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The Occurrence and Antimicrobial Susceptibility Patterns of *Mycoplasma hominis* and *Ureaplasma urealyticum* in Pregnant Women in Three District Hospitals in Douala, Cameroon

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Authors' contributions

This work was carried out in collaboration between all authors. Authors NAL, HEEG, WAD and MKFX designed the study and wrote the protocol. Authors NAL, HEEG and KET wrote the first draft of the manuscript. Authors NAL, WAD and KET managed the analysis of the study. Authors WAD and KET managed the literature search. Authors NAL, HEEG, AJCN, MKFX and KET performed the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

Background: *Mycoplasma hominis* and *Ureaplasma urealyticum* are bacteria without cell wall, mostly isolated from the genito-urinary tract of both men and women. They are associated with infertility, pelvic inflammatory disease, cervicitis, epididymitis, obstetric pathologies as well as perinatal disorders. *M. hominis* and *U. urealyticum* have higher mutation rates and increasing antimicrobial resistance being reported. Proper treatment will reduce adverse maternal and foetal outcomes during and after pregnancy.
Aim: This study was carried out to determine the prevalence and antimicrobial susceptibility profile of *Mycoplasma hominis* and *Ureaplasma urealyticum* in pregnant women in Douala.
Study Design: This was a cross-sectional study involving pregnant women.
Methods: One hundred pregnant women enrolled from the antennal care unit of three district hospitals in Douala. A questionnaire was administered to each consenting participant and a cervical swab collected. Isolation, enumeration and sensitivity tests were done using Mycoplasma IES kit.
Results: Overall, the prevalence of genital mycoplasmas was 38% (95% CI: 28.5 – 48.3). The prevalence of *M. hominis*, *U. urealyticum* and coinfection with *M. hominis* and *U. urealyticum* were 4%, 29%, and 5% respectively. Prevalence of genital mycoplasmas was significantly higher in women between 21 and 25 years, hairdressers, and women who had a history of two spontaneous abortions. *M. hominis* isolates were most sensitive to pristinamycin (100%), josamycin (75%), clindamycin (75%) and levofloxacin (75%), while *U. urealyticum* were most sensitive to josamycin (79.31%) and pristinamycin (72.41%). All *M. hominis* isolates were resistant to erythromycin, roxythromycin, ciprifloxacin, clarithromycin, and tetracycline, meanwhile all *U. urealyticum* isolates were resistant to clindamycin.
Conclusion: This study revealed a high prevalence of genital mycoplasmas in the target population. The mycoplasmas were most sensitive to josamycin and pristinamycin. These findings underscore the need for regular screening and appropriate treatment of mycoplasmas in pregnant women in Douala.

Keywords: Mycoplasma hominis; Ureoplasma urealyticum; antibiotics; drug resistance; Douala.

1. INTRODUCTION

Mycoplasma hominis, *Ureaplasma urealyticum* and *Mycoplasma genitalium* are the mollicutes (class of bacteria lacking cell walls) most frequently isolated from the genital tract of both males and females, and the most potentially pathogenic [1]. The organisms colonise the mucosa of the genital tracts of humans. Although mycoplasmas are generally considered as extracellular organisms, intracellular localization has been reported for several species including *M. genitalium, M. hominis, M. penetrans* as well as *M. pneumoniae* [2]. This localization may protect the *Mycoplasma* sp. against host defences and contribute to disease chronicity [2]. Infection with Ureaplasma causes injury to mucosal cells and tissue damage [3]. Damage related to genital mycoplasmosis might be the result of the induced immune- and inflammatory responses rather than the direct toxic effects of Mycoplasma cellular components [4].

