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Prevalence and associated factors of chorioamnionitis among women with preterm premature rupture of membranes at Mbarara Regional Referral Hospital, Southwestern Uganda

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Abstract

Background Chorioamnionitis is a frequent complication of preterm premature rupture of membranes (PPROM) and contributes substantially to adverse maternal and neonatal outcomes. However, data on the burden and determinants of chorioamnionitis among women with PPRM in resource-limited settings, including Uganda, are limited. This study determined the prevalence and factors associated with chorioamnionitis among women admitted with PPRM at a regional referral hospital in southwestern Uganda.

Methods This hospital-based cross-sectional study was conducted from December 2024 to April 2025 among pregnant women admitted at 26 weeks to 36 weeks and 6 days of gestation, with a diagnosis of PPRM. Consecutive sampling was used to enroll participants. Data were obtained through structured interviews, review of clinical records, and laboratory investigations, including microbiological culture, to capture sociodemographic, obstetric, medical, and clinical information. Chorioamnionitis was defined as maternal fever ($\geq 38^\circ\text{C}$) with at least one additional clinical or laboratory sign (uterine tenderness, foul-smelling amniotic fluid, maternal or fetal tachycardia, leukocytosis, or elevated C-reactive protein) and a positive cervical or posterior fornix culture used to detect intra-amniotic infection. Associations were assessed using modified Poisson regression to estimate adjusted prevalence ratios (aPRs) with 95% confidence intervals.

Results A total of 324 women were enrolled with a mean age of 26.56 (± 5.86) years. Most of the women had primary or no education (69.8%), and were unemployed (65.7%). The prevalence of chorioamnionitis was 39.8% ($n = 129/324$, 95% Confidence Interval [CI]: 34.6–45.3%). The factors independently associated with chorioamnionitis were duration

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of PPROM (≥ 4 days) (aPR = 5.85, 95% CI: 2.68–12.78) and undergoing ≥ 4 digital vaginal examinations (aPR = 3.25, 95% CI: 1.51–6.70).

Conclusion Chorioamnionitis was common, affecting approximately four in ten women with PPROM at MRRH, which may be influenced by delayed presentation and initiation of prophylactic antibiotics. Prolonged duration of membrane rupture and multiple digital vaginal examinations were associated with increased prevalence of chorioamnionitis. These findings underscore the importance of preventive practices during expectant management of PPROM, including minimizing unnecessary digital vaginal examinations and maintaining clinical vigilance for signs of chorioamnionitis. Future studies could evaluate the maternal and perinatal outcomes of chorioamnionitis among women with PPROM in this setting.

Keywords Chorioamnionitis, Preterm premature rupture of membranes, Pregnancy Complications, Uganda

Introduction

Chorioamnionitis is an acute infection of the fetal membranes and intrauterine structures that commonly complicates preterm premature rupture of membranes (PPROM) and is associated with increased maternal and neonatal morbidity, including endometritis, postpartum hemorrhage, preterm birth, early-onset neonatal sepsis, and perinatal death [1–3]. Globally, chorioamnionitis contributes substantially to the burden of preterm birth, which affects approximately 15 million pregnancies annually and accounts for nearly 1 million neonatal deaths, with chorioamnionitis implicated in an estimated 40–70% of preterm births [4]. Chorioamnionitis is the most common infection-related complication encountered in labor and delivery units worldwide, affecting approximately 1–10% of pregnancies in high-income settings and up to 66% in some low- and middle-income settings, including Uganda [5–10].

Chorioamnionitis infection is often polymicrobial, involving ascending aerobic and anaerobic bacteria from the vaginal flora such as *Escherichia coli*, *Bacteroides* species, group B *Streptococcus*, *Ureaplasma urealyticum*, and *Peptostreptococcus* [11, 12]. Although less commonly, infection may follow invasive procedures or maternal systemic infections such as *Listeria monocytogenes* [13]. Several maternal, fetal, and obstetric factors have been associated with an increased risk of chorioamnionitis. These include prolonged duration of membrane rupture, prolonged labor, nulliparity, frequent digital vaginal examinations, internal fetal monitoring, meconium-stained liquor, smoking, intravaginal herbal medicine insertion, immune compromise, epidural anesthesia, and genital tract infections including bacterial vaginosis, group B *Streptococcus*, and *Ureaplasma* colonization [14, 15].

Although chorioamnionitis has been widely studied in general obstetric populations, data specifically describing its burden and determinants among women with preterm premature rupture of membranes, particularly in sub-Saharan Africa, remain limited. In women with PPROM, clinical management requires balancing the

benefits of expectant care to reduce prematurity-related neonatal morbidity against the increasing risk of ascending intrauterine infection, including chorioamnionitis, as the duration of membrane rupture lengthens [16, 17]. In countries such as Uganda, where diagnostic capacity, access to timely obstetric care, and availability of essential laboratory investigations are often constrained, the likelihood of delayed or missed diagnosis may be increased, potentially increasing the burden of maternal and neonatal complications [18]. Generating Ugandan context-specific data is therefore critical to guide clinical decision-making, inform the allocation of limited resources, and strengthen strategies for early detection and prevention. This study aimed to determine the prevalence of chorioamnionitis and identify factors associated with its occurrence among women admitted with PPROM at a referral hospital in Southwestern Uganda.

