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Sexually Transmitted Diseases and Their Associated Factors in a Cohort in Da Nang City: An Alarming Trend in Syphilis Rates and Infection at Young Ages

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Abstract: Sexually transmitted infections (STIs) remain a global issue, causing health problems and financial burdens. This study aimed to provide an update on the invasive pathogens and analyze any associated factors in patients visiting Da Nang Dermato-Venereology Hospital who were diagnosed with genital tract infections in males and lower genital tract infections in females; 535 participants underwent clinical examinations and microbiological tests to identify the invasive microorganisms, before we analyzed previously gathered laboratory results and associated risk factors. The rate of infection was 37.6% amongst 535 participants. *Treponema pallidum* infection accounted for the highest rate of 21.3%, followed by HSV, standing at 6%. The prevalence of syphilis infection was highest in the 20–29 age group, standing at 51.7%. There was a positive correlation between age under 20 and infected conditions (OR = 3.78, 95% CI: 1.41–10.11, $p = 0.008$). Having multiple sexual partners was identified as a risk factor for infection, as those with three or more sexual partners showed a high correlation (OR = 3.19, 95% CI: 1.44–7.05, $p = 0.004$). The high syphilis prevalence among young adults and teenagers underscores the need for improved STI education and screening programs in Vietnam.

Keywords: STIs; syphilis; young patients; Da Nang City; Vietnam



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1. Introduction

Genital tract infections (GTIs) represent critical health issues that impact reproductive health and contribute to morbidity in both males and females. There are several key causative agents, which encompass bacteria such as *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, and *Treponema pallidum*; protozoan parasites like *Trichomonas vaginalis*; yeast, including *Candida* sp.; and viruses such as the Herpes Simplex Virus (HSV), with lower genital tract infections (LGTIs) representing an important category [1–4]. Infections in the lower genital tract of women are complex and multifaceted. The common ones are sexually transmitted infections (STIs) such as trichomoniasis, gonorrhea, syphilis, herpes, and others. Lower genital tract infections (LGTIs) also encompass bacterial vaginosis (BV), characterized by an imbalance in the normal vaginal flora, leading to an overgrowth of commensal organisms such as *Bacteroides*, *Peptostreptococcus*, *Gardnerella vaginalis*, *Mycoplasma hominis*, and *Enterobacteriaceae*, alongside a reduction in lactobacillus species [4]. The complexity of LGTIs is heightened by the diverse array of infectious agents involved, which includes bacteria, fungi, viruses, and protozoa. A further layer of complexity arises

from the interactions between the host and these infectious agents, particularly through inflammatory responses and the production of host factors such as secreted antibodies and defensin molecules that inhibit intravaginal microorganisms. Lastly, the vagina harbors a native microbiota that plays a crucial role in maintaining vaginal health while also interacting with external microorganisms that contribute to the development of vaginal infections [3].

Sexually transmitted infections (STIs) represent a significant public health challenge on a global scale. It is estimated that over 1 million STIs are contracted daily across the world, with 357 million new cases of STIs each year. In 2016, there were reports of 6.3 million new infections with *Treponema pallidum*, 86.9 million new cases of *Neisseria gonorrhoeae*, and reports stating that 988,000 pregnant women were infected with syphilis, leading to more than 200,000 stillbirths and neonatal deaths [5,6]. The prevalence of syphilis appeared to be higher in developing countries, such as those in the sub-Saharan Africa region, compared to in developed countries [7]. However, a resurgence of syphilis in high-income nations, including in nations in the European Union and the United States, was also observed [8]. In Vietnam, the availability of national data on STIs is quite limited. While the overall prevalence of STIs in the general population appears to be low, there is a documented high prevalence among key populations, particularly men who have sex with men (MSM) and female sex workers (FSWs) [5]. Despite the absence of a national reporting system or comprehensive surveys on STIs, experts have expressed concern over a rising trend in infections, especially within the MSM community, where syphilis prevalence has been reported to be approximately 10% in Can Tho city, while it was also reported that the prevalence of syphilis (13%) and gonorrhea (34%) is high in Ha Noi [9–12]. All reports indicated a pattern of rising STIs over time, which may be attributed to Vietnam's rapid economic development and urbanization in recent years.

