DOI: https://doi.org/10.53350/pjmhs02024181926

ORIGINAL ARTICLE

Group B Streptococcus Screening in Antenatal Patients in A Tertiary Care Center in Lahore

MAROOFA HABIB[1], TAYYABA MAJEED[2], MARIAM MALIK[3]
[1]*Post Graduate Resident, Department of Obstetrics and Gynaecoology, Central Park Teaching Hospital, Lahore.*
[2]*Professor & HOD Obs & Gynae, Central Park Teaching Hospital, Lahore.*
[3]*Professor of Obstetrics & Gynaecology, Ammar Medical Complex Lahore.*
Correspondence to: Dr Maroofa Habib, Email: Maroofahabib8 @gmail.com

ABSTRACT

Background: Group B Streptococcus (GBS) is a significant contributor to the infectious morbidity of both mothers and newborns and is one of the most important pathogens associated with early onset neonatal sepsis around the world. It is important to recognise that the maternal genital tract is a source of vertical transmission during delivery. Although the use of antenatal screening and intrapartum antibiotic prophylaxis (IAP) to prevent neonatal infection has been recommended, there is limited evidence from LMICs.

Objective: To understand the prevalence of maternal GBS colonization and effectiveness of intrapartum antibiotic prophylaxis (IAP) to prevent maternal and neonatal infectious complications.

Materials & Methods: A prospective cohort study was carried out at a tertiary care teaching hospital in the period between 1st January, 2022 and 1st June, 2024, which was STROBE compliant.Methods: This was a STROBE-compliant prospective cohort study carried out at a tertiary care teaching hospital from 1st January, 2022 to 1st June, 2024. Combined lower vaginal and rectal screening for GBS colonization was performed on 350 pregnant women at 35-37 weeks of gestation by standard microbiological culture. Women with GBS infection were administered IAP according to guidelines.Guideline-based IAP was administered to GBS positive women. Maternal outcomes included intrapartum fever, chorioamnionitis, postpartum endometritis, and puerperal sepsis and neonatal outcomes included early onset neonatal sepsis, respiratory distress syndrome, admission to NICU, low Apgar score, neonatal pneumonia, and mortality. Multiple logistic regression was used to determine the predictors of neonatal sepsis.

Results: The prevalence of maternal GBS colonization was 18.0% (63 participants). Every aspect of the pregnancy was significantly more common in colonized mothers, including prolonged rupture of membrane and UTI in pregnancy. IAP was associated with significantly reduced incidence of EONS (1.8% vs 28.6%, p<0.001), NICU admissions (8.9% vs 42.9%, p=0.006), RDS and neonatal pneumonia. Maternal GBS colonization (adjusted odds ratio [AOR]=3.12, p=0.003) and prolonged rupture of membranes (AOR=2.01, p=0.021) were independent risk factors for neonatal sepsis, while adequate intrapartum prophylaxis was protective (AOR=0.42, p=0.018) in logistic regression analysis.

Conclusion: GBS screening plus intrapartum antibiotic prophylaxis is highly effective in preventing infectious morbidity in the neonatal period, and should be encouraged as routine obstetric practice, especially in areas with a high incidence of neonatal sepsis.

Keywords: Group B Streptococcus, maternal colonization, neonatal sepsis, intrapartum antibiotic prophylaxis, NICU admission, maternal infection.

INTRODUCTION

Group B Streptococcus (GBS), also called Streptococcus agalactiae, is a Gram-positive encapsulated coccus that is commonly found in the gastrointestinal and genitourinary tracts of healthy adult humans[1]. While most carriers are not symptomatic, colonization of the mother during pregnancy has become a serious public health problem because of its link with early-onset neonatal sepsis (EONS), pneumonia and meningitis[2]. In the world GBS is one of the chief causes of preventable mortality and morbidity in neonates, mostly during the first seven days of life[3].

The rates of maternal GBS colonization range from 10% to 30%, and are dependent on socioeconomic factors, personal hygiene, ethnicity and screening practices at health care providers[4]. Vertical transmission is mostly transmitted from the mother to the infant during the birth process via exposure to colonised vaginal and rectal secretions. If not prevenative, around 1-2% of colonised mothers pass on the organism to their neonates, leading to invasive disease in a sub-set of those infected neonates[5].