Ureaplasma spp. and *M. hominis* are part of the genital commensal flora of a great number of people. *M. hominis* could be found in the vagina in less than 10% of healthy women while *Ureaplasma* spp. could be found in up to 50% of them [5]. Carriers all over the world are a significant reservoir to spread of the bacteria [3]. The prevalence of *M. hominis* is between 10-20% for men and 20–40% for women. An increased occurrence of this pathogen is significantly associated with age, hormonal factors, race, socioeconomic level and sexual activity [5-7]. Although most infections with *M. hominis* and *U. urealyticum* are asymptomatic, these infections are associated with an increased risk of adverse pregnancy outcomes such as miscarriage, stillbirth, and preterm labour [1,8]. Specifically, *M. hominis* is associated with conditions such as endometritis and preterm birth [1,8], while *U. urealyticum* can cause chorioamnionitis, spontaneous abortion, stillbirth, and preterm abortion during pregnancy [8,9].

Mycoplasma are inherently resistant to antibiotics that target the cell wall; so agents like Beta-lactams are completely inactive since the mycoplasmas do not have a cell wall. The most common antimicrobials active against mycoplasmas are included in the three major drug classes: tetracyclines, macrolides-lincosamides-streptogramins-ketolides (MLSK

group), and fluoroquinolones [10]. Mycoplasmas have higher mutation rates than conventional bacteria, which mean that they can rapidly develop resistance to other drugs. Resistance to oxytetracyclines was first reported in Europe in 2000 [11]. Reduced susceptibility to fluoroquinolones has also been reported [12]. Macrolides are empirically used for pregnant women, as tetracyclines and quinolones are contraindicated in pregnancy [13]. However, their therapeutic efficacy may be unpredictable due to increasing resistance; some strains of *M. hominis* have shown resistance against erythromycin [14]. *Ureaplasma* spp. are susceptible to macrolide and related antibiotics except lincosamides; *M. hominis* is resistant to erythromycin and to all 14-membered macrolides (roxithromycin, clarithromycin, dirithromycin) and 15-membered macrolides (azithromycin), but sensitive to josamycin, a 16-membered macrolide [10].

The mycoplasmas are generally resistant to a number of antimicrobials and the rate of resistance is known to vary from one geographical area to another (according to different antimicrobial therapy policies and history of prior use of antimicrobial agents) [15]. Proper treatment of pregnant women reduces the risk of post-partum disorders, intra-uterine and perinatal abnormalities [15]. Studies on the antimicrobial sensitivity patterns of genital mycoplasmas in pregnant women in Cameroon are not readily available. Therefore, this study was designed to determine the occurrence of *M. hominis* and *U. urealyticum* in pregnant women in Douala and to assess their antimicrobial susceptibility patterns.

2. MATERIALS AND METHODS

2.1 Study Settings

The present study was carried out in three district hospitals of Douala: Logbaba District Hospital (LDH), Bonassama District Hospital (BDH) and Deido District Hospital (DDH). Douala is located at 4° 03′N, 9° 42′E. It is the economic capital and largest city in Cameroon with a population of 2,446,945 [16]. It is located on the banks of the Wouri River, the two sides linked by the Bonaberi Bridge.

2.2 Study Design and Duration

This was a cross-sectional hospital-based study carried out from 20th June, 2017 to 12th August, 2017.

2.3 Sample Size Estimation

Using the following formula for sample size calculation [17];

$$n = \frac{Z^2 x\ p(1-p)}{e^2}$$

Z = 1.96.

p = prevalence of genital mycoplasma = 11.2% [18].

e = error rate = 0.05

$$n = \frac{1.96^2 x\ 0.112(1-0.888)}{0.05^2} = 153$$

2.4 Study Population

The study involved pregnant women attending the antenatal care (ANC) units of the target hospitals. Consenting participants from the selected hospitals who were not on antibiotic treatment two weeks prior to the study were enrolled. Potential participants whose pregnancy required special follow-up, had genital track bleeding, and/or a cervical cerclage was excluded from the study.

2.5 Sampling Technique

A convenient sampling technique was used, where participants were consecutively recruited into the study from the ANC units of the selected hospitals.

2.6 Socio-demographic and Risk Factor Assessment

A semi-structured questionnaire was used to collect socio-demographic and clinical data (age, profession, gestational period, parity, spontaneous abortion etc.), and information on risk factors for antibiotic resistance (such as auto-medication, non-respect of prescribed doses, non-completion of treatment etc.). The participants were guided to fill the questionnaire by members of the research team.

