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ANTIMICROBIAL RESISTANCE PROFILE OF STREPTOCOCCUS AGALACTIAE IN PARTURIENTS TREATED AT A PUBLIC HOSPITAL IN GOIÂNIA: IMPLICATIONS FOR INTRAPARTUM PROPHYLAXIS

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ABSTRACT

This study aimed to assess the prevalence of Streptococcus agalactiae colonization among parturients admitted to a public referral hospital in Goiânia, Brazil, and to characterize the antimicrobial resistance profile of the isolates, emphasizing implications for intrapartum prophylaxis. A cross-sectional study was conducted with 206 pregnant women between 35 and 37 weeks of gestation at the Dona Íris Maternity Hospital. Identification of S. agalactiae was performed using Todd-Hewitt selective broth culture, confirmed by chromogenic agar and real-time PCR (qPCR). Antimicrobial susceptibility was determined according to the 2024 BrCAST/EUCAST guidelines using the disk diffusion method on Mueller-Hinton agar supplemented with 5% horse blood and β-NAD. The prevalence of maternal colonization was 25.7% by qPCR and 20.4% by culture, with the vaginal site being the most affected (41.8%) and combined vaginal–anal colonization accounting for 25.4%. High susceptibility was observed to β-lactam antibiotics—penicillin (85.5%), ampicillin (92.8%), and ceftriaxone (96.4%)—while significant resistance was detected to clindamycin (83.6%), erythromycin (54.6%), and tetracycline (70.9%). No sociodemographic or obstetric variables were significantly associated with colonization. In conclusion, β-lactams remain the first-choice agents for intrapartum prophylaxis, whereas high resistance rates to macrolides and lincosamides reinforce the need for individualized antimicrobial susceptibility testing in penicillin-allergic women. The progressive incorporation of rapid molecular methods such as qPCR, in association with conventional culture, can enhance screening accuracy and support evidence-based strategies for preventing S. agalactiae infections in obstetric care.

Keywords: Group B Streptococcus, Antimicrobial susceptibility, Maternal colonization, Post-exposure prophylaxis, Beta-lactams.

INTRODUCTION

Streptococcus agalactiae, also known as Group B Streptococcus (GBS), is recognized as an important agent of perinatal morbidity and mortality in several countries. Although it may be part of the normal genitourinary and gastrointestinal microbiota of healthy adults, its presence in pregnant women represents a significant risk for early-onset neonatal infection resulting from vertical transmission during childbirth.[1–3] GBS infection is associated with sepsis, pneumonia, and meningitis in newborns, and is also a frequent cause of chorioamnionitis and puerperal endomyometritis in women during the perinatal period.

Since 2002, the Centers for Disease Control and Prevention (CDC) has recommended universal screening between 35 and 37 weeks of gestation, followed by intrapartum antimicrobial prophylaxis for colonized pregnant women—a strategy that has significantly reduced the incidence of early-onset neonatal sepsis in countries that have adopted it.[4] In Brazil, however, the systematic implementation of these measures remains limited, particularly in public institutions with high obstetric demand and lower laboratory capacity.

The absence of national guidelines for routine GBS screening in pregnant women reflects a longstanding gap in epidemiological and microbiological surveillance of the agent. Brazilian studies on the prevalence of maternal colonization are concentrated in the South and Southeast regions,[5–11] with variable findings and restricted samples. In the state of Goiás, Pires[12] identified a colonization rate of 15.4% among parturients but highlighted the scarcity of data on the antimicrobial resistance profile of circulating strains.

The increasing resistance to macrolides and lincosamides has been reported in several regions, raising concerns about the effectiveness of alternative therapies in pregnant women with penicillin allergy.[3,13] The maintained susceptibility to β-lactams, on the other hand, reinforces their importance as the gold standard for intrapartum prophylaxis. Nonetheless, the empirical use of antimicrobials without laboratory confirmation may favor the emergence of resistant strains and compromise prevention strategies.

Within the national context, the Brazilian Ministry of Health[14] and recent studies[15,16] emphasize the importance of local investigations on GBS prevalence and resistance patterns, in order to support public policies and clinical protocols adapted to regional realities.

