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RESEARCH ARTICLE
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URINARY TRACT INFECTION AND ANTIBIOTIC SUSCEPTIBILITY PROFILE OF UROPATHOGENS AMONG PREGNANT WOMEN

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Abstract

Background: UTIs are considered to be among the most common types of bacterial infections during pregnancy and can lead to adverse maternal and child outcomes, including pyelonephritis, preterm birth, and low birth weight. It is crucial to comprehend the risk factors and prevalence of antibiotic susceptibility of the uropathogens in pregnant women so that one can be able to offer effective and safe clinical care.

Purpose: The aim of the study was to find the incidence of bacteriuria in pregnant women, predictive demographic and clinical factors of such infection, as well as the profile of susceptibility to antibiotics of single uropathogens.

Methods: A cross-sectional study was conducted on 279 pregnant women who attended the antenatal clinics. Data regarding demographic characteristics, clinical history, and symptoms were collected by use of a validated questionnaire. Cultures were done in midstream urine, and a significant bacteriuria was defined as 10. The isolates were characterized through the common microbiological tests, and antibiotic susceptibility testing was done through the use of the Kirby-Bauer disk diffusion test according to the CLSI guidelines. The normality, reliability, and validity tests were carried out, followed by an independent sample t-test, one-way ANOVA, Kruskal-Wallis test, Chi-square test of independence, Pearson correlation, and logistic regression tests.

Results: The reliability of the questionnaire was excellent (Cronbach's Alpha = 0.812), and the validity measures were decent (KMO = 0.713, p< 0.001 = Bartlett). Compared to the other groups, group comparisons revealed significant associations of culture positivity and demographic variables, which were age (t = 2.45, p = 0.015), trimester (F = 4.12, p = 0.008), education (H = 6.37, p = 0.041), and past UTI history (H 2 = 10.56, p = 0.005). Pearson correlation showed good and significant correlation between the age, parity, trimester, and previous UTI and the outcomes of the cultures (p < 0.05). Logistic regression had determined that age (OR = 1.16, p = 0.005), trimester (OR = 1.23, p = 0.002), and parity (OR = 1.19, p = 0.004) were predictive factors of bacteriuria. The sensitivity of nitrofurantoin and fosfomycin to E. coli and Klebsiella spp. was high, whereas pre-existing agents were moderately sensitive.

Conclusion: UTIs have become a significant problem in pregnant women, particularly in the aged and multiparous women in the later trimesters and with a history of previous infection. Safe and effective management is compulsory for the regular screening, culture confirmation, and making use of the local antibiotic sensitivity patterns. Nitrofurantoin and fosfomycin can still be regarded as first-line therapy in pregnancy. Enhanced surveillance and entrenching certain interventions in the antenatal care will result in a drastic shift in the maternal and neonatal outcomes.

Keywords: The keywords used were Urinary tract infection, pregnancy, uropathogens, antibiotic susceptibility, bacteriuria, nitrofurantoin, and fosfomycin.

Introduction

UTIs belong to the number of most common bacterial infections that plague women throughout the world, and their impact is even more disastrous concerning pregnancy. Pregnant women are predisposed to develop bacteriuria and subsequent infections because of the physiological and anatomical changes in the urinary system, namely due to the progesterone-induced relaxation of the smooth muscles and increase in the bladder capacity. UTIs in pregnancy do not have clinical significance on maternal pain alone due to the already established associated consequences, including pyelonephritis, anemia, hypertensive complications, and sepsis, as well as adverse neonatal outcomes such as preterm birth, intrauterine growth retardation, and low birth weight. In this connection, the prevention, early detection, and effective treatment of UTIs among pregnant women are a significant part of the antenatal care (Kebede et al., 2025).

Asymptomatic bacteriuria during pregnancy is between 2 and 15 percent per the world, and other pathological diseases are also widespread, such as cystitis and pyelonephritis. The most consistent risk factors that are associated with bacteriuria include the senior maternal age, multiparity, low socioeconomic status, low hygiene, diabetes mellitus, and prior urinary infection. The burden of UTIs in pregnancy is negatively affected by the resource-limited environment due to ineffective screening and the lack of the capacity to process laboratory tests, which ultimately causes unnecessary maternal and neonatal morbidity. The Agranul and other national guidelines recommend a routine screening of bacteriuric pregnant women during the antenatal visit, but adherence to the guidelines is a heterogeneous practice across the healthcare systems, particularly in the low and medium-income states (Al-Shehari et al., 2025).

Most populations of Escherichia coli (70-80) are involved, and gram-negative bacilli are prevalent in the microbiology of UTIs in pregnant women. Other uropathogens that have clinical importance include Klebsiella spp, Proteus spp, Enterococcus spp, and Staphylococcus saprophyticus. They primarily are the gastrointestinal or perineal organisms that go as far as the colonization of the urinary tract. The treatment of UTIs in pregnancy is complicated by the factor of fetal safety since the majority of the antimicrobials, such as fluoroquinolone or tetracycline, and others, are contraindicated. This lowers the array of treatment options, and one should identify the pattern of causative organisms in immediate surroundings and the local trends of susceptibility to the antibiotics (Gena et al., 2025).

One of the significant challenges in clinical practice is antimicrobial resistance (AMR) as an international health crisis, and uropathogen resistance is a problem. Most regions, South Asia, and Sub-Saharan Africa have reported developing resistance against the first-line antibiotics such as ampicillin, trimethoprim-sulfamethoxazole, and some cephalosporins. Conversely, nitrofurantoin and fosfomycin have been effective in most of the Gram-negative uropathogens; hence, they are a superior option in reducing UTIs in pregnancy. However, the local differences in the pattern of resistance require that the local surveillance studies be used to inform the evidence-based empiric therapy. Without timely and accurate antibiograms, there is a likelihood of pregnant women being exposed to ineffective antibiotics, which contributes to the common cases of re-infection, complications, and further transmission of resistant strains (Edin et al., 2025).

Although UTIs are recognized as a major issue in the course of pregnancy, bacteriuria and susceptibility trends of uropathogens are scarce in most low-resource environments. In case there are studies, there will be variability in the methodology and also inconsistency in screening practices that will make it difficult to compare. Furthermore, the need to place the microbiological findings into the context of the demographic and clinical predictors, such as maternal age, parity, trimester, and history of previous infections, is increasing, as the latter define the risks and outcomes. Such gaps will be elaborated, thus providing valuable information to the clinicians as well as the policy makers of public health (Adjei & Adjei, 2025).

The paper at hand will be devoted to determining the incidence of bacteriuria among pregnant women, the spectrum of uropathogenic agents, and the tendency of antibiotic susceptibility. The proposed study is expected to contribute to the enhanced knowledge of the burden of UTIs in pregnancy and to design tailored screening and management strategies using the combination of the microbiological information and demographic and clinical risk factors. Such evidence has a high tendency of ultimately improving maternal and neonatal outcomes, promoting better antimicrobial stewardship, and contributing to the achievement of successful policies of antenatal care (Ifrah et al., 2025).

Literature Review

UTIs are also one of the most common bacterial infections that are very much experienced during the term of pregnancy and have been studied widely all over the world. The biological alterations in pregnancy, which occur because of the ureter dilatations, bladder expansion, and hormonal influence on the urinary stasis, put pregnant women at risk of bacterial and symptomatic infections. According to the literature, UTIs in pregnancy are not merely harmless diseases, but they are related to other complications that include maternal anemia, hypertension, premature birth, and low birth weight. UTIs are, hence, not merely a clinical problem, but also a health problem (Derebe et al., 2025).

