

Prevalence and risk factors of genitourinary *Chlamydia trachomatis* infection among patients attending sexually transmitted disease clinics in northern Malaysia

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ABSTRACT

Introduction: *Chlamydia trachomatis* is one of the most common sexually transmitted diseases (STDs) globally. However, data on its prevalence and risk factors in Malaysia is still scarce.

Objective: We aimed to identify the prevalence and risk factors of genitourinary *C.trachomatis* infection among patients attending STD clinics in northern Peninsular Malaysia.

Methods: A hospital-based cross-sectional study was conducted in STD clinics of Hospital Pulau Pinang and Hospital Sultanah Bahiyah, Kedah from January to November 2014. Participants were individually interviewed using a structured data collection form followed by a physical examination and laboratory tests. Nucleic Acid Amplification Test (NAAT) was used to detect *C.trachomatis* infection. Analysis was carried out using SPSS Version 15.

Results: Eighty-three sexually active patients were enrolled, consisting of 51 males and 32 females. The median age was 28.0 years. In general, 32.5% patients were asymptomatic, the remaining presented with genital discharge (41.0%), genital warty lesion (25.3%), genital ulcer (13.3%), dysuria (13.3%), dyspareunia (2.4%), urine hesistancy (1.2%) and genital swelling (1.2%). The prevalence of genitourinary *C.trachomatis* infection was 21.7% in the study population; 17.6% in males and 28.1% in females. Among the infected females, 44.4% were pregnant. Of those infected 56.6% did not show any symptoms of genital infection, and 77.8% were aged between 18 and 30 years, of which most were females. Among newly diagnosed HIV patients, the prevalence was 14.3%. From multivariable logistic regression analysis, age under 28 years, being married and engagement in oral sex had significantly increased odds of *C.trachomatis* infection.

Conclusions: *C.trachomatis* infection was common among patients attending STD clinics in northern Peninsular Malaysia especially in the younger age groups. Majority of the infected patients were asymptomatic.

KEY WORDS:

Chlamydia trachomatis, sexually transmitted disease, prevalence, infection

INTRODUCTION

Chlamydia trachomatis is a gram-negative bacterium that infects the columnar epithelium of the cervix, urethra, and rectum and nongenital sites such as the lungs and eyes. It is a sexually transmitted infection (STI). *C.trachomatis* infection is responsible for a wide spectrum of diseases, including cervicitis, salpingitis, endometritis, urethritis, epididymitis, conjunctivitis, and neonatal pneumonia. Most of the infected patients are asymptomatic. Hence, diagnosis is often delayed until a positive screening result is obtained or a symptomatic partner discovered.

C.trachomatis is a common bacterial STI. In year 2008, the World Health Organization (WHO) reported 499 million new cases of curable STIs; i.e., gonorrhoea, chlamydia, syphilis and trichomoniasis, globally and of these, about 21.2% (105.7 million) were due to *C.trachomatis*. The prevalence of *C.trachomatis* infection among adults in the WHO Western Pacific region was estimated to be about 37.8 million. It was the highest compared with the other three STIs; i.e., 13.3 million with *Neisseria gonorrhoea*, 1.2 million with syphilis and 30.1 million with *Trichomonas vaginalis*, that had been studied.

C.trachomatis infection is not a notifiable disease in Malaysia and its actual prevalence in Malaysia is unknown. To date, there is no large population-based study published, in Malaysia, the earlier few published were hospital-based studies most of which were done almost ten years ago. Thus, the objective of this study was to identify the prevalence and risk factors of genitourinary *C.trachomatis* infection among patients attending STD clinics in northern Peninsular Malaysia.

MATERIALS AND METHODS

A hospital-based cross-sectional study was conducted in STD clinics of Hospital Pulau Pinang and Hospital Sultanah Bahiyah, Kedah from January 2014 to November 2014. The inclusion criteria were patients ≥ 18 years old, newly diagnosed with STD/HIV (within the earlier three months) and is sexually active (reported to have sexual intercourse in the last three months). Patients excluded were those who refused to participate in the study, or were unable to undergo vagina (speculum) examination or had undergone hysterectomy. Those who were on antibiotics for his/her

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current STI were also excluded. Women who refused pelvic examination were excluded because good sampling site as the habitat of *Neisseria gonorrhoea* is at the endocervical. Thus, decision was made with consideration of the detection of co-infection in the subject population. In addition, we also sent endocervical swabs for *N.gonorrhoea* culture in modified Thayer-Martin media. Sample size calculation was done using single proportions formula, with estimated difference of 10% and percentage (p) of 20% at a confidence level of 95%.

