
GYNAECOLOGY

Clinical Characteristics and Risk Factors Associated with *Chlamydia Trachomatis* Infection in Women Presenting at “Da Nang Hospital for Women and Children”

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ABSTRACT

Objectives: To investigate clinical characteristics and risk factors associated with *Chlamydia trachomatis* infection in women examined at Da Nang Hospital for Women and Children.

Materials and Methods: This was a cross-sectional study of 600 women undergoing examinations at Da Nang Hospital for Women and Children from October 2018 to June 2019. All women were clinically examined and diagnosed with *C. trachomatis* infection by Enzyme-linked Immunosorbent Assay (ELISA) to determine the presence of serum immunoglobulin (Ig) M and IgG antibodies.

Results: *Chlamydia trachomatis* (*C. trachomatis*) infection rate was 26.0%, of which 70.5% had positive IgG antibodies and 41.6% had positive IgM antibodies, whereas 12.1% had both IgM and IgG antibodies. The majority of patients (49.3%) reported at least three clinical symptoms. The most prevalent clinical and testing manifestations were abnormal vaginal discharge (88.5%), vaginitis (75.0%), cervicitis (65.4%), and Candida co-infection (14.7%). Risk factors associated with *C. trachomatis* infection included manual laborer (odds ratio (OR) 2.1, 95% confidence interval (CI) 1.4 - 3.2, $p = 0.0004$), first sexual intercourse age < 18 years (OR 1.9, 95%CI 1.2 - 2.7, $p = 0.0023$), pelvic pain (OR 2.1, 95%CI 1.4 - 3.4, $p = 0.0007$), vaginitis (OR 2.0, 95%CI 1.2 - 3.2, $p = 0.0076$), and cervicitis (OR 2.2, 95% CI 1, 5 - 3.3, $p = 0.0001$).

Conclusion: *C. trachomatis* infection accounted for a high percentage of women aged 18 or older who had experienced sexual intercourse presenting at Da Nang Hospital for Women and Children. Following the investigation of the risk factors, clinicians should pay particular attention to high-risk patients (manual laborer, first sexual intercourse age < 18 years, pelvic pain, vaginitis, cervitis) to enhance sensitivity to disease screening and facilitate timely detection and diagnosis.

Keywords: *Chlamydia trachomatis*, ELISA, risk factors, characteristics, women

Introduction

One of the most pressing social problems facing countries across the globe is the rise of sexually transmitted infections (STIs). Morbidity and mortality associated with STIs have a significant impact on quality of life as well as sexual, reproductive, and child health. According to the World Health Organization (WHO), there were an estimated 127.2 million incident *C. trachomatis* infections between 2012 and 2016 worldwide⁽¹⁾.

Untreated *C. trachomatis* infection leads to severe complications such as pelvic inflammatory disease, salpingitis, ectopic pregnancy, and infertility, affecting women and babies. However, it is often latent in nature, with 50.0 - 70.0% of infections reported to be asymptomatic⁽²⁾. In addition, this condition adversely affects many aspects of quality of life and increases the risk of cervical cancer and HIV infection by 2 to 3 times^(3,4).

In Vietnam, the Central Highlands region occupies a large area and plays a crucial role in establishing trade links between the South and the North. However, there has not been a complete and systematic study of *C. trachomatis* infection in this region. Therefore, this study was conducted to investigate the clinical characteristics and identify risk factors related to *C. trachomatis* infection in patients examined at Da Nang Hospital for Women and Children.

Materials and Methods

This was a descriptive cross-sectional study of 600 women undergoing examinations at Da Nang Hospital for Women and Children from October 2018 to June 2019. The women were recruited using convenience sampling.

Sample size calculation

Formular

$$n = \frac{z_{(1-\alpha/2)}^2 p(1-p)}{d^2}$$

α : Type I error.

Z: standard normal distribution: $\alpha = 0,05 \rightarrow Z_{1-\alpha/2} =$

$Z_{0,975} = 1,96$.

p: 0.51⁽⁵⁾.

d: 0,04.

n: minimum sample size.

n = 600 women

Women aged 18 or older, who had experienced sexual intercourse were examined at Da Nang Hospital for Women and Children, were included. All women were informed about the study's purpose and signed a written consent form. Pregnant women, women with mental disorders, and those who refused to participate in the study were excluded.

Patients were examined in an outpatient clinic. The sociodemographic data, clinical and gynecological history were obtained from every eligible participant using a proforma. This was followed by a pelvic examination. Examining the clinical manifestations of abnormal discharge, assessing the condition of the vagina and cervix, mucopurulent endocervical discharge, abdominal and pelvic pain, cervical motion, and uterine or adnexal tenderness.

