characterization of microbial pathogens, identify predictors of adverse outcomes, and evaluate long-term maternal and neonatal consequences of PROM.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the conduct of this study or the publication of its findings.

REFERENCES

American College of Obstetricians and Gynecologists. (2020). *Prelabor rupture of membranes* (Practice Bulletin No. 217). *Obstetrics & Gynecology, 135*(3), e80–e97. https://doi.org/10.1097/AOG.0000000000003700

Ameh, C. A., White, S., Dickinson, F., Mdegela, M., Madaj, B., van den Broek, N., & Moxon, S. G. (2019). Retention of knowledge and skills after emergency obstetric care training: A multicountry longitudinal study. *PLOS ONE, 14*(10), e0224055. https://doi.org/10.1371/journal.pone.0224055

Blencowe, H., Cousens, S., Chou, D., Oestergaard, M. Z., Say, L., Moller, A. B., Kinney, M., & Lawn, J. E. (2013). Born too soon: The global epidemiology of 15 million preterm births. *Reproductive Health, 10*(Suppl. 1), S2. https://doi.org/10.1186/1742-4755-10-S1-S2

Blencowe, H., Krasevec, J., de Onis, M., Black, R. E., An, X., Stevens, G. A., et al. (2023). National, regional, and worldwide estimates of low birthweight in 2020, with trends from 2000: A systematic analysis. *The Lancet Global Health, 11*(8), e1180–e1190. https://doi.org/10.1016/S2214-109X(23)00198-2

Clinical and Laboratory Standards Institute. (2023). *Performance standards for antimicrobial susceptibility testing* (33rd ed., CLSI Supplement M100). Clinical and Laboratory Standards Institute.

Eleje, G. U., Eke, A. C., Ikechebelu, J. I., Ezebialu, I. U., & Okam, P. C. (2015). Clinical management of prelabour rupture of membranes at term: A review. *African Journal of Reproductive Health, 19*(4), 11–18.

FIGO Safe Motherhood and Newborn Health Committee. (2023). FIGO good practice recommendations for preterm labour and preterm prelabour rupture of membranes. *International Journal of Gynecology & Obstetrics, 163*(Suppl. 2), 12–27. https://doi.org/10.1002/ijgo.15100

Goldenberg, R. L., Culhane, J. F., Iams, J. D., & Romero, R. (2008). Epidemiology and causes of preterm birth. *The Lancet, 371*(9606), 75–84. https://doi.org/10.1016/S0140-6736(08)60074-4

Hannah, M. E., Ohlsson, A., Farine, D., Hewson, S. A., Hodnett, E. D., Myhr, T. L., Wang, E. E., Weston, J. A., Willan, A. R., & TermPROM Study Group. (1996). Induction of labor compared with expectant management for prelabor rupture of the membranes at term. *The New England Journal of Medicine, 334*(16), 1005–1010. https://doi.org/10.1056/NEJM199604183341601

Kenyon, S., Boulvain, M., & Neilson, J. P. (2013). Antibiotics for preterm rupture of membranes. *Cochrane Database of Systematic Reviews*, (12), CD001058. https://doi.org/10.1002/14651858.CD001058.pub3

Lawn, J. E., Gravett, M. G., Nunes, T. M., Rubens, C. E., Stanton, C., & GAPPS Review Group. (2010). Global report on preterm birth and stillbirth (1 of 7): Definitions, description of the burden and opportunities to improve data. *BMC Pregnancy and Childbirth, 10*(Suppl. 1), S1. https://doi.org/10.1186/1471-2393-10-S1-S1

Lawani, L. O., Iyoke, C. A., Okafo, C. N., Ajah, L. O., & Anozie, O. B. (2020). Maternal and fetal outcomes following premature rupture of membranes in a tertiary hospital in Nigeria. *Nigerian Journal of Clinical Practice, 23*(5), 679–685. https://doi.org/10.4103/njcp.njcp_519_19

Mercer, B. M. (2003). Preterm premature rupture of the membranes. *Obstetrics & Gynecology, 101*(1), 178–193. https://doi.org/10.1016/S0029-7844(02)02366-9

Menon, R., & Richardson, L. S. (2017). Preterm prelabor rupture of the membranes: A disease of the fetal membranes. *Seminars in Perinatology, 41*(7), 409–419. https://doi.org/10.1053/j.semperi.2017.07.012

National Population Commission (NPC) [Nigeria], & ICF. (2019). *Nigeria demographic and health survey 2018*. NPC & ICF.

Noor, S., Nazar, A. F., Bashir, R., & Sultana, R. (2020). Maternal and neonatal outcomes in women with premature rupture of membranes. *Journal of the College of Physicians and Surgeons Pakistan, 30*(6), 614–618. https://doi.org/10.29271/jcpsp.2020.06.614

Okeke, T. C., Enwereji, J. O., Ikeako, L. C., & Ezenyeaku, C. C. (2022). Determinants of premature rupture of membranes in a tertiary hospital in southeast Nigeria. *Nigerian Journal of Medicine, 31*(2), 150–156.

Royal College of Obstetricians and Gynaecologists. (2019). *Care of women presenting with suspected preterm prelabour rupture of membranes* (Green-top Guideline No. 73). Royal College of Obstetricians and Gynaecologists.

Romero, R., Dey, S. K., & Fisher, S. J. (2014). Preterm labor: One syndrome, many causes. *Science, 345*(6198), 760–765. https://doi.org/10.1126/science.1251816

Romero, R., Miranda, J., Chaiworapongsa, T., Korzeniewski, S. J., Chaemsaithong, P., Gotsch, F., Dong, Z., Ahmed, A. I., Yeo, L., & Hassan, S. S. (2015). Preterm labor and preterm premature rupture of membranes. *American Journal of Obstetrics and Gynecology, 213*(4 Suppl.), S1–S4. https://doi.org/10.1016/j.ajog.2015.08.010

Tessema, G. A., Laurence, C. O., Melaku, Y. A., Misganaw, A., Woldie, S. A., Hiruye, A., et al. (2021). Trends and determinants of adverse birth outcomes in sub-Saharan Africa: A systematic review. *BMJ Global Health, 6*(8), e006705. https://doi.org/10.1136/bmjgh-2021-006705

United Nations Children's Fund. (2024). *The State of the World's Children 2024*. UNICEF.

von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C., & Vandenbroucke, J. P. (2007). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. *PLoS Medicine, 4*(10), e296. https://doi.org/10.1371/journal.pmed.0040296

World Health Organization. (2022). *WHO recommendations on antenatal care for a positive pregnancy experience: Update 2022*. World Health Organization.

World Health Organization. (2023). *Preterm birth*. https://www.who.int/news-room/fact-sheets/detail/preterm-birth

World Medical Association. (2013). World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA, 310*(20), 2191–2194. https://doi.org/10.1001/jama.2013.281053