ORIGINAL ARTICLE

Urinary tract infections in pregnant women from the Russian--Ukrainian military conflict regions: A multicenter study (2022-2025)

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ABSTRACT

Aim: To estimates of the prevalence rate of urinary tract infections (UTIs) in pregnant women from the Ukrainian-Russian military conflict regions and antimicrobial resistance of causing pathogens.

Materials and Methods: Retrospective multicenter cohort study was conducted from April, 2022 to May, 2025.The study population consisted of 2,576 pregnant women from the Ukrainian-Russian military conflict regions. Antibiotic susceptibility was done by the disc diffusion test as recommended by EUCAST guidelines.

Results: Among 2,576 pregnant women, 1,002 (38.9%) UTIs were observed. The most frequently reported UTI types were cystitis (48.4%) and asymptomatic bacteriuria (39%). Of all UTI cases, 14.6% were defined as acute pyelonephritis. The most common causative agents of UTIs were *Escherichia coli* (27.6%), *Klebsiella pneumoniae* (13.9%), *Proteus mirabilis* (11.2%), *Coagulase-negative staphylococci* (8.7%), *Enterococcus faecalis* (8.5%), *Enterobacter spp.* (7.2%), and *Pseudomonas aeruginosa* (6.6%). *Methicillin-resistance S. aureus* (MRSA), vancomycin resistance enterococci (VRE), and extended spectrum beta-lactamases (ESBL) production among Enterobacteriales was found observed in 11.3%, 9.1%, and 29.4% isolates, respectively. Carbapenem resistance was identified in 13.7% of P. aeruginosa strains.

Conclusions: This study findings demonstrate the high rate of UTIs in pregnant women from the Ukrainian-Russian military conflict regions and many cases are caused by pathogens that are resistant to antibiotics. Strategies for deterrence include optimal hygiene practices to minimize the risk of bacterial colonization and ascending infection.

KEYWORDS: Ukrainian-Russian military conflict regions, pregnant women, urinary tract infection, asymptomaticbacteriuria, cystitis, pyelonephritis, antimicrobial resistance

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INTRODUCTION

Urinary Tract Infections (UTIs) are one of the most common bacterial diseases in women during pregnancy period worldwide. According to the literature, a global estimated prevalence of UTIs in pregnant women of approximately 23.9% (ranging widely from 5% to over 70% depending on region) [1]. Is reported that in developed countries UTIs to affect between 10% [2, 3] and 24.3% [4] of pregnant women. UTIs during pregnancy represent a potentially serious complication, posing risks to both maternal and fetal health [5]. These infections can lead to complications such as pyelonephritis, preterm birth, low birth weight, and even maternal sepsis [6]. Therefore, prevention and control of urinary tract infections during pregnancy are important to protect the health of both the mother and the developing fetus.

According to the literature, UTIs in pregnancy can arise from a variety of causes, primarily attributed to anatomical

and physiological changes that occur during gestation. These changes often cause urine to become stagnant and make it easier for bacteria to move from the urethra into the bladder and potentially the kidneys [7]. Therefore, early detection and treatment of UTI during pregnancy are crucial to prevent complications that may affect the health of both the mother and the foetus.

In military conflict countries such as Ukraine, there is a high UTIs rate in pregnant women. According to the literature, the prevalence of UTIs in Ukraine was 29.5%. The most frequently reported UTI types were: 36.5% asymptomatic bacteriuria, 51,7% cystitis, and 11.8% pyelonephritis [8]. This work showed that many cases of UTIs are caused by pathogens that are resistant to antibiotics [8]. However, this study did not include pregnant women from regions of Ukraine affected by military action.

Current Ukrainian guidelines for management of UTIs in pregnant women recommend the use of antibiotics for treatment these infections. However, the high-level antimicrobial resistance is limiting antibiotic use for treatment of UTIs in Ukraine. To date, there is limited data describing the prevalence of UTIs in pregnant women from the Ukrainian-Russian military conflict regions and antimicrobial resistance of causing pathogens.

AIM

The aim of this study was to estimates of the prevalence rate of UTIs in pregnant women from the Ukrainian-Russian military conflict regions and antimicrobial resistance of causing pathogens.

MATERIALS AND METHODS

STUDY DESIGN AND PARTICIPANTS

We performed a retrospective multicenter cohort study was based on surveillance data for UTIs in pregnant women from the Ukrainian-Russian military conflict regions. (Kharkiv, Dnipro, Kherson, Zaporizhzhia, Odessa). A total of 2,576 pregnant women with and without symptoms of urinary tract infection (UTI) were included as a study subject 36 months period from April, 2022 to May, 2025. The selection criterion for the inclusion in this study was above 18 years and no past history related to any sexually transmitted diseases and immunocompromised status was noted.

