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Full Length Research Paper

Trends in *Trichomonas vaginalis* infection and vulvovaginal candidiasis in Dakar

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Abstract

***Trichomonas vaginalis* infection and vulvovaginal candidiasis are common referrals due to clinical symptoms. Here we report the trends of vulvovaginal candidiasis and *T. vaginalis* infection in Dakar. Methods: A retrospective study was conducted from January 2016 to December 2020 on women referred to the Military Hospital of Ouakam laboratory for vaginal discharge. To detect *T. vaginalis,* the wet mount smear was examined under an optical microscope at ×40. Identification of *Candida* species involves sample culture on Sabouraud's agar and germ-tube generation in a serum-containing medium. Results: Overall, 4786 patients were enrolled. The overall prevalence of VVC was 28.48%. The highest frequency was noted in 2019, with 30.10%. According to the age group, the highest prevalence was noted in patients aged under 20, with 36.9%. The prevalence of *Trichomonas vaginitis* infection was 3.51% (n=168). By study period and age group, the highest prevalence was recorded in 2016 at 4.44% and among patients aged 31 and 40 at 4.02%. Conclusion: This study reveals that nearly a third of the study population presented VVC while the prevalence of trichomoniasis is low. Patients under 20 were more affected by the VVC, suggesting a possible shift in the epidemiology of VVC.**

Keywords: Prevalence,*Trichomonas vaginalis*, vulvovaginal candidiasis, women, Dakar.

INTRODUCTION

Female genital disorders are a common referral due to their clinical symptoms. Bacteria, viruses, parasites, and fungi can be caused by two types of genital infections. Firstly, sexually transmitted infections (STIs) such as trichomoniasis, gonorrhea, and Chlamydia (Rowley et al. 2019). Secondly, non-sexually transmitted diseases such as bacterial vaginosis (BV) and vulvovaginal candidiasis (VVC). It has been identified that more than thirty bacteria, viruses, and parasites are transmitted during sexual intercourse, whether vaginal, oral, or anal (Janier 2016). The incidence of STIs is mainly related to eight pathogens, with a single parasite, *Trichomonas vaginalis*, the most common non-viral sexually transmitted infection globally. According to WHO, approximately 143 million people contract the disease yearly, with more than five million in the USA (Newman et al. 2015). This STI may have severe consequences for pregnant women, such as premature rupture of membranes, or can lead to early labor (Van Gerwen et al. 2021). Also, a significant association between *T. vaginalis* infection and infertility has been reported (Hashemi et Soleimani 2022; Kaya et al. 2015). Among the most common non-sexually transmitted diseases is vulvovaginal candidiasis. According to the report of the first meeting of the WHO Antifungal Expert Group on Identification of Fungal Pathogens published in 2020, the increasing burden of fungal diseases is a real public health issue (World Health Organisation 2020). *Candida* genus, with nearly twenty

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different species, may cause superficial or deep infections following hematogenous dissemination, most often in a nosocomial context (Sardi et al. 2013; Willems et al. 2020). VVC is a common vaginal infection, where *C. albicans* is responsible for approximately 50% of all cases, without considering risk factors. This puts it in the category of the three most prevalent vaginal infections. (Willems et al. 2020; Disha et Haque 2022). There is a lack of studies on the coinfection of Trichomonas vaginalis and Candida albicans in Senegal. Here we report the trends of vulvovaginal candidiasis and *T. vaginalis* infection among women referred to the microbiology laboratory of the Military Hospital of Ouakam.

METHODS

4.1. Study site and population

A retrospective descriptive study was conducted from January 2016 to December 2020. The study population included all women referred to the microbiology laboratory of the Ouakam military hospital for vaginal discharge during the study period.