Methods

Study setting, study design and study population

A cross-sectional study was conducted at the Maternity Ward of Mbarara Regional Referral Hospital (MRH) from December 2024 to April 2025 among pregnant women admitted at 26 weeks to 36 weeks and 6 days of gestation, with a diagnosis of PPROM. MRRH is a regional referral center for obstetric care serving a high client volume, with approximately 11,000 maternity admissions annually and about 87 women with PPROM seen monthly [19]. The hospital has a level III-accredited microbiology and molecular laboratory that participates in external quality assurance programs. At MRRH, women with PPROM are admitted for inpatient care and managed in accordance with Uganda national obstetric guidelines, with management guided by gestational age and maternal–fetal condition [20]. Expectant management is recommended for eligible pregnancies before 34 weeks, including close monitoring, antenatal corticosteroids, prophylactic antibiotics, and magnesium sulfate when indicated. Delivery is recommended for suspected chorioamnionitis, fetal compromise, other obstetric indications, or between 34 and 37 weeks of gestation [20].

Inclusion and exclusion criteria

We included pregnant women admitted between 26 weeks 0 days and 36 weeks 6 days of gestation with preterm premature rupture of membranes (PPROM), defined as watery per vaginal discharge before the onset of labor and confirmed on sterile speculum examination as fluid draining from the cervical os on coughing and/or pooling of fluid in the posterior vaginal fornix. The lower gestational age limit was based on the nationally recognized threshold of fetal viability in Uganda. We excluded women in advanced labor (cervical dilatation ≥ 6 cm), as membrane rupture at this stage is more consistent with intrapartum rupture of membranes rather than true PPRM.

Sample size and sampling

The sample size was calculated using the Kish Leslie formula of 1965 for cross-sectional studies [21], assuming a 95% confidence level ($Z = 1.96$), a prevalence of 25.4% from a previous study of women with PPRM in a public hospital in Dhaka, Bangladesh, and a margin of error of 5%. After adjusting for a 10% nonresponse rate, the minimum required sample size was 324 participants. The Bangladesh estimate was used because, at the time of study design, there were limited published data on the proportion of women with PPRM who develop chorioamnionitis in Uganda or similar settings. Consecutive sampling was used to enroll all eligible women with PPRM admitted to the maternity ward during the study period.

Collection of data and samples

We used an interviewer-administered, pretested questionnaire to obtain data on participants' demographics, medical and obstetric factors. The questionnaire was developed for this study and is provided in Appendix 1. Sociodemographic data were collected through participant interviews conducted by trained midwife research assistants, while clinical assessment and collection of blood and cervical/posterior fornix samples were performed by the principal investigator, an obstetrician, in collaboration with the clinical care team using standard infection-prevention procedures. At hospital admission and prior to initiation of antibiotic therapy, blood samples were collected for complete blood count (CBC) and C-reactive protein (CRP) concurrently with amniotic fluid sampling. A sterile cervical swab was obtained by rotating the swab 360° in the cervical canal. For external quality control, a second cervical sample was collected from every 20th participant and sent to the Epi-centre Laboratory at Mbarara University of Science and Technology (MUST). All samples were labeled with unique participant identification numbers and delivered to the laboratory without accompanying clinical information.

Cervical swabs were transported in charcoal-free Amies transport medium and delivered to the laboratory within 2 h for analysis by a qualified laboratory technician.

Sample testing by culture

The amniotic fluid sample was inoculated onto 5% sheep blood agar, MacConkey agar, Mannitol salt agar, and modified Thayer martin agar to isolate aerobic bacteria. The inoculated media was incubated at 37 °C aerobically for 24–72 h. Modified Thayer martin agar plates were incubated in a humidified atmosphere with 5% carbon dioxide. Identification of the cultured isolate was done by conventional phenotypic and biochemical methods, which included catalase, coagulase, and DNA-ase for *S. aureus* (which produces positive catalase, coagulase, and DNA-ase tests) and urease, citrate utilization, oxidase, and triple sugar iron for identification and differentiation of Gram-negative bacilli. Antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion method following standard laboratory procedures [22]. Bacterial culture and antibiotic susceptibility testing were performed using standard microbiological procedures, including appropriate media, incubation conditions, and disk diffusion testing with inocula standardized to a 0.5 McFarland turbidity standard.

Study variables

The dependent variable was the presence of chorioamnionitis in women with PPRM.