The prevalence rates of bacteriuria during pregnancy vary in various regions, which is evidence of methodological differences in screening and the effects of the socio-demographic factors. In high-income countries, the prevalence of asymptomatic bacteria is usually calculated to be 210 percent as compared to 1020 percent in low and middle-income countries (LMICs). A study on the prevalence of some Nigerian, Ethiopian, and Indian diseases has been published, indicating that prevalence was over 15 percent and, therefore, unexplained disproportionate burden in resource-constrained settings. The World Health Organization (WHO) believes that it is possible to attribute most of this high burden to poor access to routine antenatal screening, poor state of hygiene, and the availability of effective antimicrobial agents (Balaji et al., 2025).

The literature body has also documented risk factors associated with bacteriuria during pregnancy. Age of the mother has continuously been cited as an important attribute, where women in their later years have been reported to have higher rates of infections. One more issue, which is well known, is the parity, since multiparous women tend to be at increased risk due to cumulative anatomical and physiological changes between pregnancies. The socioeconomic status, level of education, and hygienic practices have also been proven to influence susceptibility. Further research also suggests that women who have a prior history of urinary tract infection are likely to experience it during

pregnancy. The comorbidities that predispose the risk factor are diabetes mellitus and hypertension, which impair the functions of the immune system and prepare good environments in which the bacteria can survive (Mastura et al., 2025).

The microbial pathophysiology of UTI in pregnancy has remained remarkably unchanged over decades of study, in which Escherichia coli is most commonly causative. It is a disease brought about by E. coli because it can bind to uroepithelial cells and ascend through the urinary tract, and it has been discovered to have 6080 percent cases (European, Asian, and African studies). Other common uropathogens were found by Kellebleu et al. as Klebsiella pneumoniae, Proteus mirabilis, Enterococcus faecalis, and Staphylococcus saprophyticus. Rarely, Pseudomonas aeruginosa, other Gram-negative bacilli have also been implicated and especially in recurrent infections or complicated infections. Geographical reasons, environmental reasons, and health care-related reasons have been identified as the common reasons for the microbial distribution, but the universal reality has been the prevalence of E. coli (Waheed et al., 2025).

Based on the susceptibility patterns of these uropathogens to antibiotics has also been of great interest since it has come into the limelight of focus as the number of cases of antimicrobial resistance (AMR) has been escalating. Historically, the first-generation cephalosporins, ampicillin, cotrimoxazole (trimethoprim-sulfamethoxazole), and first-generation cephalosporins were used as first-line drugs in pregnancy. However, recent reports in Asia and Africa are encountering resistance frequencies to E. coli and Klebsiella isolates of over 50 percent to these agents. This has been attributed to the large-scale abuse and over-the-counter sale of antibiotics in the majority of LMICs, leading to the selection of the dominant antigens. Comparatively, nitrofurantoin and fosfomycin have been demonstrated to be susceptible to E. coli with the highest amount (typically greater than 8090). This makes them the first-line agents of choice for lower UTIs in pregnancy despite the fact that nitrofurantoin is not administered in suspected pyelonephritis and in late-term pregnancy due to neonatal hemolysis (Elarusy et al., 2025).

Resistance trends. The growing threat of extended-spectrum beta-lactamase (ESBL)-producing isolates, in particular Enterobacterales (e.g., E. coli and Klebsiella pneumoniae), has also come into the limelight as a result of studies of resistance trends. Manufacturers of ESBN are resistant to third-generation cephalosporins, which have become commonly used in different environments. Reportedly, in India, in Pakistan, and in certain regions of Sub-Saharan Africa, the incidence of ESBL is between 20 to 40 percent of the uropathogens that are isolated in pregnant women, and this significantly limits the treatment choices. Preferably, among them, carbapenems can be used in such cases, but they require care during pregnancy due to their safety and the risk of stimulating further resistance. This scenario raises the need to carry out routine local antibiogram surveillance to inform the selection of empiric therapy (Odindo et al., 2025).

In addition to microbial and pharmacological conditions, several studies have been done regarding the significance of screening measures in the reduction of UTI-related complications during pregnancy. The most effective method of diagnosis is urine culture regularly, but this is often not used in LMICs due to the cost and capacity of the laboratories. Many medical professionals therefore use leukocyte esterase or nitrite dipstick tests, but they are less sensitive and specific than culture, though cheap and fast in method. The evidence that untreated asymptomatic bacteriuria is associated with a significantly elevated risk of developing pyelonephritis and preterm birth has been proven in systematic reviews, but antibiotic treatment will lower the risk by a significant margin. Therefore, incorporation of the culture-based screening into the antenatal processes is strongly advised in any possible way (Trinchera et al., 2025).

It was also mentioned in the recent literature that risk stratification with the use of both demographic and clinical predictors should be regarded as significant. The microbiological data can be added to their predictors (age, parity, trimester, history of past UTIs) to help clinicians better focus their screening and intervention efforts on women who are at the highest risk. Various cohort studies have demonstrated these associations and provide an element of credibility to the significance of a multi-faceted risk-based approach. Along with that, the medical and health education sources indicate that health education must be prepared in a way that would promote awareness of the needs

of pregnant women regarding the hygiene practices, adherence to the regimen of antibiotics given by a doctor, and the danger of the untreated infection (Mahshouri et al., 2025).
Despite the massive research studies, there are gaps that are critical. There is much literature available that has small sample sizes, is centred-based based and lacks standardized approaches to the antibiotic susceptibility testing. There are also no longitudinal studies that investigate the recurrence of infections in pregnancy and postpartum. In addition, there is little researches that use microbiological evidence and maternal and neonatal outcomes, which leaves gaps in the comprehension of how the incidence of antibiotic resistance specifically influences the issues related to pregnancy. This will necessitate the filling of these gaps with multicenter research, standardized procedures, and microbiological, clinical, and epidemiological data (Tebabal et al., 2025).

Research Methodology

In our research, the phenomenon under investigation was the incidence of urinary tract infection (UTIs) in pregnant women and the determination of the antibiotic susceptibility profile of isolated uropathogens. The study design employed in the study was a cross-sectional, observational study design. The research design was sound in ensuring the scientific rigor, reproducibility, and adherence to ethical principles (Taha, 2024).

Study Setting and Population

The research was conducted in the antenatal clinics of Department of Gynaecology and Obstetrics, Indus Medical College, Tando Muhammad Khan, Sindh, which is a referral center to the urban and peri-urban population. The pregnant women who received regular antenatal care during the study period were considered the study population. Inclusion criteria consisted of informed consent of women aged 18 to 42 years old, at any stage of pregnancy. To minimize confounding factors, the women, who had received some antibiotic therapy within the previous two weeks, had indwelling catheters or were known to have a structural abnormality in the urinary tract, were excluded (Tula et al., 2020).
Place of Study: Department of Gynaecology and Obstetrics, Indus Medical College, Tando Muhammad Khan, Sindh, Pakistan.

Sample Size and Sampling Technique

The sample size of 279 was determined with the help of the prevalence of bacteriuria that was anticipated to be approximately 20, a 95 percent confidence interval, and the margin of error should be 5. The sampling strategy adapted was systematic random sampling, and all the third pregnant women who came to the clinic were recruited up to the target sample. It has been chosen because this sampling technique would reduce selection bias but make the sample representative of the population of people at the antenatal stage (Ejerssa et al., 2021).