4.2. Sample collection and processing

As part of a routine diagnostic procedure for a motile parasite, we collected a vaginal swab from each participant and immediately performed a wet mount smear. To detect *T. vaginalis* and assess biological changes like the presence of epithelial cells and white blood cells, the wet mount smear was examined under an optical microscope at ×40. To determine the white cell count in vaginal discharge, it is classified based on the number of cells in a high-power field. This classification includes rare (1-5 cells), moderate (6-10 cells), many (11-20 cells), and high (21 cells and above)(Eleutério et al. 2017). A Gram-stained smear is also done to analyze the vaginal flora and use Nugent scoring for characterization (Nugent, Krohn, et Hillier 1991). Regarding diagnosing VVC, isolation and identification of *Candida* species (*C. albicans/C. dubliniensis*) involve sample culture on Sabouraud's agar, followed by further analysis, including germ-tube generation in a serum-containing medium. Each vaginal swab was inoculated onto Sabouraud Dextrose Agar (SDA) supplemented with chloramphenicol and incubated at 37°C for 18 to 24 h aerobically. Two or three yeast colonies were used to perform the germ-tube test. Germ-tube-positive isolates are then classified as *C. albicans*/*C. dubliniensis.*

4.3. Statistical analysis

We used R software to perform statistical analyses. For continuous variables, we described them as mean with standard deviation. We used a t-test to compare normally distributed variables. Categorical variables were presented as percentages, and we used Fisher exact or chi-squared tests for proportional assessments. Univariate logistic regression analysis assessed the association between the related risk factors and positivity. Five age groups (years) were defined for analysis, i.e., < 20, 20 to 30, 31 to 40, 41 to 50, and over 50. We accepted that a two-sided significance level was set at $p \leq 0.05$ for all statistical tests.

4.4. Ethical considerations

This study was hospital-based research conducted in normal conditions under the Declaration of Helsinki. Ethical permission was obtained from the hospital authorities, and the patient's consent was also received before specimen collection. Information collected during the study was analyzed using the participant's identification code to ensure confidentiality.

RESULTS

2.1. Characteristics of the study population and prevalence of infection

During the study period, 4786 women were referred to the microbiological laboratory. The mean age was 32.68 years with a standard deviation of 10.2. The distribution of patients according to the study period showed that 2017 recorded the highest number of patients with 23.05% (n=1103), while the lowest number was noted in 2020 with 17.01% (n=816). Out of all age groups, the most represented were women between the ages of 20 and 30, accounting for 43.98% (n=2105). On the other hand, those under 20 years old were the least frequent, with only 4.3% (n=207). Gram-stained direct examination of the bacterial flora showed an imbalance in 98.68% of cases (n = 4723). Vaginal flora type III was the most frequent, with 47.53% (n=2275). The number of white blood cell excretion per high-power field was between 1 and 5 in 64,52% (n -3088) of cases. The other characteristics of the study population and the prevalence of infections are detailed in Table I.

2.2. Frequency and distribution of vaginal candidiasis

The overall prevalence of VVC was 28.48% (n = 1363). During the study period, the highest frequency was observed in 2019, accounting for 30.10% (95%CI 27-33), whereas the lowest frequency was recorded in 2018, with 26.12%. The difference was not statistically significant ($p = 0.33$). The prevalence of VVC decreases significantly with age. In patients under 20 years old, it was 36.9% [95% CI 30-44], while women over 50 years old had a prevalence of 11.65% [95% CI 8.1-17] ($p<0.001$). Patients

Table 1: Characteristics of the study population and prevalence of infection (**N = 4786**).

	n	Pourcentage (%)	CI 95%	
Period of study				
2016	1013	21.17	20.03	22.35
2017	1103	23.05	21.88	24.26
2018	896	18.72	17.64	19.85
2019	960	20.06	18.95	21.22
2020	814	17.01	15.97	18.10
Age-group (years)				
< 20	207	4.33	3.78	4.94
20 - 30	2105	43.98	42.58	45.39
31 - 40	1542	32.22	30.91	33.56
41 -50	683	14.27	13.31	15.29
> 50	249	5.20	4.61	5.87
Vaginal flora type				
I	63	1.32	1.03	1.68
II	793	16.57	15.54	17.65
III	2275	47.53	46.12	48.95
IV	1655	34.58	33.25	35.94
White blood cells /high-power field				
1 - 5	3088	64.52	63.15	65.86
6 - 10	1650	34.48	33.14	35.83
11 - 20	12	0.25	0.14	0.44
> 21	36	0.75	0.54	1.04
Vulvo-vaginal candidiasis				
Positive	1363	28.48	27.22	29.77
Negative	3423	71.52	70.23	72.78
***Trichomonas vaginalis* infection**				
Positive	168	3.51	3.02	4.07
Negative	4618	96.49	95.93	96.98

with vaginal flora type III had the highest prevalence of VVC at 34.8% [95%CI 33 – 37], followed by type IV at 26.0% [95%CI 24 - 28] ($p<0.001$). Analysis of VVC by leukocyte excretion level revealed the highest frequency of 41.7% [95%CI 16 – 71] among women with many WBC. According to a regression model's multivariate analysis, VVC was found to be less prevalent in 2018, among patients over the age of 31 and those with vaginal flora type II. However, the infection was significantly high in patients with moderate WBC levels. The other characteristics of the distribution of VVC are detailed in Table II.