As a significant urban center in central Vietnam, Da Nang is a major tourist attraction and an essential transportation nexus for accessing various other tourist locations. The burgeoning tourism sector in this city poses the risk of STIs and contributes to increased occupational stress among local residents, both of which may lead to an increase in STIs within the common community. Nevertheless, there has been a scarcity of up-to-date research addressing these health issues in recent years. To explore the situation regarding STIs, specifically genital tract infections in males and common lower genital tract infections in females, excluding cervical and upper genital disorders, our study aims to evaluate the incidence of common pathogens among patients seeking clinical assessment and investigate the various factors correlated to the likelihood of these infections, especially STIs. This study could contribute to a comprehensive understanding of STIs in Vietnam and raise awareness of these diseases among the population.

2. Materials and Methods

2.1. Ethical Considerations and Study Population

The study adhered to the ethical guidelines outlined in the Declaration of Helsinki. Approval for the research was granted by the Biomedical Ethics Committee of Da Nang University of Medical Technology and Pharmacy, as well as the Board of Directors of Da Nang Dermato-Venereology Hospital, under reference number 1390/BVDLDN-HDYD (approval was issued on 29 October 2020). Written informed consent to participate in the study was obtained from the patients or their legal representatives. All information extracted from medical records was utilized solely for research purposes. Participants had the right to withdraw or discontinue their involvement in the study at any point. The research focused on patients admitted between 1 January 2021, and 1 May 2021, with each patient assigned a unique identifier and their names anonymized. All data gathered from

the research questionnaires were encrypted to ensure confidentiality, and access to the research data was restricted to the research team leader. Particularly, in this study, sexual history was defined using the following terms: (i) spouse as a legally married partner; (ii) sexual partner as a partner with whom the participant has had sexual intercourse in the past 12 months; (iii) high-risk group as those with non-marital sexual partners considered to have a higher STI risk due to behavioral or occupational reasons (such as sex work, drug addiction, etc.). This study did not address sexual orientation, and therefore, no inquiries regarding this aspect were included in the questionnaires.

2.2. Participants

This research study recruited a total of 535 participants coming for clinic examination at Da Nang Dermato-Venereology Hospital who consented to participate. The common GTIs of males and LGTIs of females, including STIs, were diagnosed based on WHO Guidelines for the management of symptomatic sexually transmitted infections [13] and the Guidelines for the Diagnosis and Treatment of Sexually Transmitted Infection, published by the Vietnamese Ministry of Health (issued with the decision No. 4568/QĐ-BYT, dating back to 14 November 2013) [14]. Exclusion criteria for the study included individuals who declined to participate, those diagnosed with neurological disorders (such as epilepsy, mental health conditions, or intellectual disabilities), pregnant individuals, and those currently menstruating or experiencing vaginal bleeding. Additionally, individuals who engaged in douching or utilized vaginal medications within 48 h before the visit, as well as those who took systemic antibiotics within three days or systemic antifungal medications or unspecified drugs within one week before the visit, were excluded. Furthermore, females with positive results from Chlamydia and HPV PCR tests were not included.

2.3. Microbiology Laboratory Assessment

Data regarding the study individuals were gathered, encompassing their age, residence, educational background, occupation, marital status, and sexual history, also including details about partners, number of sexual partners, and condom usage. Laboratory test results were obtained to identify the presence of infectious factors in collected samples. This process involved identifying *Neisseria gonorrhoeae*, various local vaginal bacteria, *Trichomonas vaginalis*, and *Candida* species through microscopic analysis, alongside ancillary tests. These tests included the Whiff test for local vaginal bacteria, Thayer–Martin culture for *N. gonorrhoeae*, and ChromAgar for *Candida* yeast. The detection of *T. pallidum* was accomplished using the *Treponema pallidum* hemagglutination assay (TPHA) and Rapid Plasma Reagin (RPR) tests. In addition, the Herpes Simplex Virus (HSV), including both types 1 and 2, was identified using a PCR test conducted with the Agilent AriaMX system (Santa Clara, CA 95051, USA).

2.4. Statistical Analysis

IBM SPSS Statistics version 20 (IBM, Armonk, NY, USA) and Excel 2010 (Microsoft, Redmond, Washington) were utilized for statistical analysis. We compared two percentages by Chi-squared (χ^2) and Fisher tests and also used them for ordinal variables. We set the statistical significance threshold at a p -value < 0.05 and also calculated the odds ratio (OR) and their 95% confidence intervals (CIs). Figures were plotted using R software (opened source program, version 4.3.0).