Data Collection Tools and Procedures

The structured questionnaires were given to the participants by trained research assistants to gather the demographic data (age, parity, education level, occupation), clinical history (UTIs in past, use of antibiotics in past three months, comorbid diseases like diabetes, high blood pressure, or anemia) and symptoms (dysuria, frequency, urgency, suprapubic pains, fever, pain in the waist). In addition, the degree of knowledge and practice of the participants concerning the issue of UTIs and antibiotic usage was documented (Bhargava et al., 2022).
As one of the requirements to perform the microbiological analysis, all the participants were recommended to provide a clean-catch midstream urine sample in a sterile vessel. These samples were transported less than 2 hours post collection, or refrigerated at 4 o C, and in less than four hours, lest the contaminants grew excessively (Teferi et al., 2023).

Laboratory Analysis

Samples of urine were on Cystine Lactose Electrolyte Deficient (CLED) agar, MacConkey agar, and blood agar plates. An incubation period was performed at 37 o C for 24-48 hours. The high bacteriuria was deemed to be the multiplication of 105 colony-forming units per milliliter (CFU/mL) or more of a single organism or 104 CFU/mL or more of CFU/mL in symptomatic women. The identification of the isolates was done by standard biochemical tests, and where possible, further confirmation was done using automated systems (Ngong et al., 2021).

Kirby-Bauer disk diffusion assay on Mueller-Hinton agar to establish the susceptibility to antibiotics was performed according to the recommendations of Clinical and Laboratory Standards Institute (CLSI). Some of the antibiotics in the panel included nitrofurantoin, fosfomycin, amoxicillin-clavulanate, cephalexin, ceftriaxone, gentamicin, piperacillin-tazobactam, and meropenem. They also noted resistant profiles of trimethoprim-sulfamethoxazole and ciprofloxacin, but these are not widely used in pregnancy to determine their stewardship. Quality control strains (E. coli ATCC 25922, S. aureus ATCC 25923, P. aeruginosa ATCC 27853, E. faecalis ATCC 29212) were used to ensure quality control (Dube et al., 2022).

Data Management and Analysis

The data have been entered into the spreadsheet and analyzed using SPSS 26. Such as the rates of prevalence, the distribution of pathogens, and the percentage of susceptibility have been determined using descriptive statistics. The relationship between demographic/clinical factors and bacteriuria was assessed with the help of the chi-square test. Logistic regression was used to determine independent risk factors. The level of statistical significance defined was $p<0.05$ (Diorio de Souza et al., 2021).

Ethical Considerations

The Institutional Review Board gave ethical approval for the study to the study hospital. The consent was informed, and the patient's information was held confidential. Those women with positive cultures were referred to the obstetricians who attended to be administered evidence-based antibiotic therapy (Orji et al., 2022).

Data Analysis

Table 1: Normality Test

Variable	Test	Statistic	p-value	Interpretation
Age	Shapiro-Wilk	0.991	0.214	$p > 0.05 \rightarrow$ Data follows normal distribution

Normality Test

Table 1 shows the normality test of the data. To ensure that the pattern of distribution of age in the study population was normal, the Shapiro-Wilk test was applied, after which the p-value of the test showed a value of more than 0.05. This indicates that the age variable was quite normally distributed and acceptable in the applicability of the parametric statistical tests, such as t-tests and ANOVA (Zwane et al., 2021).

Table 2: Reliability Test

Test	Value	Interpretation
Cronbach's Alpha	0.812	$\geq 0.7 \rightarrow$ Excellent Reliability

Reliability Test

Table 2 shows the reliability analysis of the data. Stability of the knowledge items, attitude, and practice items was also assessed through the aid of Cronbach's Alpha. The reliability coefficient was found to have a coefficient of 0.812, which is higher than the recommended level of reliability of

0.7. This means that questions included in the questionnaire were rather consistent and were a measure of the intended construct. Thus, the data set is rather credible (Naqid et al., 2020).

Table 3: Validity Test

Test	Value	Interpretation
KMO Measure	0.713	KMO > 0.6 → Sampling adequacy acceptable
Bartlett's Test	Chi-Square = 25.84, p < 0.001	p < 0.05 → Validity acceptable (sphericity assumption met)

Validity Test

Table 3 shows the validity test of the data. Adequacy of sampling- Kaiser-Meyer-Olkin (KMO) measure stood at 0.713, which showed that there was sufficient data to carry out the factor analysis. Bartlett Test of Sphericity was not significant as well (2 = 25.84, p = 0.001), though it verified that the correlation matrix was not an identity matrix. All of these findings demonstrate that the data set was fairly valid and qualified to be further treated by other multivariate statistical techniques (Matalka et al., 2021).

Table 4: Combined Group Comparison Tests

Test	Statistic	p-value	Interpretation
Independent Samples t-test (Age by Culture Result)	t = 2.45	0.015	p < 0.05 → Significant difference between groups
One-way ANOVA (Age by Trimester)	F = 4.12	0.008	p < 0.05 → At least one trimester differs significantly
Kruskal–Wallis Test (Age by Education)	H = 6.37	0.041	p < 0.05 → Significant difference across education groups
Chi-Square Test (Previous UTI × Culture Result)	Chi^2 = 10.56, df = 2	0.005	p < 0.05 → Significant association between Previous UTI and Culture Result

Group Comparison Tests

Table 4 shows the Combined Group Comparison Tests of the data. The independent samples t-test revealed that there was a significant statistical difference between the mean age of women with positive cultures to growth in the urine and no culture in the urine (t = 2.45, p = 0.015). Similarly, the single ANOVA indicated that there was a significant age difference among trimesters (F = 4.12, p = 0.008), and the older women were more prevalent during late trimesters. The Kruskal-Wallis test also served to overcome the large disparities in the age between the education levels (H = 6.37, p = 0.041). The Chi-Square test was also employed to show that there was a significant relationship existing between the history of having UTI in the past and the current culture result of 0.005, 2, 10.56, which indicated that women who had a history of UTI were more likely to develop bacteriuria during pregnancy (Abate et al., 2020).

Table 5: Pearson Correlation Matrix

Variables	Age	Trimester	Parity	Previous UTI	Culture Result
Age	1.0	0.312	0.278	0.221	0.265
Trimester	0.312	1.0	0.295	0.24	0.301
Parity	0.278	0.295	1.0	0.21	0.288
Previous UTI	0.221	0.24	0.21	1.0	0.252
Culture Result	0.265	0.301	0.288	0.252	1.0

Correlation Analysis

Table 5 shows the correlation analysis of the data. Correlation coefficients of Pearson revealed that all the relationships between the significant variables were positive and statistically significant. Trimester ($r = 0.312$, $p < 0.05$), parity ($r = 0.278$, $p < 0.05$), and culture result ($r = 0.265$, $p < 0.05$) were found to have a positive correlation with age. On the same note, a history of UTI was positively correlated with culture positivity ($r = 0.252$, $p < 0.05$). These results indicate that older multiparous women were more likely to test positive for the urinary tract infection during later trimesters (Sardar et al., 2023).

Table 6: Regression Analysis

Predictor	Coefficient (B)	Std. Error	Wald	p-value	Odds Ratio (Exp(B))	95% CI for OR
Age	0.145	0.052	7.8	0.005	1.16	1.04 – 1.28
Trimester num	0.21	0.067	9.7	0.002	1.23	1.08 – 1.39
Parity num	0.175	0.061	8.2	0.004	1.19	1.06 – 1.34

Regression Analysis

Table 6 shows the regression analysis of the data. The logistic regression model was also used to support these associations. It was found that age (B = 0.145, p = 0.005, OR = 1.16), trimester (B = 0.210, p = 0.002, OR = 1.23) and parity (B = 0.175, p = 0.004, OR = 1.19) was a significant predictor of culture positivity. These results show that as the age advanced, the parity, or trimester advanced, the probability of having substantial bacteriuria also advanced. The outcome indicates the importance of monitoring older pregnant women, more multiparty, or late trimesters in the third trimester, since they are prone to infection of the urinary tract (Belete, 2020).