All participants were individually interviewed using a structured data collection form, and followed with physical examination and laboratory tests. Urine and endocervical samples were taken for the NAAT test from all patients. Multiplex real-time PCR detection (Anyplex™ II STI-7 Detection by Seegene Inc.) was used for this study. STI-7 was able to detect *C.trachomatis*, *N.gonorrhoea*, *Trichomonas vaginalis*, *Mycoplasma genitalium*, *Mycoplasma hominis*, *Ureaplasma urealyticum* and *Ureaplasma parvum*.

Statistical Analysis

Categorical data were summarised as frequencies and percentages. Significance was defined by a $p \leq 0.05$. The predictors of *C.trachomatis* infection were identified using logistic regression. All analysis was carried out using SPSS Version 15.

RESULTS

Demographic characteristics of the study population

A total of 110 new patients were screened, 83 patients who fulfilled the inclusion and exclusion criteria were enrolled into the study. The median age of the study population was 28 years (range 18-58 years). Majority of the study population were heterosexuals (79.5%), followed by homosexuals (18.1%) and bisexuals (2.4%). More than half (61.5%) never used condoms, 31.3% sometimes used and only 7.2% always used condoms. Only 36.1% of the patients had one sexual partner in their life while the remaining had two or more. Reported commercial sex use was low (13.2%). Table I summarises the demographic characteristics of the study population.

Clinical presentation of the study population

In general, 32.5% were asymptomatic and the others presented with genital discharge (41.0%), genital warty lesion (25.3%), genital ulcer (13.3%), dysuria (13.3%), dyspareunia (2.4%), urine hesitancy (1.2%) and genital swelling (1.2%). Asymptomatic patients consisted of asymptomatic HIV, syphilis, and also contact tracing cases. None of the patients presented with trachoma- or lymphogranuloma venereum-like signs or symptoms.

Genital discharge, dysuria, dyspareunia, lower abdominal pain and genital pain were considered as signs/symptoms suggestive of *C.trachomatis* infection. A total of 36 (43.4%) patients had at least one sign/symptom suggestive of the infection. However, only 18 tested positive for *C.trachomatis* infection. Of these, 8 (44.4%) subjects were symptomatic. Three of the detected positive symptomatic subjects also presented with other STD signs/symptoms. Of the *C.trachomatis* infected symptomatic patients, 62.5% were

female and 37.5% were male. The most common *C.trachomatis* symptom was non purulent genital discharge.

Laboratory results of the study population

Investigations were done according to the study methodology. Results for all investigations are shown in Table II. STI-7 and wet mount microscopy was done for all subjects.

Prevalence of genitourinary *Chlamydia trachomatis* in the study population

The prevalence of genitourinary *C.trachomatis* was 21.7% in the study population, 17.6% among the males and 28.1% among the females. Figure 1 shows the age group distribution of the infected subjects. The age range of this group of patients was 19-46 years old.

Among the 18 *C.trachomatis* infected patients, only 5 (27.8%) had mono-infection. Co-infection of with other organisms was common. Prevalence of genitourinary *C.trachomatis* infection in newly diagnosed HIV patients was 14.3%. More than half of the *C.trachomatis* infected patients had at least two co-infections (68.7%). Females were at a higher odds of contracting multiple infections compared to male (Odds Ratio 4.35; 95% Confidence interval, 95%CI 1.40, 13.49).

There were 18 (21%) newly diagnosed syphilis patients. This included all stages of syphilis infection (primary/secondary/latent) who never received treatment before. Among the 18 patients, only two of them had co-infection.