3. Results

3.1. Demographic Characteristics of Study Cohort

The majority of the study subjects were in the 20–39 age group, accounting for 80.8% of the sample; they were primarily concentrated in urban areas (71.6%), with only 28.4% being from rural areas (Table 1). Males accounted for a higher percentage (63%) of the sample than females (37%). The dominant occupational groups were those with freelance jobs and students, at 32.9% and 22.2%, respectively, while the driver occupation ranked last at 3.9%. The literacy rate was relatively high, as 40% of participants had received tertiary education, and 20.4% had vocational or college degrees. Marriage status varied amongst participants, with 58.1% being single, 38.3% being married, and 3.6% being divorced. Sexual relations with casual partners had the highest rate of reporting at 59.4%, and relations with high-risk individuals had the lowest rate at 2.2%.

Table 1. Demographic data of the population.

Factor	Group	No (%)
Sex	Male	337 (63.0)
	Female	198 (37.0)
Residence	Urban	383 (71.6)
	Rural	152 (28.4)
Age group	<20	19 (3.6)
	20–29	262 (48.9)
	30–39	170 (31.8)
	40–49	67 (12.5)
	>49	17 (3.2)
Education	University	214 (40.0)
	College or vocational school	109 (20.4)
	High school or lower	212 (39.6)
Occupation	Student	119 (22.2)
	Farmer	38 (7.1)
	Industrial worker	58 (10.8)
	Driver	21 (3.9)
	Businessman	87 (16.3)
	Officer	36 (6.7)
	Freelancer	176 (32.9)
Marriage	Single	311 (58.1)
	Married	205 (38.3)
	Divorced	19 (3.6)
Sexual history	Non-spousal partner	318 (59.4)
	Spouse	205 (38.3)
	High-risk group	12 (2.3)
Number of sexual partners	1	461 (86.2)
	2	46 (8.6)
	≥3	28 (5.2)
	Used (regularly)	0 (0)
Condom usage	Used (occasionally)	322 (60.2)
	Not used	213 (39.8)

Note: “Sexual partners” refer to individuals with whom participants had sexual intercourse in the past 12 months, including spouses.

3.2. Prevalence of Pathogens in Target Infections over Different Age Groups

Among the 535 patients, there were 201 patients diagnosed with an infection, representing a diagnosis rate of 37.6% (Table 2). To further explore which pathogen was dominantly transmitted in each age group, we calculated the number of cases infected by each pathogen (Figure 1a). Regarding the proportion of pathogens, Figure 1a shows that a substantial proportion of patients were infected by *T. pallidum*, with the rate of infection

being 20% in groups of young adults (from 20 to 49 years old), followed by other sexually transmitted infections, including HSV and *N. gonorrhoeae*. Candidiasis as an opportunistic infection was found with small proportions in adults aged from 20 to 50 years old.

Table 2. Proportion of common etiological factors.

Group	Number	Percent (%)
Negative	334	62.4
Positive	201	37.6
<i>T. pallidum</i>	114 (95M, 19F)	21.3
<i>N. gonorrhoeae</i>	17 (16M, 1F)	3.2
HSV	32 (14M, 18F)	6.0
Other local vaginal bacteria	9 (0M, 9F)	1.7
<i>Candida</i> sp.	21 (0M, 21F)	3.9
<i>Trichomonas vaginalis</i>	0	0.0
<i>T. pallidum</i> + <i>N. gonorrhoeae</i>	2 (2M, 0F)	0.4
<i>T. pallidum</i> + HSV	1 (1M, 0F)	0.2
HSV + <i>Candida</i> sp.	2 (0M, 2F)	0.4
HSV + Other local vaginal bacteria	3 (0M, 3F)	0.6

Abbreviations: M: male; F: female; HSV: Herpes Simplex Virus. The italic numbers indicate the subcategory.