Accordingly, the present study aimed to evaluate the prevalence of Streptococcus agalactiae colonization among parturients treated at a public referral hospital in Goiânia, Goiás, and to characterize the antimicrobial resistance profile of the isolated strains, with emphasis on its implications for intrapartum prophylaxis and the rational use of antimicrobials in obstetric care.

MATERIALS AND METHOD

This was a cross-sectional study conducted at Hospital e Maternidade Dona Íris (HMDI), a municipal public referral unit for women's and children's healthcare in Goiânia, Goiás. The project was approved by the Research Ethics Committee of HMDI (Approval nº 3.361.799; CAAE: 13320819.5.0000.8058), in accordance with Resolution nº 466/12 of the Brazilian National Health Council. All participants were properly informed about the objectives of the study and signed the Informed Consent Form (ICF).

A total of 206 pregnant women between 35 and 37 weeks of gestation were included, admitted to the HMDI pre-labor service from August to October 2024. Pregnant women could present single

or multiple gestations, with or without premature rupture of membranes, and with or without associated morbidities such as hypertension, diabetes mellitus, or HIV infection. Exclusion criteria were: use of antimicrobials or vaginal creams within the seven days prior to sample collection, or having received intrapartum prophylaxis less than six hours before delivery.

Sample size calculation was based on an expected colonization prevalence between 15% and 30%, with a 95% confidence level and a 5% sampling error, resulting in a minimum required sample of 203 pregnant women. The final number of participants (n = 206) met the established statistical criteria.

Sample collection was performed by trained hospital staff following a standardized protocol. Vaginal and anorectal samples were obtained from each participant using sterile swabs. Samples were stored in Stuart transport medium and sent to the Applied Bacteriology Laboratory of the Institute of Tropical Pathology and Public Health (IPTSP/UFG) within 12 hours after collection. When necessary, specimens were refrigerated between 2°C and 8°C for up to 24 hours.

Isolation of Streptococcus agalactiae was performed in Todd–Hewitt broth supplemented with gentamicin (15 µg/mL) and nalidixic acid (8 µg/mL), followed by incubation at 36°C for 18 to 24 hours. Cultures were then plated on 5% sheep blood agar and reincubated under microaerophilic conditions for 24 hours. Beta-hemolytic colonies compatible with the Streptococcus genus were submitted to Gram staining, catalase testing, and the CAMP test. Presumptive confirmation of GBS was performed on chromogenic agar, with bluish colonies considered positive. Confirmed isolates were preserved in BHI broth with 30% glycerol and stored at –70°C until antimicrobial susceptibility testing.

The susceptibility profile was determined according to the standards of the Brazilian Committee on Antimicrobial Susceptibility Testing (BrCAST/EUCAST), 2024 version. The disk diffusion method was used on Mueller–Hinton agar supplemented with 5% horse blood and 20 mg/L β-NAD, incubated at 35±1°C for 18±2 hours in an atmosphere containing 5% CO_2. Inhibition zone diameters were interpreted according to BrCAST breakpoints, classifying isolates as susceptible, intermediate, or resistant. For selected samples, Minimum Inhibitory Concentration (MIC) determination was performed using broth microdilution to confirm resistance observed by diffusion.

Data were entered into an electronic spreadsheet and analyzed using SPSS® software (version 21.0). Descriptive analyses of demographic and clinical variables of the pregnant women, as well as resistance rates to the antimicrobials tested, were performed. Results were presented as absolute and relative frequencies, with a significance level of 5% ($p < 0.05$).

RESULTS

A total of 206 pregnant women participated in the study, with ages ranging from 14 to 43 years (mean ± SD = 24.9 ± 5.7 years). Among the women evaluated, 53 were colonized by Streptococcus agalactiae, resulting in a prevalence of 25.7% of carriers of the agent (Table 1).