Associated factor(s) for *Chlamydia trachomatis* infection in the study population

The prevalence and odds ratio for *C.trachomatis* infection is shown in Table III. The unadjusted odds of being diagnosed with *C.trachomatis* infection was significantly increased in those who were younger (<28 years), who were currently married, who were having sexual intercourse more than once a week and in those who engaged in oral sex.

Adjusting for other factors, age under 28 years (AOR: 5.61; 95% CI: 1.34-23.56), being married (AOR: 17.95; 95% CI: 3.33-96.65) and engaging in oral sex (AOR: 6.02; 95% CI: 1.51-23.94) increased the odds ratio of getting *C.trachomatis* infection.

DISCUSSION

The prevalence of genitourinary *C.trachomatis* infection in our study cohort was 21.7%. Table IV shows the summary of prevalence studies of *C.trachomatis* infection in Malaysia and other countries. The prevalence of *C.trachomatis* infection in the STD population of Malaysia was reported to be 17.0% in year 1994¹ and 21.5% in year 2007.² Most of the local studies on *C.trachomatis* infection in STD populations were retrospective study. They were mainly focused on symptomatic patients and diagnosis done with non-PCR techniques such as the direct fluorescent antibody detection test. We used NAAT which was widely recommended and a more sensitive test for *C.trachomatis* detection. We also recruited asymptomatic high-risk patients into our study.

Table I: Demographic characteristics of the study population

Characteristic	N	%
Gender		
Male	51	61.4
Female	32	38.6
Ethnic		
Malay	51	61.4
Chinese	21	25.3
Indian	5	6.0
Others	6	7.3
Pregnant (female) n=32		
Yes	14	43.7
No	18	56.3
Education level		
None	1	1.2
Primary	27	32.5
Secondary	26	31.3
Tertiary	29	35.0
Marital status		
Single	32	38.6
Cohabiting	1	1.2
Married	47	56.6
Divorced	2	2.4
Widow/widower	1	1.2
Occupation		
Professional	7	8.4
Non-Professional	54	65.1
Student	7	8.4
Housewife	10	12.1
Unemployed	5	6.0
Alcohol intake		
Non-drinker	59	71.1
≤2drinks per day	22	26.5
>2 drinks per day	2	2.4
History of drug abuse^b		
Yes	13	15.7
No	70	84.3

a. Any alcohol drink regardless of the percentage of alcohol, b. Any kind of harmful or hazardous use of psychoactive substances and illicit drug

Table II: Investigation results of the study population

Investigation methods			N (%)
Bacteria and protozoa	Chlamydia trachomatis	STI-7 (NAAT)	18 (21.7)
	Ureaplasma parvum	STI-7 (NAAT)	24 (28.9)
	Ureaplasma urealyticum	STI-7 (NAAT)	15 (18.1)
	Mycoplasma hominis	STI-7 (NAAT)	14 (16.9)
	Mycoplasma genitalium	STI-7 (NAAT)	4 (4.8)
	Neisseria gonorrhoea	STI-7 (NAAT)	15 (18.1)
		Culture	5 (6.0)
		Gram stain	3 (3.6)
	Syphilis	Rapid Plasma Reagin test	18 (21.7)
		Treponema Pallidum particle agglutination assay(TPPA)	18 (21.7)
	Trichomonas vaginalis	Wet-mount microscopy examination	0
		STI-7 (NAAT)	0
	Yeast	Candida albicans	Culture
Gram stain			9 (10.8)
Virus	HIV	HIV	14 (16.9)
	HBV	HBsAg	4 (4.8)
	HCV	HCV antibody	1 (1.2)
UTI	-	Urine FEME	2 (2.4)

Table III: Prevalence and odds for Chlamydia trachomatis infection in the study population