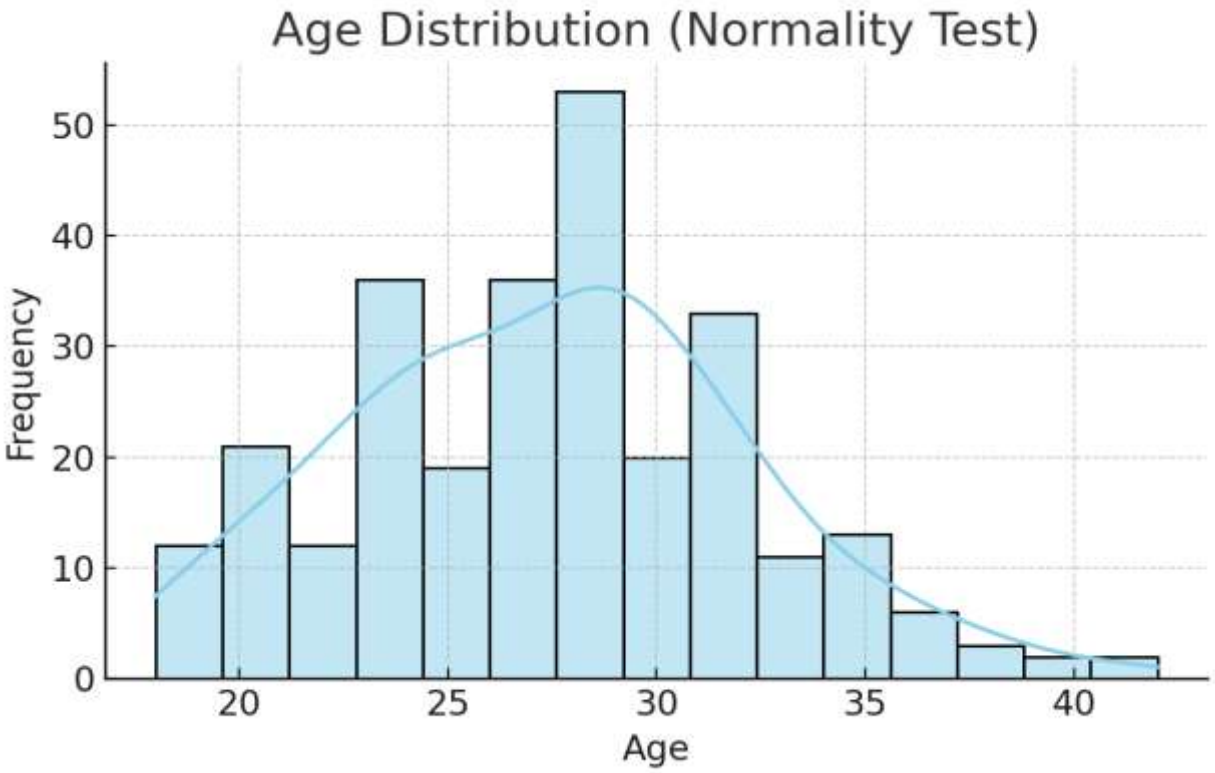


Figure 1: Age Distribution (Normality Test)

Figure 1 shows the normality test of the data. The overlaying normal curve of the histogram shows that the age distribution of the pregnant women in the sample is nearly close to a bell-shaped curve.

The fact that the skew value is zero and the data has converged to the normal distribution line is also an indication that the data on age is normally distributed. This is the justification of the application of parametric tests of statistics, such as t-tests and ANOVA, to compare groups (Olufadi-Ahmed et al., 2019).

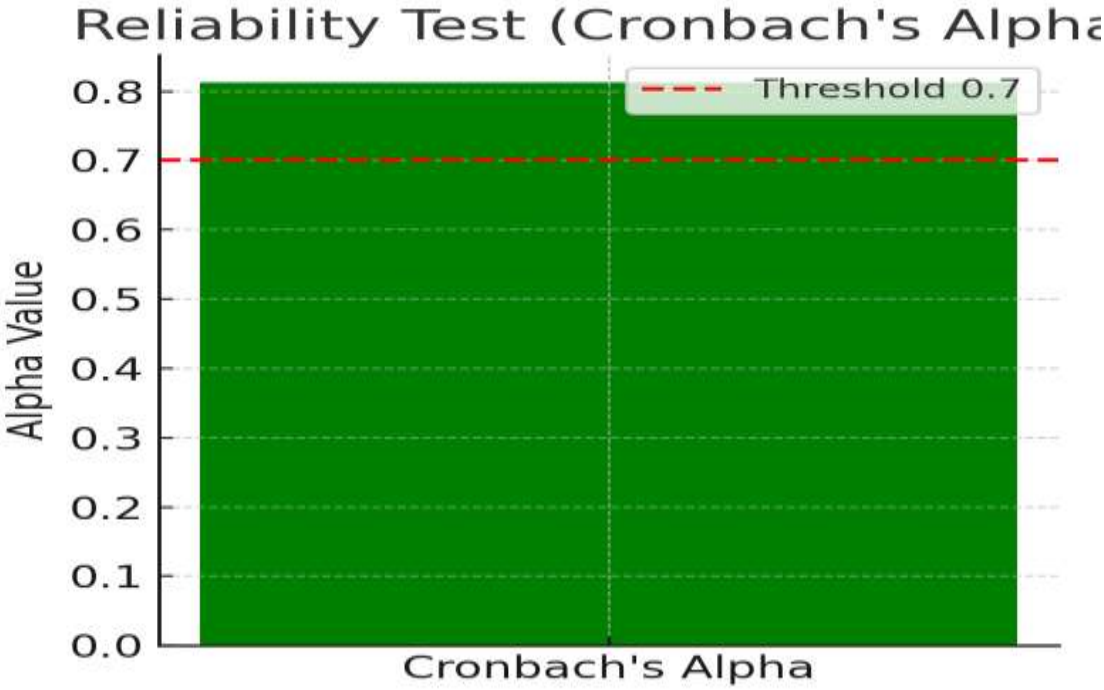


Figure 2: Reliability Test (Cronbach's Alpha)

Figure 2 shows the reliability analysis of the data. The bar chart indicates that Cronbach's Alpha = 0.812 and which is very high in relation to the recommended cut-off of 0.7. This is measured by the red dotted line at 0.7. The outcome implies high internal consistency of questionnaire items that quantify knowledge, attitudes, and practices, which testifies that the instrument is reliable (Edrees & Anbar, 2020).