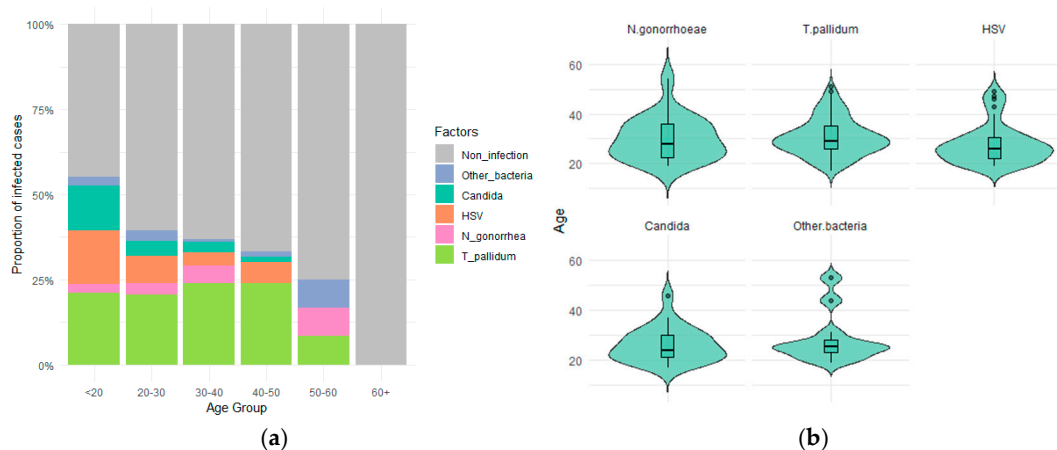


Figure 1. Prevalence of microorganisms in the cohort. (a) Percentage of infected cases by microorganism across age groups of patients; the y axis indicates the proportion of infected cases within the age group, while the x axis represents age groups of patients. (b) Violin plots showing the distribution of microorganisms across different ages in the cohort. The y-axis indicates the age (years) of patients, also including the differences in gender distributions regarding diagnoses with the main pathogens, including *N. gonorrhoeae*, *T. pallidum*, Herpes Simplex Virus, and *Candida* sp.

We then investigated etiological factors causing infections in the studied cohort by identification of pathologic organisms in the patients' specimens. The primary microorganisms contributing to infections in our study included *N. gonorrhoeae*, *T. pallidum*, Herpes Simplex Virus, and *Candida* sp. Bacterial infections were mostly distributed across the 20–30 years of age group (Figure 1b). In particular, the average ages of those diagnosed with HSV, *T. pallidum*, and *N. gonorrhoeae* were 28.4, 30.7, and 30.2 years old, respectively. The average age of those infected with *Candida* is lower, standing at 26.1 years old.

Regarding the distribution of infected cases over different ages, our data showed that the greatest number of infected cases were in patients aged between 20 and 30 (Figure 2). The number of infectious cases showed reducing trends over the older population, with a peak of 16 cases identified in those aged 29 years old and only a few cases being observed in those over 50 years old.

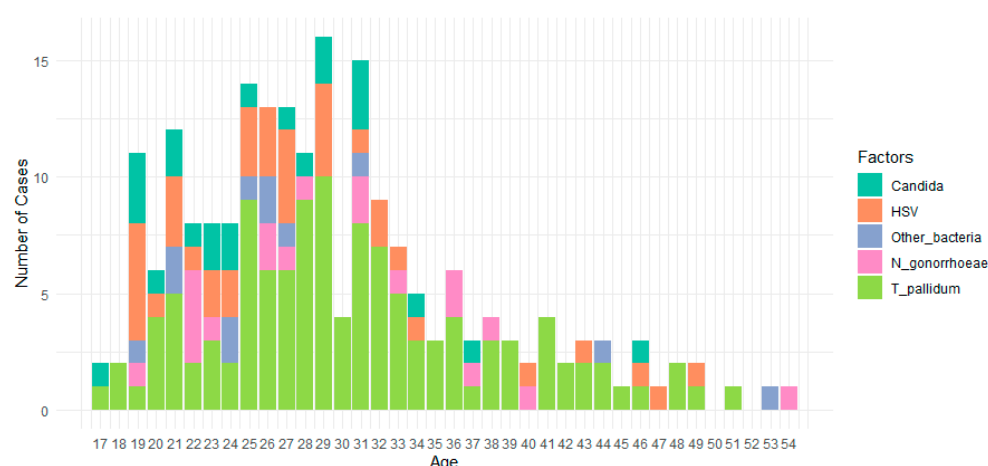


Figure 2. Count of pathogen cases with different microorganisms over the patient age groups; the y axis indicates the number of cases, whereas the x axis represents the patient age groups.