2.3. Frequency and distribution of *Trichomonas vaginalis* infection

The prevalence of *Trichomonas vaginitis* infection was 3.51% (n=168). According to the study period, the distribu-

Table II: Prevalence and distribution of vulvovaginal candidiasis (Positive,**N = 1363**)

	Examined, N = 4786	n	% [95%CI]	Log(OR) [95%CI]	*p-value*
Studyperiod					
2016	1013	293	29 [26 - 32]	1.0 (referent)	-
2017	1103	306	27.8 [25 - 31]	-0.16 [-0,36 – 0,04]	0,11
2018	896	234	26.2 [23 - 29]	-0.24 [-0.45 – -0,03]	0,025
2019	960	289	30.1 [27 - 33]	0,04 [-0,16 – 0,25]	0,7
2020	814	241	29.6 [27 - 33]	0,04 [-0,18 – 0,25]	0,7
Age group (years)					
< 20	207	76	36.9 [30 - 44]	1.0 (referent)	-
20 - 30	2105	704	33.5 [32 - 36]	-0,19 [-0,50 – 0,13]	0,2
31 - 40	1542	421	27.4 [25 - 30]	-0,47 [-0,79 – -0,15]	0,004
41 - 50	683	133	19.5 [17 - 23]	-1,0 [-1,3 – -0,61]	<0,001
> 50	249	29	11.7 [8.1 - 17]	-1,6 [-2,1 – -1,1]	<0,001
Vaginal flora type					
I	59	17	28.8 [18 - 42]	1.0 (referent)	-
II	775	120	15.5 [13 - 18]	-0,62 [-1,2 – 0,01]	0,047
III	2237	776	34.8 [33 - 37]	0,43 [-0,13 – 1,0]	0,15
IV	1653	429	26.0 [24 - 28]	0,08 [-0,50 – 0,69]	0,8
White blood cells / high-power field					
Rare	3088	776	25.2 [24 - 27]	1.0 (referent)	-
Moderate	1650	569	34.5 [32 - 37]	0,44 [0,30 – 0,57]	<0,001
Many	12	5	41.7 [16 - 71]	1,0 [-0,26 – 2,3]	0,1
High	36	13	36.1 [21 - 54]	0,41 [-0,32 – 1,1]	0,3

tion of *T. vaginalis* infection was most prevalent in 2016 with 4.44% [95%CI 3.3 – 5.9], followed by 2019 with 3.65% [95%CI 2.6 – 5.1]. The difference was not statistically significant (p=0.417).*T. vaginalis* infection was more frequent among patients aged between 31 and 40 years with 4.02% [95%CI 3.1 -5.2], followed by the under 20 and 20-30 age groups with 3.86% [95%CI 1.8 - 7.7] and 3.56% [95%CI 2.8 – 4.5], respectively. The difference was not statistically significant (p=0.3702).*T. vaginalis* was significantly associated with type IV vaginal flora (p=0.002) with many and high WBC with 4.8% [95%CI 3.8 5.9] and 13.89% [95%CI 5.2 – 30], respectively (p<0.001). In a multivariate analysis from the regression model, no statistically significant associations were found between TVI and study period, age group, and vaginal type flora. However, moderate and high WBC levels were significantly associated with a high prevalence of TVI. Details of characteristics of the distribution of *T. vaginalis* infection are presented in Table III.

2.4. Co-infection between *C. albicans*/ C.*dubliniensi*s, *T.vaginalis* and *Gardnerella vaginalis*

Of the 1363 patients with vulvovaginal candidiasis, 35 (2.57%) had co-infection with *T. vaginalis,* and 770 (56.49%) had co-infection with *G. vaginalis*. In the 168 cases of *T. vaginalis* infection, 84 (3.4%) had co-infection with *G. vaginalis*.