DEFINITION

The classifications of UTIs in pregnancy include (a) lower urinary tract infections (Asymptomatic bacteriuria and Cystitis) and (b) upper urinary tract infection (Pyelonephritis) [7]. A UTIs in pregnancy is a bacterial infection of the urinary system (bladder, urethra, or kidneys) occurring during pregnancy. It is characterized by significant bacterial growth (≥105 CFU/mL) and ranges from asymptomatic bacteriuria (ASB) to acute cystitis or pyelonephritis. In this study type of UTIs in pregnant women includes asymptomatic bacteriuria (no symptoms but high bacteria count), cystitis (bladder infection), and pyelonephritis (kidney infection). UTIs in pregnant women is defined as the presence of at least 100,000 organisms per milliliter of urine in an asymptomatic patient, or as more than 100 organisms/mL of urine with accompanying pyuria in a symptomatic patient. A diagnosis of UTI should be supported by a positive culture for a uropathogen, particularly in patients with vague symptoms [9]. ASB is defined as the presence of more than 100,000 organisms/mL in two consecutive urine samples in the absence of declared symptoms. Cystitis involves only the lower urinary tract; it is characterized by inflammation of the bladder as a result of bacterial or nonbacterial causes. Acute pyelonephritis is characterized by fever, flank pain, and tenderness in addition to significant bacteriuria. Other symptoms may include nausea, vomiting, frequency, urgency, and dysuria. In this study two consecutive voided urine specimens with the same bacterial species isolated in quantitative count of >105 CFU/ml in pregnant women were considered to be positive for UTIs.

MICROBIOLOGICAL METHODS

In this study midstream urine samples from pregnant women were collected and processed following standard bacteriological tests. Urine of all patients was sampled and subjected to routine and microscopy examination and culture. Colony counts were performed, and confirmatory identification and antibiotic susceptibility tests were completed using a Vitek2 instrument system (BioMérieux, France). The significant bacteriuria was 105 CFU/ml was taken into consideration while confirmation as UTI. Bacterial isolates from urine samples were identified using standard microbiological techniques. Antimicrobial susceptibility testing was performed according to EUCAST guidelines at the private laboratories.

DATA COLLECTION

A standard data collection form was created to extract demographic and clinical data. Si this study clinical and microbial data were collected from medical records. Relevant information, including demographic data, baseline comorbidities, obstetrical characteristics, antimicrobial therapy regimens, urine culture results and antibiotic susceptibility testing data, was collected. In this work UTIs were diagnosed using midstream urine culture.

ETHICS

The study was conducted after getting a full approval by the research unit of The Zarifa Aliyeva International Center of Medical Science (Kyiv, Ukraine). Written informed consent for the study was obtained from the study participants. Confidentiality of results was kept and pregnant women's data were anonymised prior to the analysis.

STATISTICAL ANALYSIS

Statistical data was performed using Excel and SPSS 10.0 Statistical Software Package. Frequencies and percentages were reported for categorical variables. The prevalence of UTIs (asymptomatic bacteriuria, cystitis and pyelonephritis) was reported as the percentage of the total number of pregnant women. All data concerning associated risk factors were collected using structured questionnaires. Descriptive statistics and chi-square tests were used to analyze the data, and $p<0.05$ was considered to indicate statistical significance.

RESULTS

PREVALENCE OF UTIS

A total of 2,576 pregnant women from the Ukrainian-Russian military conflict regions were included as a study subject 36 months period (April, 2022 to May, 2025). During the study period, 1,002 of 2,576 pregnant women were found to have UTIs. The overall prevalence of UTIs in pregnant women from the Ukrainian-Russian military conflict regions was 38.9% [95% confidence interval (CI) 37.9-39.9%, P<0.001]. The UTIs cases among pregnant women from the Ukrainian-Russian military conflict regions varied significantly. In terms of these regions, fluctuations of the indicator values were observed of UTI in pregnant women – from the smallest in the Kharkiv and Odessa while higher percentages were reported in the Dnipro, Kherson and Zaporizhzhia regions of Ukraine.

The most frequently reported UTI types in pregnant women from the Ukrainian-Russian military conflict regions were 39% (95% CI 36.1-37.9) asymptomatic bacteriuria and 48,4% (95% CI 47.4-49.4) cystitis. Among all cases of UTIs, pyelonephritis was 14.6% (95% CI 13.9-15.3).

