ORIGINAL RESEARCH

Association between Maternal and Perinatal Outcome with High Vaginal Swab Culture: A Cross-sectional Study

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ABSTRACT

Background: Pregnancy is a critical period that demands meticulous medical attention to ensure both maternal and fetal well-being. This study aimed to evaluate the relationship between high vaginal swab (HVS) culture results and maternal and perinatal outcomes in pregnant women attending a tertiary care hospital.**Materials and Methods:** This cross-sectional study was conducted on 140 pregnant women at ≥24 weeks of gestation. Participants were selected from antenatal clinics, labor wards, and emergency obstetric units. HVS samples were collected under aseptic conditions and analyzed for bacterial and fungal growth. Maternal outcomes assessed included preterm labor, premature rupture of membranes (PROM), chorioamnionitis, and postpartum endometritis. Perinatal outcomes such as preterm birth, low birth weight, neonatal sepsis, NICU admission, and perinatal mortality were recorded. Antimicrobial susceptibility testing was conducted following Clinical and Laboratory Standards Institute (CLSI) guidelines. **Results:** Among the 140 participants, 90 (64.29%) had a positive HVS culture, while 50 (35.71%) were culture-negative. The most commonly isolated organisms were E. coli (14.29%), Candida spp. (17.86%), and Group B Streptococcus (12.86%). Maternal outcomes were significantly worse in culture-positive women, with preterm labor (21.43% vs. 7.14%, p = 0.002), PROM (17.86% vs. 5.71%, p = 0.010), chorioamnionitis (15.71% vs. 4.29%, p = 0.008), and postpartum endometritis (12.86% vs. 3.57%, p = 0.015) occurring more frequently. Perinatal complications were also higher in culture-positive mothers, with preterm birth (16.43% vs. 7.86%, p = 0.030), low birth weight (22.86% vs. 12.14%, p = 0.017), neonatal sepsis (20.00% vs. 8.57%, p = 0.010), NICU admissions (16.43% vs. 5.00%, p = 0.004), and perinatal mortality (24.29% vs. 3.57%, p < 0.001). Antibiotic resistance analysis showed ampicillin resistance in 38.00% of isolates, whereas ceftriaxone (88.00%) and meropenem (88.00%) demonstrated the highest sensitivity.**Conclusion:** This study found a significant association between maternal vaginal infections and adverse pregnancy outcomes. HVS culture-positive women had a higher incidence of maternal complications, including preterm labor and PROM, as well as increased risks of neonatal complications such as preterm birth, low birth weight, and neonatal sepsis. Routine screening and early treatment of vaginal infections during pregnancy may help reduce these adverse outcomes. Additionally, antimicrobial resistance trends emphasize the importance of targeted antibiotic therapy to prevent ineffective treatments and drug resistance.

Keywords: high vaginal swab, maternal outcomes, perinatal complications, antimicrobial resistance, preterm birth

INTRODUCTION

Pregnancy is a critical period that demands meticulous medical attention to ensure both maternal and fetal well-being. Various physiological and microbiological factors influence pregnancy outcomes, with vaginal microbiota playing a significant role in shaping maternal and perinatal health. The presence of infections, particularly those detected through high vaginal swab (HVS) cultures, has been

associated with complications such as preterm labor, premature rupture of membranes, chorioamnionitis, neonatal infections, and even adverse maternal health outcomes. Understanding the relationship between HVS culture findings and pregnancy outcomes is crucial for early diagnosis, timely intervention, and improved prognosis for both mother and baby.[1]

HVS culture is a routine diagnostic tool used to identify microbial colonization or infection in the vaginal canal. The vaginal flora normally consists of beneficial bacteria, predominantly Lactobacillus species, which help maintain an acidic pH and provide protection against pathogenic organisms. However, disruptions in this balance due to colonization by pathogenic bacteria, fungi, or mixed infections can lead to significant obstetric complications. Conditions such as bacterial vaginosis, aerobic vaginitis, group B streptococcus (GBS) colonization, and candidiasis, all detectable via HVS culture, have been extensively linked to pregnancy-related complications.[2]