Laboratory tests performed on patients includes the Whiff test and wet mount microscopy of vaginal secretions for the detection of Trichomonas and Candida. Serology testing for the detection of anti - *Chlamydia trachomatis* IgM and IgG antibodies by ELISA technique, using SERION ELISA Kit.

The machine used to perform the test is Elisys Uno (HUMAN - Germany). The ELISA test was validated according to standard procedures of the Department of Biochemistry, Danang Hospital for Women and Children. The quality of the ELISA test was confirmed through the Internal Quality Control (IQC) of ELISA serology testing for anti - *C. trachomatis* antibodies at the Hospital.

Our study used the method of detecting *C. trachomatis* by ELISA to find specific antibodies against pathogens. The antigen used was major outer membrane protein (MOMP) (a species-specific

antigen for *C. trachomatis*), attached to the surface of the bacterial envelope. The first immune response to Chlamydia infection is an IgM antibody, which appears after 2–3 weeks. In the following 6 to 8 weeks, IgG will be produced. Both IgM and IgG antibodies react to MOMP antigens.

Test results: levels of Anti - *Chlamydia trachomatis* IgM and IgG antibodies were as follows: + < 9 U/ml: Negative; 9 - 11 U/ml: Border line; 11 U/ml: Positive.

Table 1 reveals diagnostic criteria for *C. trachomatis* infection by serological tests⁽⁶⁾

Table 1. Result interpretation for *C. trachomatis* antibodies⁽⁶⁾

IgM	IgG	Meaning
-	-	- No evidence of <i>C. trachomatis</i> infection.
+	-	- Recent infection with <i>C. trachomatis</i> . A repeat test should be conducted to confirm the diagnosis.
-	+	- IgG antibodies persisted following <i>C. trachomatis</i> infection. - Presently infected with <i>C. trachomatis</i> . - Reinfection with <i>C. trachomatis</i> . - Chronic <i>C. trachomatis</i> infection. A repeat test confirms the diagnosis of chronic infection at one month and after three months (and/or the onset of clinical symptoms).
+	+	- Being infected with <i>C. trachomatis</i>

Ig: immunoglobulin

Data were coded and analyzed using Stata software. The chi-square test with a 95% significance level was used to determine the relationship between the variable of *C. trachomatis* infection and other variables including demographic and baseline characteristics, clinical symptoms, and testing results. The difference was considered statistically significant when $p < 0.05$ with a 95% confidence interval. A univariate and multivariate logistic regression analysis was used to identify risk factors and control for potential confounders of *C. trachomatis* infection.

The study had patient consent and was approved by the Ethical Review Committee of the Danang Hospital for Women and Children. Decision number of the Ethical Review Committee was 45/BVPSN-ĐN/HĐYD//2018.

Results

During the research period from October 2018 to June 2019 at Da Nang Hospital for Women and Children, 600 research samples were collected and analyzed. Patients' demographic and baseline characteristics and the gynecological history are illustrated in Table 2.

In our study, the prevalence of *C. trachomatis* infection was 156 cases, accounting for 26.0%. Among of these patients with positive *C. trachomatis* antibodies, IgG antibodies accounted for 70.5%, and 65 cases (41.6%) were positive for IgM antibodies. Only 19 cases (12.1%) were positive for both IgM and IgG antibodies.

The clinical symptoms were heterogeneities, including abnormal vaginal discharge, vulvar pruritus, dyspareunia, intermenstrual bleeding, dysuria,

abdominal and pelvic pain (Fig. 1). 49.3% of patients with at least three clinical symptoms. In wet mount

testing, the more frequent coinfection manifestations were Candida (14.7%) (Table 3).

Table 2. Patients’ baseline characteristics

Factors	n (%)
Demographic	
Age group	
18 – 25	101 (16.8)
26 – 35	401 (66.8)
36 – 45	94 (15.7)
> 45	4 (0.7)
Occupation	
Intellectual laborer	241 (40.2)
Manual laborer	232 (38.7)
Other	127 (21.1)
Marital status	
Single	20 (3.3)
Married	562 (93.7)
Divorced	11 (1.8)
Other	7 (1.2)
Gynecological history	
Age at first sexual intercourse	
< 18 years old	263 (43.8)
History of genital infections	
Yes	302 (50.3)
History of STIs	
Yes	216 (36.0)
History of contraceptive use	
No	564 (94.0)
Condom	22 (3.7)
Other	14 (2.3)

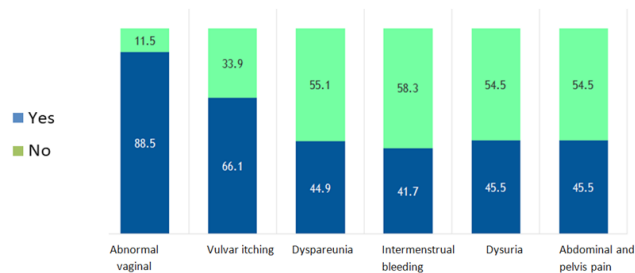


Fig. 1. Common symptoms in patients infected with *C. trachomatis*.

