Prevalence of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections in Tlaxcala, Mexico

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Abstract

Chlamydia trachomatis (CT) and *Neisseria gonorrhoeae* (NG) are widely recognised as two prevalent sexually transmitted infections that can have detrimental effects on women's reproductive health. Previous research has concentrated on studying high-risk populations, resulting in limited epidemiological data regarding the general population. Therefore, the objective of this study was to estimate the prevalence of CT and NG among women attending public primary health care in Tlaxcala, Mexico. The study sample included 2,396 women already participating in the cervical cancer screening programme, from July to November 2014. After obtaining informed consent, the CT and NG tests were conducted on cervical samples, using a nucleic acid amplification test. We estimate the prevalence with 95% confidence intervals (CIs). Women who tested positive were promptly notified and provided with appropriate treatment. In our study population, CT and NG prevalences were 3.2 (95% CI: 2.6–4.0) and 0.01 (95% CI: 0.01–0.03), respectively. CT prevalence was higher in younger women (age < 40), although the results indicate a low prevalence; due to the potentially significant impact of CT and NG on women's health, we require adequate surveillance, and guaranteeing rapid referral to the correct treatment is a priority for the control of these diseases.

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Chlamydia trachomatis (CT) and *Neisseria gonorrhoeae* (NG) are the most common bacterial sexually transmitted infections (STIs) worldwide (1). However, there have been limited studies on the prevalence of CT and NG among the general population in Mexico. Some studies have indicated CT prevalence ranging from 1.5% to 6.7% among women attending routine gynaecological services, while in college students, the prevalence was determined to be approximately 0.5% (2-4).

Nowadays, CT and NG are uncommon in the general population; however, people who get the infection may be asymptomatic and remain undiagnosed and untreated, favouring the spread of the infection among their sexual partners (5). Monitoring CT and NG prevalence in the general population and high-risk groups is an essential part of control efforts (1). Currently, there is no current information on the prevalence of CT and NG among the general population of Tlaxcalteca women. Thus, our aim was to estimate the prevalence of CT and NG infections in women who attended the cervical cancer screening programme (CCSP) in Tlaxcala, Mexico.

This project was approved by the Institutional Review Board (IRB) at the National Institute of Public Health (No. 1094) and the Tlaxcala Ministry of Health (SS-DECI-OI-13/12). Verbal consent was obtained, and confidentiality was assured for all participants. The Tlaxcala State Health Service is divided into three administrative districts or sanitary jurisdictions. This study is being performed in Sanitary Jurisdiction No. 1, which includes 32 of 60 Tlaxcala's municipalities with a population of 604,161 females, which accounts for 51.6% of the total population. In this jurisdiction, the target population for the high-risk human papillomavirus (hrHPV)-based CCSP is about 100,000 women between the ages of 30 and 64; for the Forwarding Research for Improved Detection and Access for Cervical Cancer Screening and Triage (FRIDA study), we enrolled approximately 31.0%. Within this sample, we recruited 2,396 women. From July to November 2014, all women attending the CCSP were invited to be tested for CT and NG. Before testing, all potential participants received an explication of the benefits of CT and NG diagnosis and obtained informed consent. Health personnel conducted face-to-face interviews with

participants using pre-printed pen and paper surveys designed to elicit details of age, marital status, age of sexual debut, number of lifetime sexual partners, parity, miscarriage, use of contraceptives (intrauterine device (IUD), condom, and hormonal), smoking history, and history of previous STIs (6). As part of CCSP procedures, a nurse performed a pelvic examination and collected a cervical sample using a Cervex-Brush® (Rovers) (6). The samples were placed in ThinPrep® vials and stored at room temperature until delivered to the Molecular Diagnostic Laboratory of the National Institute of Public Health in Cuernavaca, Morelos, Mexico, within a period of two weeks. The samples were analysed for CT and NG screening, using the cobas 4800 CT/NG test (Roche®), according to the manufacturer's instructions (7). STI results were given to participants, and appropriate treatment was offered to positive cases.

To summarise the socio-demographic and sexual behavioural characteristics, we used descriptive statistics (Supplementary Table S1), and then, we estimated CT and NG prevalence with 95% confidence intervals (CIs), stratified by age groups. Additionally, factors associated with CT infection status were analysed. Odds ratios (ORs) were calculated with their respective 95% CIs; all analysis was performed using Stata software version 14.0 (Stata Corp. LP: College Station, TX).

Our study sample consisted of 2,396 women aged 30 and 64 years, and the mean age was 41.6 years (95% CI: 41.3–42.0). Most participants were married. 85.6 (95% CI: 84.1–86.9) and 70.0 (95% CI: 68.1–71.8) had one sexual partner in their lifetime, while 30.0 (95% CI: 28.2–31.9) reported having had more than one sexual partner; 35.5 (95% CI: 33.6–37.4) had their sexual debut before age 18. The majority had more than one pregnancy 96.7 (95% CI: 95.9–97.3), with a median of three pregnancies. For birth control, 28.0 (95% CI: 26.2–29.8) of women used an IUD, 17.5 (95% CI: 16.0–19.1) used hormonal contraceptives, and 3.3 (95% CI: 2.6–4.1) self-reported a history of STIs (Supplementary Table S1). Overall CT prevalence was 3.2 (95% CI: 2.6–4.0), and CT prevalence declined with older age. The highest prevalence observed was 3.9 (95% CI: 2.9–5.2) among women aged 30 to 39 and declined to 1.3 (95% CI: 0.4–4.0) among women aged 50 to 64. NG prevalence was very low at 0.01 (95% CI: 0.01–0.03) (Table 1).