3.3. Correlation of Associated Risk Factors and Target Infections

To understand the risk factors of infection, we analyzed the correlation between infected conditions and risk factors in our cohort. An odds ratio analysis found no association between sex category and infection (Figure 3). However, analysis of the factor of age showed that participants under 20 years old had a significantly higher incidence of microorganism invasion, with a p -value < 0.01 , while the other age groups showed no significant correlation. Neither education nor occupation showed any correlation. Interestingly, married participants had a decreasing risk of infection (OR = 0.6, 95% CI 0.41–0.86, p -value < 0.01), while single and divorced people showed a positive correlation. In particular, the single group showed a significantly increasing risk (OR = 1.5, 95% CI 1.04–2.14, p -value = 0.028).

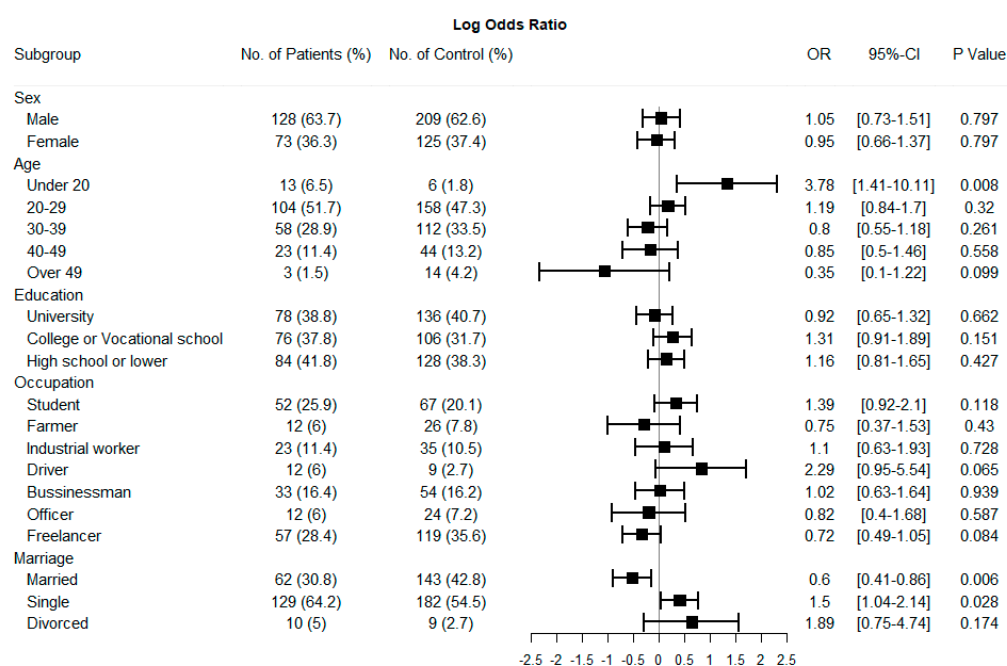


Figure 3. Correlation of general factors with microorganism-invasive conditions in the cohort, as demonstrated by odds ratios with a 95% confidence interval. Log odds ratio > 0 indicates an increased risk of invasion, while log OR < 0 indicates a decreased risk.

In addition, the infectious condition factor showed a significant correlation with those whose sexual relations were with those in the high-risk group (OR = 3.43, 95% CI: 1.02–11.52,

p -value = 0.047) (Figure 4). In contrast, those recording sexual relations with only their spouse indicated the lowest risk, with statistical significance (OR = 0.6, 95% CI: 0.41–0.86, p -value = 0.006). We found that increasing the number of sexual partners was strongly correlated with a higher risk, as demonstrated by the rising odds ratio observed in the group reporting more than one sexual partner (p -value < 0.05). Meanwhile, the usage of condoms showed no correlation with the risk of microorganism invasion.