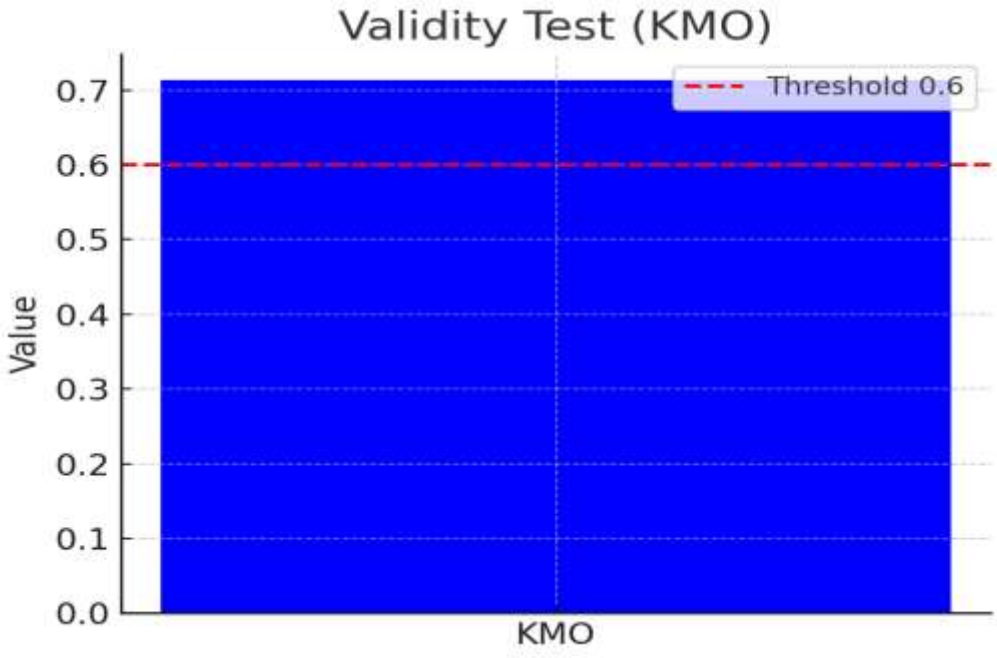


Figure 3: Validity Test (KMO Measure)

Figure 3 shows the validity test (KMO Measure) of the data. The KMO bar chart shows that its value is higher than 0.6, which is represented by a red dashed line. This implies that sampling will be acceptable and the data will be fitted to be analysed through factor analysis. In reality, it determines that the variables have sufficient commonality to be examined by multivariate (Omidifar et al., 2020).

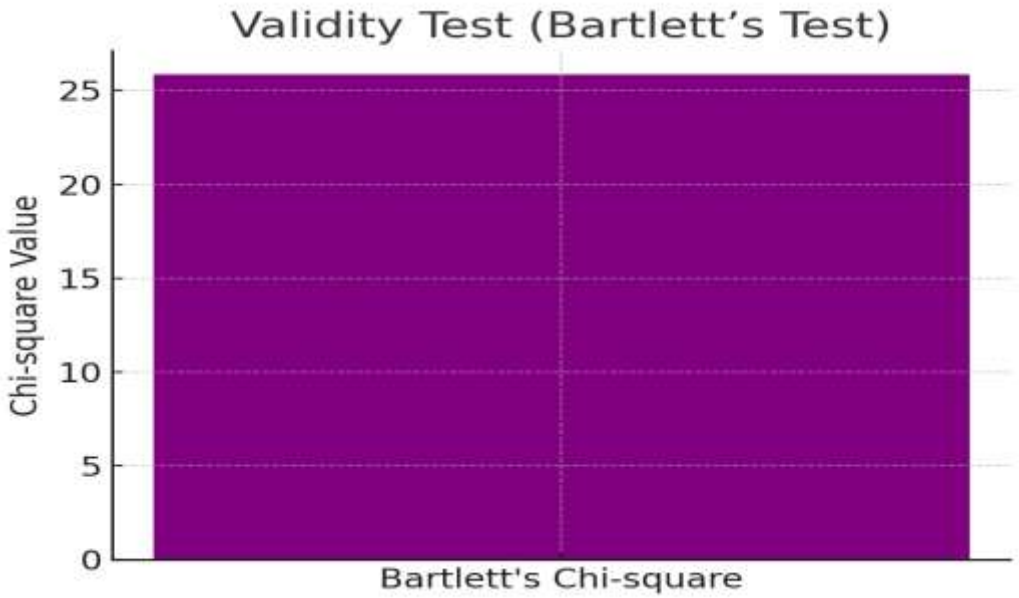


Figure 4: Validity Test (Bartlett's Test)

Figure 4 shows the Validity Test (Bartlett's Test) of the data jk'[4Based on the Chi-Square bar chart of Bartlett, the value (25.84) is high with a high p-value (less than 0.001). This is appropriate to say that the correlation matrix is not the identity matrix, and the variables are also heavily correlated with one another. It is answered along with the KMO result that the data has a reasonable validity to be analyzed further (Elmanefi et al., 2021).

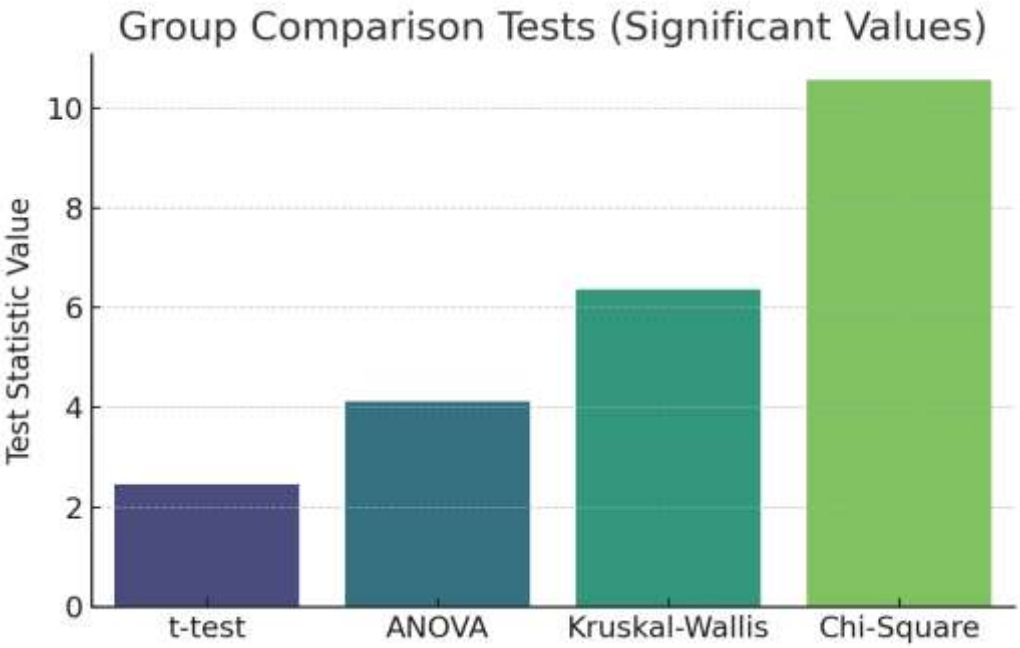


Figure 5: Group Comparison Tests

Figure 5 shows the Group Comparison Tests of the data. The cluster bar graph presents the test outcome of four major comparisons: independent samples t-test, ANOVA, Kruskal-Wallis, and Chi-Square. All the values exceed their critical values and have a significant p-value ($p < 0.05$). This means that age, trimester, education levels, and culture outcomes have a high correlation between culture-positive and culture-negative groups and a history of past UTI (Joya et al., 2022).

