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Research Article

Microbiological Profile of Vaginal Swabs from Infertile Women in the Cities of Ngaoundere and Garoua, Cameroon

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Abstract

Genital infections are a real public health problem in developed countries. They have serious consequences such as ectopic pregnancy (EP), chronic pelvic pain, premature delivery, miscarriage, cervical cancer and even infertility. The objective of this study was to determine the epidemiological and microbiological profile of genital infections among infertile women in the cities of Ngaound é é and Garoua. This descriptive study was carried out in the Protestant and regional hospitals, as well as the military and regional hospitals serving the cities of Ngaound é é and Garoua, over a period of five months, from August 2020 to January 2021. Women of reproductive age (15 to 45 years) who met the inclusion criteria, gave their informed consent, and had at least one consultation in the gynecology department of the aforementioned hospitals for infertility made up our population. Thus, the study included 100 women, or 50 women per city. A pre-tested questionnaire was employed to get data from the subjects. Blood samples were taken for chlamydia testing, and cervical-vaginal samples were taken for microbiological analysis (PCV+ATB and mycoplasma testing). The gathered information. SphinxPlus. V5 was the program used to analyze the data that were collected. Ninety-six percent of the 100 women who participated in this study had a vaginal infection. The infertile women's modal age range was 26–35 years old, with a mean age of 29. Of the women, 54% were housewives, 33% had completed their elementary; education, and 55 were in monogamous marriages. At 65%, secondary infertility was the most prevalent type. 5.15 years was the average length of infertility. Abortions accounted for 41% of the patients' histories, whereas genital infections made up 69%. When the infertile women's vaginal pH was analyzed, the majority (69%) had a pH > 4.5. Chlamydia trachomatis (28.41%), Ureaplasma urealyticum (22.63%), Candidas albicans (20.58%), Gardnerella vaginalis (14.40%), Mycoplasma hominis (9.46%), Candidas spp (1.65%), Staphylococcus (1.64%), Trichomonas vaginalis (0.82%), and Neisseria gonorrhoeae (0.41%) were among the microbiological analyses of the samples. The etiological identification of genital infections and infertility of infectious or tubal origin, which can be avoided with early intervention, is greatly aided by microbiology.

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Keywords

Ngaoundere, Garoua, Microbiology, Infertility, Genital Infection

1. Introduction

All clinical and biological symptoms that arise from microscopic and live pathogens—such as bacteria, parasites, yeast, and viruses—penetrating the genital canal are referred to as genital infections [1]. Globally, genital tract infections (GTIs) are acknowledged as significant public health issues. Sexually transmitted diseases (STIs) are thought to affect over a million individuals worldwide each day, according to estimates from the World Health Organization (WHO). The four sexually transmitted infections (STIs) that are thought to affect 357 million people annually are trichomoniasis (143 million cases), chlamydia (131 million cases), gonorrhea (78 million cases), and syphilis (5.6 million cases) (WHO, 2019). According to Koanga et al. [2] and Nsagha et al. [3], there was a 28% prevalence of genital infections in Douala, Cameroon, and a 68.7% prevalence in Yaoundé and Douala.

Based on the location of the causative germ, female genital infections (GIs) are divided into two main groups: upper genital infections (UGI), which are found in the uterus, fallopian tubes, and ovaries, and lower genital infections (LGI), which affect the vulva, vagina, and cervix [4].

These latter have major side effects such ectopic pregnancy (EP), chronic pelvic discomfort, early birth, miscarriage, cervical cancer, and infertility and are typically caused by lower infections that are either undiagnosed or improperly managed [5]. According to a study by Mai Abdessalem [6] in Algeria, ovarian inadequacy (9.52%), fallopian tube issues (12.69%), and vaginal infections (13.49%) are the most common causes of infertility.

The failure of a woman who is not using contraception to become pregnant while engaging in regular sexual activity—roughly two to three different days per week for a year—to conceive is known as female infertility [7]. It is common, affecting at least one out of six couples (Boivin et al., 2007 [7, 8]). Between 20 and 30 percent of gynecological consultations in Cameroon are related to infertility [9]. It stands for 20.69% in Ngaoundere, where primary infertility is 35.9% and secondary infertility is 64.1% [10]. According to a Yaounde investigation, infectious causes accounted for 48.9% of cases, with female etiologies reported in 30% of cases [11]. Microbiology plays a significant role in the clinical and paraclinical investigations used to identify the infectious etiology of female infertility. Numerous investigations on the etiological diagnosis of infertility, particularly in radiology (ultrasound and hysterosalpingography), have been conducted in Cameroon. [9, 10]. The microbiological component, however, has received little attention; this is especially true in the city of Ngaoundéré, where infertility is common. Therefore, the current study intends to investigate the microbiological and epidemiological characteristics of genital infections in infertile women in the towns of Garoua and Ngaoundere.