Table 1. Summary of the main findings among parturients colonized by Streptococcus agalactiae

Category	Variable analyzed	Main result
Demographic profile	Mean age (years)	24.9 ± 5.7
	Predsominant age group	23 to 30 years (47.6%)
	Area of residence	Urban (97.1%)
	Predominant race/ethnicity	Brown (73.6%)
	Most common marital status	Single (62.3%)
Socioeconomic conditions	Family income	R$ 2.000 to R$ 2.999 (43.4%)
	Educational level	Completed high school (60.4%)
	Ocupation	Homemaker (39.6%), formal employment (34.0%)
Obstetric aspects	Gestational age ≥ 37 weeks	90.6%
	≥ 4 prenatal visits	92.5%
	Gestational diabetes	9.4%
	Obesity grade I	39.6%
	Obesity grade I	62.3%
	Primiparous	13.2%
Primiparous	Vaginal	41.8%
	Anal	7.3%
	Vaginal and anal	25.4%

Sociodemographic analysis showed that 97.1% of the pregnant women lived in urban areas, and nearly half were from Goiânia (47.5%), followed by Aparecida de Goiânia (32.5%). The geographic distribution of colonized women followed a similar pattern, suggesting that GBS colonization is relatively homogeneous across the metropolitan area.

Regarding social characteristics, 56.8% of participants were single, a percentage that increased among colonized women (62.3%), which may reflect social vulnerability and reduced family support during pregnancy. The predominant self-reported race/ethnicity was mixed-race (68.9%), and this percentage was even higher among colonized women (73.6%), indicating a possible overlap between racial factors and inequalities in access to healthcare (Table 6).

Concerning family income, 77.4% of the pregnant women had household incomes between R$ 1,000 and R$ 3,999, with colonized women predominantly concentrated in intermediate income brackets (R$ 2,000 to R$ 2,999). This distribution underscores the predominance of women from lower and middle socioeconomic strata, the typical population served by the municipal public health system.

In terms of education, all participants were literate, and most (63.6%) had completed high school. Only 2.4% reported having completed higher education, a slightly higher proportion among colonized women (5.7%) (Table 7). This educational homogeneity suggests that schooling level alone did not appear to function as a protective or risk factor for colonization.

Regarding occupation, 48.1% of the pregnant women were homemakers, and 29.6% held formal employment. Among colonized participants, the proportion of formally employed women was higher (34.0%), followed by informal workers (9.5%), which may indicate that greater exposure in collective environments could represent an additional risk factor, although no statistically significant association was observed.

Most participants had a gestational age of 37 weeks or more (94.6%), and prenatal care was

satisfactory, with 90.8% attending four or more consultations. This adherence was similar among colonized women (92.5%), indicating that GBS screening does not appear to depend on the frequency of obstetric follow-up.

Regarding associated clinical conditions, 14.1% of pregnant women had gestational diabetes, a slightly lower proportion among colonized women (9.4%). Class I obesity was more frequent in the colonized group (39.6%), whereas severe obesity (classes II and III) was rare or absent. This finding may suggest an association between moderate excess weight and colonization, although the sample size limits definitive conclusions (Table 8).

Recent medication use (28.6%), history of chorioamnionitis (3.4%), placental complications (3.4%), and preeclampsia (3.9%) showed low prevalence, with no relevant differences between groups. Labor duration was predominantly between 13 and 24 hours (52.4%), with a slightly higher proportion among colonized women (58.5%), which may indicate a mild tendency toward longer labor in this subgroup, although without statistical significance.

Most pregnant women had up to two previous pregnancies (69.4%), and 13.2% of colonized women were primiparous, a proportion higher than that of the overall group (7.8%). This may suggest greater susceptibility to colonization among primiparous women, a hypothesis also observed in other population contexts.

Approximately 24.5% of colonized women reported a previous miscarriage, and 62.3% had a history of urinary tract infection during pregnancy, a condition that remained among the most frequent in the positive group. Other events—such as prior preterm birth, membrane rupture, or intrapartum fever—were rare. However, a higher proportion of previous neonatal deaths before three months of age was observed among colonized women (20.8% vs. 14.6%), suggesting a possible indirect clinical impact of maternal GBS colonization.

Positivity was most frequently observed in vaginal samples (41.8%), followed by simultaneous vaginal and anal collections (25.4%), while isolated anal colonization was less common (7.3%). In about one quarter of positive pregnant women (25.4%), it was not possible to determine the specific colonization site due to inconclusive results in one of the tests.