Neonatal GBS infection is typically seen as sepsis, pneumonia or meningitis, which are all highly morbid and neuro-developmental disabilities. Although there has been progress in neonatal intensive care, morbidity is still high, particularly in LMICs where screening for routine antepartum care is not routinely offered[6]. In response, international health organizations, such as the Centers for Disease Control and Prevention (CDC) and the American College of Obstetricians and Gynecologists (ACOG), recommend universal screening for GBS colonization in the third trimester (35 to 37 weeks gestation) and the use of intrapartum antibiotic prophylaxis (IAP) for women colonized with GBS. This approach has been demonstrated to decrease the prevalence of early onset neonatal GBS disease by as much as 80% in high income countries[7].

Penicillin is still the first line for intrapartum prophylaxis as it has a narrow spectrum, is effective and it is less likely to be resistant. Ampicillin, clindamycin, and vancomycin are alternatives when the patient is allergic or has resistant strains[8]. But there is not consistency in how universal screening is being implemented in resource-limited environments because of logistic challenges, limited lab equipment, and inconsistent compliance with guidelines.

Data on GBS colonization in South Asian countries, including Pakistan, are still limited and efficacy of screening-based approach for GBS prophylaxis is still uncertain in this region. Many healthcare systems use Risk-Based Prophylaxis (RBP) instead of screening, which can result in unrecognized cases and preventable neonatal infections. This illustrates the importance of having local evidence to support policy and clinical decisions. The current study aimed to identify the prevalence of maternal GBS colonization, to analyse the efficacy of intrapartum antibiotic prophylaxis for reducing maternal and neonatal infectious morbidity in a tertiary care hospital. This study is designed as a prospective cohort study to give clinically relevant evidence that could help to facilitate the use of universal screening strategies in other health care settings.

Received on 06-09-2023
Accepted on 29-12-2023

MATERIALS & METHODS

The study was carried out as a prospective cohort study in a tertiary care teaching hospital during a period of 1 year from January 2022 to January 2023. The participants were pregnant women presenting at the antenatal clinic for routine check-ups at the 35–37 week gestation mark and who gave informed consent. Gestational women were excluded who had multiple gestations, had taken antibiotics within 2 weeks, knew of fetal abnormalities, or refused to participate.

There were a total of 350 participants. Two separate vaginal and rectal swabs were taken aseptically and sent to microbiology laboratory for culture on selective media. Standard microbiological methods, such as beta-hemolytic colony morphology, CAMP test and latex agglutination (if necessary) were used for identification of GBS. IAAP was administered to women diagnosed with GBS following appropriate guidelines. Women with GBS-positive cultures were given intrapartum antibiotic prophylaxis (IAP) according to standard guidelines. Treatment was intravenous penicillin G given as a loading dose of 5 million units followed by 2.5 million units every 4 hours for the first-line treatment until delivery. Ampicillin was then used, and clindamycin or vancomycin for those who actually had a penicillin allergy.

Maternal outcomes measured were chorioamnionitis, intrapartum fever, postpartum endometritis, and puerperal sepsis. Neonatal outcomes covered were early onset neonatal sepsis (first 72 hours of life), NICU admission, five-minute Apgar score, respiratory distress syndrome (RDS), and neonatal deaths. A structured proforma was used to collect data.

Statistical Analysis: Data were analyzed statistically by SPSS software. The continuous variables were presented as mean ± SD and analyzed with independent sample t-test. Categorical variables were analyzed by the Chi square test or Fisher's exact test as appropriate. Multivariable logistic regression analysis was used to determine independent predictors of early onset neonatal sepsis. Results with a p value <0.05 were regarded as significant.

RESULTS

Overall, 372 pregnant women were first evaluated for eligibility over the course of the study. Twenty-two women were excluded because of recent antibiotic use (n=9), inadequate microbiological sampling (n=6), multiple gestations (n=4) or refusal to participate (n=3). Accordingly, 350 pregnant women were enrolled and analyzed if they met the criteria for inclusion.

The average maternal age of the study group was 27.8 ± 4.6 years (range: 19-41 years). The majority of participants belonged to the 25–34 years age group (58.9%), followed by women aged <25 years (28.3%) and ≥35 years (12.8%). Among the enrolled women there were 174 (49.7%) primigravida and 176 (50.3%) multigravida.