2. Methods

Over the course of five months (05) from September 2020 to January 2021, this descriptive and cross-sectional study was conducted at the Ngaoundere Protestant and Regional Hospitals as well as the Garoua Military and Regional Hospitals. The group consisted of females between the ages of 15 and 45 who had visited the gynecology department of the aforementioned hospitals at least once for an infertility consultation.

2.1. Cervico-Vaginal and Blood Sampling

The participants were given an information sheet to complete after being informed about the purpose of the study. Upon completion of the forms, individuals who satisfied the inclusion criteria had their samples taken. The requirements included not taking any oral or topical antibiotics, maintaining proper personal hygiene, not having had sex the day before the exam, not urinating for at least two hours, and not being menstruating. After that, the patient was positioned in the gynecological position, with the speculum horizontally opened and positioned at the level of the vagina. Four sterile swabs were used to randomly obtain the sample.

The first ectocervical swab was utilized for culture in Sabouraud, Chapman, and EMB, while the second swab was used for the potassium test and microscopic inspection. The culture on chocolate+VCN, blood agar, and Gram staining were performed using the first endocervical swab; the mycoplasma test was performed using the second endocervical swab. The macroscopic aspect was also noticed prior to sampling.

A venipuncture was used to draw blood into a dry tube with a red cap.

2.2. PCV Sample Microbiological Analysis

The isolation, identification, and examination of bacteria as well as their antibiotic sensitivity are all part of the microbiological analysis.

2.2.1. Vaginal pH Measurement

The test involved putting a piece of pH indicator paper to the leucorrhoea-laden area of the speculum. The color of the pH paper was then compared to the color scale to get the matching pH.

2.2.2. The Potassium Test

Leucorrhoea was mixed with a drop of 10% potassium hydroxide on a slide. The release of an amine-like odor of "spoiled fish" indicates a positive reaction (presence of *Gardnerella vaginalis).*

2.2.3. Microscopic Examination

Fresh state performance:

Two drops of physiological water were used to suspend vaginal secretions, which were then viewed under a microscope at a magnification of 40. Trichomonas vaginalis, yeasts with or without mycelial filament, leukocytes, red blood cells, and epithelial cells can all be seen with this test.

Stained condition (Gram):

To create a uniform smear, secretions were distributed by gently rolling the swab on a slide and pressing. The samples were examined under a microscope at 100 magnification following Gram staining. This test was designed to look for leukocyte reactivity, gram (positive or negative), bacteria form and abundance, presence of clue cells that evoke Gardnerella vaginalis (GV), and type (I to IV) vaginal flora.

CVP culture and identification of bacterial shoots

The various culture media, prepared according to the manufacturer's instructions, were added to the sterile petri dishes. The inoculum was then streaked with a platinum loop, and the dishes were then incubated for 24 to 48 hours at 37 ℃. The required bacteria were injected into blood-containing media (blood agar and chocolate VCN) and placed in an environment with high CO_2. The identification of the shoots followed incubation.

The study of the bacterial family and its physical, cultural, and biochemical traits served as the foundation for the identification of individual strains of bacteria. Antibiograms and antifungiograms were carried out following the identification of the isolated germs.

Study of the sensitivity of germs to antibiotics/antifungals

The antibiogram/antifungal was realized using the procedure outlined in [12] Ngaba et al., 2014. Susceptibility to each bacterial strain was assessed using a standard antibiogram or antifungal swab, with the antibiogram being measured on Mueller-Hinton agar and the antifungal being determined on Sabouraud medium. Following a 15-minute incubation period following the flooding of Muller Hinton/Saboraud agar with a bacterial suspension standardized to 0.5 Mac Farland scale, the antibiotic discs were positioned on top of the gel, separated from both the Petri dish's edges and each other. After 18 to 24 hours of incubation, the antibiogram and antifungiogram were read by measuring the inhibitory zones. Sensitive, intermediate or resistant antibiotics or antifungals were distinguished according to the recommendations of the SFM antibiogram committee.

Examination of samples of mycoplasma microbiologically

A comprehensive kit called "Mycoplasma IST 2" was utilized to diagnose genital mycoplasma and reaplasma. It enables the culture, identification, indicative count, and assessment of Mycoplasma hominis (MH) and Ureaplasma urealyticum (Uu) antibiotic sensitivity.

Following swabbing, the sample was added to Mycoplasma R1 broth. After 15 to 20 minutes, 3 ml of the inoculated Mycoplasma R1 was added to Mycoplasma R2 broth. Next, 55 ul of broth were added to each well in the gallery after waiting 20 minutes. For anaerobic growth, two droplets of kerosene oil were added to each well, and the gallery was incubated for 48 hours at 37 ℃. One of the two wells with an orange to red color denotes a positive culture; the other well with a yellowish tint indicates a negative culture (bacteria are absent).