	N (%)	Prevalence, % (95%CI)	Odds ratio (95%CI)	P value^a
All patients	83	21.7 (12.6, 30.7)	-	
Age				
≥28 years old	46 (55.4)	13.0 (2.9, 23.2)	1.00	0.033
<28 years old	37 (44.6)	32.4 (16.6, 48.3)	3.20 (1.07, 9.61)	
Gender				
Male	51 (61.4)	17.6 (6.8, 28.5)	1.00	0.264
Female	32 (38.6)	28.1 (11.7, 44.6)	1.83 (0.64, 5.24)	
Marital status				
Not married	36 (43.4)	8.3 (0.64, 5.24)	1.00	0.007
Currently married	47 (56.6)	31.9 (18.1, 45.7)	5.16 (1.36, 19.53)	
Education				
Nil or Primary	28 (33.7)	25.0 (7.9, 42.1)	1.00	0.627
Secondary	26 (31.3)	15.4 (0.5, 30.2)	0.55 (0.14, 2.14)	0.385 ^b
Tertiary	29 (34.9)	24.1 (7.6, 40.7)	0.96 (0.29, 3.19)	0.940 ^b
Employment				
Employed	61 (73.5)	19.7 (9.4, 29.9)	1.00	0.466
Unemployed	22 (26.5)	27.3 (7.1, 47.5)	1.53 (0.49, 4.74)	
Income				
≤RM1,000	22 (26.5)	13.6 (0, 29.2)	1.00	0.524
>RM1,001=5,000	54 (65.1)	24.1 (12.3, 35.9)	2.01 (0.51, 7.89)	0.318 ^b
>RM5,000k	7 (8.4)	28.6 (0, 73.7)	2.53 (0.33, 19.53)	0.372 ^b
Smoke				
No	63 (75.9)	23.8 (13.0, 34.6)	1.00	0.391
Active	20 (24.1)	15.0 (0, 32.1)	0.57 (0.15, 2.20)	
Alcohol				
No	59 (71.1)	23.7 (12.5, 34.9)	1.00	0.471
Yes	24 (28.9)	16.7 (0.6, 32.7)	0.64 (0.19, 2.20)	
Sex orientation				
Heterosexual	66 (79.5)	25.8 (14.9, 36.6)	1.00	0.059
Homo/Bisexual	17 (20.5)	5.9 (0, 18.4)	0.18 (0.02, 1.46)	
Condom use				
Never use	51 (61.5)	25.5 (13.1, 37.9)	1.00	0.557
Always use	6 (7.2)	16.7 (0, 59.5)	0.59 (0.06, 5.48)	0.638 ^b
Sometimes use	26 (31.3)	15.4 (0.5, 30.2)	0.53 (0.15, 1.83)	0.317 ^b
Number of sexual partners in life				
1	30 (36.1)	20.0 (4.8-35.2)	1.00	0.779
≥2	53 (63.9)	22.6 (11.0-34.3)	1.17 (0.39, 3.52)	
Practice of oral sex during last sexual intercourse				
No	41 (49.4)	12.2 (1.7, 22.7)	1.00	0.035
Yes	42 (50.6)	31.0 (16.4, 45.5)	3.23 (1.03, 10.11)	
Practice of anal sex during last sexual intercourse				
No	62 (74.7)	22.6 (11.9, 33.3)	1.00	0.732
Yes	21 (25.3)	19.0 (0.7, 37.4)	0.81 (0.23, 2.79)	
Use of commercial sex				
No	72 (86.8)	23.6 (13.6, 33.7)	1.00	0.237
Yes	11 (13.2)	9.1 (0, 29.3)	0.32 (0.04, 2.71)	
Any sign/symptom suggestive of CT infection				
No	47 (56.6)	21.3 (9.1, 33.4)	1.00	0.918
Yes	36 (43.4)	22.2 (8.0, 36.5)	1.06 (0.37, 3.03)	
Circumcision in male subject either patient or sexual partner				
No	24 (28.9)	20.8 (3.3, 38.4)	1.00	0.936
Yes	53 (63.9)	22.6 (11.0, 34.3)	1.11 (0.34, 3.61)	0.859 ^b
Unsure	6 (7.2)	16.7 (0, 59.5)	0.76 (0.07, 8.07)	0.820 ^b

a. Likelihood Ratio (LR) test; b. Wald test

Table IV: Summary of prevalence studies of *C.trachomatis* infection in Malaysia and other countries