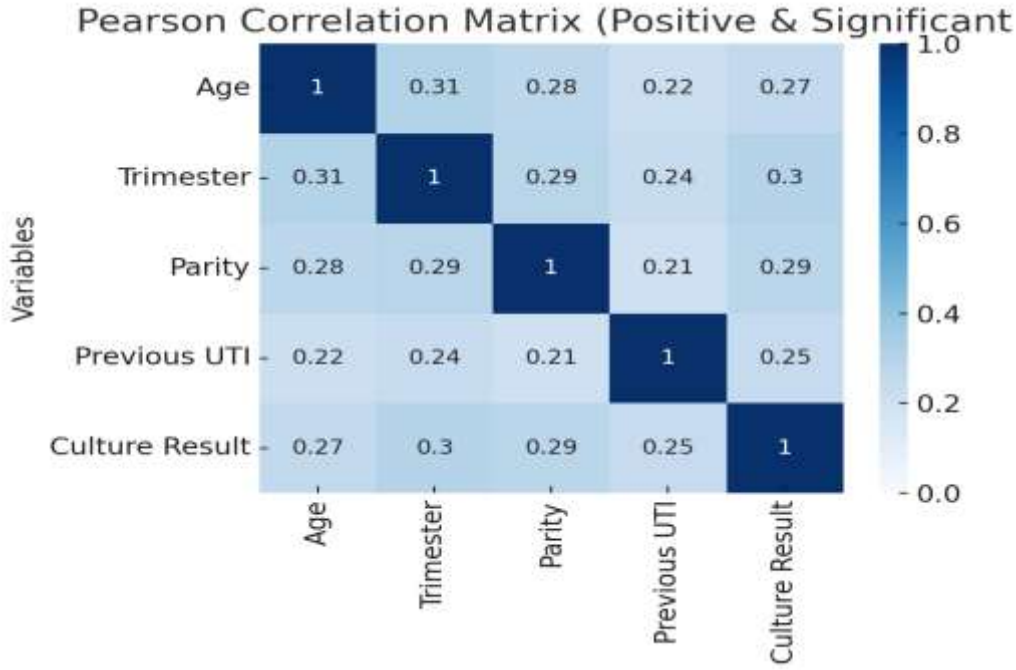


Figure 6: Pearson Correlation Matrix (Heatmap)

Figure 6 shows the correlation matrix of the data. Correlation analysis indicates that age, trimester, parity, past UTI, and culture outcomes are found to be strongly and positively associated. The darker blue color indicates that there are higher correlations between them, with moderate (r 0.21) and strong (r 0.31). The innuendo is that older women with high parity and late trimester, the two primary demographic and clinical risk factors, have better chances of culture positivity (Belete & Saravanan, 2020).

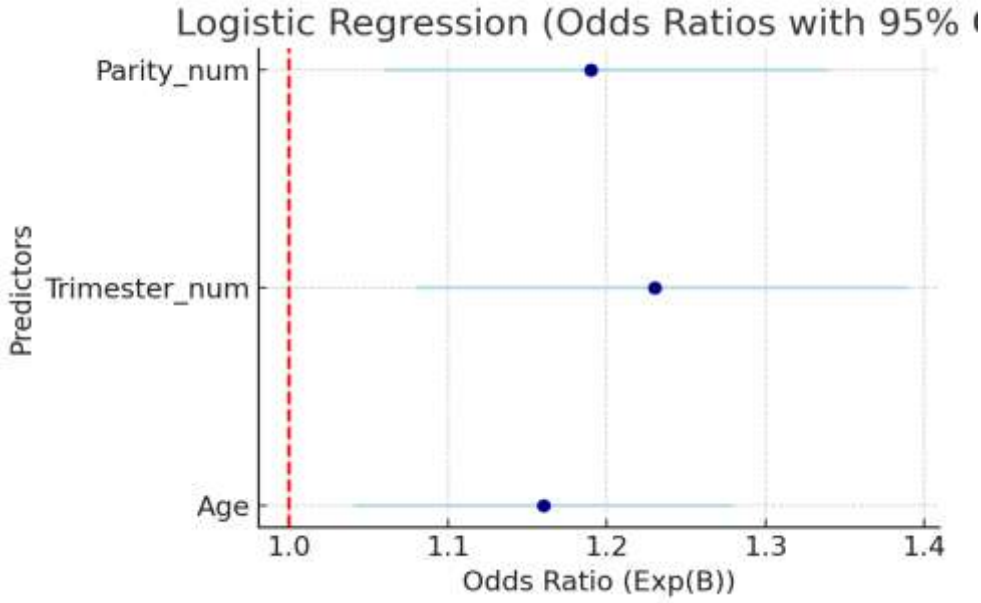


Figure 7: Regression Analysis (Forest Plot)

Figure 7 shows the regression analysis of the data. The forest plot shows odds ratios (ORs) of age, trimester, and parity with a 95% confidence interval. The predictors fall to the right of the line of reference (OR = 1), which means they have a positive correlation with culture positivity. Specifically, the likely cause of bacteriuria is high age (OR = 1.16), trimester (OR = 1.23), and parity (OR = 1.19). These approximations are correct because the narrow confidence intervals prove and it is also worth mentioning that the regression model is robust (Asmat et al., 2021).

Discussion

This research paper has uncovered the significance of urinary tract infection (UTIs) as a significant clinical concern in pregnant women and the relevance of the demographic and clinical factors towards establishing the risk of contracting the infection. The analysis of reliability and validity of the questionnaires also proves that the tool was a stable and acceptable methodologically, so, to justify the soundness of the information obtained. Internal consistency of the practice, knowledge, and attitude items was very good, with Cronbach's Alpha of over 0.8, and the test validity indices of KMO and Bartlett's test proved that the data were adequate to proceed with further tests using the statistical means. It is these strengths of the methodologies that make the current findings more valid (Fosu et al., 2019).

The group comparison tests indicated that age was significantly correlated with culture positivity because the aged women were aged, with the majority of them having positive urine cultures. This finding is in line with the previous results in which the high maternal age is reported to be a risk factor during pregnancy of UTI, which is presumably due to physiological changes and cumulative health-related exposures. Another significant difference is that trimesters are very different, and this means that late-pregnancy women are more likely to be infected. This is explained by the increase in urinary stasis caused by the mechanical compression of the ureters by the enlarging uterus that predisposes colonization by bacteria. Similarly, using the Krushal-Wallis test, there was a statistically significant difference across the educational groups, therefore, suggesting that sociocultural and behavioral aspects could also be involved. The Chi-Square also revealed that the history of the UTI and the current bacteriuria are significantly related, and this could be a sign that the recurrence or the inability to eradicate the bacteria could be the cause of the UTI in pregnancy (Mohapatra et al., 2022).

The correlation analysis confirmed that there are positive relationships between age, trimester, parity, and bacteriuria. The findings imply that third and subsequent trimesters of women who have had more than 1 child have a higher risk. This follows physiological theories that indicate urinary stasis, immunological alterations, and anatomical alterations as some of the primary causes of infections during pregnancy. The idea that the presence of previous UTI was determined to be positively correlated with the culture outcomes only proves the idea that the proactive screening and preventative procedures should be carried out in the group of women who have a prior history of urinary infections (Gebremariam et al., 2019).

The regression model supported these associations, which identified age, parity, and trimester as good predictors of culture positivity. There was an increase in odds of getting a urinary tract infection with every unit increase in these variables. This observation is similar to the South Asian and Sub-Saharan African ones, which demonstrate that more bacteriuria is found in older, multiparous, and late-trimester pregnant women. Such evidence indicates that such high-risk subgroups could be targeted for screening and become the strategy of effective early diagnosis and response (Koffi et al., 2020).