Serological analysis of Chlamydia trachomatis (Ct) samples

The manufacturer's recommended method for detecting IgG and IgM antibodies on an IgM/IgG antibody cassette was used to look for Chlamydia trachomatis. If there is a red dot in the quality control area (C) and the test area (T) both have red dots, the test is deemed positive. Otherwise, it is deemed negative. An invalid result is indicated by the absence of a red dot in the quality control area (C).

2.3. Data Analysis and Processing

The collected data were analyzed using SphinxPlus.V5 software. The obtained results were presented in the form of graphs, which were realized with the help of the software MICROSOFT OFFICE EXCEL and XLstat 2016.

2.4. Ethical and Administrative Considerations

The directors of the aforementioned facilities, the Regional Health Delegate for Adamaoua and the North regions, and the Department of Biomedical Sciences at the University of Ngaoundéré granted permission for the study. Participants gave their written informed consent, and all patient data was handled with the utmost secrecy.

3. Results

During the trial, 100 participants in total who met the inclusion criteria were registered. Ninety-six percent (96) of the 100 women who signed up for the study had a vaginal infection. Out of them, 69 had positive results from serological swabs and 88 from cervico-vaginal swabs.

3.1. Sociodemographic Profile of the Study Population

The sociodemographic profile of the research population is displayed in Table 1. The patients' modal age range was (26-35) years, with an average age of 29. With a percentage of 54%, housewifery was the most common occupation. Seventy-four percent of the patients were urban dwellers. 33% of the 88% of married women belonged to polygamous families, while 55% were part of monogamous ones. 33 percent of the patients had only completed their primary school. The majority of participants had been married for an average of 18.41 years, and women who had been together for fewer than five years made up the largest group (42%).

Table 1. *Sociodemographic profile of the study population.*

Modalities		**Population Size**		
		Ngaoundere	**Garoua**	**Total**
Age	(15-25)	15	16	31
	(26-35)	23	28	51
	(36-45)	12	6	18
Profession	Housewife	25	29	54
	Student	8	4	12
	Informal Sector	6	7	13
	Private Sector	11	10	21
Residence	Urbain	47	45	92
	Rural	3	5	8
Marital status	Monogamy	19	36	55
	polygamy	25	8	33
	cohabitation	6	6	12
Educational level	Primary school	22	21	42
	secondary school	15	17	32
	University	13	12	25
Duration of relationship	Lest than 5 years	21	19	40
	5 - 10 years	20	18	38
	More than 10 years	9	13	22

3.2. Pathological Profile of the Study Population

3.2.1. Distribution of Patients According to Abortion Status and Personal Hygiene Product Used

38% of the patients had previously undergone a spontaneous abortion, 3% had undergone an elective abortion, and none had undergone a therapeutic abortion, according to Figure 1.

As shown in Table 2, 29% of patients performed vaginal hygiene and 71% performed vulval hygiene. Patients who used soap (32%), plain water (31%), frothy antiseptic solutions (14%), and intimate gels (12%) were the most common. Of the patients, 42% utilized these products while bathing, 27% during menstruation and after sexual activity, and 24% after sexual activity. Table 2: Products for intimate hygiene.

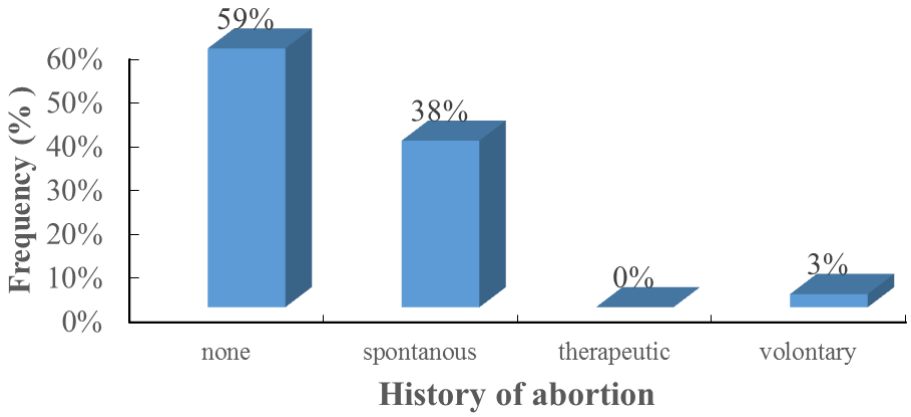

Figure 1. *Distribution of patients by previous abortion status.*

Table 2. *Product used for intimate hygiene.*

Intimate hygiene		Population Size	Frequency (%)
Type of toilet	Vulvar grooming	71	71
	Vaginal grooming	29	29
Product used	Simple Water	31	31
	Hot water	1	1
	Lemon Water	2	2
	Chlorine water	1	1
	Soap	32	32
	Traditional product	7	7
Period of realization	SAM	14	14
	Intimate Gel	12	12
	PM	2	2
	PM+ARS	27	27
	AM+LB	24	24
	ARS	5	5
	LB	42	42