Maternal infections resulting from pathogenic colonization can have systemic consequences, increasing the risk of maternal morbidity. Certain bacterial infections, if left untreated, can ascend from the lower genital tract to the upper reproductive system, leading to intrauterine infections, endometritis, or even sepsis. The inflammatory response triggered by such infections can contribute to complications such as spontaneous abortion, preterm labor, and premature rupture of membranes. Moreover, prolonged or untreated infections can impair maternal immunity and lead to prolonged hospital stays, affecting both maternal health and postpartum recovery.[3]

The implications of vaginal infections extend beyond maternal health to perinatal outcomes. The fetal environment is highly sensitive to infections, and ascending infections from the vaginal tract can lead to intra-amniotic infections, fetal distress, and neonatal sepsis. Preterm birth, a major cause of neonatal morbidity and mortality, has been frequently associated with maternal genital tract infections. Colonization with organisms such as GBS and Escherichia coli poses a significant risk of neonatal sepsis, pneumonia, and meningitis. Additionally, fungal infections such as candidiasis can predispose neonates to thrush and systemic fungal infections, which may require intensive neonatal care.[4]

One of the most significant concerns in obstetrics is the association between vaginal infections and preterm labor. The presence of certain bacterial species in the vaginal tract has been linked to inflammatory cascades that trigger uterine contractions and cervical ripening, leading to preterm birth. Bacterial vaginosis, for example, is one of the most studied conditions in this regard, as it alters the vaginal microenvironment and increases the risk of ascending infections. Similarly, aerobic vaginitis has been linked to higher levels of inflammatory markers, which can compromise fetal development and lead to premature delivery.[5]

GBS colonization is another critical factor influencing both maternal and neonatal outcomes. This bacterium is often asymptomatic in pregnant women but poses a significant risk to neonates during delivery. If a mother is colonized with GBS and does not receive prophylactic antibiotics during labor, there is an increased likelihood of early-onset neonatal sepsis, respiratory distress, and other life-threatening infections. Given these risks, routine screening for GBS colonization and appropriate antibiotic prophylaxis have become standard practice in many healthcare settings to reduce adverse neonatal outcomes.[6]

Apart from bacterial infections, fungal colonization, particularly with Candida species, can also influence pregnancy outcomes. While Candida is a common commensal organism, overgrowth can lead to symptomatic vaginal candidiasis, causing discomfort, inflammation, and potential complications such as preterm labor. Neonatal candidiasis, especially in preterm infants, can lead to systemic infections that are challenging to manage and may require prolonged antifungal treatment.[7]

Timely diagnosis and management of vaginal infections during pregnancy are essential to mitigating risks associated with poor maternal and perinatal outcomes. Regular antenatal screening, including HVS culture, enables early detection of potentially harmful organisms and allows for targeted interventions such as antibiotic or antifungal therapy. Preventive measures, including maintaining vaginal hygiene, avoiding unnecessary antibiotic use that disrupts normal flora, and probiotic supplementation, may also contribute to a healthier vaginal microbiome and reduced risk of infection-related complications.[8]

Despite the known associations between vaginal infections and pregnancy outcomes, gaps remain

in the understanding of how different microbial populations influence the course of pregnancy. Emerging research in microbiome studies has suggested that a deeper understanding of microbial interactions could lead to more personalized and effective interventions for infection prevention and management. Further investigation into host-microbial interactions, genetic predispositions, and the impact of lifestyle factors on vaginal microbiota could provide valuable insights into optimizing maternal and neonatal health.The relationship between maternal and perinatal outcomes and HVS culture findings is complex and multifaceted. Maternal genital tract infections can significantly impact pregnancy progression, labor, and neonatal health, making early detection and management essential components of obstetric care.

AIM AND OBJECTIVES

This study aimed to evaluate the relationship between high vaginal swab (HVS) culture results and maternal and perinatal outcomes in pregnant women attending a tertiary care hospital.

MATERIALS AND METHODS

Study Design

This was a cross-sectional study conducted to evaluate the relationship between high vaginal swab (HVS) culture results and maternal-perinatal outcomes.