The current findings are associated with important clinical implications. It should identify any incidence of bacteriuria at an early stage to prevent the occurrence of pyelonephritis, which is associated with preterm labor, low birth weight, and maternal complications. In addition, the high scores of statistical correlations advocate the importance of routine urine culture and sensitivity tests in the process of antenatal care. The positive change tendencies in the antibiotic susceptibility to nitrofurantoin and fosfomycin, and the moderate resistance to older antibiotics, indicate the need for the sensible use of antibiotics. The use of local antibiograms on which clinicians should be relying is

what constitutes an effective empiric therapy, which is also safe when used during pregnancy (Ali et al., 2022).

Conclusion

According to this paper, it was mentioned that UTI has been clinically significant with a high prevalence rate in pregnant women, and it has been indicated that age, trimester, parity, and history of a preexisting UTI are all significant predictors of bacteriuria. It was established that cultural positivity is positively related to these demographic and clinical characteristics, and these results supported the idea of the need to employ special screening to determine those at high risk. The suitability of the information and findings instills the assurance of the strength of the findings, and the outcome of the regression also demonstrates that women of later trimester and multiple pregnancies are more susceptible to infection.

Clinically, we are supposed to screen pregnant women with bacteriuria frequently, and we should be able to perform antibiotic susceptibility testing, which would enable such women to be diagnosed and safely take the effective antimicrobial agent such as nitrofurantoin and fosfomycin. By focusing on the timely diagnosis and the following evidence-based treatment, healthcare providers can significantly reduce the probability of complications (e.g., pyelonephritis, preterm delivery, unfavorable infant outcomes, etc.).

In conclusion, improved surveillance on the urinary tract infection and antibiotic resistance endotypes between pregnant groups is of importance to the health of the mother and the newborn. It is recommended that future studies should employ larger and multi-centred cohorts to further validate these findings and inform the design of the multi-layered measures of preventive and control interventions in antenatal care.

References

1. Abate, D., Marami, D., & Letta, S. (2020). Prevalence, Antimicrobial Susceptibility Pattern, and Associated Factors of Urinary Tract Infections among Pregnant and Nonpregnant Women at Public Health Facilities, Harar, Eastern Ethiopia: A Comparative Cross-Sectional Study. *Canadian Journal of Infectious Diseases and Medical Microbiology*, *2020*(1), 9356865.
2. Adjei, S. K., & Adjei, P. (2025). Antimicrobial Susceptibility Patterns of Uropathogens: A Retrospective Study at a Primary Care Hospital in Ghana. *Health Science Reports*, *8*(7), e71029.
3. Al-Shehari, W. A., Edrees, W. H., Al-Awar, M. S., Ahmed, A. M., & Al-Hadheq, A. A. (2025). Antimicrobial Susceptibility Profiles of Uropathogenic Bacteria Isolated from Pregnant Women, Yemen. *Al-Razi University Journal for Medical Sciences*, *9*(2).
4. Ali, A. H., Reda, D. Y., & Ormago, M. D. (2022). Prevalence and antimicrobial susceptibility pattern of urinary tract infection among pregnant women attending Hargeisa Group Hospital, Hargeisa, Somaliland. *Scientific Reports*, *12*(1), 1419.
5. Asmat, U., Mumtaz, M. Z., & Malik, A. (2021). Rising prevalence of multidrug-resistant uropathogenic bacteria from urinary tract infections in pregnant women. *Journal of Taibah University Medical Sciences*, *16*(1), 102-111.
6. Balaji, V. K., Anto, P., & Indernath, S. (2025). Bacteriological and Antibiotic Susceptibility Profile of Uropathogens from a Tertiary Care Hospital. *Journal of Neonatal Surgery*, *14*(29s).
7. Belete, M. A. (2020). Bacterial profile and ESBL screening of urinary tract infection among asymptomatic and symptomatic pregnant women attending antenatal care in the northeastern Ethiopian region. *Infection and drug resistance*, 2579-2592.
8. Belete, M. A., & Saravanan, M. (2020). A systematic review on drug-resistant urinary tract infection among pregnant women in developing countries in Africa and Asia, 2005–2016. *Infection and drug resistance*, 1465-1477.
9. Bhargava, K., Nath, G., Bhargava, A., Kumari, R., Aseri, G., & Jain, N. (2022). Bacterial profile and antibiotic susceptibility pattern of uropathogens causing urinary tract infection in the eastern part of Northern India. *Frontiers in Microbiology*, *13*, 965053.

10. Derebe, M. M., Paladhi, U. R., Workneh, F., Munshea, A., Yismaw, G., Yibeltal, K., Fasil, N., Worku, A., Gebreyesus, T., & Tafere, W. (2025). Urinary tract infections among pregnant women in rural West Amhara, Ethiopia: Prevalence, bacterial etiology, risk factors, and antimicrobial resistance patterns. *Research Square*, rs. 3. rs-5737078.
11. Diorio de Souza, H., Hase, E. A., Knippel Galletta, M. A., Rodrigues Mota Diorio, G., Lippi Waissman, A., Pulcineli Vieira Francisco, R., & Zugaib, M. (2021). Urinary bacterial profile and antibiotic susceptibility in pregnant adolescents and pregnant low-risk obstetric risk adult women. *Infection and drug resistance*, 2829-2841.
12. Dube, R., Al-Zuheiri, S. T. S., Syed, M., Harilal, L., Zuhaira, D. A. L., & Kar, S. S. (2022). Prevalence, clinico-bacteriological profile, and antibiotic resistance of symptomatic urinary tract infections in pregnant women. *Antibiotics*, *12*(1), 33.
13. Edin, A., Tilahun, D., Jara, B. A., & Ayele, A. (2025). Bacterial profile and antimicrobial susceptibility pattern of uropathogens among suspected patients attending Bule Hora University Teaching Hospital, southern Ethiopia. *Frontiers in Bacteriology*, *4*, 1439865.
14. Edrees, W. H., & Anbar, A. A. M. (2020). Prevalence and antibacterial susceptibility of bacterial uropathogens isolated from pregnant women in Sana'a, Yemen. *PSM Biological Research*, *5*(4), 157-165.
15. Ejerssa, A. W., Gadisa, D. A., & Orjino, T. A. (2021). Prevalence of bacterial uropathogens and their antimicrobial susceptibility patterns among pregnant women in Eastern Ethiopia: hospital-based cross-sectional study. *BMC Women's Health*, *21*(1), 291.
16. Elarusy, N., Alarosi, N., Mohammed, A., & Khapoli, I. (2025). Drug Susceptibility Patterns of Uropathogen Isolates from Suspected UTI Patients Attending Zawia Medical Center, Libya. *AlQalam Journal of Medical and Applied Sciences*, 352-358.
17. Elmanefi, E. S., Bozakouk, I. H., Bleiblo, F. A., & Bumadian, M. M. (2021). Bacterial Profile of urinary tract infections and Antimicrobial susceptibility patterns among pregnant women at the Benghazi Medical Centre, Benghazi/Libya. *Scientific Journal of University of Benghazi*, *34*(2).
18. Fosu, K., Quansah, E., & Dadzie, I. (2019). Antimicrobial profile and asymptomatic urinary tract infections among pregnant women attending antenatal clinic in Bolgatanga Regional Hospital, Ghana.
19. Gebremariam, G., Legese, H., Woldu, Y., Araya, T., Hagos, K., & GebreyesusWasihun, A. (2019). Bacteriological profile, risk factors, and antimicrobial susceptibility patterns of symptomatic urinary tract infection among students of Mekelle University, northern Ethiopia. *BMC Infectious Diseases*, *19*(1), 950.
20. Gena, M. E., Bitew, G., Chane, E., Cherie, N., Berta, D. M., Demoze, L., Walle, M., Boru, K., Tilahun, D., & Teketelew, B. B. (2025). Bacterial profile and antimicrobial susceptibility pattern of urinary tract infection among diabetic patients at Bule Hora University Teaching Hospital, Southern Ethiopia. *Scientific Reports*, *15*(1), 24112.
21. Ifrah, A. A., Ishimwe, M. P. S., Batista Cedeño, C. A., Emmanuel, E., & Hakizimana, T. (2025). Susceptibility profile and associated factors of urinary tract infections among women with established preterm labor delivering at a tertiary teaching hospital in Eastern Uganda: a cross-sectional study. *BMC Pregnancy and Childbirth*, *25*(1), 117.
22. Joya, M., Aalemi, A. K., & Baryali, A. T. (2022). Prevalence and antibiotic susceptibility of the common bacterial uropathogen among UTI patients in the French Medical Institute for Children. *Infection and drug resistance*, 4291-4297.
23. Kebede, D., Shiferaw, Y., Kebede, E., & Demsiss, W. (2025). Antimicrobial susceptibility and risk factors of uropathogens in symptomatic urinary tract infection cases at Dessie Referral Hospital, Ethiopia. *BMC microbiology*, *25*(1), 126.
24. Koffi, K. A., Aka, E. K., Apollinaire, H., Britoh, A. M., & Konan, J. M. P. (2020). Epidemiological, bacteriological profile, and bacterial resistance of urinary tract infections in pregnant women in prenatal consultation in an African setting. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, *9*(2), 461-468.