3.2.2. Patient Distribution Based on History of Genital Infection

Table 3 shows that 52% of patients had a history of vaginal mycoses. This represents the vast majority of patients. 994% of the patients had had one genital infection before, whereas just 6% had had two. Biomedicine was used by 80% of the patients, while biomedicine and ethnomedicine by 7%, and self-medication and ethnomedicine by 4% and 3%, respectively, were the least common approaches.

Table 3. *History of genital infection of patients.*

Previous genital infection (GI)		Population Size	Frequency (%)
Type of GI	None	31	31
	Vaginal mycosis	52	52
	Vaginitis	2	2
	Vaginosis	4	4
	Cervicitis	4	4
	MIP/PID	2	2
	Vaginitis + vaginosis	2	2
	Vaginal mycosis+ Cervicitis	1	1
	Mycosis + vaginosis	2	2
Frequency of Occurrence of GI	once	65	94
	Twice	4	6
	More than twice	0	0
Treatment options	Pharmaceutical products	55	80
	Ethnomedecine	8	11
	Automedication	6	9

GI: genital infection

3.2.3. Patient Distribution Based on Type and Duration of Infertility

According to Table 4, 65% of the women surveyed had secondary infertility, whereas 35% have primary infertility. 46% have spent more than 5 years in this situation.

Table 4. *Type and duration of infertility.*

Variables	Modalities	Popilation size
Type of infertility	Primary infertility	35
	Secondary infertility	65
Time spent in infertility	1-2 years	22
	3-4 years	33
	More than 5 years	46

3.3. Macroscopic Characteristics of CVP

According to Table 5, the normal cervix was the most common, accounting for 95% of cases. The leucorrhoea hue had the most representation (68%). In terms of consistency, fluid leucorrhoea was observed in 47% of participants. Medium odorless leucorrhoea (72%) affects 61% of the study population.

Table 5. Macroscopic examination.

Macroscopic examination		Population Size		
		Ngaoundere	Garoua	Mean
Aspect of the cervix	Inflammation	3	2	5
	Normal	47	48	95
Color of leukorrhea	White-Greyish	6	17	23
	Whitish	41	27	68
	Yellowish	1	6	7
	Grennish	2	0	2
Consistency of leucorrhoea	Curdled	32	7	39
	Thick	4	10	14
	Fluid	14	33	47
Amount of leucorrhoea	Discreet	8	6	14
	Important	11	14	25
	Medium	31	30	61
Odor of leucorrhoea	Festered odor	3	2	5
	Odorless	44	28	72
	Rotten fish	3	20	23

3.4. Microbiological Characteristics of Vaginal and Blood Samples

Two types of samples were collected for our study: a blood sample for *chlamydia trachomatis* and a vaginal sample for CVP+ATB and mycoplasma detection. Table 6 shows that 88 of the 100 CVP samples collected tested positive for vaginal infections. 69 of the blood samples tested positive for *Chlamydia trachomatis*.

Table 6. Microbiological characteristics of vaginal and blood samples.

Samples	Cervico-vaginal swab (SVS)	Blood sampling
Positive	88	69
Negative	12	31

3.5. Physicochemical Characteristics of the PCV

Table 7 shows that 34% of patients were test positive (presence of *Gardnerella vaginalis*) and 66% were test negative. As far as pH is concerned, 69% of the patients had a pH > 4.5 against 31% who had a pH between 3.8-4.5.

Table 7. Physicochemical characteristics of CVP.

pH	3, 8-4, 5	> 4, 5
	69	31
Potash test	Positive	Negative
	34	66

3.6. Microscopical Characteristics of PCV

Table 8 indicates that the fresh state consists of 1% *Trichomonas vaginalis*, 47% leukocytes, and 1% epithelial cells. Gram staining revealed that 32% and 6.5% of the samples, respectively, had Gram-positive bacilli and cocci. *Gardnerella vaginalis* was detected in 17.5% of the samples, *Trichomonas vaginalis* in 30%, gram-negative cocci in 0.5%, and yeast in 1% of the samples. Under a microscope, 13% of the samples showed no microorganisms.

Table 8. *Microscopic characteristics of servico-vaginal swabs.*

Macroscopic characteristics		Size	Fréquency (%)
Fresh appearance	Leukocytes	90	47
	Epithelial cells	100	52
	TV	2	1
stained state	Absence	25	12,5
	BGP	64	32
	CGP	13	6,5
	CCN	1	0,5
	GV	35	17,5
	TV	2	1
	Levure	60	30

TV: Trichomonas vaginalis BGN=Gram-negative bacillus, BGP Gram-positive bacillus, CGP=Gram-positive coccis, CGN= Gram-negative coccis.