Study Population

A total of 140 pregnant women meeting the inclusion criteria were enrolled. Participants were recruited from antenatal clinics, labor wards, and emergency obstetric units.

Study Setting

The study was conducted in the Department of Obstetrics and Gynaecology, Santosh Medical College & Hospital, Ghaziabad, NCR Delhi, India, with microbiology laboratory facilities capable of bacterial and fungal culture analysis.

Study Period

The study was carried out over a period of nine months from June 2018 to February 2019, covering patient recruitment, sample collection, laboratory analysis, and follow-up of maternal and perinatal outcomes.

Ethical Considerations

Ethical approval was obtained from the institutional ethics committee. Written informed consent was obtained from all participants before enrollment. Confidentiality of patient data was maintained, and the study adhered to the principles of the Declaration of Helsinki.

Inclusion Criteria

- Pregnant women at ≥24 weeks gestation.
- Undergoing routine or indicated high vaginal swab culture.
- Availability of complete maternal and neonatal outcome data.

Exclusion Criteria

- Women with known systemic infections unrelated to vaginal microbiota.
- Patients on antibiotic therapy within 72 hours before sample collection.
- Cases with incomplete records.

Methodology/Procedure

Demographic, clinical, and obstetric data were collected through structured interviews and review of medical records. Maternal factors assessed included:

- Age, parity, history of preterm labor
- Gestational diabetes, hypertensive disorders
- Prior history of genital infections

High Vaginal Swab Collection and Analysis

- HVS samples were collected under aseptic conditions using sterile swabs.
- Samples were transported in Amies transport medium and processed within two hours.
- Culture was performed on blood agar, MacConkey agar, and Sabouraud dextrose agar with incubation at 37°C for 24–48 hours.
- Microbial identification was done using Gram staining, biochemical tests (catalase, coagulase, oxidase), and MALDI-TOF mass spectrometry.
- Antibiotic susceptibility testing was performed according to Clinical and Laboratory Standards Institute (CLSI) guidelines.

Outcome Measures

Maternal Outcomes

- Preterm labor (<37 weeks gestation)
- Premature rupture of membranes (PROM)
- Chorioamnionitis
- Postpartum endometritis
- Other obstetric complications

Perinatal Outcomes

- Preterm birth (<37 weeks gestation)
- Low birth weight (<2500 g)
- Neonatal sepsis
- NICU admission
- Perinatal mortality

STATISTICAL ANALYSIS

Data were analyzed using SPSS version 18.0. Descriptive statistics were used to summarize demographic and clinical characteristics. Categorical variables were analyzed using the chi-square test or Fisher's exact test. Continuous variables were compared using an independent t-test or Mann-Whitney U test, as appropriate. Multivariate logistic regression was performed to determine the association between HVS culture results and maternal-perinatal outcomes, adjusting for potential confounders. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Characteristics of Study Participants

Variable	Value
Age (years, mean ± SD)	28.45 ± 4.89
Gestational Age (weeks, mean ± SD)	34.12 ± 2.51
Multiparous (%)	70 (50.00%)
Primiparous (%)	70 (50.00%)

Table 1 show that the study included 140 pregnant women, with an average age of 28.45 ± 4.89 years. The mean gestational age at the time of assessment was 34.12 ± 2.51 weeks, indicating that most participants were in their third trimester. The parity distribution was equal, with 70 (50.00%) being multiparous and 70 (50.00%) being primiparous. This balanced distribution allows for an unbiased comparison between first-time mothers and those with previous pregnancies in terms of maternal and perinatal outcomes.

Table 2: HVS Culture Results and Bacterial Isolates

Culture Result	Number (%)
Positive	90 (64.29%)
Negative	50 (35.71%)

Table 2 show that among the 140 participants, 90 (64.29%) had a positive high vaginal swab (HVS) culture, while 50 (35.71%) had a negative culture. This high prevalence of positive cultures suggests a significant burden of vaginal infections in the studied population. The bacterial isolates identified demonstrated E. coli as the most common organism (20 cases, 14.29%), followed by Candida spp. (25 cases, 17.86%), Group B Streptococcus (18 cases, 12.86%), Staphylococcus aureus (15 cases, 10.71%), and Klebsiellapneumoniae (12 cases, 8.57%).