For the purposes of this study, chorioamnionitis was operationally defined as the presence of clinical features suggestive of intra-amniotic infection supported by microbiological evidence from lower genital tract culture. Specifically, a case was defined by a positive cervical or posterior fornix amniotic fluid culture in combination with maternal fever (≥ 38 °C) and at least one additional clinical or laboratory sign, including leukocytosis (WBC $\geq 15,000/\mu\text{L}$), elevated C-reactive protein (CRP ≥ 5.0 mg/l), uterine tenderness, foul-smelling amniotic fluid and fetal tachycardia (≥ 160 b/m) [16]. Although amniocentesis remains the diagnostic gold standard for confirming intra-amniotic infection, its use is often limited in resource-limited settings due to procedural risks, technical requirements, and limited availability. Therefore, cervical or posterior fornix cultures were used as a pragmatic proxy measure in this study.

The independent variables were classified into four categories. Socio-demographic factors included age, employment status, level of education, residence, and marital status. Socioeconomic variables were defined a priori based on prior experience and evidence from previous studies in comparable contexts. Household income was categorized using the Ugandan poverty line, with

women earning < 1 USD per day classified as living below the poverty line. Maternal age was grouped into clinically relevant obstetric categories: <20 years (teenage mothers), 20–34 years, and ≥ 35 years (advanced maternal age). Obstetric factors included parity, duration of PPROM, gestational age (based on the last normal menstrual period or first-trimester ultrasound scan), antenatal care attendance, number of digital vaginal examinations, meconium-stained liquor, labor, use of vaginal herbal medicine, and use of internal uterine and fetal monitors. Digital vaginal examinations included in the analysis primarily referred to examinations conducted prior to referral and hospital admission, typically at lower-level health facilities, and before the documented diagnosis of chorioamnionitis. Duration of PPROM was categorized using a ≥ 4 -day threshold based on prior studies demonstrating a substantially increased risk of intrauterine infection and chorioamnionitis after 72–96 h of membrane rupture [23, 24]. Behavioral factors included alcohol consumption assessed as current alcohol consumption. Medical factors included maternal diabetes and hypertension (diagnosed before or during pregnancy), history of urinary tract infection, history of abnormal vaginal discharge, and HIV status (as reported by the participant or confirmed by a recorded test result; HIV-negative participants who last tested ≥ 3 months prior to enrollment were referred for re-testing). All these variables were examined as potential risk factors for chorioamnionitis.

Data management and analysis

Data from the study tool were entered into REDCap® and then exported to STATA version 17 (Stata Statistical Software: Release 17. College Station, TX: StataCorp LLC, USA), for analysis. We conducted a descriptive analysis of the independent variables. Continuous variables were described as mean $\pm$ standard deviation (SD), while categorical variables were expressed as frequencies and percentages. Comparisons between women with and without chorioamnionitis were performed using the Student's *t*-test for continuous variables and the chi-square test for categorical variables; Fisher's exact test was used when expected cell counts were fewer than five.

The prevalence of chorioamnionitis was computed as the number of women with chorioamnionitis expressed as a percentage of the total number of participants. The prevalence was reported with its corresponding 95% confidence interval (CI). We used a modified Poisson regression analysis to determine the factors associated with chorioamnionitis, and prevalence ratio was reported as the measure of association. We used modified Poisson regression with robust variance because chorioamnionitis was a common outcome, and logistic regression would have overestimated the effect size [25]. Variables with *p*-values < 0.20 at bivariate and those which were

biologically plausible were purposively selected for the multivariable modified Poisson regression analysis model. Those with a *p*-value < 0.05 at this level were considered statistically significant and therefore independently associated with chorioamnionitis among women with PPROM at MRRH. Collinearity was evaluated using variance inflation factors, applying a conservative threshold of VIF < 5. All variables included in the multivariable model met this criterion, indicating no evidence of problematic collinearity.

Results

A total of 334 women admitted with preterm premature rupture of membranes (PPROM) were assessed for eligibility. Ten women were excluded because they were in advanced labor, leaving 324 women who were enrolled in the study. Among those enrolled, 129 met the study criteria for chorioamnionitis, while 195 did not (Fig. 1).

Sociodemographic characteristics of study participants

The mean maternal age was 26.56 years (standard deviation [SD] ± 5.86). Most participants were married (93.2%), had primary or no education (69.8%), and were unemployed (65.7%). The majority did not consume alcohol (82.4%). Compared with those without chorioamnionitis, a higher proportion of women with chorioamnionitis were aged > 34 years (14.7% vs. 5.6%, *p* = 0.006). Similarly, primary or no formal education was more common among women with chorioamnionitis than those without (79.9% vs. 62.1%, *p* = 0.003). Lower household income was more common among women with chorioamnionitis, with a greater proportion reporting a monthly household income $\leq$ 300,000 Ugandan shillings compared with women without chorioamnionitis (70.5% vs. 37.6%, *p* < 0.001). No statistically significant differences were observed by marital status, employment status, current alcohol use (all *p* > 0.05) (Table 1).