Phenotypic analysis of the isolated strains revealed universal resistance (100%) to at least one antibiotic tested, indicating the presence of multidrug-resistant strains in the study population. Resistance rates were markedly high for clindamycin (83.6%), erythromycin (54.6%), and tetracycline (70.9%), suggesting important limitations in the use of these drug classes as alternative therapies for pregnant women with penicillin allergy.

In contrast, β-lactams maintained broad efficacy, with sensitivity rates above 85% for all agents tested: penicillin (85.5%), ampicillin (92.8%), cefazolin (81.8%), and ceftriaxone (96.4%). These results indicate that circulating strains remain largely susceptible to first-line agents recommended for intrapartum prophylaxis. Table 2 presents the consolidated susceptibility profile of the antimicrobials tested.

Table 2. Consolidated antimicrobial susceptibility profile of the isolates

Antibiotic tested	Susceptible n (%)	Resistant n (%)
Tetracycline	16 (29.1)	39 (70.9)
Ceftriaxone	53 (96.4)	2 (3.6)
Cefazolin	45 (81.8)	10 (18.2)
Ampicillin	51 (92.8)	4 (7.2)
Penicillin	47 (85.5)	8 (14.5)
Cefazolin	25 (45.4)	30 (54.6)
Clindamycin	9 (16.4)	46 (83.6)

Overall, the findings reveal a concerning pattern of resistance among maternal isolates, particularly to macrolides and lincosamides, and reinforce the efficacy of β-lactams as the agents of choice for intrapartum prophylaxis. The consistent presence of multidrug resistance highlights the importance of continuous microbiological surveillance and the rational use of antimicrobials in high-complexity obstetric settings.

DISCUSSION

The prevalence of maternal colonization by Streptococcus agalactiae observed in this study—20.4% by culture and 25.7% by qPCR—falls within the globally estimated range (10% to 40%)[16–19] and is comparable to that reported by Ha et al.[20] in Vietnam (25.5%). These findings confirm that GBS colonization remains frequent in the Brazilian context as well, requiring continuous surveillance and sensitive diagnostic strategies to ensure adequate prophylaxis.

The discrepancy between the methods reinforces the importance of integrating molecular techniques with conventional culture for screening pregnant women. qPCR showed a higher detection rate, consistent with studies demonstrating its superior sensitivity, which reduces the number of false negatives and provides rapid results for intrapartum decision-making.[21–23] This agility is particularly relevant in obstetric care, where the interval between diagnosis and delivery may be decisive for timely antibiotic prophylaxis.

The predominance of the vaginal site as the main location of colonization (41.8%), followed by simultaneous vaginal and anal colonization (25.4%), confirms the lower genital tract as the primary maternal reservoir of GBS. This pattern has been consistently reported across different countries[22,24] and supports the recommendation to include combined vaginal and anal swabbing in screening routines, as outlined by CDC guidelines.[4,25]

Standardization of sampling procedures and the use of more sensitive methodologies are therefore essential for the success of intrapartum prophylaxis. Studies by Rocha et al.[26] and Bogiel et al.[23] demonstrate that real-time PCR enables the identification of colonized women even during labor, allowing immediate antimicrobial administration before birth, which reduces the incidence of early-

onset neonatal infection and maternal complications.

The results obtained demonstrate preserved efficacy of β-lactams against S. agalactiae, corroborating the international consensus that penicillin and ampicillin should remain the first-line drugs for intrapartum prophylaxis.[4,27,28] In the present study, more than 90% of isolates were susceptible to ampicillin and 85.5% to penicillin, values consistent with recent findings from Dutra et al.[29,30] and Ramos.[30] This sustained susceptibility is encouraging, particularly in a scenario of increasing resistance among other obstetric pathogens.