In all, 2,576 pregnant women from the Ukrainian-Russian military conflict regions with a mean age of 27.8 ± 6.9 years participated in the study. The majority among pregnant women, 60.5% (1,559), were aged 20 to 29 years, 74.5% (1,918) were self-employed, 52.0% (1,339) had basic education, 97.5% (2512) were married, and 81.0% (2,087) resided in an urban settlement (Table 1).

The majority, 48.0% (1,236) of all the study participants (pregnant women from the Ukrainian-Russian military conflict regions), reported for booking in the second trimester of their current pregnancy. The most, 91.5% (2,358) of the

Table 1. Characteristics of 2,675 pregnant women from the Ukrainian-Russian military conflict regions (2022-2025)

Variable	Total (n = 2,576)	UTI		P - value
		No (n = 1,574)	Yes (n = 1,002)	
	n (%)	n (%)	n (%)	
Age (years)				
Mean ± SD	27.8±6.9	27.9±6.8	27.7±5.51	
≥18	91 (3.5)	52 (57.1)	39 (42.9)	0.63
20-29	1559 (60.5)	979 (62.8)	580 (37.2)	
30-39	809 (31.4)	501 (61.9)	308 (38.1)	
≥ 40	117 (4.5)	39 (33.3)	78 (66.7)	
Occupation				
Salaried worker	181 (7.0)	129 (71.4)	52 (28.6)	0.76
Self-employed	1918 (74.5)	1159 (60.4)	759 (39.6)	
Unemployed	477 (18.5)	284 (59.5)	193 (40.5)	
Educational status				
Basic	1339 (52.0)	708 (52.9)	631 (47.1)	0.06
Secondary	748 (29.0)	554 (74.1)	194 (25.9)	
Tertiary	489 (19.0)	309 (63.2)	180 (36.8)	
Marital status				
Married	2512 (97.5)	1519 (60.5)	993 (39.5)	0.65
Single	64 (2.5)	52 (81.3)	12 (18.8)	
Place of residence				
Rural	489 (19.0)	233 (47.6)	256 (52.4)	0.06
Urban	2087 (81.0)	1339 (64.2)	748 (35.8)	
Trimester				
First	1198 (46.5)	811 (67.7)	387 (32.3)	0.15
Second	1236 (48.0)	696 (56.3)	540 (43.8)	
Third	142 (5.5)	64 (45.5)	78 (54.9)	
Dysuria				
Yes	218 (8.5)	103 (47.2)	115 (52.9)	0.30
No	2358 (91.5)	1470 (62.3)	888 (37.7)	

Table 1. Cont.

Frequency				
Yes	168 (6.5)	117 (69.6)	51 (30.8)	0.77
No	2408 (93.5)	1454 (60.4)	954 (39.6)	
Urgency				
Yes	64 (2.5)	38 (59.4)	26 (40.6)	1.00
No	2512 (97.5)	1533 (61.0)	979 (39.0)	
Lower abdominal pain				
Yes	451 (17.5)	283 (62.7)	168 (37.1)	0.85
No	2125 (82.5)	1288 (60.6)	837 (39.4)	

UTI, urinary tract infection
Source: compiled by the authors of this study

pregnant women did not experience any dysuria, 93.5% (2,408) had a normal frequency of urination, and 97.5% (2,512) had no urgency to urinate. Regarding pregnant women from the Ukrainian-Russian military conflict regions experiencing lower abdominal pain, most, 82.5% (2,125) did not experience any pain. There was no statistical association between the study variables and pregnant women obstetric and medical characteristics (Table 1).

RESPONSIBLE PATHOGENS AND ANTIMICROBIAL RESISTANCE

A total of 3295 isolates were recovered in 1.002 pregnant women from the Ukrainian-Russian military conflict regions with UTIs, of which 768 (23.3%), 2494 (75.7%), and 33 (1%) isolates were different Gram-positive cocci, and Gram-negative bacilli species, and Fungi (Candida albicans) respectively. In this study of all UTIs in pregnant women 87.8% were reported to be polymicrobial. The most common causative agents of UTIs in pregnant women from the Ukrainian-Russian military conflict regions was *Escherichia coli* (27.6%), *Klebsiella pneumoniae* (13.9%), *Proteus mirabilis* (11.2%), *Coagulase-negative staphylococci* (8.7%), *Enterococcus faecalis* (8.5%), Enterobacter spp. (7.2%), and *Pseudomonas aeruginosa* (6.6%) followed by *Streptococcus spp.* (4.2%), *Klebsiella oxytoca* (2.9%), *Citrobacter spp.* (2.8%), *Serratia*

Table 2. Distribution of microorganisms causing of Urinary Tract Infections (UTIs) in pregnant women from the Ukrainian-Russian military conflict regions (2022-2025)