3.7. Cultural Aspects of the Cervico-vaginal Swabs

According to Figure 2, 77 out of the 100 CVP samples tested positive for microbial cultures, while 23 were found to be sterile. The positive cultures consisted of 61 instances of mono-infection, 15 cases of bi-infection, and a single case of poly-infection. A total of 94 microorganisms belonging to five different species were isolated from the 77 cultures that tested positive. The species distribution analysis revealed that *Candidas albicans* was the most prevalent species, accounting for 53% of the total. *Gardnerella vaginalis* followed with a prevalence of 37%, while *Staphylococcus aureus* accounted for just 5%. Figure 3.

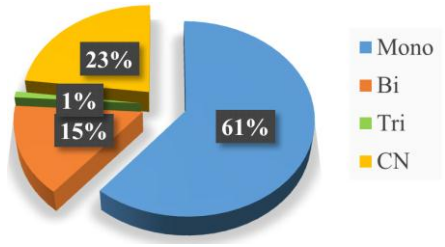

Figure 2. *Frequence of germe isolate in cervico-vaginal swab cultures. Mono=Monomicrobial, Bi=Bimicrobial, Tri=Trimicrobial, CN= Negative Culture.*

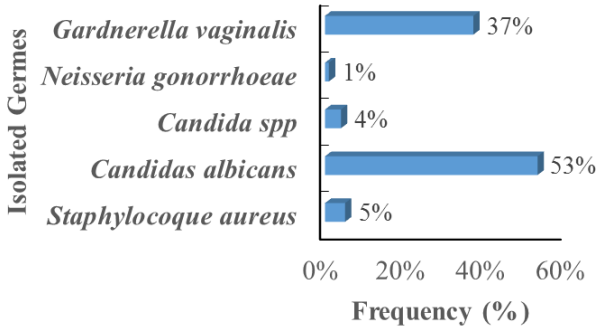

Figure 3. *Distribution of germs isolated in culture.*

3.8. Microbiological Profile of the Pathogenic Vaginal Flora

The distribution of isolated germs in the vaginal flora consisted mainly of by *Chlamydia trachomatis* (28.41%), *Ureaplasma urealyticum* (22.63%), *Gardnerella vaginalis* (14.40%), *Mycoplasma hominis* (9.46%), Candidas spp. (1.65%), *Staphylococcus aureus* (1.64%), *Trichomonas vaginalis* (0.82%), and *Neisseria gonorrhoeae* (0.41%), as depicted in Figure 4.

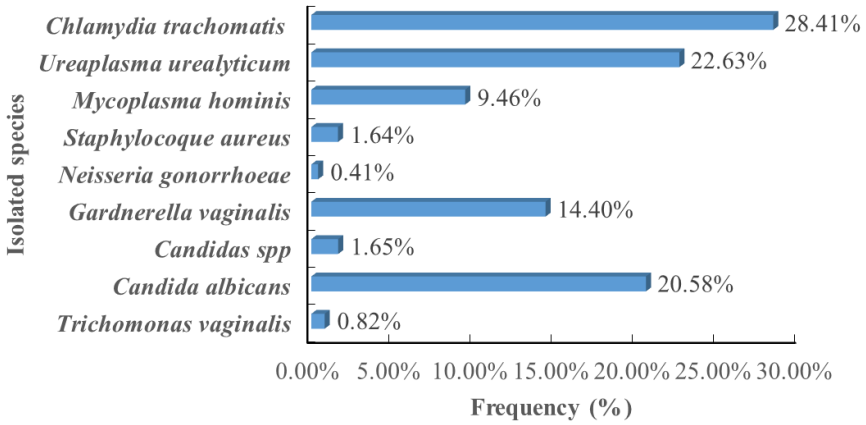

Figure 4. *Microbiological profile of pathogenic flora.*

3.9. Sensitivity Profile of Isolated Germs to Different Antifungal and Antibiotic Drugs

3.9.1. Sensitivity of the Isolated Germs to the Different Antifungal Drugs

Based on the examination of table 9, it is evident that *Candida albicans* showed a 100% sensitivity to Nystanine and a 73.47% sensitivity to miconazole, as observed in the susceptibility of the isolated germs to the antifungal medicines. Econazole, Ketonazole and Fluconazole had a resistance rate of 85.72%, 65.30%, and 51.02% respectively.