Obstetric, medical and clinical characteristics of study participants

Among the 324 women enrolled, most were multigravidas (59.9%), had attended ≥ 4 ANC visits (55.2%), and were admitted at < 34 weeks of gestation (64.2%). Several obstetric characteristics differed significantly between women with and without chorioamnionitis. A higher proportion of women with chorioamnionitis had attended fewer than four ANC visits compared to those without the condition (58.9% vs. 35.4%, *p* < 0.001). Prolonged rupture of membranes (≥ 4 days) was more frequent in the chorioamnionitis group than in the non-chorioamnionitis group (98.4% vs. 14.9%, *p* < 0.001), as were frequent digital vaginal examinations (≥ 4 exams) (96.9% vs. 19.5%, *p* < 0.001) (Table 2).

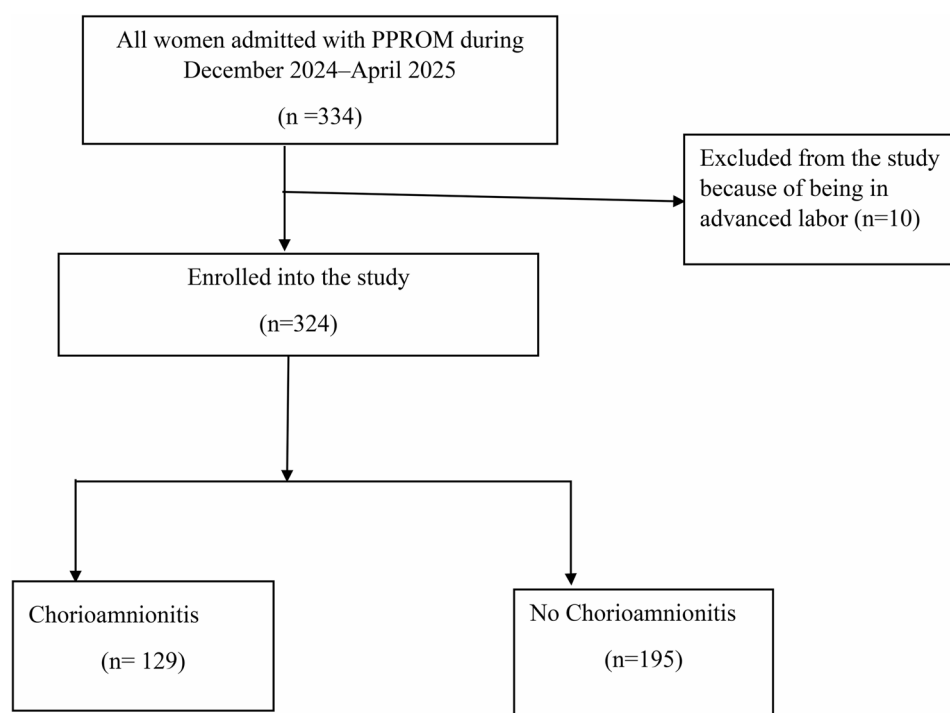


Fig. 1 Flow diagram showing screening, eligibility, exclusions, and enrolment of study participants at Mbarara Regional Referral Hospital, Uganda, December 2024–April 2025

The proportion of women in early labor at admission (< 6 cm cervical dilatation) was higher among those with chorioamnionitis compared to those without (24.0% vs. 11.3%, $p=0.002$), and the proportion with meconium-stained amniotic fluid was likewise greater in the chorioamnionitis group (58.9% vs. 10.8%, $p<0.001$). Urinary tract infection was more common among women with chorioamnionitis (58.9% vs. 45.1%, $p=0.015$), and a history of abnormal vaginal discharge was reported more frequently in this group (45.0% vs. 26.2%, $p<0.001$). No significant differences were observed in gravidity, gestational age, prophylactic antibiotic use, hypertension, HIV status, diabetes mellitus, or herbal medicine use (Table 2).

Prevalence of chorioamnionitis among women admitted with PPROM

Among the 324 participants, 129 were diagnosed with chorioamnionitis, yielding a prevalence of 39.8% (95% CI: 34.6%–45.3%). Among the 129 culture-positive samples, *Escherichia coli* was the most frequently isolated organism, identified in 79 samples (61.2%), followed by *Klebsiella* spp. in 33 (25.6%) and *Enterobacter* spp. in 15 (11.6%) (Supplementary Figure S1). Antibiotic susceptibility testing of culture-positive isolates showed the highest sensitivity to meropenem (38.1%), amikacin (37.5%), and aztreonam (34.7%), with low sensitivity to commonly used beta-lactam antibiotics, including cefuroxime and ceftriaxone (Supplementary Figure S2).