Author, year, Country	Study Population	Sample size	Prevalence of CT			Testing technique technique
			Total (%)	M (%)	F (%)	
Fenton et al, 2001, UK (5)	General population	11161	1.7	2.2	1.5	NAAT (urine)
Gangaram et al. 2003, Malaysia(1)	STD clinic: Male patients with urethritis	100	17.0	17.0	-	DFA test (urethral swab)
Vall-Mayans et al. 2007, Spain(4)	Female street prostitutes	301	4.7	-	4.7	NAAT (urine)
Chen et al. 2007, Taiwan(3)	STI clinic: attendees	536	4.3	4.3	4.5	NAAT (urine)
Norashikin et al 2007, Malaysia(2)	2 STD clinics: attendees	653	18.4	16.7	22.8	NAAT (urine)
Svenstrup et al. 2014, UK(6)	STD clinic: Symptomatic NGU patients	596	21.5	23.5	17.5	DFA test (endocervical & urethral swab)
Current study 2015, Malaysia	2 STI clinics: female attendees	2180	3.8	-	3.8	NAAT (vaginal/ cervical)
	2 STD clinics: attendees	83	21.7	17.6	28.1	NAAT (urine & endo-cervical swab)

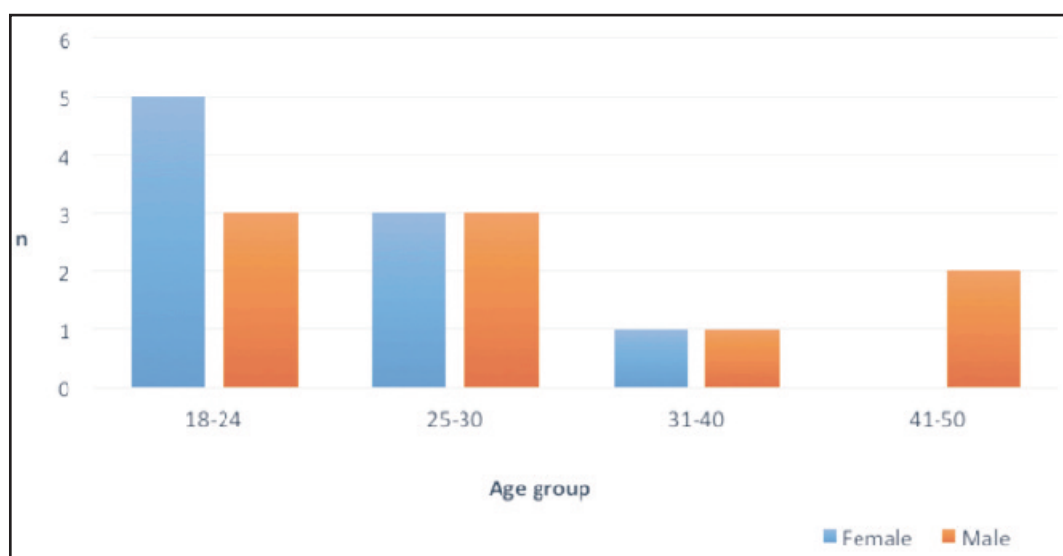


Fig. 1: Cases of Chlamydia trachomatis by age group.

When compared with other similar, published studies such as that from Taiwan and Spain, the prevalence of *C.trachomatis* infection in our study cohort was higher than both of those countries, with the prevalence of 18.4% in Taiwan³ and 4.3% in Spain.⁴ This alarming finding should alert doctors who are treating STD patients, to investigate for *C.trachomatis* infection in all STD patients irrespective of the presentation. Screening for *C.trachomatis* in high risk populations is recommended by the Center for Disease Control and Prevention (CDC), the United State of America and the British Association for Sexual Health and HIV(BASHH). Early detection and treatment can prevent serious long-term sequelae of *C.trachomatis* infection including pelvic inflammatory disease, ectopic pregnancy, and infertility.

Majority of the *C.trachomatis* infected patients were aged between 18 and 25 years old, especially among the females. Up to 55.5% of the females were at this younger age group and 44.4% of them were pregnant. This finding was consistent with most of the *C.trachomatis* related studies,

including a study done at our neighbouring country, Singapore.⁷ As this infection is common in the young reproductive population it comes with a higher disease burden. Hence, we should advocate the implementation of opportunities for screening of sexually active young population in Malaysia.