We performed an analysis of factors associated with Chlamydia; however, we observed a significant association for lower prevalence in the group of 50–59 years; however, this association was not maintained in women aged 60–64 years (Supplementary Table S2).

These findings are consistent with previous studies conducted in Mexico, which reported CT prevalence ranging from 0.5% to 6.7% (2–4). One of them, carried out in the southeast of Mexico, found a

CT prevalence of 10% among women aged 21 to 30 years during routine gynaecological examinations, while a lower prevalence was observed among women older than 40 years (2). Another study performed in the same region reported a prevalence of 6.7% among sexually active women aged 15 to 45 years; however, it does not specify the prevalence for different age groups (3). Additionally, a study conducted among college students at Morelos State University found a CT prevalence of 0.5% and no cases of NG (4). In line with these previous findings, our study also found a low prevalence of NG (0.04%).

Discrepancies between our results and previous findings may be explained by different methods in diagnostic techniques (enzyme immunoassay (3) vs. nucleic acid amplification tests (NAATs) (2)), and the enzyme immunoassay is not as sensitive and specific as NAATs, which is the reason why their use is discouraged (7;8). Also, biological samples were used (urine (4) vs. cervical) (2;3), and urine might detect up to 10% fewer infections compared with cervical samples.

Our findings showed that women under 40 years had a higher CT prevalence; therefore, it is important to emphasise the significance of CT screening in sexually active women, particularly among high-risk populations. High-risk populations may include women <25 years and women >25 years, who report having more than two sexual partners over the past 12 months, or who have recently changed sexual partners (8). These recommendations align with the guidelines established by the Centers for Disease Control and Prevention (CDC) and the British Association for Sexual Health and Human Immunodeficiency Virus (HIV) (8;9). The implementation of these recommendations will improve prevention practices and treatment of these STIs and avoid the indiscriminate use of doxycycline in asymptomatic women (8–10).

Untreated women can have adverse reproductive outcomes related to these infections, such as fallopian tube damage, scarring, and blockage, which may result in an ectopic pregnancy, infertility, and chronic pelvic pain (3–5). Improving the diagnosis and ensuring appropriate treatment for these bacterial STIs are crucial not only for combating the emergence of antibiotic resistance but also for minimising complications that may harm the sexual and reproductive health of women and their partners (1;3;8).

The main strength of our study is that we focused on users of CCSP, which gave us an overview of these infections in the general population, in contrast to studies that predominantly examine high-risk populations. Additionally, sample collection through CCSP offers the opportunity to have a non-high-risk population sample compared with previous studies (2–4). This can be seen by comparing the characteristics of our population with the sample

Table 1. Prevalence of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* by age group (*n* = 2,396) in Tlaxcala, Mexico, July to November 2014

		Age groups			
		30–39	40–49	50–59	60–64
	Total	*n* = 1,118	*n* = 825	*n* = 374	*n* = 79
		% (95% CI)			
C. trachomatis					
C. trachomatis-positive	3.2 (2.6–4.0)	3.9 (2.9–5.2)	3.3 (2.2–4.7)	1.3 (0.6–3.2)	1.3 (0.2–8.8)
N. gonorrhoeae					
N. gonorrhoeae-positive	0.01 (0.01–0.03)	0.1 (0.1–0.6)	0.0	0.0	0.0
CI: confidence interval					

studied by Newman et al. used to estimate the global prevalence of STIs: 4.2% (95% CI, 3.7–4.7%) for CT and 0.8% (95% CI, 0.6–1.0%) for NG in the non-high-risk population (1). Although the sample is not representative of the population of the region or country, it is representative of the general population that attends CCSP (6). Another advantage of this report is that we used NAATs for the detection of CT and NG, which have high clinical accuracy (7;8). This diagnostic approach is recommended by the CDC as opposed to other available tests (8). However, our study results have several limitations, and information on the immigration status of the partners was not collected as part of the screening. Also, the sexual partners of the CT-positive women were not tested, as it is likely that they act as a reservoir for this infection, which could explain the high prevalence of CT in women under 40 years of age. We strongly recommend the implementation of an extensive public awareness campaign aimed at educating the general population about Chlamydia infection (10). This campaign should focus on raising awareness about the modes of transmission, potential complications, and preventive measures. We emphasise the need for CT screening in sexually active women under 25 years of age and in those who are at risk of infection (8;9); moreover, we also recommend the implementation of an extensive public awareness campaign focused on educating the general population about Chlamydia infection and giving information about transmission, potential complications, and prevention methods (10). Additionally, our findings suggest that the prevalence of NG is low (close to zero) in women in the general population. Our findings significantly contribute to estimating the prevalence of STIs among non-high-risk Mexican women.

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