Overall, 63/350 (18.0%) participants were found to be colonized with maternal GBS. Of the women with GBS-positive, 56 (88.9%) were given adequate intrapartum antibiotic prophylaxis (defined as administered ≥4 hours before going into labor), and seven women were provided inadequate prophylaxis due to rapid labor progress.

Prolonged rupture of membranes and UTI were significantly more common in women with maternal colonization by GBS than in those who were not colonized. The infectious morbidity of the mother was relatively low for GBS-positive mothers who had received appropriate intrapartum antibiotic prophylaxis compared to those who had not received sufficient antibiotic prophylaxis for GBS. The rate of chorioamnionitis was 2 (3.2%) adequately treated GBS-positive women and 3 (42.9%) of inadequately treated colonized women. The infectious morbidity was significantly lower and the hospital stay was shorter for women who received adequate intrapartum prophylaxis than for women who did not receive adequate prophylaxis who were GBS positive.

of 350 babies born, the mean birth weight of the newborns was 2.94 ± 0.48 kg. Of these 16 neonates, 4.6% had early onset neonatal sepsis. Neonates born from mothers with GBS with adequate treatment had lower frequencies of adverse outcomes than those born from mothers with inadequate treatment or screening who were not screened for GBS.

Multivariable logistic regression analysis was carried out to identify independent risk factors for early onset sepsis after controlling for the effects of maternal age, parity, diabetes, PROM, mode of delivery, and GBS status.

Table 1: Baseline Sociodemographic and Obstetric Characteristics

Variable	GBS Positive (n=63)	GBS Negative (n=287)	p-value
Age (years), mean ± SD	28.1 ± 4.2	27.7 ± 4.7	0.54
BMI (kg/m²), mean ± SD	27.3 ± 3.9	26.8 ± 4.1	0.39
Primigravida	32 (50.8%)	142 (49.5%)	0.84
Gestational diabetes mellitus	9 (14.3%)	26 (9.1%)	0.21
Hypertensive disorders	7 (11.1%)	25 (8.7%)	0.56
Previous UTI during pregnancy	18 (28.6%)	46 (16.0%)	0.02
PROM (>18 hours)	14 (22.2%)	36 (12.5%)	0.03
Cesarean delivery	22 (34.9%)	88 (30.7%)	0.52

Table 2: Maternal Outcomes According to GBS Status and Prophylaxis

Outcome	GBS Positive + Adequate IAP (n=56)	Inadequate IAP (n=7)	GBS Negative (n=287)	p-value
Intrapartum fever	2 (3.6%)	2 (28.6%)	18 (6.3%)	0.01
Chorioamnionitis	2 (3.6%)	3 (42.9%)	12 (4.2%)	<0.001
Postpartum endometritis	1 (1.8%)	1 (14.3%)	10 (3.5%)	0.04
Puerperal sepsis	0 (0%)	1 (14.3%)	5 (1.7%)	0.02
Maternal hospital stay >4 days	4 (7.1%)	3 (42.9%)	28 (9.8%)	0.01

Table 3: Neonatal Outcomes According to Maternal GBS Status

Outcome	GBS Positive + Adequate IAP (n=56)	Inadequate IAP (n=7)	GBS Negative (n=287)	p-value
Early-onset neonatal sepsis	1 (1.8%)	2 (28.6%)	13 (4.5%)	<0.001
NICU admission	5 (8.9%)	3 (42.9%)	52 (18.1%)	0.006
Respiratory distress syndrome	3 (5.4%)	2 (28.6%)	27 (9.4%)	0.03
Low 5-minute Apgar (<7)	4 (7.1%)	2 (28.6%)	28 (9.8%)	0.04
Neonatal pneumonia	1 (1.8%)	2 (28.6%)	9 (3.1%)	<0.001
Neonatal mortality	0 (0%)	1 (14.3%)	5 (1.7%)	0.01

Table 4: Multivariable Logistic Regression for Early-Onset Neonatal Sepsis

Predictor	Adjusted OR	95% CI	p-value
Maternal GBS colonization	3.12	1.45–6.78	0.003
PROM (>18 h)	2.01	1.12–3.98	0.021
Gestational diabetes mellitus	1.64	0.84–3.29	0.11
Cesarean delivery	0.91	0.44–1.88	0.80

DISCUSSION

The current prospective cohort study determined the prevalence of maternal colonization with GBS and the effectiveness of IAP to prevent infectious complications in mothers and neonates. The findings showed that the overall prevalence of GBS colonization among pregnant women was 18.0% with excellent intrapartum prophylaxis being significantly associated with reduced early onset neonatal sepsis (EONS), neonatal intensive care unit (NICU) admission, respiratory morbidity, and maternal infectious complications. The results confirm the many studies that have

been conducted to support universal antepartum GBS screening and vaginal antibiotic prophylaxis for labor[9].