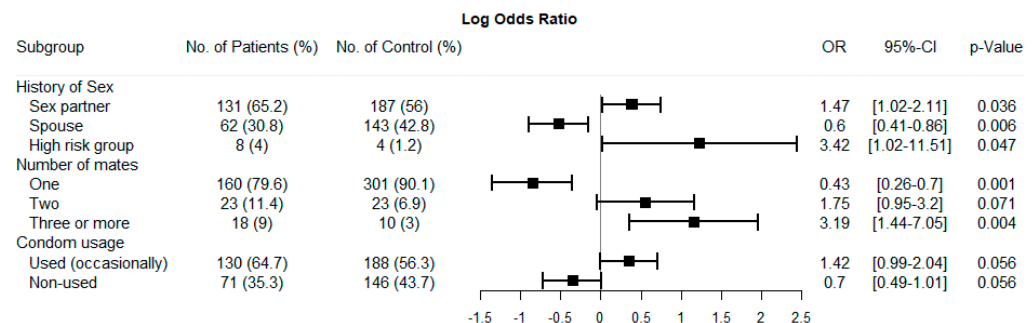


Figure 4. Correlation of risk factors with infectious condition in the cohort, as demonstrated by odds ratios with 95% confidence intervals. Log odds ratio > 0 indicates increased risk, while log odds ratio < 0 indicates decreased risk.

4. Discussion

4.1. Scenario of Infection in Our Cohort

Our data revealed that among the 535 individuals seeking medical attention, the prevalence of target infections was found to be 37%. The remaining cases may involve other issues, such as cervical or fallopian tube conditions, as well as mechanical injuries potentially caused by means other than infections, such as sexual device use. This prevalence was slightly lower than that reported in another study conducted in Ca Mau city, located in the southernmost region of Vietnam, which recorded a rate of 45.9% [15]. In this study, 8 out of 201 infected individuals had two concurrent infectious factors, accounting for around 4% of the cohort. Similarly, studies by Themba G. Ginindza (2017) and An V. Nguyen (2024) indicated concurrent infection percentages of 4.3% and 5%, respectively [16,17]. Additionally, our findings discovered a significant occurrence of infection among individuals under the age of 20, consistent with earlier research [18]. These data showed that STIs played an important role in target infections for 85% of positive cases. Our study found patients exhibiting a high rate of *Treponema pallidum* of 21.3%. *T. pallidum* is etiological for syphilis as a sexually transmitted disease, and people infected by *T. pallidum* are the source of transmission. The incubation period of syphilis can be prolonged from 10 to 90 days [19]. Patients may develop multiple painless, non-tender chancres following infection with *T. pallidum*. These initial lesions may resolve without leaving scars, even in the absence of any treatment for the patients [20], leading to a shortage of awareness and a higher risk of transmission to sexual partners. Previously, in an article published in 2007, syphilis infection was estimated to have a relatively low prevalence of approximately 0.9–13% in Vietnam [21]. It is reported that syphilis infection increased during the period spanning 1990–2010, before the re-escalation of syphilis transmission was observed internationally [22]. Our data found that *T. pallidum* is the most common infectious pathogen for over 20% of young adults (from 20 to 39 years old), followed by HSV and Gonorrhea bacteria. This is consistent with a study conducted in Chengdu, China, reporting a 28.1% syphilis rate [23]. The high current prevalence, consistent with reported trends in STIs generally and syphilis in particular, has also been observed in various Asian nations, including Thailand and Sri Lanka. Reports indicate that syphilis cases in these countries surged by an average of 2.4 times in Sri Lanka and 5.1 times in Thailand from the period of 2000–2009 to 2010–2019, and Thailand experi-

enced a 1.7-fold surge in gonorrhea cases during the same timeframe [24,25]. Meanwhile, our study found no instances of *T. vaginalis* infection, suggesting potential enhancements in the water supply infrastructure and the likely absence of this protozoan pathogen within the community of Da Nang City.

These findings underscore the importance of implementing targeted public health interventions and awareness campaigns for young populations in Vietnam and, more broadly, in Southeast Asia to enhance awareness of syphilis, particularly among teenagers. However, our study has several limitations in investigating other pathogens such as Chlamydia or HPV due to shortage of resources and the limited scope of the study. Given that sexual relationships are a natural part of youth development, it is essential to improve education and training for adolescents on the prevention and identification of syphilis and other sexually transmitted infections. Failing to bolster public awareness about sexually transmitted diseases could result in a rise in the prevalence of these infections.