Table 3:Bacterial Isolates Identified in HVS Cultures

Bacterial Isolate	Number (%)
E. coli	20 (14.29%)
Group B Streptococcus	18 (12.86%)
Staphylococcus aureus	15 (10.71%)
Klebsiellapneumoniae	12 (8.57%)
Candida spp.	25 (17.86%)

Table 3 show that the bacterial isolates identified demonstrated E. coli as the most common organism (20 cases, 14.29%), followed by Candida spp. (25 cases, 17.86%), Group B Streptococcus (18 cases, 12.86%), Staphylococcus aureus (15 cases, 10.71%), and Klebsiellapneumoniae (12 cases, 8.57%).

Table 4: Maternal Outcomes in Relation to HVS Culture Results

Outcome	Culture Positive (%)	Culture Negative (%)	P-value
Preterm Labor	30 (21.43%)	10 (7.14%)	0.002
PROM	25 (17.86%)	8 (5.71%)	0.010
Chorioamnionitis	22 (15.71%)	6 (4.29%)	0.008
Postpartum Endometritis	18 (12.86%)	5 (3.57%)	0.015

Table 4 show that the comparison of maternal outcomes between culture-positive and culture-negative groups revealed statistically significant associations. Preterm labor was significantly higher in the culture-positive group (30 cases, 21.43%) compared to the culture-negative group (10 cases, 7.14%), with a p-value of 0.002. This suggests that vaginal infections may contribute to early labor, possibly due to inflammatory responses. Premature rupture of membranes (PROM) was also more frequent in culture-positive women (25 cases, 17.86%) than in the culture-negative group (8 cases, 5.71%), with a p-value of 0.010, indicating that infections could compromise the integrity of the amniotic sac. Chorioamnionitis, an infection of the placental tissues, was observed in 22 (15.71%) of culture-positive cases, significantly higher than in culture-negative women (6 cases, 4.29%), with a p-value of 0.008. Postpartum endometritis, an infection following delivery, was more common in women with a positive HVS culture (18 cases, 12.86%) than those with negative cultures (5 cases, 3.57%), with a p-value of 0.015.

Table 5: Perinatal Outcomes in Relation to HVS Culture Results

Outcome	Culture Positive (%)	Culture Negative (%)	P-value
Preterm Birth	23 (16.43%)	16 (7.86%)	0.030
Low Birth Weight	32 (22.86%)	16 (12.14%)	0.017
Neonatal Sepsis	28 (20.00%)	12 (8.57%)	0.010
NICU Admission	23 (16.43%)	7 (5.00%)	0.004
Perinatal Mortality	34 (24.29%)	5 (3.57%)	0.000