However, the high resistance to macrolides and lincosamides observed in this study (54.6% for erythromycin and 83.6% for clindamycin) represents a significant clinical challenge. These rates exceed the averages reported by Fitoussi et al.,[31] Santana et al.,[32] and Bekele et al.,[33] suggesting a possible expansion of MLS_B phenotypes (mediated by erm and mef genes). Such resistance has a direct impact on obstetric management, since clindamycin and erythromycin are the main alternatives for pregnant women with penicillin allergy.

Given this scenario, it is strongly recommended that, whenever possible, individual susceptibility testing be performed, including the D-test to detect inducible resistance before choosing macrolides or lincosamides, as recommended by the CDC.[25] Failure to follow this approach may result in ineffective prophylaxis and increased risk of early-onset neonatal infection.

Cefazolin, the first-line alternative for patients with mild penicillin hypersensitivity, showed satisfactory susceptibility (81.8%), a value above the critical threshold of 80% proposed by Schrag et al.[4] Ceftriaxone (96.4%) maintained excellent performance, further supporting the safety of β-lactam–based regimens. Nonetheless, the isolated presence of strains resistant to penicillin (14.5%) and ampicillin (7.2%) warrants attention and continuous monitoring, since sporadic cases of resistance have been reported in Europe and Asia.[28,34]

Another relevant point is the heterogeneity of laboratory methods used for GBS screening in Brazil. Culture remains predominant in public healthcare units due to its low cost, but implementation of rapid molecular tests, such as qPCR, could optimize intrapartum diagnosis and prevent unnecessary antibiotic use in women with undefined risk. As highlighted by Costa et al.[21] and Ferreira et al.,[22] qPCR significantly increases detection rates and provides results quickly enough to support timely clinical decision-making, particularly in high-volume maternity hospitals.

In this context, combining low-cost methods (such as the CAMP test) with rapid molecular approaches may represent a feasible hybrid strategy for public services, ensuring diagnostic accuracy and operational efficiency. Implementing these protocols in referral hospitals could reduce costs associated with neonatal infections and improve delivery safety protocols.

The marked resistance to tetracyclines (70.9%), macrolides, and lincosamides reinforces the need for antimicrobial stewardship policies, especially in obstetric units. This pattern has already been documented in Brazil by Ramos,[30] as well as in international studies.[27,35,36] The persistence of high resistance rates suggests environmental selective pressure related to the indiscriminate use of broad-spectrum antibiotics, including outside the hospital setting.

Thus, β-lactam–based intrapartum prophylaxis remains the most effective and safest strategy, and should be administered in a targeted manner and supported by continuous microbiological surveillance. Such vigilance must include the systematic collection of clinical isolates to monitor resistance trends, thereby informing periodic updates of therapeutic recommendations.

CONCLUSION

In this study, maternal colonization by Streptococcus agalactiae showed a prevalence of 25.7% by qPCR and 20.4% by culture, values consistent with the global average. The vaginal site was the most affected (41.8%), followed by simultaneous vaginal and anal colonization (25.4%). The phenotypic profile revealed high susceptibility to β-lactams—penicillin (85.5%), ampicillin (92.8%), and ceftriaxone (96.4%)—and high resistance to clindamycin (83.6%), erythromycin (54.6%), and tetracycline (70.9%), representing an important warning for the empirical management of penicillin-allergic pregnant women. No sociodemographic or obstetric variable showed a statistically significant association with colonization.

Overall, it can be concluded that β-lactams remain the first choice for intrapartum prophylaxis, with penicillin and ampicillin being the most effective and safest agents for prophylactic use. The marked resistance to macrolides and lincosamides reinforces the need for individualized antimicrobial susceptibility testing and the performance of the D-test in pregnant women with penicillin allergy, thereby avoiding therapeutic failures. The gradual implementation of rapid molecular methods, such as qPCR, in combination with conventional culture, may enhance screening and ensure more timely, evidence-based prophylaxis.

This study has limitations, including its cross-sectional design and the inability to apply molecular testing to all samples, which restricts sensitivity and specificity analyses. Future research should expand the number of participants, explore the genotypic characterization of resistant isolates, and evaluate the cost-effectiveness of implementing molecular tests for intrapartum screening. Such advances may strengthen public health policies aimed at preventing perinatal infections and promoting maternal–fetal safety within public healthcare services.

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