2.7 Sample Collection

Cervical specimens were collected at the collection unit of the hospital laboratory. The discharge from the exo-cervix was collected using the cotton-swab. The mucosa was thoroughly scrapped to collect as many cells as possible since mycoplasma has a high affinity for mucus cell membranes.

2.8 Laboratory Analysis

The laboratory analyses were done at the Bacteriology unit of Afriquelabo, a private laboratory in Douala, using the Mycoplasma IES kit (BIOLYS SAS, France). The proceedings were according to the manufacturer's instruction. The commercial kit is a dehydrated culture medium based assay for the screening, indicative enumeration, identification and antibiotic susceptibility testing of *U. urealyticum* and *M. hominis* in the genitourinary tract. The selection and performance of the sensitivity testing was based on the Clinical and Laboratory Standards Institute (CLSI) recommendations using the following antibiotics: Pristinamycin PRI (2mg/l), Minocycline MIN (2mg/l, 8mg/l), Josamycin JOS (2mg/l, 8mg/l), Erythromycin ERY (8mg/l, 16mg/l), Roxythromycin ROX (1mg/l, 4mg/l), Clindamycin CLI (0.25mg/l, 0.5mg/l), Ofloxacin OFL (1mg/l, 4mg/l), Ciprofloxacin CIP (1mg/l, 2mg/l), Clarithromycin CLA (1mg/l, 4mg/l), Tretracycline TET^{Uu} (1mg/l, 2mg/l), Levofloxacin LEV^{Uu} (2mg/l, 4mg/l), Tretracycline TET^{Mh} (4mg/l, 8mg/l), and Levofloxacin LV^{Mh} (1mg/l, 2mg/l).

2.9 Reading and Interpretation

After 24 hours of incubation, the change in colour of the inoculated Urea-Arginine broth was read and interpreted according to the manufacturer's instructions.

For susceptibility tests, a negative reading in both of the wells indicated susceptible to antibiotic, a positive reading in the upper well and a negative reading in the lower well indicated intermediate to antibiotic and a positive reading in both of the wells indicated resistant to antibiotic.

2.10 Statistical Analysis

Data were entered into EPI-Info™ 7 and analysed; Statistical tests performed included the Pearson's chi-square to measure the association between categorical variables. A $p \leq 0.05$ was considered statistically significant.

2.11 Ethical Considerations

Ethical clearance for the study protocol was obtained from the Institutional Review Board of the Faculty of Health Sciences, University of Buea, Cameroon. Administrative authorisation was obtained from the Delegation of Public Health of the Littoral Region and from the hospitals where the study was carried out (LDH, BDH, and DDH).

3. RESULTS

3.1 Socio-demographic Characteristics of the Study Population

One hundred participants were enrolled, 34, 33, and 33 from DDH, LDH and BDH respectively. The ages of the women ranged from 16 to 39 years with a mean of 26.74±4.5. A majority (66%) of the participants were single and 31% were students (Table 1).

3.2 Obstetric and Gynaecologic Characteristics of the Participants

The average gestation period was 22.84 weeks, ranging from 4 weeks to 40 weeks, with the majority of pregnancies being in their second trimester (45%). Most of the women (28%) were primigravidae (Table 2). A majority (77%) of the participants had no history of spontaneous abortion. Most of the women (48%) reported having had 1-2 sex partners throughout their sexual life (Table 2).

3.3 Prevalence of Mycoplasmas

Of the 100 specimens tested, 38(38%) were positive for mycoplasmas while 28 (28%) were mere colonisation (growth < 10^4 CFU). The highest frequency of colonisation was for *U. urealyticum* (78.57%) while the frequency of *Mycoplasma hominis* colonisation and co-colonisation was 7.14% and 14.29% respectively. DDH, BDH and LDH had 5 (13.16%), 12(31.58%) and 21(51.26%) cases of infection respectively.