Factors associated with chorioamnionitis among women with PPROM

In bivariate analyses, several obstetric characteristics were significantly associated with chorioamnionitis, including fewer than four ANC visits, duration of PPROM ≥ 4 days, ≥ 4 digital vaginal examinations, and meconium-stained amniotic fluid. Gravidity and gestational age at admission showed no statistically significant associations (Table 3). Among medical and clinical characteristics, history of urinary tract infection and abnormal vaginal discharge were significantly associated with chorioamnionitis; women reporting urinary tract infection had a 1.4-fold higher prevalence of chorioamnionitis compared with those without, and those reporting abnormal vaginal discharge had a 1.6-fold higher prevalence.

In multivariable analysis, only two factors remained significantly associated with chorioamnionitis: duration of PPROM and number of digital vaginal examinations. Women whose membranes had ruptured for four or more days had 5.85 times higher prevalence chorioamnionitis compared to those with a duration of < 4 days (adjusted prevalence ratio [aPR]: 5.85; 95% CI: 2.68–12.78). Similarly, women who underwent ≥ 4 digital vaginal examinations had 3.25 times higher prevalence of chorioamnionitis than those with fewer than four examinations (aPR: 3.25; 95% CI: 1.51–6.70) (Table 3).

Table 1 Sociodemographic characteristics of study participants by chorioamnionitis status (N=324)

Characteristics	Chorioamnionitis			p-value [†]
	Total	Yes	No	
	N=324 n (%)	n=129 n (%)	n=195 n (%)	
Maternal age (years)	26.56 (5.86)	26.69 (6.52)	26.48 (5.39)	0.750
Maternal age (years)				
<20	34 (10.5)	17 (13.2)	17 (8.7)	
20-34	260 (80.2)	93 (72.1)	167 (85.6)	
>34	30 (9.3)	19 (14.7)	11 (5.6)	0.006*
Education level				
None	98 (30.2)	45 (34.9)	53 (27.2)	0.003*
Primary	126 (38.9)	58 (45.0)	68 (34.9)	
Secondary	77 (23.8)	17 (13.2)	60 (30.8)	
Tertiary	23 (7.1)	9 (7.0)	14 (7.2)	
Marital status				
Unmarried	22 (6.8)	9 (7.0)	13 (6.7)	0.910
Married/Cohabiting	302 (93.2)	120 (93.0)	182 (93.3)	
Employment status				
Unemployed	213 (65.7)	92 (71.3)	121 (62.1)	0.085
Employed	111 (34.3)	37 (28.7)	74 (37.9)	
Monthly household income (UGX)**				
≤300,000	167 (50.5)	91 (70.5)	76 (37.6)	<0.001*
>300,000	164 (49.5)	38 (29.5)	126 (62.4)	
Current alcohol use				
No	267 (82.4)	105 (81.4)	162 (83.1)	
Yes	57 (17.6)	24 (18.6)	33 (16.9)	0.700

*p-value<0.05; UGX: Ugandan Shillings; **1 United States dollar (USD) ≈ 3,500 UGX; †P-values were obtained using the chi-square test for categorical variables and the Student's t-test for maternal age

Discussion

Chorioamnionitis is a key contributor to maternal and neonatal complications, particularly in pregnancies complicated by PPROM. In this study, approximately 4 in every 10 of women admitted with PPROM at a tertiary referral hospital in southwestern Uganda had chorioamnionitis. Prolonged duration of membrane rupture (≥ 4 days) and multiple digital vaginal examinations (≥ 4) were significantly associated with increased prevalence of chorioamnionitis.

The prevalence of chorioamnionitis among women admitted with PPROM in the current study was 39.8%. This high prevalence may be influenced by delayed presentation and initiation of prophylactic antibiotics; in this setting, delayed referral from lower-level facilities or the community often results in women presenting several days after membrane rupture, limiting the benefit of timely antibiotic prophylaxis [26]. Evidence on chorioamnionitis among women with PPROM in East Africa remains limited, with most regional studies focusing on general obstetric populations rather than PPROM-specific cohorts. Reported prevalence varies widely across settings and is influenced by diagnostic methods, timing

Table 2 Obstetric, medical and clinical characteristics of study participants by chorioamnionitis status (N=324)