Table 9. *Sensitivity of isolated germs to different antifungals.*

ATF	NYS	MCZ	KTZ	FLU	ECO
C. albicans	S (100%)	S (73,46%)	S (65,30)	R (51, 02%)	R (85, 72%)
Candida spp.	S (100%)	S (50%)	R (75%)	R (50%)	R (100%)

NYS: Nystatine, MCZ: Miconazole, KTZ: Ketonazole, FLU: Fluconazole, ECO: Econazole.

3.9.2. Sensitivity of Isolated Germs to Different Antibiotics

Tables 10 and 11 shows the susceptibility of various bacteria to different antibiotics. Table 10 indicates that Staphylococcus aureus exhibited 100% susceptibility to Amoxicillin+clavulanic acid, Fosfomycin, and oxacillin. The isolate demonstrated elevated levels of resistance to cefoxitin, oxacillin, and cefixime.

Table 10. *Sensitivity of Staphylococcus aureus and Neisseria gonorrhoeae to different antibiotics.*

Sensitivity of isolated germs to antimicrobials							
Staphylococcus aureus							
ATB	AMC	FOX	OX	LINCO	AF	CX	CIP
Frequency (%)	S (100%)	S (100%)	S (100%)	S (75%)	S (25)	S (25)	S (25)
Neisseria gonorrhoeae							
ATB	IMP	CN	AMC	OX	FOX	CFM	CAZ
Frequency (%)	S (100%)	R (100%)	R (100%)	R (100%)	R (100%)	R (100%)	R (100%)

AMC: l'Amoxicilline+acide clavulanique, FOX.: Fosfomycine, OX: Oxacilline, LINCO: Lincomycine, CFM: cefixime, CX: cefoxitine, AF: acide fusidique, CN: Gentamycine, CAZ: Ceftazidime IMP: Imipénème, CFM: Cefixime.

Table 11 shows the susceptibility of Mycoplasma to antibiotics. The results indicate that Pristamycin, Clarythromycin, Josamicin, and Doxycycline displayed efficacy against *Mycoplasma hominis* (Mh). Nevertheless, a complete resistance of 100% was found for azithromycin, ofloxacin, and ciprofloxacin. Based on the data from the table, it was shown that *Ureaplasma urealyticum* (Uu) showed resistance to Oflaxacin (57.15%) and Ciprofloxacin (71.43%), but susceptibility to Pristamycin (94.29%), Josamicin (91.43%), Doxycycline (68.57%), Clarythromycin (57.15%), and Azithromycin (54.30%). In addition, it shows that co-infections of *Mycoplasma hominis* and *Ureaplasma urealyticum* (Uu+Mh) were susceptible to 85% of the effects of Josamicin and Pristamycin, 65% of Doxycycline, and 55% of the effects of Erythromycin and Tetracycline. The reported resistance rates for Ciprofloxacin, Azithromycin, Oflaxacin, and Clarythromycin were 80%, 65%, 55%, and 35% respectively.

Table 11. *Sensitivity of Mycoplasma to different antibiotics.*

Isolated germs	Antibiotics								
	TET	DOT	ERY	CLA	JOS	PRI	AZI	OFL	CIP
Mh	S (33,34%)	S (66,66%)	S (33,34%)	S (33,34%)	S (66,66%)	S (66,66%)	R (66,66%)	R (66,66%)	R (100%)
Uu	S (33,34%)	S (68,57%)	S (33,34%)	S (57,15%)	S (91,43%)	S (94,29%)	S (54,30%)	R (71,43%)	R (57,15%)
Uu+MH	S (55%)	S (65%)	S (55%)	R (35%)	S (85%)	S (85%)	R (65%)	R (80%)	R (55%)

AZI: Azithromycine, CIP: Ciprofloxacine, CLA: Clarythromycine, DOT: Doxycycline, ERY: Erythromycine, JOS: Josamycine, OFL: Oflaxacine, PRI: Pristinamycine, TET: Tétracycline.

3.10. Distribution of Different Frequencies

3.10.1. Distribution of Frequencies According to Vaginal pH and the Personal Hygiene Product Used

Table 12 depicts the frequency distribution of vaginal pH and intimate hygiene product. The results shows a significant relationship ($P < 0.0001$) between the vaginal pH and the kind, type of products and timing of the cleansing operation.

Table 12. *Frequency distribution by vaginal pH and the product used for intimate hygiene.*

Variables Modalities		pH=3,8- 4,5	pH> 4,5	p-value	Khi ²	DDL	Relation
Type of toilet	Toilette vulvaire	35	36	< 0,0001	21,99	1	S
	Toilette vaginale	0	29				
Product use for toilet	Eau chaude	0	1	< 0,0001	85,66	15	S
	Eau citronée	0	2				
	Eau de javel	0	1				
	Eau simple	31	0				
	Savon	2	30				
	SAM	0	14				
	Produit traditionnel	0	7				
	Gel intime	2	10				
Period of realization of the intimate toilet	AM	0	2	< 0,0001	55,87	4	S
	PM+RS	1	26				
	AM+LB	23	1				

Variables Modalities		pH=3,8- 4,5	pH> 4,5	p-value	Khi ²	DDL	Relation
	ARS	0	5				
	LB	11	31				

NB: PM=During menstruation, ARS=After sexual intercourse, AM=After micturition, LB=Bathing.