The overall prevalence of genital mycoplasmas was 38% (95% CI: 28.5 – 48.3). The prevalence of *M. hominis* infection was 4% (95% CI: 1.1 – 9.9), and *U. urealyticum* infection 29% (95% CI: 20.4 – 38.8) while the prevalence of co-infection with *M. hominis* and *U. urealyticum* was 5% (95% CI: 1.6 – 11.3).

3.4 Antibiotic Susceptibility Patterns of Isolates

Antimicrobial susceptibilities were determined using the Mycoplasma IES. Among *M. hominis*, the highest drug sensitivity rates were recorded for pristinamycin (100%), josamycin (75%) and clindamycin (75%) (Table 3).

Table 1. Socio-demographic characteristics of study participants

	Number tested (%)	*M. hominis* (%)			*U. urealyticum* (%)			Co-infection (%)			Overall № infected (%)		
		No infected (%)	χ^2	p-value	No infected (%)	χ^2	p-value	No infected (%)	χ^2	p-value	No infected (%)	χ^2	p-value
Age													
16-20	12	2 (16.7)			3 (23.1)			0 (0.0)			5 (41.7)		
21-25	31	0 (0.0)			15 (48.4)			3 (9.7)			18 (58.1)		
26-30	37	1 (2.7)	7.822	.09	9 (24.3)	9.652	.04	1 (2.7)	3.523	0.47	11 (29.7)	10.039	.04
31-35	10	1 (10.0)			1 (10.0)			1 (10.0)			3 (30.0)		
36-40	10	0 (0.0)			1 (10.0)			0 (0.0)			1 (10.0)		
Profession													
Dressmaker	5	0 (0.0)			2 (0.4)			0 (0.0)			2 (40.0)		
Hairdresser	10	0 (0.0)			5 (50.0)			1 (10.0)			6 (60.0)		
Housewife	10	0 (0.0)			7 (70.0)			1 (10.0)			8 (25.8)		
Student	31	4(12.9)	6.524	.26	10 (32.3)	8.506	.13	2 (6.5)	2.720	0.74	16 (51.6)	11.975	.04
Trading	6	0 (0.0)			2 (33.3)			1 (16.7)			3 (50.0)		
Other	17	0 (0.0)			3 (17.7)			0 (0.0)			3 (17.7)		
Marital status													
Monogamy	29	1 (3.5)			7 (24.1)			1 (3.5)			9 (31.0)		
Polygamy	5	0 (0.0)	0.282	.87	1 (20.0)	0.784	.68	0 (0.0)	0.566	0.75	1 (20.0)	1.833	.39
Single	66	3 (4.6)			21 (31.8)			4 (6.1)			28 (42.4)		