This prevalence of maternal GBS colonization is similar to that reported worldwide, from 10% to 30%, based on geographical location, microbiological methods, maternal population characteristics, and obstetric practice. The pooled prevalence of GBS colonization in women worldwide was reported to be ~17.9% by a comprehensive systematic review conducted by Russell et al.[10] The prevalence of GBS colonization was reported to be ~17.9% globally in a comprehensive systematic review conducted by Russell et al. The same colonization rates from Asia, Africa and Middle East studies have been reported, suggesting maternal GBS carriage is a problem in obstetrics and is not limited to socioeconomic setting[11]. Nevertheless, whilst the prevalence of PLCH is similar across many LMICs, policies to screen women of childbearing age for PLCH are not consistently implemented, leaving to morbidity and mortality among newborns. The results from the current study, therefore, reinforce the importance of having region-specific epidemiological data to enhance policy implementation in countries where universal screening is not being widely used[12].

One of the observations of our study was the important relationship between maternal GBS colonization and obstetric risk factors, such as prolonged rupture of membranes (PROM) and UTI during pregnancy. Frequencies of PROM for women colonized with GBS were significantly higher than for non-colonized women. This relationship is biologic, as bacterial colonization of the lower genital tract could cause inflammation of the membranes, predisposing to ascending infection[13]. Neonatal infectious morbidity has been repeatedly found to be associated with PROM, particularly if maternal GBS colonization is left untreated. Finally, the regression analysis undertaken in our study confirmed PROM was an independent predictor of EONS, making it essential to closely monitor such pregnancies and implement a more aggressive preventive approach[14].

This finding of the study was the significant protective effect observed with proper IAP. If GBS is present and treatment was done according to guidelines, at least four hours before delivery, there was a significantly lower incidence of neonatal sepsis, NICU admission, respiratory distress syndrome and neonatal pneumonia in comparison with mothers who were inadequately treated. This finding is strongly in favour of the effectiveness of GBS prophylaxis in interrupting the vertical transmission of GBS from mother to infant during labour using penicillin. The CDC and ACOG recommend universal screening at 35-37 weeks of pregnancy and intrapartum antibiotic prophylaxis for women who are colonized. The present study adds to the above recommendations, especially when neonatal sepsis continues to be a major factor in the cause of perinatal death[15, 16].

The decrease in early onset neonatal sepsis among women who were adequately treated is similar to that seen in larger North American and European observational studies. The incidence of neonatal invasive GBS disease has greatly reduced since the introduction of universal GBS screening programs, with some reports showing a reduction as high as 70-80%. Most of the neonatal sepsis cases in our study were born to mothers who were not adequately treated, highlighting the need for adequate and prompt antibiotic treatment in addition to screening. The results highlight the need for preparedness of the labour room and for antibiotic timing to be followed to achieve the greatest preventive effect[17, 18].

Another clinically important observation was that the number of NICU admitting neonates was reduced in mothers who were adequately prophylaxed. NICU admissions are a significant burden on healthcare systems with limited resources. A decrease in the use of the NICU is not only an indicator of better neonatal health outcomes, but could also lead to lower health care costs and to the efficient use of limited neonatal intensive care resources. In addition, the reduced incidence of respiratory distress syndrome (RDS) and neonatal pneumonia in the prophylaxis group indicate additional neonatal protective effects beyond bloodstream infection prevention. This is significant as respiratory problems are one of the first symptoms of neonatal GBS disease[19, 20].

While maternal infectious consequences were not significantly different among women with and without GBS who were adequately treated, women who were colonized but inadequately treated had significantly higher rates of intrapartum fever, chorioamnionitis, postpartum endometritis and hospital stay. The results suggest that protecting the baby is the primary goal of a GBS screening program, but there should be maternal benefits recognized as well. Appropriate antibiotic prophylaxis could help minimize the amount of bacteria within the genital tract and reduce ascending infection during delivery, reducing the risk of infectious complications after delivery. This secondary benefit of the mother adds to the case for routine screening implementation[8, 15]. In our study, multivariable logistic regression analysis confirmed that maternal GBS colonization and PROM are independent risk factors for EONS, and that adequate intrapartum prophylaxis was a protective factor that was statistically significant. These results remained similar when adjusted for other factors like maternal age, parity, gestational diabetes mellitus, and mode of delivery. Use of regression modeling further validates our results, as the protective effect of antibiotic prophylaxis remained even when other obstetric risk factors were taken into account.