Microorganisms	n	%
Gram-positive cocci	768	23.3
Enterococcus faecalis	279	8.5
Enterococcus faecium	27	0.8
Streptococcus spp.	138	4.2
CoNS	288	8.7
Staphylococcus aureus	36	1.1
Gram-negative bacilli	2494	75.7
Escherichia coli	911	27.6
Klebsiella pneumoniae	458	13.9
Klebsiella oxytoca	97	2.9
Enterobacter spp.	236	7.2
Proteus mirabilis	369	11.2
Serratia spp.	68	2.1
Citrobacter spp.	93	2.8
Pseudomonas aeruginosa	219	6.6
Acinetobacter spp.	43	1.3
Fungi	33	1.0
Candida albicans	33	1.0
Total	3295	100.0

CoNS, Coagulase-negative staphylococci
Source: compiled by the authors of this study

Table 3. Resistance profile of the main causative agents of UTIs in pregnant women from the Ukrainian--Russian military conflict regions (2022-2025)

Pathogen	Antibiotic	Total (n=1,957) %	Type of UTIs			P value
			ASB %	Cystitis %	Pyelonephritis %	
Escherichia coli	CRO	12.4	11.1	9.1	17.2	0.0081
	CIP	27.2	24.7	24.3	32.5	0.0637
	NOR	27.6	28.9	27.4	26.6	0.749
	TMP-SMX	28.4	25.4	26.7	33.0	0.0411
	FFM	2.3	2.3	2.2	2.3	0.975
	NIT	2.2	2.1	1.0	3.4	0.128
	AMC	32.3	23.5	31.5	38.8	<0.001
Klebsiella pneumoniae	CRO	10.2	7.5	7.2	15.5	0.0642
	CIP	19.7	15.5	15.0	28.6	0.0312
	NOR	15.3	17.8	15.0	13.2	0.565
	TMP-SMX	13.9	10.1	12.4	19.1	0.0631
	FFM	30.0	19.6	39.8	30.7	0.001
	NIT	66.6	70.1	63.5	66.1	0.547
	AMC	16.8	14.5	16.7	19.2	0.535
Proteus mirabilis	CRO	3.2	1.0	0.0	8.5	0.0061
	CIP	20.6	25.0	16.3	20.5	0.487
	NOR	19.9	25.3	15.9	18.6	0.378
	TMP-SMX	31.2	27.8	28.6	37.3	0.419
	FFM	20.5	28.6	19.6	13.2	0.154
	NIT	100.0	100.0	100.0	100.0	-
	AMC	6.9	7.4	4.9	8.3	0.654
Pseudomonas aeruginosa	CEF	12.3	14.8	17.0	8.0	0.173
	CIP	10.5	7.6	13.8	10.1	0.311
	PIP	14.1	16.7	15.4	10.2	0.378
	CAZ	10.2	11.8	10.9	8.0	0.614
	IMI	13.6	14.4	14.4	11.9	0.745

ASB, asymptomatic bacteriuria; UTIs, urinary tract infections.
CRO, Ceftriaxone; CIP, Ciprofloxacin; NOR, Norfloxacin; TMP-SMZ, trimethoprim-sulfamethoxazole; FFM, fosfomycin; NIT, Nitrofurantoin; AMC, Amoxicillin/clavulanic acid; CEF, cefepime; PIP, piperacillin-tazobactam; CAZ, ceftazidime; IMI, Imipenem
Source: compiled by the authors of this study

spp. (2.1%), *Acinetobacter spp.* (1.3%), and *Staphylococcus aureus* (1.1%) (Table 2).

In this study antimicrobial susceptibility tests (AST) were performed on a total of 3262 bacterial isolates (Gram-positive cocci and Gram-negative bacilli). In this study, many of isolates displayed a high resistance to antimicrobials, although there were some differences depending on the species and type of UTI (Table 3).

DISCUSSION

The aim of present study was to estimates of the prevalence rate of UTIs in pregnant women from the Ukrainian-Russian military conflict regions and antimicrobial resistance of major causing pathogens. The results presented in this study are based on multicentre retrospective surveillance data. According to the literature, many studies have already described resistance of responsible pathogens of UTIs in pregnant women, Ukrainian data are limited. This study expands upon the previous reports in Ukraine [4, 8] and is the first study to publish the prevalence of UTIs in pregnant women from the Ukrainian-Russian military conflict regions and antimicrobial resistance of responsible pathogens of UTIs.