Table 2. Obstetric and gynecologic characteristics of study participants

	Number tested	*M. hominis* (%)			*U. urealyticum* (%)			Co-infection (%)			Overall N° infected (%)		
		No infected (%)	χ^2	p-value	No infected (%)	χ^2	p-value	No infected (%)	χ^2	p-value	No infected (%)	χ^2	p-value
Gestation period													
1st trimester	21	1 (4.8)			8 (38.1)			2 (9.5)			11 (52.4)		
2nd trimester	45	1 (2.2)			13 (28.9)			2 (4.4)			16 (35.3)		
3rd trimester	34	2 (5.9)	0.707	.70	8 (23.5)	1.338	.51	1 (2.9)	1.237	.54	11 (32.4)	2.418	.29
Number of children													
0	37	4 (10.8)			8 (21.6)			1 (2.7)			13 (35.2)		
1	24	0 (0.0)			12 (50.0)			2 (8.3)			14 (58.3)		
2	21	0 (0.0)			6 (28.6)			1 (4.8)			7 (33.3)		
3	16	0 (0.0)	7.095	.21	3 (18.8)	7.924	.16	1 (6.3)	1.133	.95	4 (25.0)	6.908	.23
4	1	0 (0.0)			0 (0.0)			0 (0.0)			0 (0.0)		
5	1	0 (0.0)			0 (0.0)			0 (0.0)			0 (0.0)		
Number of pregnancies													
1	28	4 (14.3)			6 (21.4)			1 (3.6)			11 (39.3)		
2	20	0 (0.0)			9 (45.0)			1 (5.0)			10 (50.0)		
3	22	0 (0.0)			8 (36.4)			2 (9.1)			10 (45.5)		
4	17	0 (0.0)	10.714	.06	4 (23.5)	5.523	.36	0 (0.0)	4.763	.45	4 (23.5)	4.510	.48
5	9	0 (0.0)			1 (11.1)			1 (11.1)			2 (22.2)		
6	4	0 (0.0)			1 (25.0)			0 (0.0)			1 (25.0)		
Number of spontaneous abortion													
0	77	4 (5.2)			26 (33.8)			3 (3.9)			33 (42.9)		
1	17	0 (0.0)			1 (5.9)			2 (11.8)			3 (17.7)		
2	4	0 (0.0)	1.245	.74	2 (50.0)	6.936	.07	0 (0.0)	2.151	.54	2 (50.0)	9.355	.03
3	2	0 (0.0)			0 (0.0)			0 (0.0)			0 (0.0)		
Number of sex partners													
1-2	48	3 (6.3)			9 (18.8)			3 (6.3)			15 (31.3)		
3-4	36	1 (2.8)			16 (44.4)			1 (2.8)			18 (50.0)		
5-6	12	0 (0.0)	1.440	.69	3 (25.0)	8.475	.04	1 (8.3)	1.023	.79	4 (25.0)	3.526	.32
>6	4	0 (0.0)			1 (25.0)			0 (0.0)			1 (25.0)		

Table 3. The antibiotic susceptibility rates of *Mycoplasma hominis* and *Ureaplasma urealyticum* in infected women

Antibiotics	*Mycoplasma hominis*			*Ureaplasma urealyticum*			*Mycoplasma hominis*/*Ureaplasma urealyticum* coinfection		
	Sensitive n (%)	Intermediate	Resistant	Sensitive n (%)	Intermediate n (%)	Resistant n (%)	Sensitive n (%)	Intermediate n (%)	Resistant n (%)
PRI	4 (100.0)	0 (0.0)	0 (0.0)	21 (72.4)	0 (0.0)	8 (27.6)	3 (60.0)	0 (0.0)	2 (40.0)
JOS	3 (75.0)	1 (25.0)	0 (0.0)	23 (79.3)	6 (20.7)	0 (0.0)	4 (80.0)	1(20.0)	0 (0.0)
CLI	3 (75.0)	0 (0.0)	1 (25.0)	0 (0.0)	0 (0.0)	29 (100.0)	0 (0.0)	0 (0.0)	5 (100.0)
LEV^{Uu}	3 (75.0)	0 (0.0)	1 (25.0)	18 (62.1)	5 (17.2)	6 (20.7)	3 (60.0)	2 (40.0)	0 (0.0)
MIN	2 (50.0)	2 (50.0)	0 (0.0)	18 (62.1)	2 (6.9)	9 (31.0)	1 (20.0)	2 (40.0)	2 (40.0)
OFL	0 (0.0)	3 (75.0)	1 (25.0)	1 (3.5)	21 (72.4)	7 (24.1)	0 (0.0)	5 (100.0)	0 (0.0)
LEV^{MH}	0 (0.0)	3 (75.0)	1 (25.0)	3 (10.4)	16 (55.2)	10 (34.5)	2 (40.0)	1 (20.0)	2 (40.0)
ERY	0 (0.0)	0 (0.0)	4 (100.0)	17 (58.6)	4 (13.8)	8 (27.6)	0 (0.0)	0 (0.0)	5 (100.0)
ROX	0 (0.0)	0 (0.0)	4 (100.0)	14 (48.3)	7 (24.1)	8 (27.6)	0 (0.0)	0 (0.0)	5 (100.0)
CIP	0 (0.0)	0 (0.0)	4 (100.0)	0 (0.0)	2 (6.9)	27 (93.1)	0 (0.0)	0 (0.0)	5 (100.0)
CLA	0 (0.0)	0 (0.0)	4 (100.0)	19 (65.5)	2 (6.9)	8 (27.6)	0 (0,0)	0 (0.0)	5 (100.0)
TET^{Uu}	0 (0.0)	0 (0.0)	4 (100.0)	5 (17.2.0)	7 (24.1)	17 (58.6)	1 (20.0)	0 (0.0)	4 (80.0)
TET^{Mh}	0 (0.0)	0 (0.0)	4 (100.0)	17 (58.6.0)	2 (6.9)	10 (34.5)	1 (20.0)	0 (0.0)	4 (80.0)