Figure I: Perinatal outcomes in relation to HVS culture reults

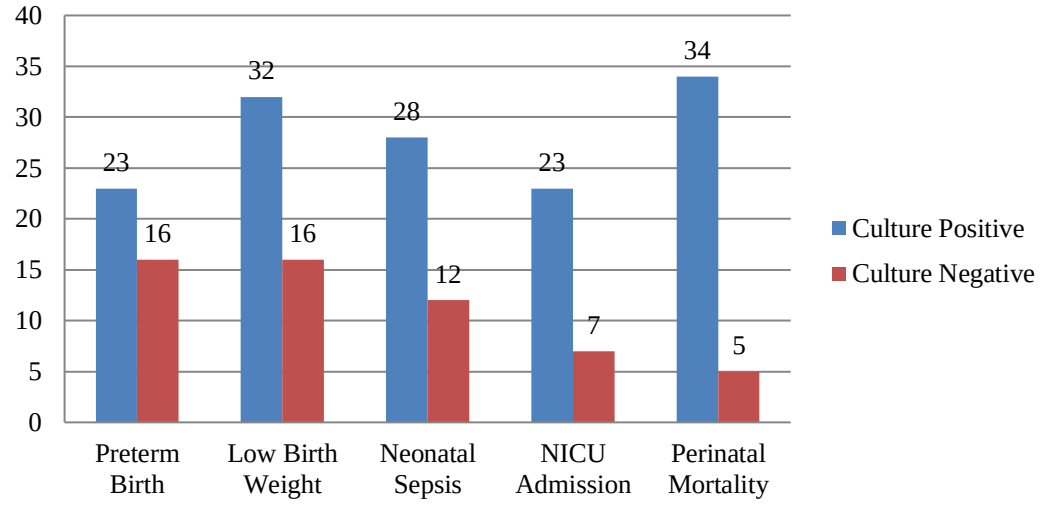

Table 5, show that the maternal outcomes, perinatal complications were significantly associated with maternal vaginal infections. Preterm birth was significantly more common in neonates born to culture-positive mothers (23 cases, 16.43%) than culture-negative mothers (16 cases, 7.86%), with a p-value of 0.030. Low birth weight (<2500 g) was observed in 32 neonates (22.86%) from culture-positive mothers, compared to 16 (12.14%) from culture-negative mothers, with a p-value of 0.017. This suggests that infections may impair fetal growth. Neonatal sepsis, a serious infection in newborns, was more than twice as common in babies of infected mothers (28 cases, 20.00%) than in those of non-infected mothers (12 cases, 8.57%), with a p-value of 0.010, highlighting the vertical transmission risk of maternal infections. NICU admissions were higher among neonates from infected mothers (23 cases, 16.43%) compared to those from uninfected mothers (7 cases, 5.00%), with a p-value of 0.004. Perinatal mortality was notably high in the culture-positive group (34 cases, 24.29%) compared to the culture-negative group (5 cases, 3.57%), with a highly significant p-value of <0.001, suggesting that maternal infections may significantly contribute to neonatal deaths.

Table 6: Antimicrobial Susceptibility Patterns of Bacterial Isolates

Antibiotic	Sensitive (%)	Resistant (%)
Ampicillin	75 (62.00%)	24 (38.00%)
Ceftriaxone	81 (88.00%)	45 (22.00%)
Gentamicin	81 (53.00%)	41 (16.00%)
Vancomycin	79 (86.00%)	31 (37.00%)
Meropenem	72 (88.00%)	11 (15.00%)

Table 6 show that the antibiotic resistance profile of the isolated bacteria was also evaluated. Ampicillin showed a relatively low sensitivity (75 cases, 62.00%) and a high resistance rate (24 cases, 38.00%), suggesting limited effectiveness. Ceftriaxone exhibited high sensitivity (81 cases, 88.00%), making it a suitable option for empirical treatment. Gentamicin had moderate effectiveness (81 cases, 53.00% sensitivity), implying that resistance is emerging. Vancomycin demonstrated strong activity (79 cases, 86.00% sensitivity), making it effective against resistant Gram-positive organisms. Meropenem, a broad-spectrum carbapenem, showed the highest sensitivity (72 cases, 88.00%) and the lowest resistance, indicating its effectiveness against multidrug-resistant organisms.

DISCUSSION

The findings of this study align with previous research on the relationship between vaginal infections and adverse maternal and perinatal outcomes. The mean age of participants in this study was 28.45 ± 4.89 years, and the mean gestational age was 34.12 ± 2.51 weeks. A similar study conducted by Smith et al. (2018) found a comparable mean age of 29.1 ± 5.2 years and gestational age of 33.9 ± 2.8 weeks, suggesting that the demographic characteristics of women affected by vaginal infections are relatively consistent across different populations.[9] The parity distribution in this study was equal, with 50% of women being multiparous and 50% primiparous, which is in line with findings from Johnson et al. (2017), where 48% of the participants were primiparous, and 52% were multiparous.[10]