Table 3. Results of wet mount of abnormal vaginal discharge in patient's *C. trachomatis* infection.

Co – infection factors	n (%)
Trichomonas	19 (12.2)
Candida	23 (14.7)
Other bacteria	19 (12.2)

A univariate analysis of factors affecting the rate of *C. trachomatis* infection found that patients with manual laborer, age at first sexual intercourse < 18 years, abnormal vaginal discharge, vulvar itching, lower abdominal and pelvic pain, vaginitis,

and cervicitis were all associated with the risk of *C. trachomatis* infection. Particularly, it was found that patients with three or more clinical symptoms were at a 1.6 times greater risk of *C. trachomatis* infection (95%CI 1.1 – 2.3, $p = 0.0154$) (Table 4).

Table 4. Results of univariate logistic analysis of factors associated with *C. trachomatis* infection.

Factors	p value	OR value	95%CI
Patients' demographic	19 (12.2)		
Occupation	0.0009	1.9495	1.3 – 2.9
Age at first sexual intercourse	0.0139	1.6	1.1 – 2.3
Clinical symptoms			
Abnormal vaginal discharge	0.0031	2.3	1.3 – 3.9
Vulvar itching	0.0426	1.5	1.0 – 2.2
Lower abdominal and pelvic pain	0.0001	2.2	1.5 – 3.2
Three or more clinical symptoms	0.0154	1.6	1.1 – 2.3
Physical examinations			
Abnormal amount of vaginal discharge	0.0122	1.7	1.1 – 2.4
Vaginitis	0.0004	2.1	1.4 – 3.2
Cervicitis	< 0.0001	2.2	1.5 – 3.2
Vaginitis + Cervicitis	< 0.0001	3.0	2.1 – 4.4

CI: confidence interval, OR: odds ratio

Multivariate regression analysis revealed that there were five factors that influence *C. trachomatis* infection. Specifically, manual laborers had a 2.1 times higher risk of *C. trachomatis* infection than intellectual workers ($p = 0.0004$), being sexually active before the age of 18 increased the risk of *C. trachomatis* infection by 1.9 times ($p = 0.0023$), the group of patients with

pelvic pain symptoms had a 2.1 times higher risk of *C. trachomatis* infection compared to the asymptomatic group ($p = 0.0007$). Similarly, the risk of *C. trachomatis* infection was 2.0 times higher in the group of patients with vaginitis ($p = 0.0076$) and 2.2 times higher in patients with cervicitis compared with the asymptomatic group ($p = 0.0001$) (Table 5).

Table 5. Investigating independent factors of *C. trachomatis* infection using multivariable regression analysis.

Features	OR	95%CI	p value
Occupation	2.1	1.4 – 3.2	0.0004
Age at first sexual intercourse	1.9	1.2 – 2.7	0.0023
Lower abdominal pain and pelvic pain	2.1	1.4 – 3.4	0.0007
Vaginitis	2.0	1.2 – 3.2	0.0076
Cervicitis	2.2	1.5 – 3.3	0.0001

CI: confidence interval, OR: odds ratio

Discussion

Regarding the demographic and baseline characteristics of the study sample, age is one of the key features associated with STIs in general and *C. trachomatis* infection in particular. Different age groups have different biological and social risks. Many studies have shown that *C. trachomatis* infection is more prevalent in youths with strong sexual activity, which greatly affects reproductive health, fetus, and infants^(1,2,5,7).

With regard to the infection rate of *C. trachomatis*, significant differences were found between the studies. The infection rate in our study was the same as that of Ahmadnia (2013)⁽⁷⁾, but higher than that of Chandeying et al (2002)⁽⁸⁾ and Francis et al (2017)⁽⁹⁾. This can be explained by different study methods, including the study subjects (women with/without clinical symptoms in population, women examined at general hospitals/specialized hospitals, or those who had complications due to *C. trachomatis* infection), methodology (sample size, tests used in diagnosis (culture, Polymerase chain reaction-enzyme linked immunosorbent assay (PCR-ELISA)), as well as changes in sexual habits, younger age at sexual intercourse, multiple sex partners and a sex partner with other concurrent sex partners.

PCR is recommended “gold standard” to defined diagnosis *C. trachomatis* by WHO, however, this is a complicated and expensive technique that requires a standard laboratory and highly trained technicians, as well as takes more time for results. So,

it is difficult to apply frequently in developing countries like Vietnam. ELISA is an option for screening.