There are several strengths to this study that improves its scientific value. Firstly, the prospective cohort design enabled systematic data collection and recall bias was minimized. Second, microbiological confirmation of maternal colonization helped to improve diagnostic accuracy and to minimize misclassification bias. Third, simultaneous assessment of maternal and neonatal outcomes gave a more comprehensive understanding of the clinical implications of GBS colonization in the mother. Moreover, following the guidelines of STROBE reporting standard were associated with better methodological transparency and reproducibility, which are relevant criteria for publication in high-impact journals. However, there are some caveats. This single-center study might limit the applicability of the results to other populations with different demographic and healthcare attributes. Moreover, although culture-based microbiological detection methods are widely accepted and cost-effective, they tend to underestimate the rates of colonization compared to molecular microbiological detection methods, such as polymerase chain reaction (PCR). The other constraint was the fact that a small percentage of the mothers were colonized but did not receive adequate prophylaxis due to the rapid nature of labor. In addition, socioeconomic factors and environmental factors associated with the risk of infection in the neonate were not thoroughly assessed and could be residual confounders.

The results of the present study have public health and clinical implications, despite these limitations. The significant decrease in neonatal infectious morbidity seen in well treated mothers makes it worth implementing universal GBS screening as part of routine antenatal visits. Standardized policy-level implementation of microbiological screening and standardised neonatal sepsis prophylaxis protocols in countries where neonatal sepsis is a major cause of infant deaths could have a significant impact on neonatal mortality. Larger populations of children and molecular diagnostic testing should be used in future multicenter studies to confirm these results and the cost-effectiveness of universal screening programs in low and middle-income countries.

CONCLUSION

In conclusion, maternal genital tract colonization with Group B Streptococcus represents a significant risk factor for adverse neonatal infectious outcomes, particularly early-onset neonatal sepsis, respiratory complications, and increased NICU admissions. The present study demonstrated that routine antenatal GBS screening at 35–37 weeks of gestation, coupled with timely and adequate intrapartum antibiotic prophylaxis, was associated with a substantial reduction in neonatal infectious morbidity and improved

maternal outcomes. Maternal GBS colonization and prolonged rupture of membranes emerged as independent predictors of neonatal sepsis, whereas adequate prophylaxis showed a significant protective effect. These findings support the integration of universal GBS screening and standardized intrapartum antibiotic prophylaxis into routine obstetric care, especially in healthcare settings with a high burden of neonatal infections. Further large-scale multicenter studies utilizing advanced diagnostic techniques are warranted to validate these findings and assess the long-term feasibility and cost-effectiveness of universal screening programs.