PRI: Pristinamycin, MIN: Minocycline, JOS: Josamycin, ERY: Erythromycin, ROX: Roxythromycin, CLI: Clindamycin, OFL: Ofloxacin, CIP: Ciprofloxacin, CLA: Clarithromycin, TET^{Uu}: Tretracycline, LEV^{Uu}: Levofloxacin, TET^{Mh}: Tretracycline, and LV^{Mh}: Levofloxacin.

Among *U. urealyticum* isolates, the highest sensitivity rates were recorded for josamycin (79.31%) and pristinamycin (72.41%); all *U. urealyticum* isolates were resistant to clindamycin. The most sensitive antibiotics in *U. urealyticum* and *M. hominis* co-infection were Josamycin (80%), pristinamycin (60%) and levofloxacin in high doses (60%). All mixed isolated were resistant to erythromycin, roxithromycin, clindamycin, ciprofloxacin and clarithromycin (Table 3).

Among the 100 women included in our study, a majority (51%) of the participants admitted using auto-medication, approximately one-third of the participants (33%) did not complete their treatment with antibiotics, and a few (16%) did not respect the prescribed doses of drugs. Furthermore, a majority (54%) of the participants were not aware that misuse of antibiotics can lead to acquired bacterial resistance and therapeutic failure.

4. DISCUSSION

This study recorded an overall prevalence of 38%. In this study, we could not attain the required sample size because of the low turnout of pregnant women to the selected hospital during the study period. The prevalence of genital mycoplasma recorded in this study was lower compared to the 76% obtained by Redelinghuys et al. [19] or the 55.2% obtained by Lee et al. [20]. The prevalence was also lower compared to the 65% reported in women in Yaounde, Cameroon [21]. The discrepancies between these results and ours could be attributed to differences in population demographics and the sites of sample collection. In these studies, vagina swabs were collected, and since genital mycoplasmas are present in the vagina of about 80% of sexually active women, it can lead to an increased detection of vagina secretions.

In this study, *U. urealyticum* infection was more prevalent than *M. hominis* infection (29% vs. 4%). The high prevalence rate of *U. urealyticum* was similar to those observed in other studies conducted by Lee et al. [20] and Redelinghuys et al. [19]. This may be due to the fact that *U. Urealyticum* infection appeared to be linked with bacterial vaginosis or other genital infection [21]. The vagina environment created by this infection is, therefore, a suitable milieu for *U. Urealyticum* growth.

Pregnant women of the age 21-25 years were the most affected. Skiljevic et al. [12] also found younger women more prone to the infection while Bayraktar et al. [22] reported the age group of 25-30 was more vulnerable to the infection. Moreover, the rate of infection was also high in women who reported 2 spontaneous abortion. This is in conformity with the study by Lee et al. [20]. However, this finding should be interpreted with caution as there were only a few women who reported spontaneous abortion in the current study. Furthermore, although not significant, pregnant women who have had 3-4 sex partners throughout their active sexual life had higher infection rate than the other groups, which is in conformity with studies that show that increased number of sex partners increases the risk of genital mycoplasmosis [23]. Students and hair dressers were the most infected categories. This could be due to the fact that these groups of women do not have steady incomes; most of them being young and highly sexually active thus having multiple sex partners to augment their meager income. This finding ties with others studies who associated the increase in genital mycoplasmas with low socio-economic status [6].