3.10.2. Frequency Distribution by Vaginal pH and Type of Genital Infection

P = 0.02 in Table 13 indicates a statistically significant correlation between vaginal pH and genital infection.

Table 13. *Frequency distribution by vaginal pH and type of genital infection.*

Infection génitale	pH=3,8- 4,5	pH> 4,5	p-value	Khi ²	DDL	Relation
Chlamydia and mycoplasma infection	3	5				
Candidiasis	0	1				
Candidiasis + chlamydia	4	10				
Candidiasis + Chlamydia and mycoplasma infection	6	8				
Candidiasis + gonococcal and mycoplasma infection	0	1				
Candidiasis + mycoplasma infection	0	3				
Candidiasis + vaginitis	1	0				
Candidiasis + vaginosis + mycoplasma infection	0	1				
Candidiasis and mycoplasma infections	2	5				
Candidiasis+ vaginitis+ Chlamydia and mycoplasma infection	1	0				
Candidiasis+ vaginitis+vaginosis+ chlamydia infection	0	1				
Candidosis+vaginosis+ chlamydia infection	1	5	0,02	33,920	22	S
Candidosis+vaginoseis + chlamydia and mycoplasma infection	0	3				
Chlamydiosis	5	1				
No infection	4	0				
Mycoplasma infection	2	4				
vaginitis + chlamydiosis	0	1				
vaginitis + chlamydia and mycoplasma infection	0	1				
Vaginosis	1	2				
vaginosis + chlamydiosis	0	7				
vaginosis + mycoplasma infection	0	2				
vaginosis + Chlamydia and mycoplasma infection	0	7				
vagitis + vaginosis+ chlamydiosis	1	0				

3.10.3. Frequency Distribution According to Genital Infection and Infertility Type

Table 14 demonstrates that there was no statistically significant relationship between the kind of infection and the patients' age or parity (P=0.105 for age and P=0.544 for parity). The same table shows that there was a statistically significant correlation (P=0.016) between the kind of infection and the history of abortion.

Table 14. *Frequency distribution by age, parity, abortion history, and type of infection.*

Genital infection	Age			Parity			Prior history of abortion		
	15-25	26-35	36-45	Nulli-parous	Primi-parous	Pauci-parous	None	Spontaneous	Volon-tary
CT	3	1	2	5	1	0	4	2	0
Ct +M	1	4	0	3	2	0	2	3	0
C	1	0	0	1	0	0	1	0	0
C+CT	2	6	6	10	4	0	13	1	0
C+CT+M	4	9	1	7	7	0	9	5	0
C+GO+M	1	0	0	1	0	0	1	0	0
C+M	6	11	4	4	5	1	5	5	0
C+VA	0	0	1	0	0	1	1	0	0
C+VO+M	1	0	0	1	0	0	1	0	0
C+VA+CT+M	0	1	0	1	0	0	1	0	0
C+VA+VO+CT	0	1	0	1	0	0	0	1	0
C+VA+CT	1	5	0	3	3	0	3	3	0
C+VA+CT+M	1	2	0	1	1	1	3	0	0
Absence	2	0	2	2	1	1	1	1	2
M	3	1	0	3	1	2	4	2	0
CT+M	1	0	1	0	1	1	1	1	0
VA+CT	0	1	0	1	0	0	1	0	0
VA+CT+M	0	1	0	0	1	0	0	1	0
VO	1	2	0	1	2	0	2	1	0
VA+CT	1	6	0	4	1	2	4	3	0
VA+M	2	0	0	2	0	0	2	0	0
VA+CT+M	4	5	0	4	4	1	4	5	0
VA+VO+CT	0	0	1	0	1	0	1	0	0

NB: C=Candidose, CT=Chlamydia trachomatis, M=Mycoplasme, GO=Gonocoque, VA=Vaginite, VO=Vaginose

4. Discussion

4.1. Microbiological Results

The microbiological analysis of this study indicates a significant occurrence of vaginal infections among infertile women, with Chlamydia trachomatis (28.41%) and Ureaplasma urealyticum (22.63%) being the predominant infectious agents. These findings correlate with previous research that reveals a strong association between Chlamydia trachomatis infections and reproductive challenges, specifically tubal infertility [12]. A recent study has found that this bacterium is a major cause of infertility in different regions, emphasizing the importance of detecting it early [13]. The presence of many pathogenic agents, such as Candida albicans and Gardnerella vaginalis, underscores the intricate nature of vaginal infections. A recent study conducted by Kauffman et al. (2021) has revealed that women experiencing symptoms of vaginal infection often have polymicrobial infections, which can make diagnosis and treatment more complex [14]. Furthermore, our study has found that infections caused by Mycoplasma hominis and Trichomonas vaginalis, albeit less prevalent, are similarly associated with poorer reproductive outcomes [15].