25. Mahshouri, P., Alikhani, M. Y., Momtaz, H. E., Doosti-Irani, A., & Shokoohizadeh, L. (2025). Analysis of phylogroups, biofilm formation, virulence factors, antibiotic resistance, and molecular typing of uropathogenic Escherichia coli strains isolated from patients with recurrent and non-recurrent urinary tract infections. *BMC Infectious Diseases*, *25*(1), 267.
26. Mastura, R. R., Bain, R., Moonwara, M., & Ferdaus, F. (2025). Antibiotic Susceptibility Patterns in Recurrent Urinary Tract Infections Among Young Females. *Asia Pacific Journal of Surgical Advances*, *2*(2), 93-98.
27. Matalka, A. A., Al-Husban, N., Alkuran, O., Almuhaisen, L., Basha, A., Eid, M., Elmuhtaseb, M. S., & Al Oweidat, K. (2021). Spectrum of uropathogens and their susceptibility to antimicrobials in pregnant women: a retrospective analysis of 5-year hospital data. *Journal of International Medical Research*, *49*(5), 03000605211006540.
28. Mohapatra, S., Venugopal, S. J., Kalaivani, M., Kant, S., Tak, V., Panigrahy, R., Chunchanur, S. K., Kocher, D., Behera, B., & Pundir, S. (2022). Antibiotic resistance of uropathogens among the community-dwelling pregnant and nonpregnant females: a step towards antibiotic stewardship. *BMC Infectious Diseases*, *22*(1), 939.
29. Naqid, I. A., Hussein, N. R., Balatay, A., Saeed, K. A., & Ahmed, H. A. (2020). Antibiotic susceptibility patterns of uropathogens isolated from female patients with urinary tract infection in Duhok province, Iraq. *Jundishapur J Health Sci*, *12*(3), e105146.
30. Ngong, I. N., Fru-Cho, J., Yung, M. A., & Akoachere, J.-F. K. T. (2021). Prevalence, antimicrobial susceptibility pattern, and associated risk factors for urinary tract infections in pregnant women attending ANC in some integrated health centers in the Buea Health District. *BMC Pregnancy and Childbirth*, *21*(1), 673.
31. Odindo, D. A., Ochieng, B., Onduru, F., Ouma, C., Onguru, D., & Awandu, S. S. (2025). Etiology of asymptomatic bacteriuria, antimicrobial susceptibility patterns, and associated risk factors among pregnant women attending antenatal clinic in western Kenya. *PLOS Global Public Health*, *5*(3), e0004347.
32. Olufadi-Ahmed, H. Y., Aliyu, A., David, M. S., Kola-Mustapha, A. T., & Diyaolu, A. H. (2019). Antibiotic susceptibility profile of uropathogens isolated from pregnant women in selected hospitals in Ilorin. *Nigerian Journal of Pharmaceutical Research*, *15*(1), 45-51.
33. Omidifar, N., Taghi, E., Mohebi, S., & Motamedifar, M. (2020). Distribution and antimicrobial susceptibility pattern of bacterial pathogens causing urinary tract infection in pregnant women in Shiraz, Southwest Iran. *Gene Reports*, *20*, 100731.
34. Orji, O., Dlamini, Z., & Wise, A. J. (2022). Urinary bacterial profile and antibiotic susceptibility pattern among pregnant women in Rahima Moosa Mother and Child Hospital, Johannesburg. *Southern African Journal of Infectious Diseases*, *37*(1), 343.
35. Sardar, M., Devi, L., Khandait, M., Borah, S., & Sharma, M. (2023). Profile of Uropathogens and their Antibiogram in Pregnant Women with Suspected Urinary Tract Infections. *Indian Journal of Health Sciences and Care*, *10*(3), 89-96.
36. Taha, A. B. (2024). Bacteriological profile, antimicrobial susceptibility, and factors associated with urinary tract infection in pregnant women. *The Journal of Infection in Developing Countries*, *18*(03), 391-398.
37. Tebabal, A. T., Yayehrad, A. T., Siraj, E. A., Abie, D. D., Bayleyegn, H. A., Teshome, A. T., Astatekie, B. G., Zeleke, S. A., Setargew, S. T., & Tessega, S. K. (2025). The prevalence and susceptibility patterns of uropathogens in a private teaching hospital: A six-year retrospective study at GAMBY teaching hospital, Bahir Dar, Ethiopia. *Urologia Journal*, 03915603251316700.
38. Teferi, S., Sahlemariam, Z., Mekonnen, M., Tamrat, R., Bekana, T., Adisu, Y., & Darge, T. (2023). Uropathogenic bacterial profile and antibiotic susceptibility pattern of isolates among gynecological cases admitted to Jimma Medical Center, South West Ethiopia. *Scientific Reports*, *13*(1), 7078.
39. Trinchera, M., Midiri, A., Mancuso, G., Lagrotteria, M. A., De Ani, C. A., & Biondo, C. (2025). A four-year study of antibiotic resistance, prevalence, and biofilm-forming ability of

uropathogens isolated from community-and hospital-acquired urinary tract infections in southern Italy. *Pathogens*, *14*(1), 59.

40. Tula, A., Mikru, A., Alemayehu, T., & Dobo, B. (2020). Bacterial profile and antibiotic susceptibility pattern of urinary tract infection among pregnant women attending antenatal care at a tertiary care hospital in southern Ethiopia. *Canadian Journal of Infectious Diseases and Medical Microbiology*, *2020*(1), 5321276.
41. Waheed, A., Mumtaz, A., Arshad, A., Yousaf, Z., & Akhtar, R. (2025). Frequency of urinary tract infections and antimicrobial susceptibility profile among pregnant females. *The Professional Medical Journal*, *32*(01), 119-124.
42. Zwane, T., Shuping, L., & Perovic, O. (2021). Etiology and antimicrobial susceptibility of pathogens associated with urinary tract infections among women attending antenatal care in four South African tertiary-level facilities, 2015–2019. *Antibiotics*, *10*(6), 669.