Asymptomatic *C.trachomatis* infection was common. Up to 55.6% of the *C.trachomatis* infected patients did not present any symptoms suggestive of genitourinary *C.trachomatis* infection. Of the asymptomatic patients, 44.4% were females. The most common symptom was non purulent genital discharge. Genitourinary *C.trachomatis* infection can also present with dysuria, dyspareunia and lower abdominal pain. However, it is well known that majority of the patients are asymptomatic. Consequently, screening is necessary to identify this infection in all STD patients irrespective of clinical presentation. With this secondary preventive method, it can help reduce the transmission rate of the infection in this high-risk population.

The prevalence of genital *C.trachomatis* infection in our study cohort are 17.6% in males, and 28.1% in females. This finding is consistent with CDC statistics that showed the overall rate of genital *C.trachomatis* infection is more common in females.⁸ In fact, *C.trachomatis* infection can cause more serious complication in females than in males. It is one of the leading causes of infertility and pelvic inflammatory disease (PID). PID can cause tubal factor infertility, ectopic pregnancy and chronic pelvic pain. Women with *C.trachomatis* infection are at 6.5 times greater risk of developing cervical cancer than women without infection.⁹ Additionally, infected females can spread the infection to newborns delivered through the birth canal. Their infant might develop chlamydia pneumonia or chlamydia conjunctivitis. Untreated neonatal conjunctivitis can result in blindness.

Our study results showed that patients aged <28 years old were independent risk factors for the infection. The age group was slightly older than that found to be significant in developed countries. This is possibly because Asian populations experience sexual intercourse later than populations in developed countries. Studies of female youths suggest that 2-11% of Asian women have had sexual intercourse by the age of 18 years.¹⁰ In western countries, more young women have already had sex prior to the age of 20 years – 67% in France, 79% in Great Britain, and 71% in the USA.¹¹ Among male youths, studies suggest that 24%-75% of Asian men have had sex by the age of 18 years.¹⁰ Compared with western countries, more young men have had sex prior to the age of 20 years – 83% in France, 85% in Great Britain, and 81% in the USA.¹¹ In a Taiwanese study,³ the significant ages associated with *C.trachomatis* infection was 30 years old or less. This shows that *C.trachomatis* infection was more common in older young adults in Asia as compared with western countries. However, in the “National Chlamydia Screening Programme” of United Kingdom, the screening age for *C.trachomatis* infection is under 25 for those who have ever been sexually active. Future studies in Asia on *C.trachomatis* infection should explore on older age groups as among western countries. This is important in adjusting the screening age for *C.trachomatis* infection in Asian communities.

Interestingly in our study, currently being married, was one of the significant risk factors for *C.trachomatis* infection. In our study cohort, 56.6% was currently married. In Malaysia, the mean age at first marriage for male and female were 28.0 years and 25.1 years, respectively.¹² The mean marriage age was almost parallel to the significant common age group for *C.trachomatis* infection in our study, which was aged <28 years old. Thus, this might be the reason why being married was a risk factor for *C.trachomatis* infection. In fact, this added our worries because it seems like young married adult is at higher risk of *C.trachomatis* infection. The impact or complication of the disease is not only confined to the affected couple but also their newborn. This will cause a significant burden to the family and community.

In terms of sexual behaviour, practice of oral sex was more common than anal sex in our study cohort, at 50.6% and 25.3%, respectively. All the patients had normal findings on

oral examinations and we did not perform any laboratory test to detect oral pharyngeal *C.trachomatis* infection in our study population. Pharyngeal *C.trachomatis* infection rate was reported as 3.6% in man who have sex with men (MSM) population and 3.2% in female casual sex workers by studies done in Thailand¹³ and Hong Kong¹⁴ respectively. In our study, we found oral sex was one of the statistically significant risk factors for genitourinary *C.trachomatis* infection. The practice of fellatio was common in both heterosexual and homosexual patients in our cohort. There were 79.5% heterosexuals and 20.5% male homosexuals/bisexuals in our study cohort (who practiced fellatio). Our finding may explain why *C.trachomatis* infection in STD populations was persistently high for the past 20 years in Malaysia. Thus, education about the transmission of diseases through unprotected oral sex is warranted as part of our safe sex education. Promotion of the use of condom for fellatio should be incorporated. We also hope this finding can give insight and inspire future research on oropharyngeal *C.trachomatis* in Malaysia.