It is noteworthy that most women in our sample had a vaginal pH above 4.5, a condition commonly linked to vaginal dysbiosis. According to recent study, changes in

vaginal pH might affect the microbial flora and encourage the growth of harmful bacteria, hence raising the likelihood of infections [16]. This observation emphasizes the importance of regularly assessing vaginal health, particularly in women who are of reproductive age.

The implications of these findings are substantial. If left untreated, infections can result in serious outcomes such as chronic pelvic pain and fertility issues, as evidenced by multiple studies [17]. Hence, it is imperative to integrate methodical screening techniques and suitable therapeutic interventions into reproductive healthcare for women experiencing infertility.

4.2. Epidemiological Profile of the Participants

The examination of the sociodemographic characteristics of the female participants in our study uncovers noteworthy patterns that could impact the occurrence of genital infections. Most of the women in our study were between the ages of 20 and 35, which is frequently linked to riskier behaviors including having more sexual partners and unprotected sex [18]. Multiple studies have shown that young women are more vulnerable to contracting sexually transmitted infections (STIs), which may account for the high occurrence of infections in the population [19]. Moreover, the prevalence of infections seems to be influenced by marital status. A notable proportion of our sample consists of unmarried women, who have a tendency to participate in more hazardous sexual activities, hence increasing their susceptibility to sexually transmitted infections (STIs) [20]. According to a recent study, women in relationships who have fewer sexual partners may still be at risk of infections if their spouse has a history of untreated infections [21]. When evaluating infection risks, it is essential to consider the relationship environment.

The educational attainment of the individuals has also been discovered as a significant factor. Studies have found a link between a limited level of education and a lack of knowledge about sexual health practices, which can result in a higher incidence of genital infections [19]. Women who have attained a higher level of education tend to possess a greater understanding of the dangers associated with sexually transmitted infections (STIs) and are more inclined to engage in preventive measures [22]. This highlights the importance of focused educational initiatives aimed at increasing knowledge and understanding of reproductive health, especially in vulnerable groups.

The findings of our study indicate that women who have a medical history of sexually transmitted illnesses have a higher likelihood of experiencing vaginal infections. These findings align with the research conducted by other scholars, which has shown that individuals with a history of sexually transmitted infections (STIs) are more likely to experience reinfection and related effects, such as infertility [23].

4.3. Clinical Consequences of Genital Infections

Neglected genital infections can result in severe clinical ramifications, such as persistent pelvic discomfort, complications during pregnancy, and most significantly, the inability to conceive. Research indicates that infections caused by Chlamydia trachomatis and Neisseria gonorrhoeae are of special concern due to their potential to cause pelvic inflammatory disorders (PID), which are a significant factor in female infertility [24]. According to a recent study, it has been found that as many as 15% of women diagnosed with pelvic inflammatory disease (PID) may suffer from lasting effects such as chronic pelvic discomfort and pelvic adhesions [25].

Moreover, reproductive health may be affected by vaginal infections caused by bacteria such as Gardnerella vaginalis and Candida albicans. Studies have shown that these infections might disturb the equilibrium of vaginal microorganisms, hence heightening the susceptibility to other diseases and affecting fertility [15]. Research findings indicate that women diagnosed with bacterial vaginosis are more likely to experience pregnancy complications, including early rupture of membranes and preterm birth [26].

The psychological ramifications of genital illnesses should not be disregarded. Women afflicted with persistent infections may encounter emotions of shame, anxiety, and sadness, which can likewise influence their overall well-being and psychological state [27, 28].

Men may also encounter challenges associated with sexually transmitted infections (STIs), leading to a cycle of transmission and reinfection [29]. This highlights the importance of implementing a comprehensive sexual health strategy that encompasses screening and treatment for infections in both individuals involved.

5. Conclusion

The fight against genital infections requires a multidimensional approach that encompasses education, screening, treatment, and tailored public health policies. Recent data highlights the significance of increased awareness of sexual health, particularly through comprehensive sexual education, which helps to decrease risky behaviors among young people [30]. Furthermore, regular and accessible screening is crucial in order to identify and treat infections at an early stage, hence minimizing long-term problems such as infertility and chronic pelvic pain [31].

Abbreviations

PID	Pelvic Inflammatory Disease
STIs	Sexually Transmitted Infections
VCN	Vancomicyn
UGN	Upper Genital Infections

Author Contributions

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Conflicts of Interest

The authors declare no conflicts of interest.

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