This study identified a high prevalence of UTIs (38.9%) in pregnant women from the Ukrainian-Russian military conflict regions. The most frequently reported UTI types in pregnant women were 39% ASB and 48,4% Cystitis. Among all cases of UTIs, Pyelonephritis was 14.6%. A previous study in Ukraine conducted in 2020-2022 found that prevalence of UTIs among pregnant women from without Ukrainian-

Russian military conflict regions were 29.5%. Of these cases of UTIs, ASB, Cystitis, and Pyelonephritis was observed in 36.5%, 51,7%, and 11.8% in pregnant women, respectively [8]. According to the literature, overall global prevalence of UTIs (both symptomatic and asymptomatic) in pregnant women to be 23.9% [1]. Other studies report that prevalence of UTIs among pregnant women was 10% [2, 11] to 26% [12]. The prevalence of ASB and Cystitis occurs varied in 2% to 10% and 1% to 2% of pregnant women, respectively [7, 10]. Other studies report an UTI prevalence rate of ASB in pregnant women were 2-13% [13, 14] and acute cystitis in 1-4% [13, 15]. It is estimated, the prevalence of acute pyelonephritis in pregnant women were 0.5-4% [16].

In this study the most common causative agents of UTIs in pregnant women from the Ukrainian-Russian military conflict regions was *E. coli, K. pneumoniae, P. mirabilis, Coagulase-negative staphylococci* (CoNS), *E. faecalis, Enterobacter spp., and P. aeruginosa*. This is consistent with the results of previous studies conducted in Ukraine [4, 8] and other studies [17, 18]. In our study many of isolates displayed a high resistance to antimicrobials, although there were some differences depending on the species and type of UTI. *Methicillin-resistance S. aureus* (MRSA), *vancomycin resistance enterococci* (VRE), and *extended spectrum beta-lactamases* (ESBL) production among Enterobacteriales was observed in 11.3%, 9.1%, and 29.4% strains, respectively. ESBL production among *E. coli* isolates was higher than in K. pneumoniae. Resistance to third generation cephalosporins was observed in 12.4% *E. coli* and in 10.2% K. pneumoniae isolates, respectively. In this study carbapenem resistance was identified in 13.7% of P. aeruginosa strains, isolated from pregnant women from the Ukrainian-Russian military conflict regions with UTIs. Our findings correlate with various other studies [4, 8, 14, 17-19] where multidrug resistant uropathogens were isolated from pregnant women with UTIs.

The most common risk factors of UTIs in pregnant women was lack of healthcare facilities, lack of essential medication, lack of personnel and equipment. Medical clinics across the Ukrainian-Russian military conflict regions are depleted and under immense strain. This has led to a decline in the quality of healthcare services and main reason for the high rate of UTIs in pregnant women.

STRENGTHS AND LIMITATIONS

The main strength of this study was the first study to publish the prevalence of UTIs in pregnant women from the Ukrainian-Russian military conflict regions and antimicrobial resistance of responsible pathogens of UTIs. We believe our findings are a solid representation of the current prevalence of UTIs in pregnant women from the Ukrainian-Russian military conflict regions and antimicrobial resistance of major causing pathogens. Our data, together with other papers in the literature, complement the picture of antimicrobial resistance of major causing pathogens isolated from pregnant women. The limitations of this study include the retrospective nature of this analysis. The results were dependent on accurate and complete documentation in the medical records. The health status of our cohort may have been inadequately powered to detect significant findings and other associated risk factors for UTIs.

CONCLUSIONS

This study findings demonstrate the high rate (38.9%) of UTIs in pregnant women from the Ukrainian-Russian military conflict regions and many cases are caused by pathogens that are resistant to antibiotics. The most common risk factors of UTIs in pregnant women was lack of healthcare facilities, lack of essential medication, lack of personnel and equipment. Medical clinics across the Ukrainian-Russian military conflict regions are depleted and under immense strain. This has led to a decline in the quality of healthcare services and main reason for the high rate of UTIs in pregnant women. Untreated UTIs in pregnant women can lead to severe complications. Early detection and treatment of UTIs during pregnancy are crucial to prevent complications. Prevention of UTIs in women during pregnancy are essential to safeguard the health of both the mother and the fetus. Strategies for deterrence include optimal hygiene practices to minimize the risk of bacterial colonization and ascending infection. Preventive measures also involve screening for ASB during prenatal visits and promptly treating to symptomatic UTI. Preventive strategies and patient education, healthcare workers (physicians, advanced care practitioners, nurses, pharmacists, and other health professionals) can mitigate the prevalence of UTIs in pregnancy in women from the Ukrainian-Russian military conflict regions and promote optimal maternal and fetal outcomes.

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CONFLICT OF INTEREST
The Authors declare no conflict of interest

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