4.2. Factors Related to Infection Prevalence

Our study found a significant correlation between infectious conditions and the under 20 age group (OR = 3.78, $p < 0.01$). Although only 3.6% of the study subjects were under 20, this group had the highest prevalence. Our findings on STIs-related factors were consistent with previous research where a significant ratio of sexually transmitted diseases in young adults aged between 19 and 24 years old was found [26]. Recently, a study found that women in Indonesia (17.08%) and the Philippines (9.81%) aged 15 to 24 years were at a higher risk of STIs compared to their counterparts aged 25 to 49 years, emphasizing the rising trend in infections in young people in a similar way [27]. Furthermore, it is important to highlight a case in our study involving a 17-year-old female high school student diagnosed with syphilis. Her age is below the legal marriage age of 18 in Vietnam. While there may be additional related cases, they were not documented in this study, as some patients might have sought treatment at private healthcare facilities. Vietnam's recent economic progress has influenced shifts in societal attitudes, resulting in increased permissiveness regarding sexual relationships. This shift leads to earlier sexual initiation and a greater number of sexual partners, thereby raising the risk of sexually transmitted infections [28]. Additionally, the prevalence of STIs across all age groups in this study is significantly higher than that of vaginosis local microorganisms (*Candida*, vaginal bacteria). This raises concerns about adolescent reproductive health. It also prompts questions about the adequacy of sexual health education in both schools and families. Notably, the sex education curriculum in Vietnamese high schools tends to emphasize the fear of HIV. A notable phenomenon exists within both educational institutions and families regarding sex education, where the topic is often sidestepped. Discussions tend to be approached with caution, lacking direct engagement with specific scientific matters that would offer comprehensive information to the audience. This is compounded by the fact that those teaching adolescents in schools are typically biology teachers rather than medical professionals, and many parents lack the requisite knowledge to properly educate their children. Consequently, our findings indicate a troubling trend of younger individuals, including adolescents, being diagnosed with syphilis, which is a significant public health concern that warrants urgent attention.

Marital status indicated some increasing risk, but those who were single had an OR of 1.5 ($p = 0.028$). Those who were married or have a history of sexual relations with a spouse show significantly lower risks of infection. This pattern was similar when we analyzed the correlation of the number of sexual partners and infection risk. The findings indicate that an increased number of sexual partners is associated with a higher risk of infection in these groups. This correlation could suggest that commitment to a single sexual partner within

marriage leads to protection and prevention from sexually transmitted diseases, such as *T. pallidum* or HSV.

Using condoms during sex, nevertheless, was analyzed without any significant correlation with infection, with a p -value > 0.05 . Condom use is believed to reduce the risk of STI transmission. However, condoms fail to protect against STIs if they are not applied consistently and correctly during sexual relationships [29]. The lack of a significant association in the data is probably due to insufficient information and whether the participants used condoms consistently and correctly. Another concern in preventing STIs is the fact that condoms are not guaranteed to perfectly protect against all STIs, particularly those transmitted through skin-to-skin contact or oral sex [30]. To protect health, it is recommended to have fewer sexual partners and practice consistent condom usage. Moreover, the quality of condoms and knowing how to use condoms correctly also play a critical role in protection. It is necessary to improve disease prevention knowledge via providing effective communication and sexual health education to all sexually active individuals, especially young people, including students.

5. Conclusions

To conclude, our study found that the prevalence of syphilis accounted for the greatest proportion (21%) of infected cases. The unexpectedly high prevalence of *Treponema pallidum* meant that it was the most prevalent STI among patients at a central Vietnamese hospital, particularly affecting individuals under 20 years old. These findings reinforce the urgent need for targeted sexual health education in schools and improved access to screening and care services for youth.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of DA NANG DERMATO-VENEREOLOGY HOSPITAL under protocol code 1390/BVDLDN-HDYD (date of approval: 29 October 2020).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Further inquiries can be directed to the corresponding author.

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Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

BV	Bacterial vaginosis
CIs	Confidence intervals
FSWs	Female sex workers
GTIs	Genital tract infections
HSV	Herpes Simplex Virus
LGTIs	Lower genital tract infections

MSM	Men who have sex with men
OR	Odds ratio
RPR	Rapid Plasma Reagin
STIs	Sexually transmitted infections
TPHA	Treponema pallidum hemagglutination assay

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