Characteristics	Chorioamnionitis			P-value [†]
	Total	Yes	No	
	(N=324) n (%)	(n=129) n (%)	(n=195) n (%)	
Gravidity				
Primigravida (1)	74 (22.8)	33 (25.6)	41 (21.0)	0.630
Multigravida (2-4)	194 (59.9)	74 (57.4)	120 (61.5)	
Grand multigravida (>4)	56 (17.3)	22 (17.1)	34 (17.4)	
ANC visits				
<4	145 (44.8)	76 (58.9)	69 (35.4)	<0.001*
≥4	179 (55.2)	53 (41.1)	126 (64.6)	
Gestational age (weeks)				
<34	208 (64.2)	82 (63.6)	126 (64.6)	0.850
≥34	116 (35.8)	47 (36.4)	69 (35.4)	
Duration of PPROM				
<4 days	168 (51.9)	2 (1.6)	166 (85.1)	
≥4 days	156 (48.1)	127 (98.4)	29 (14.9)	<0.001*
Prophylactic antibiotics				
No	113 (34.9)	42 (32.6)	71 (36.4)	
Yes	211 (65.1)	87 (67.4)	124 (63.6)	0.480
Number of vaginal exams				
< 4 exam	161 (49.7)	4 (3.1)	157 (80.5)	
≥4 exams	163 (50.3)	125 (96.9)	38 (19.5)	<0.001*
In labor				
Early labor (<6cm)	175 (54.0)	31 (24.0)	22 (11.3)	0.002*
Not in labor	149 (46.0)	98 (76.0)	173 (88.7)	
Meconium stained amniotic fluid				
No	227 (70.1)	53 (41.1)	174 (89.2)	
Yes	97 (29.9)	76 (58.9)	21 (10.8)	<0.001*
History of herbal medicine use				
No	270 (83.3)	107 (82.9)	163 (83.6)	
Yes	54 (16.7)	22 (17.1)	32 (16.4)	0.880
Hypertension				
No	308 (95.1)	119 (92.2)	189 (96.9)	
Yes	16 (4.9)	10 (7.8)	6 (3.1)	0.057
HIV				
Positive	34 (10.5)	16 (12.4)	18 (9.2)	0.360
Negative	290 (89.5)	113 (87.6)	177 (90.8)	
Diabetes mellitus				
No	322 (99.4)	129 (100.0)	193 (99.0)	
Yes	2 (0.6)	0 (0.0)	2 (1.0)	0.250
Urinary tract infection				
No	160 (49.4)	53 (41.1)	107 (54.9)	
Yes	164 (50.6)	76 (58.9)	88 (45.1)	0.015*
History of abnormal vaginal discharge				
No	215 (66.4)	71 (55.0)	144 (73.8)	
Yes	109 (33.6)	58 (45.0)	51 (26.2)	<0.001*

*p-value<0.05; †P-value were obtained using the chi-square test or Fischer's exact test for variables with cell counts<5; PPROM: Preterm premature rupture of membranes

Table 3 Results of multivariable analysis of factors associated with chorioamnionitis among pregnant women admitted with PPROM at Mbarara Regional Referral Hospital, Uganda, December 2024–April 2025

Characteristics	Chorioamnionitis		Bivariate analysis		Multivariable analysis	
	Yes (n = 129) n (%)	No (n = 195) n (%)	Crude PR (95% CI)	P-value	Adjusted PR (95% CI)	P-value
Maternal age (years)						
< 20	17 (13.2)	17 (8.7)	1.40[0.96,2.03]	0.079	1.02[0.60,1.76]	0.915
20–34	93 (72.1)	167 (85.6)	1		1	
> 34	19 (14.7)	11 (5.6)	1.77[1.29,2.43]	< 0.001*	1.08[0.63,1.85]	0.768
ANC visits						
< 4	76(58.9)	69 (35.4)	1.77[1.35,2.33]	< 0.001*	1.10[0.76,1.59]	0.595
≥ 4	53(41.1)	126 (64.6)	1		1	
Duration of PPROM (days)						
< 4	2 (1.6)	166(85.1)	1		1	
≥ 4	127(98.4)	29 (14.9)	68.38[17.2,271.7]	< 0.001*	5.85[2.68,12.78]	< 0.001*
Number of digital vaginal exams						
< 4	4 (3.1)	157 (80.5)	1		1	
≥ 4	125 (96.9)	38 (19.5)	30.86[11.68,81.54]	< 0.001*	3.25[1.51,6.70]	0.003*
Meconium-stained amniotic fluid						
No	53 (41.1)	174 (89.2)	1		1	
Yes	76 (58.9)	21 (10.8)	3.36[2.59,4.34]	< 0.001*	1.12[0.78,1.62]	0.535
History of Urinary tract infection						
No	53 (41.1)	107 (54.9)	1		1	
Yes	76 (58.9)	88 (45.1)	1.40[1.06,1.84]	0.017*	1.05[0.74,1.49]	0.775
History of Abnormal vaginal discharge						
No	71 (55.0)	144 (73.8)	1		1	
Yes	58 (45.0)	51 (26.2)	1.61[1.24,2.09]	< 0.001*	1.05[0.74,1.50]	0.773

PR prevalence ratio, CI confidence interval, * $p < 0.05$; PPROM Preterm premature rupture of membranes

of clinical presentation, and management practices. For example, lower prevalence has been reported in Bangladesh, where women with PPROM received prompt hospital admission and early antibiotic therapy [27]. Conversely, retrospective record-review studies, such as those conducted in Brazil, may underestimate prevalence due to incomplete documentation of clinical signs [28]. Higher prevalence estimates have been reported in studies using combined clinical and advanced microbiological or molecular diagnostic approaches, including cytokine profiling, with rates up to 63% in the United States [27]. These findings suggest that differences in clinical management, diagnostic approach, and study methodology may partly explain variation in reported prevalence across settings.