Bacterial resistance is linked with misuse of antibiotics: inappropriate prescription, non-completion of treatment as well as non-respect of dosage when taking antibiotics. In the current study, 51% of the women practiced auto medication, 33% habitually did not complete their treatment with antibiotics, and 16% did not respect the prescribed doses of drugs. These results are similar to the findings of Pechere where 69% of interviewees claimed to have taken the course of antibiotics until the end and 75% actually took all their daily doses [24]. Furthermore, a majority (54%) of the women were not aware that misuse of antibiotics could lead to acquired bacterial resistance and therapeutic failure. These findings underscore the need of regular sensitization of the target population against indiscriminate use of antibiotics.

In this study, *M. hominis* was most sensitive to pristinamycin, josamycin and clindamycin. The high sensitivity to pristinamycin and josamycin is in conformity with studies performed elsewhere [20,22]. This could be due to the fact that these antibiotics are relatively new in the market and are not frequently prescribed for the treatment of genital mycoplasmosis. Limited usage of antibiotics lead to limited resistance rate. On the contrary, a Serbian study reported resistance

rates as high as 66.7% for Josamycin and 50% for pristinamycin [12]. These differences could be attributed to the geographical variation in the rate of antimicrobial resistance fuelled by differences in national drug policies and history of prior use of antimicrobial agents. Furthermore, all *M. hominis* isolates were resistant to erythromycin, roxythromycin, ofloxacin, ciprofloxacin, clarithromycin, tretracycline, levofloxacin, and ciprofloxacin. This acquired resistance was also found in Serbia [12] although the resistance to ciprofloxacin was just half of what we observed (50%). However, caution should be exercise when interpreting this data as the number of isolates of *M. hominis* in our study was very few (4). Larger studies will be required to shed more light. The pan resistance to erythromycin, roxithromycin and clarithromycin observed in this study are in conformity with the study by Waites and Talkington [6].

In the present study, most *U. urealyticum* isolates were found to be sensitive to pristinamycin, josamycin and clarithromycin. Resistance rate to erythromycin was very low 27.59% as compared to the 85% found in Hungary [25], but similar to the 30% reported by Safaa et al. [26]. Furthermore, clarithromycin resistance rate in one Serbian study [12] was very high (94.6%) than the rate (27.59%) we found. All these discrepancies could also be attributed to the differences in the local usage of antibiotics. All the isolates were found to be resistant to clindamycin, a member of the Lincosamines family of antibiotics, which corroborates the study by Waites and Talkington [6].

In this study, coinfection with *M. hominis* and *U. urealyticus* exhibited the highest resistance rate to all the antibiotics ranging from 40% (for pristinamycin and minocycline) to 100% (for erythromycin, roxithromycin, clindamycin, clarithromycin and ciprofloxacin). These results are similar to the findings of Wang et al. [27] and Huang et al. [28]. Erythromycin resistance of mixed isolates is comparable to Domingues et al. [29] and Kechagia et al. [30] who reported 90.7% and 100% erythromycin resistance respectively. Tetracycline resistance of mixed isolates observed in this study, was very high (97%) when compared to similar studies by Kechagia et al. [30] and Koh et al. [31].

5. CONCLUSION

This study showed a high prevalence of 38% for genital mycoplasmas in pregnant women. The prevalence of *U. urealyticum* and *M. hominis* infection were 29% and 4% respectively and co-infection with these pathogens was 5%. *U. urealyticum* and *M. hominis* infection were common in women aged between 21 and 25 years and in those who have had 2 spontaneous abortion or more. *M. hominis* was most sensitive to pristinamycin, josamycin and clindamycin, meanwhile *U. urealyticus* was most sensitive to pristinamycin, josamycin. Resistant rates were generally higher in cases of coinfection with *M. hominis* and *U. urealyticus*. These findings underscore the need for regular screening of pregnant women for genital mycoplasmas and appropriate treatment to mitigate the high rate of resistance in the study area.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the author(s)

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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