On the other hand, using ELISA for diagnosing *C. trachomatis* is valuable in epidemiological studies describing the spectrum of infections caused by *C. trachomatis*, supporting the diagnosis of acute complications due to *C. trachomatis* infection (Reiter-reactive arthritis), chronic and invasive infections (PID, infertility due to tubal factors, etc.)^(10, 11). Thanks to its many advantages, the ELISA technique is now widely used to screen and diagnose *C. trachomatis* at provincial levels of healthcare. Using this test is simple, cost-effective, and does not require extensive equipment. It provides faster results, assists with early detection, and contributes to the reduction of genital complications as well as the control of infection in the community⁽¹²⁾. However, the ELISA test has lower sensitivity and specificity than the polymerase chain reaction (PCR). Furthermore, the MOMP antigen used in ELISA is also present on the cell membrane of other pathogenic *C. trachomatis* serotypes (e.g., Trachoma, Lymphogranuloma venereum), so cross-reactivity with other *C. trachomatis* serotypes and some other bacterial strains can still occur⁽¹²⁾. Conversely, the antibody-forming reaction takes time, resulting in the possibility of missing patients at an early stage.

According to the WHO, the clinical manifestations of STIs, particularly *C. trachomatis* infection, are neither progressive nor specific. Approximately 50.0% - 75.0% of women infected with *C. trachomatis* are asymptomatic, but the pathogens are detectable when

tested. Therefore, this is a significant challenge in diagnosing and treating this disease in a timely manner in order to prevent its transmission to the spouse or partner. According to our findings, *C. trachomatis* infection causes a variety of symptoms that were similar to those described by many domestic and foreign researchers^(2, 7, 13).

However, previous studies have shown that clinical symptoms are only predictive of *C. trachomatis* infection in men and of marginal value in women. According to Muvunyi (2011), common symptoms such as lower abdominal pain, dysuria, vaginal discharge, and vaginal itching are not related to the risk of *C. trachomatis* infection in women⁽¹⁴⁾. The studies of Gravningen (2012)⁽¹⁵⁾, Torrone (2014)⁽¹⁶⁾, Lallemand⁽¹⁷⁾ (2016), and Pinto (2016)⁽¹⁸⁾ also reported that multiple sexual partners and symptomatic sexual partners were significant predictors of *C. trachomatis* infection in women. Therefore, in our study, we examined the relationship between the number of reported symptoms and the prevalence of *C. trachomatis* infection. It was found that in patients with three or more clinical symptoms, the rate of *C. trachomatis* infection increased by 1.6 times. This finding also serves as a reminder for clinicians to consider the possibility of *C. trachomatis* infection in women with many clinical symptoms. However, the relationship between *C. trachomatis* infection and the number of clinical symptoms might not be statistically significant when using multivariate regression analysis. Therefore, further studies are needed to clarify this association.

After investigating related risk factors with multivariable regression analysis, there were five factors that are actually related to the prevalence of *C. trachomatis* infection, including manual laborer, lower abdominal and pelvic pain, vaginitis, and cervicitis. They doubled the odds of having chlamydial infection. Sexual intercourse at younger age was associated with a higher prevalence. These variables have been shown in many studies to be significantly related to *C. trachomatis* infection. According to a study conducted in Swaziland (2017), the risk of *C. trachomatis* infection in the unemployed group was

2.2 times higher than the stable employment group (OR 2.2, 95%CI 1.0 – 4.7, $p = 0.045$) and 2.8 times higher than in the other groups of labor (OR 2.8, 95%CI 1.5 – 5.5, $p = 0.002$)⁽¹⁹⁾. Similarly, regarding the age of sexual intercourse and the risk of STIs, Gravningen (2012) noted that younger sexual intercourse was associated with a higher prevalence of *C. trachomatis* infections ($p < 0.05$)⁽¹⁵⁾. Additionally, cervicitis is one of the common clinical symptoms of *C. trachomatis* infection. Research by Schoeman (2012) also found this association with OR 4.9⁽²⁰⁾.

Conclusion

C. trachomatis infection accounted for a high percentage of women aged 18 or older who had experienced sexual intercourse. Burden of *Chlamydia trachomatis* was high in this region. Manual laborers, women with coitarche before age of 18 years and women having genital symptoms had a doubled odds of having *Chlamydia trachomatis* infection. Following the investigation of the risk factors, clinicians should pay particular attention to high-risk patients to enhance sensitivity to disease screening and facilitate timely detection and diagnosis in order to prevent reproductive complications associated with *Chlamydia trachomatis* infection. This test helps detect infection early in patients with symptoms for timely treatment. Although this is not a PCR test - the gold standard, ELISA is low cost, takes short time to get results, and has simple techniques that are easy to perform, so it is meaningful in community screening.

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Potential conflicts of interest

The authors declare no conflicts of interest.

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