The low sensitivity of isolated organisms to commonly used beta-lactam antibiotics such as cefuroxime and ceftriaxone raises concern regarding the effectiveness of empiric treatment regimens commonly used in obstetric care in Uganda. Although carbapenems and aminoglycosides demonstrated higher sensitivity in this study, their routine use may be limited by cost, availability, and antimicrobial stewardship considerations [29]. These findings highlight the importance of strengthening local

microbiological surveillance and periodically updating empirical antibiotic guidelines for the management of PPROM and suspected intra-amniotic infection in referral hospitals. Incorporating local antimicrobial resistance patterns into treatment protocols may improve maternal outcomes while minimizing unnecessary exposure to broad-spectrum antibiotics [29].

Women who underwent four or more digital vaginal examinations were more likely to have chorioamnionitis compared to those who underwent less than 4 digital vaginal examinations. This finding aligns with evidence from previous studies indicating that repeated vaginal examinations increase the risk of intrauterine infection. For instance, retrospective cohort studies from Israel and Canada observed that the likelihood of chorioamnionitis rises with the number of vaginal examinations, with risk increasing progressively as examinations accumulate [30]. Repeated examinations facilitate microbial transfer from the vagina to the chorioamniotic sac, increasing susceptibility to intrauterine infection and postpartum endometritis [31]. This biological plausibility has informed clinical guidelines that recommend minimizing cervical examinations in women with PPROM or PROM at term, emphasizing that “once an examination has been

performed, the clock of infection starts to tick.” [32]. The association with multiple digital vaginal examinations suggests variability in examination practices across the continuum of care, where repeated assessments may occur before referral or in the absence of strict adherence to recommended speculum-based evaluation. This is a modifiable care-related factor that can be addressed through enforcing clearer protocols and supervision, to reduce maternal and neonatal morbidity, particularly in resource-limited settings.

Prolonged duration of PPROM (≥ 4 days) was strongly associated with an increased prevalence of chorioamnionitis in this study. Similar associations have been reported in prospective studies from the United States and India, where higher rates of chorioamnionitis were observed with longer PPROM-to-delivery intervals [33]. Although not all studies have demonstrated this association [34], the association is biologically plausible, as rupture of the membranes compromises the normal protective barrier between the lower genital tract and the intra-amniotic environment [35, 36]. Longer latency periods may be associated with greater opportunity for microbial colonization and inflammatory response [16]. These findings underscore the importance of timely evaluation and risk-based management of women presenting with PPROM.

In the bivariate analysis, women with fewer than four antenatal care (ANC) visits appeared more likely to develop chorioamnionitis; however, this association was not retained after adjustment for other clinical factors. This finding suggests that the apparent relationship may reflect broader health-system factors such as delayed presentation, referral delays, or differences in access to obstetric care rather than ANC attendance itself [18]. Nonetheless, adequate and timely ANC remains essential for the early detection and management of pregnancy complications, including PPROM, and may facilitate earlier referral and appropriate clinical monitoring [37].

From a policy perspective, the results reinforce the need for clear and consistently enforced guidelines that limit unnecessary vaginal examinations, promote strict infection-prevention practices, and support timely clinical decision-making, regarding expectant versus active management of PPROM. At the health-system level, targeted training of maternity care providers, regular clinical audits, and improved supervision may help address care practices associated with chorioamnionitis. Although antimicrobial resistance was not directly assessed, the observed associations suggest that modifiable infection prevention care-related factors, including repeated digital vaginal examinations and prolonged duration of PPROM, during expectant management may contribute to increased antibiotic use in referral settings. Strengthening preventive, system-level practices may therefore

complement ongoing efforts toward antibiotic stewardship in low-resource settings.