Besides *C.trachomatis* detection, tests for a multitude of organisms were also done in our study. With the advantage of multiplex PCR technique, our study was able to investigate in detail the possible causative organisms of non gonococcal-non Chlamydial urethritis.

We found co-infection was very common in our *C.trachomatis* infected patients. Up to 72.2% have co-infection with other viral, bacterial or candida infection. The pattern of the co-infections was variable.

Prevalence of genitourinary *C.trachomatis* infection in newly diagnosed HIV patients was 14.3%. This prevalence was higher than another study done in Thailand where the prevalence of *C.trachomatis* in HIV population was 9.7%.¹⁵ However, our sample size was much smaller than the Thai study which involved 824 HIV patients. *C.trachomatis* can facilitate transmission of HIV.^{16,17}

In Malaysia, HIV transmission through sexual routes has increased by alarming 140%, from 1,269 to 3,032 cases from year 2002 to 2017. In addition, the proportions among adolescents and young people aged 13-29 years have been increasing. About 90% of the young population had acquired HIV infection through sexual routes.¹⁸ Thus, for STDs, including *C.trachomatis*, detection and treatment are one of the essential components of HIV prevention programmes. *C.trachomatis* infection can also play a role as an important biological behavioral marker that indicates the probability of HIV patients exposing others to HIV via sexual activities. Hence, the control of *C.trachomatis* infections may be one of the important steps to prevent HIV transmission in our country.

Co-infection rate of *C.trachomatis* and *N.gonorrhoea* was 11.1% in our study cohort. This finding was lower than a Taiwanese study³ which detected 25% of *N.gonorrhoea* in *C.trachomatis* positive group with statistically significant co-infection. Our study did not find any statistical significance between these two bacteria. Both *C.trachomatis* and *N.gonorrhoea* are commonly occurring sexually transmitted

bacteria that produce broadly overlapping clinical syndrome. Additionally, patients infected with *N.gonorrhoea* frequently are co-infected with *C.trachomatis*; this finding has led to the recommendation that patients treated for gonococcal infection also be treated routinely with a regimen that is effective against uncomplicated genital *C.trachomatis* infection.¹⁹

However, because gonococci are also susceptible to doxycycline and azithromycin, routine co-treatment may also hinder the development of antimicrobial-resistant *N.gonorrhoea*. The prevalence of tetracycline resistance among Gonococcal Isolate Surveillance Project (GISP) isolates, particularly those with elevated cefixime minimum inhibitory concentration (MICs), is higher than azithromycin.²⁰ Thus, etiological approach is better than syndromic approach especially dual therapy combination with doxycycline, in terms of definitive treatment and reduction of development of antimicrobial-resistant *N.gonorrhoea*. In view of this important reason and relatively lower co-infection rate of *C.trachomatis* and *N.gonorrhoea* in our study cohort, we highly recommend for etiological approach in treating STI.

The limitation of this study are the small sample size and it being a cross-sectional study. So, the finding on prevalence might not represent the actual prevalence of all time. The finding may be different if another time-frame had been chosen.

CONCLUSION

In conclusion, our study has generated an important knowledge on *C.trachomatis* infection in STD populations in northern Malaysia. The prevalence was 21.7% and most of the infected patients were asymptomatic. Hence, we highly recommend active screening for *C.trachomatis* infection in all new STD patients irrespective of clinical presentation. *C.trachomatis* infection should become one of the mandatory notifiable diseases in Malaysia.

The independent risk factors with significantly increased odds of *C.trachomatis* infection in this study cohort were age under 28 years, being married and engagement in oral sex. Safe sex education and counselling should be regularly provided to the sexually active population. In fact, it is the most cost-effective way to combat sexually transmitted diseases.

ETHICAL APPROVAL

This study was registered with the National Medical Research Registry (NMRR) [NMRR-13-935-17615]. Ethical approval for the study was obtained from the Medical Research and Ethics Committee, Ministry of Health, Malaysia, on the 8th January 2014. All the information from the data collection form were kept confidential.

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