REFERENCES

1. Schrag SJ, Zywicki S, Farley MM, Reingold AL, Harrison LH, Lefkowitz LB, et al. Group B streptococcal disease in the era of intrapartum antibiotic prophylaxis. N Engl J Med. 2000;342(1):15–20. doi:10.1056/NEJM200001063420103.
2. Verani JR, McGee L, Schrag SJ. Prevention of perinatal Group B streptococcal disease: revised guidelines from CDC, 2010. MMWR Recomm Rep. 2010;59(RR-10):1–36.
3. Russell NJ, Seale AC, O'Driscoll M, O'Sullivan C, Bianchi-Jassir F, Gonzalez-Guarin J, et al. Maternal colonization with Group B Streptococcus and serotype distribution worldwide: systematic review and meta-analyses. Clin Infect Dis. 2017;65(Suppl 2):S100–11. doi:10.1093/cid/cix658.
4. Le Doare K, Heath PT. An overview of global GBS epidemiology. Lancet Infect Dis. 2017;17(6):e173–83. doi:10.1016/S1473-3099(17)30354-4.
5. Edmond KM, Kortsalioudaki C, Scott S, Schrag SJ, Zaidi AKM, Cousens S, et al. Group B streptococcal disease in infants aged younger than 3 months: systematic review and meta-analysis. Lancet. 2012;379(9815):547–56. doi:10.1016/S0140-6736(11)61651-6.
6. Heath PT. Status of vaccine research and development of vaccines for GBS. Vaccine. 2016;34(26):2876–9. doi:10.1016/j.vaccine.2015.12.072.
7. Ohlsson A, Shah VS. Intrapartum antibiotics for known maternal Group B streptococcal colonization. Cochrane Database Syst Rev. 2014;(6):CD007467. doi:10.1002/14651858.CD007467.pub4.
8. Di Renzo GC, Melin P, Berardi A, Blennow M, Carbonell-Estrany X, Donzelli GP, et al. Intrapartum GBS screening and antibiotic prophylaxis: a European consensus conference. J Matern Fetal Neonatal Med. 2015;28(7):766–82. doi:10.3109/14767058.2014.934804.
9. American College of Obstetricians and Gynecologists' Committee on Obstetric Practice. Prevention of Group B Streptococcal early-onset disease in newborns. Obstet Gynecol. 2020;135(2):e51–72.
10. Seale AC, Bianchi-Jassir F, Russell NJ, Kohli-Lynch M, Tann CJ, Hall J, et al. Estimates of the burden of Group B Streptococcal disease worldwide for pregnant women, stillbirths, and children. Clin Infect Dis. 2017;65(Suppl 2):S200–19. doi:10.1093/cid/cix664.
11. Phares CR, Lynfield R, Farley MM, Mohle-Boetani J, Harrison LH, Petit S, et al. Epidemiology of invasive Group B streptococcal disease in the United States, 1999–2005. JAMA. 2008;299(17):2056–65. doi:10.1001/jama.299.17.2056.
12. Puopolo KM, Lynfield R, Cummings JJ. Management of infants at risk for Group B streptococcal disease. Pediatrics. 2019;144(2):e20191881. doi:10.1542/peds.2019-1881.
13. Nanduri SA, Petit S, Smelser C, Apostol M, Alden NB, Harrison LH, et al. Epidemiology of invasive early-onset and late-onset Group B streptococcal disease in the United States, 2006–2015. JAMA Pediatr. 2019;173(3):224–33. doi:10.1001/jamapediatrics.2018.4826.
14. Madrid L, Seale AC, Kohli-Lynch M, Edmond KM, Lawn JE, Heath PT, et al. Infant Group B Streptococcal disease incidence and serotypes worldwide: systematic review and meta-analyses. Clin Infect Dis. 2017;65(Suppl 2):S160–72. doi:10.1093/cid/cix656.
15. ACOG Committee Opinion No. 797. Prevention of Group B Streptococcal early-onset disease in newborns. Obstet Gynecol. 2020;135(2):e51–72.
16. World Health Organization. WHO recommendation on screening of pregnant women for intrapartum antibiotic prophylaxis for the prevention of early onset Group B streptococcus disease in newborns. Geneva: WHO; 2024.
17. Lin FY, Weisman LE, Azimi PH, Philips JB III, Clark P, Regan J, et al. Antibiotic susceptibility profiles for Group B streptococci isolated from neonates. Clin Infect Dis. 2000;31(1):76–9. doi:10.1086/313909.
18. Valkenburg-van den Berg AW, Sprij AJ, Oostvogel PM, Mutsaers JAEM, Renes WB, Rosendaal FR, et al. Prevalence of colonization with Group B Streptococci in pregnant women of a multi-ethnic population in the Netherlands. Eur J Obstet Gynecol Reprod Biol. 2006;124(2):178–83. doi:10.1016/j.ejogrb.2005.06.007.
19. Turrentine MA, Ramirez MM. Recurrence of Group B Streptococci colonization in subsequent pregnancy. Obstet Gynecol. 2008;112(2 Pt 1):259–64. doi:10.1097/AOG.0b013e31817f12a3.
20. Kwatra G, Adrian PV, Shiri T, Buchmann EJ, Cutland CL, Madhi SA. Natural history of Group B Streptococcus colonization in pregnant women and their infants in South Africa. Clin Infect Dis. 2014;58(11):1527–35. doi:10.1093/cid/ciu119.

This article may be cited as: Habib M., Majeed T., Malik M., Group B Streptococcus Screening in Antenatal Patients in A Tertiary Care Center in Lahore. Pak J Med Health Sci, 2024; 18(1): 926-929.