Limitations

Some limitations should be considered when interpreting these findings. First, the cross-sectional design precludes causal inference, and the observed associations should be interpreted as correlational rather than cause-effect relationships. Second, the diagnosis of chorioamnionitis was based on microbiological culture of amniotic fluid obtained from the cervical canal or posterior fornix rather than through amniocentesis, which is considered the diagnostic gold standard. This sampling approach may have introduced contamination from vaginal or cervical flora, potentially inflating culture-positive results and leading to an overestimation of the true prevalence of chorioamnionitis. To minimize this potential misclassification, we used a combined diagnostic approach that required microbiological evidence in addition to at least one standard clinical criterion, including maternal fever, uterine tenderness, foul-smelling amniotic fluid, leukocytosis, elevated CRP, or maternal or fetal tachycardia. Despite this mitigation, some residual misclassification may have persisted. Third, anaerobic cultures were not performed due to laboratory capacity constraints in this resource-limited setting. As a result, certain obligate anaerobic pathogens may have been under-detected. Fourth, the study was conducted at a single regional referral hospital, which may limit the generalizability of the findings to lower-level health facilities or settings with different patient populations, referral patterns, and obstetric care practices. Fifth, some exposure variables, including the duration of membrane rupture prior to admission and the number of digital vaginal examinations, relied partly on patient recall and routine clinical documentation, which may be subject to recall or recording bias. Additionally, screening for TORCH infections (including toxoplasmosis, syphilis, rubella, cytomegalovirus, and herpes simplex virus) was not performed in this study. As a result, we were unable to account for the potential contribution of these viral or parasitic infections, and residual confounding from unmeasured infections, and antibiotic treatment practices before hospital admission, cannot be excluded. Finally, neonatal outcomes were not assessed, as the primary focus of the study was on estimating the prevalence of chorioamnionitis and identifying associated maternal and care-related factors among women with PPROM. This limits assessment of the downstream neonatal impact of chorioamnionitis in this population and highlights an important area for future research. A key strength of this study is the use of microbiological culture techniques to confirm the diagnosis of chorioamnionitis rather than relying solely on clinical signs.

Conclusions

The study demonstrated that approximately four in ten women admitted with PPROM at MRRH in southwestern Uganda developed chorioamnionitis. The prevalence of the infection was significantly higher among women who underwent multiple digital vaginal examinations and among those with a prolonged duration of membrane rupture. Our findings highlight a need for preventive interventions, including minimizing digital vaginal examinations and screening for chorioamnionitis in mothers with PPROM undergoing expectant management. Systematic screening of all women with PPROM for chorioamnionitis in similar hospital settings, coupled with timely initiation of delivery when infection is suspected, may help balance the benefits of expectant management while minimizing infection-related morbidity. Implementation of these recommendations could include reinforcing speculum-based examination protocols, targeted staff training, and routine audit and feedback mechanisms within maternity units. Further studies are needed to evaluate the maternal and perinatal outcomes of chorioamnionitis among women with PPROM in this setting and to inform targeted strategies for improved clinical care.

Abbreviations

ANC	Antenatal care
aPR	Adjusted prevalence ratio
CBC	Complete blood count
CI	Confidence interval
CRP	C-reactive protein
HIV	Human immunodeficiency virus
MRRH	Mbarara Regional Referral Hospital
MUST	Mbarara University of Science and Technology
PPROM	Preterm premature rupture of membranes
PR	Prevalence ratio
SD	Standard deviation
VIF	Variance inflation factor
WBC	White blood cell

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12884-026-09014-3>.

Supplementary Material 1.

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Authors' contributions

All authors have read and approved the final manuscript and accept responsibility for the integrity and accuracy of the work in its entirety. **Concept and design: ** Ochuga Patrick Olanya, Leevan Tibaijuka, Byamukama Onesmus, Yarine Fajardo, Musa Kayondo, Godfrey R. Mugenyi. **Acquisition, analysis, or interpretation of data: ** Ochuga Patrick Olanya, Leevan Tibaijuka, Yarine Fajardo, Onesmus Byamukama, Musa

Kayondo, Godfrey R. Mugenyi, Joseph Ngonzi, [Hamson Kanyesigye](https://pubmed.ncbi.nlm.nih.gov/?term=Kanyesigye+H&cauthor_id=36064375), Anisa Salad, Begumana Daniel, Mohamed Bashir, Kasyeba Sowedi, Byaruhanga Norbert Musisi, Anyit Moses, Adupa Emmanuel and Etwop Patrick. **Drafting of the manuscript: ** Ochuga Patrick Olanya, Leevan Tibaijuka, and Richard Migisha. **Critical review of the manuscript for important intellectual content: ** Ochuga Patrick Olanya, Leevan Tibaijuka, Richard Migisha, Byamukama Onesmus, Yarine Fajardo, Joseph Ngonzi, Musa Kayondo. **Supervision: ** Ochuga Patrick Olanya, Leevan Tibaijuka, Yarine Fajardo, Onesmus Byamukama.

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Data availability

The datasets generated and analysed for this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by; Mbarara University of Science and Technology Research Ethics Committee under reference number MUST-2024-1809 and Uganda National Council for Science and Technology reference number HS5949ES. Administrative clearance was obtained from the hospital director's office at Mbarara Regional Referral Hospital before conducting the study. Written informed consent was obtained from each study participant before participation in the study. Confidentiality of the study participants was ensured by using unique identifiers. Participants were free to withdraw from the study at any time. Recruitment into the study was voluntary and free. We respected the guidelines of Helsinki and CIOMS-2002 (Council for International Organizations of Medical Sciences) regarding research with humans, avoiding any physical or moral harm.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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