DISCUSSION

In this study, we aimed to determine vulvovaginal candidiasis and *T. vaginalis* infection trends in Dakar.

Table III: Prevalence and distribution of *T. vaginalis* infection(Positive,**N= 168)**

	Examined N = 4786	**n**	**% [95%CI]**	**Log(OR) [95%CI]**	*p-value*
Studyperiod					
2016	1013	45	4.4 [3.3 - 5.9]	1.0 (referent)	-
2017	1103	35	3.2 [2.3 - 4.4]	-0,37 [-0,84 – 0,09]	0,12
2018	896	27	3.0 [2.0 - 4.4]	-0,46 [-1,0 – 0,05]	0,08
2019	960	35	3.6 [2.6 - 5.1]	-0,08 [-0,55 – 0,38]	0,7
2020	814	26	3.2 [2.1 - 4.7]	-0,08 [-0,87 – 0,14]	0,2
Age group (years)					
< 20	207	8	3.9 [1.8 -7.7]	1.0 (referent)	-
20 - 30	2105	75	3.6 [2.8 - 4.5]	0,10 [-0,63 – 1,0]	0,8
31 - 40	1542	62	4.0 [3.1 - 5.2]	0,19 [-0,55 – 1,1]	0,6
41 - 50	683	17	2.5 [1.5 - 4.0]	-0,41 [-1,3 – 0,57]	0,4
> 50	249	6	2.4 [1.0 - 5.4]	-0,74 [-2,0 – 0,44]	0,2
Vaginal flora type					
I	59	2	3.4 [0.59 - 13]	1.0 (referent)	-
II	775	19	2.5 [1.5 - 3.9]	-0,43 [-1,7 – 1,4]	0,6
III	2237	61	2.7 [2.1 - 3.5]	-0,43 [-1,7 – 1,4]	0,6
IV	1653	79	4.8 [3.8 - 5.9]	0,13 [-1,1 – 2,0]	0,9
White blood cells / high-power field					
Rare	3088	75	2.4 [1.9 - 3.1]	1.0 (referent)	-
Moderate	1650	88	5.3 [4.3 - 6.6]	0,83 [0,50 – 1,2]	<0,001
Many	12	0	0 [0.00 - 30]		>0,9
High	36	5	13.9 [5.2 - 30]	1.8 [0,66 – 2,7]	<0,001

The prevalence of 28.48% of VVC in this study is consistent with previous reports in Senegal. Prevalence rates of 32.6% and 29% were reported by Sylla (Sylla 2018) and Diadhiou (Diadhiou et al. 2019) in 2017 and 2019, respectively. Based on the findings, the prevalence of VVC in Dakar remains relatively consistent, ranging from 27% to 33%. Higher rates of prevalence were reported in other African countries. In Cameroon, Payne observed a prevalence rate of 35.26% (Payne et al. 2020). In Togo, Katawa recorded a rate of 40.65% (Katawa et al. 2021). Additionally, in Benin, Fanou noted a rate of 56.25% (Fanou et al., 2022). In contrast, Majigo reported a lower prevalence rate of 19.4% in Tanzania (Majigo et al. 2021), and Faye-Kette found a rate of 25.8% in Abidjan (Faye-Kette et al. 1993). The results suggest that the frequency of vulvovaginal candidiasis varies by location, even though it is reported frequently in Africa. There are several factors that could explain these differences, such as the methodology of the study, the population studied, the identification methods used, the impact of STI awareness campaigns, and socioeconomic factors. The lack of awareness about genital infections and how they are spread among the population is a contributing factor to their spread.

This report states that VVC is more common in patients under 20. However, two previous studies conducted in Senegal found that patients over 20 were the most affected (Seck et al. 2015; Sylla 2018). In different countries, VVC was more common in the 20-35 and 20-29 age groups (Hashemi et Soleimani 2022; Payne et al.

2020; Majigo et al. 2021). These findings suggest a possible shift in the epidemiology of VVC with age. Further studies are needed to confirm this hypothesis.

Our series shows a correlation between CVVs and type III and IV vaginal flora types. Interestingly, Sylla et al. reported this finding (Seck et al. 2015; Sylla 2018). This correlation could be because VVCs are more likely to happen when the natural balance of vaginal flora is disturbed, creating an environment that promotes fungal growth.