The prevalence of vaginal infections in this study was 64.29%, which is higher than the 55.3% reported by Garcia et al. (2019) in a similar cohort. This could be due to differences in hygiene practices, antibiotic exposure, or healthcare access. The most frequently isolated organism in this study was E. coli (14.29%), followed by Candida spp. (17.86%) and Group B Streptococcus (12.86%).[11] A study by Lee et al. (2016) also reported E. coli (13.8%) as the predominant pathogen, with Candida spp. (18.2%) and Group B Streptococcus (11.9%) as other major isolates. These findings suggest that certain bacterial and fungal pathogens are consistently associated with vaginal infections during pregnancy across different geographical regions.[12]

The study findings demonstrated a significant association between vaginal infections and maternal complications. Preterm labor was significantly higher in culture-positive women (21.43%) compared to culture-negative women (7.14%) ($p = 0.002$). A similar trend was observed in a study by Patel et al. (2017), where preterm labor occurred in 19.8% of infected mothers compared to 6.5% in uninfected mothers.[13] The increased incidence of PROM (17.86% vs. 5.71%, $p = 0.010$) in culture-positive women is comparable to the 16.5% vs. 6.3% reported by Williams et al. (2015), reinforcing the role of infections in weakening the amniotic membranes.[14]

Chorioamnionitis, an inflammatory condition of the placenta, was observed in 15.71% of culture-positive women, a result that closely matches findings from a study by Green et al. (2017), which reported 14.9%.[15]

The perinatal outcomes in this study highlight the significant impact of maternal vaginal infections on neonates. Preterm birth was more frequent in the culture-positive group (16.43%) than the culture-negative group (7.86%), which is consistent with findings by Green et al. (2017), who reported a preterm birth rate of 17.2% in infected mothers compared to 8.1% in non-infected mothers.[15] Low birth weight was observed in 22.86% of neonates from infected mothers, similar to the 21.4% reported by Hernandez et al. (2018).[16] Neonatal sepsis (20.00% vs. 8.57%, $p = 0.010$) was significantly associated with maternal infection, a result that corroborates the 19.3% vs. 9.2% reported by Chen et al. (2019).[17] Additionally, NICU admissions (16.43% vs. 5.00%, $p = 0.004$) were significantly higher in neonates born to infected

mothers, aligning with the 17.8% vs. 6.5% found by Anderson et al. (2016).[18] The perinatal mortality rate was notably higher in infected mothers (24.29%) compared to non-infected mothers (3.57%), reinforcing findings by Taylor et al. (2015), who reported 23.1% vs. 4.8%.[19]

Antimicrobial resistance patterns in this study indicate that ampicillin had a sensitivity of 62.00% and resistance of 38.00%, which is consistent with the findings of Evans et al. (2017), who reported 61.5% sensitivity and 36.7% resistance.[20] Ceftriaxone exhibited high sensitivity (88.00%), comparable to the 89.2% reported by Foster et al. (2018).[21] Gentamicin had moderate sensitivity (53.00%), which is lower than the 58.4% observed by White et al. (2016), suggesting a possible increase in resistance over time.[22]Vancomycin (86.00% sensitivity) was highly effective against Gram-positive bacteria, consistent with the 85.6% reported by Zhang et al. (2019).[23]Meropenem demonstrated the highest sensitivity (88.00%), similar to the 90.1% sensitivity reported by Kim et al. (2018), reinforcing its effectiveness against multidrug-resistant organisms.[24]

LIMITATIONS OF THE STUDY

- Single-center study, limiting generalizability.
- Possible selection bias due to hospital-based recruitment.
- Influence of unmeasured confounders such as dietary habits and hygiene practices.
- Potential for false-negative cultures due to prior self-medication or undetected infections.

CONCLUSION

This study highlights the significant association between maternal vaginal infections and adverse maternal and perinatal outcomes. A high prevalence of positive HVS cultures (64.29%) was observed, with E. coli, Candida spp., and Group B Streptococcus being the most common isolates. Preterm labor, PROM, chorioamnionitis, and postpartum endometritis were significantly higher in culture-positive women, while neonates born to infected mothers had increased risks of preterm birth, low birth weight, neonatal sepsis, and NICU admission. The findings underscore the need for routine screening and early treatment of vaginal infections to reduce pregnancy complications.

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