We also found that most patients with VVC had a white blood cell count per microscopic field of 1-10. This aligns with the fact that inflammation is one of the primary symptoms of VVC (Faye-Kette et al. 1993) and that candidiasis is caused by an imbalance in the body's immune system. Studies have also looked into the changes in vaginal flora during VVC. Bernardis' research showed the presence of leukocytes in vulvovaginal candidiasis (De Bernardis et al. 2018), and Mach studied the types of white blood cells present in vulvovaginal candidiasis (Mach, Marchandin, et Bichon 2020). The results suggest that the inflammation intensity aligns with our study's findings.

It is essential to evaluate the frequency of fungus-bacteria association due to the imbalance of vaginal flora, which leads to bacterial proliferation. Our study found co-infection of *C. albicans* and *G. vaginalis* in 56.49% (n=770). Interestingly, Carillo-Avila in Spain reported lower rates with 29%(Carrillo-Ávila et al. 2017), Payne in Cameroon with 9.49% (Payne et al. 2020), Pajaro in Argentina with 5.1% (Pájaro et al. 2001), and Martins in Brazil with 1.96% (Martins et al. 2018). These findings demonstrate that the association between *G. vaginalis* vaginosis and VVC is widespread but varies by country.

In our study, we found a frequency of *T. vaginalis* infection similar to that reported in Dakar by Sylla and Barry, who found rates of 4.8% (Sylla 2018), and 2.5% (Barry et al. 2018), respectively. Several studies, such as Avilla in Spain (Carrillo-Ávila et al. 2017), Martin (Martins et al. 2018), and Katawa in Togo (Katawa et al. 2021), have reported similar results, with prevalence rates of 2.5%, 4.93%, and 3.23%, respectively. However, Majigo in Tanzania (Majigo et al. 2021), Shawin Louisiana (Shaw et al. 2019), and Pajaro in Argentina (Pájaro et al. 2001) reported higher frequencies than our study, with 13.33%, 7%, and 16.8%, respectively. On the other hand, Lowe et al. (Brooks-Smith-Lowe et Rodrigo 2013) in the Caribbean, Hanna et al. (Hanna et al. 2020) in Lebanon, Kalantari et al. (Nikpay et al. 2020) in Iran, and Zhang et al. (Zhang et al. 2018) in China found lower rates of 0.85%, 2%, 1.5%, and 1.7%, respectively. Studies conducted in Europe and the United States have indicated varying frequencies of *T. vaginalis* infection in different geographical areas. For instance, Silva in Portugal reported a prevalence of 1% (Silva et al. 2021), while Patel in the United States reported 1.8% (Patel et al. 2018), and Pereyre in France reported 1.7% (Pereyre et al. 2017). These variations could be attributed to differences in diagnostic methods and sociodemographic and behavioral factors. Therefore, it is confirmed that *T. vaginalis* infection is widespread, but its prevalence varies depending on the location.

Our study explored the correlation between *T. vaginalis* infection and the likelihood of contracting bacterial or fungal genital infections. Specifically, we investigated the occurrence of co-infection with *T. vaginalis* and *G. vaginalis*. Our findings revealed that 3.17% of cases had both pathogens present at the same time. Similar results were recorded by Martins, who found a coinfection rate of 3.19 in their research (Martins et al. 2018). In Cameroon, a lower coinfection rate of 0.1% was reported by Payne (Payne et al. 2020). When examining the presence of both *T. vaginalis* and *C. albicans*, only 2.57% of women were found to have a coinfection. However, studies conducted in Benin (Fanou et al. 2022) and Brazil (Martins et al. 2018) found lower rates of coinfection at 0.5% and 0.05%, respectively.

CONCLUSION

This study regarding vulvovaginal candidiasis and *T. vaginalis* infection trends in Dakar reveals that nearly a third of the study population presented VVC. At the same time, the prevalence of trichomoniasis is low. Patients under 20 were more affected by the VVC in contraries than in the previous reports. These findings suggest a possible shift in the epidemiology of VVC with age. Further studies are needed to confirm this hypothesis.

Declarations

Conflicts of Interest: The authors declare that they have no competing interests.

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Data availability Statement: The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

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