Chlamydia trachomatis infection and associated risk factors in a low-income marginalized urban population in coastal Peru

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ABSTRACT

Objectives. *To estimate* Chlamydia trachomatis *(CT) infection prevalence and associated risk factors among a low-income marginalized urban population in Peru.*

Methods. *Between April 2003 and April 2005, men and women at high-risk for sexually transmitted infections (STIs) were recruited from low-income urban areas in three coastal cities in Peru (Chiclayo, Lima, and Trujillo). Consenting participants were studied using a sero-epidemiologic survey. Urine and vaginal swabs collected from men and women were evaluated using polymerase chain reaction (PCR) (COBAS® AMPLICOR (CT/NG) Test, Roche Molecular Diagnostics, Branchburg, NJ, USA) for CT.*

Results. *Among the 2 440 participants recruited for the study (2 145 men and 295 women), overall prevalence of CT infection was 6.6% (95% CI, 5.6–7.6%): 5.5% (95% CI, 4.5–6.5%) in men and 14.9% (95% CI, 11.7–27.1%) in women. Chlamydial infection was inversely associated with age and positively associated with HIV infection and dysuria in men. Among women, chlamydial infection was inversely associated with age and positively associated with number of sex partners.*

Conclusions. *CT infection was common among high-risk men and women in urban coastal Peru. Because chlamydial infection is associated with complications related to female reproduction, including infertility and ectopic pregnancy, interventions to prevent and treat infection and studies to determine the feasibility of population-based screening for CT should be conducted among the high-risk female population.*

Key words Chlamydia, sexually transmitted diseases, vulnerable populations, women, Peru.

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Infection with *Chlamydia trachomatis* (CT) is common in young adults around the world (1, 2). CT infection is asymptomatic in 75% of women. This complicates identification and treatment, as individuals are often not diagnosed (3). Once a diagnosis is made, however, CT infection is highly treatable (3, 4). Chlamydial infection is one of the main causes of cervicitis and nongonnococcal urethritis, and is a common cause of pelvic inflammatory disease (PID) (5, 6). Chlamydia is an important public health concern because it primarily affects women in reproductive age and has been associated with pregnancy complications, including decreased fertility and chronic pelvic pain (5, 7, 8).

To date, there have been few reports on the epidemiology of chlamydial infection in Latin America. In two previous reports among women in the general population in Latin American, chlamydia

prevalence was 5.0% and 6.7%, respectively (8–10). In one study, chlamydial infection was associated with young age, oral contraceptive use, number of sex partners, and genitourinary signs or symptoms (9). In Peru, studies of CT in the general population yielded 17.0%, 9.1%, and 6.1% prevalence among symptomatic men, symptomatic women, and a population-based survey in young people respectively (1, 11, 12). In two studies among young, vulnerable populations in Mexico and Brazil, chlamydial infection prevalence was 8.9% and 8.0%, respectively, and the associated risk factors included inconsistent condom use (13, 14).

The Peruvian Ministry of Health's regulations have followed World Health Organization (WHO) recommendations to focus on the syndromic management of sexually transmitted infections (STIs) (15). However, that policy does not address asymptomatic disease, and syndromic case management has low specificity and poor positive predictive value (16). The advent of new DNA-based testing strategies, such as polymerase chain reaction (PCR), makes screening and etiological clinical management among high-risk populations a potentially viable option (17, 18). As disenfranchised populations likely suffer greater adverse health consequences and are underrepresented in reports of epidemiology and infection, this report examines the epidemiology of chlamydial infection and associated risk factors in select socially marginalized subpopulations in low-income urban Peru. It is based on a formative study conducted to help adapt the Community Public Opinion Leader (C-POL) Program, an HIV prevention intervention that recruits and trains trusted opinion leaders in the community to promote safe sex behaviors through risk-reduction conversations with peers.

METHODS

Study population

The data presented herein were collected as part of the NIMH [U.S. National Institute of Mental Health] Collaborative STD/HIV Prevention Trial, which tested a behavioral intervention to prevent HIV and STIs (19). The trial included two marginalized subpopulations identified from 20 low-income urban communities in three coastal cities in Peru (20): Chiclayo, Lima, and Trujillo.

The two study populations were identified as part of pre-trial planning via an ethnographic study at venues with substantial social interaction and were classified as: 1) *esquineros*, young unemployed men who spend time socializing on street corners, the majority of whom belong to local gangs, and 2) *movidas*, young women who defy societal norms by socializing and engaging in casual sex with *esquineros*. Throughout this report, *esquineros* and *movidas* are referred to as "marginalized men and women," respectively; further description of those populations is available in other publications (19, 20).

Trial subjects were enrolled from April 2003 to April 2005. Previously identified and enumerated marginalized men and women between 18 to 40 years old were contacted and recruited. Other inclusion criteria were having sex in the last six months, frequenting venues of high social activity at least two times per week, currently living in the target neighborhoods, and planning to stay for at least two years (19). All participants gave their written informed consent using an approved consent form and were then interviewed by trained interviewers using a computer-assisted personal interview (CAPI) (21). Demographic, sexual risk behavior, alcohol, and drug use information were collected in the interview, along with data on recent genitourinary symptoms. After the interview, all participants received pre-test counseling and then provided either a urine sample (men) or a self-collected, vaginal swab (women) for laboratory testing.

Biological specimens and CT testing

In the field, the urine samples were collected in sterile screw-cap flasks and then aliquoted into polypropylene cryovials and frozen. Female participants were given instructions by the laboratory technician on how to self-collect a vaginal swab sample (22). Once collected, the vaginal swab was stored in a sterile tube without additives and frozen. Both samples were then transported on dry ice (solidified carbon dioxide) to the central laboratory for testing. The detection of CT was done using PCR (COBAS® AMPLICOR (CT/NG) Test, Roche Molecular Diagnostics, Branchburg, NJ, USA) according to the manufacturer's directions. The results were given to the participants within two weeks after sample collection, along with post-test counseling and appropriate treatment (azithromicin, 1 g by mouth) based on Peruvian guidelines (23).

Statistical analysis

The main study outcome was CT infection, analyzed as a dichotomous variable. Covariates to detect differences in chlamydial infection prevalence included socio-demographics, reported symptoms, and other factors. Continuous variables (age, number of sexually active years, sexual debut, and number of sex partners in last three months) were categorized at natural cut-points. In bivariate analysis, categorical variables were analyzed with chi-square tests (using Fisher's exact tests when needed), and ordinal or numeric variables were analyzed with the Wilcoxon-Mann-Whitney non-parametric test. Multiple logistic regression was then used to identify factors associated with chlamydial infection, adjusting for the simultaneous effect of other covariates. Sandwich estimates of the standard errors were calculated to account for the lack of independence of subjects within each neighborhood. Multiple regression analyses and likelihood ratio tests were used to determine the statistical significance of each variable in nested, forward stepwise models analyzed manually. Only significant variables ($p < 0.05$) were added to the final model. Due to their different patterns of risk and infection, all analyses were conducted separately for men and women. All confidence intervals (CIs) were calculated at 95%. The data were analyzed using Stata 9.0 (Stata Corp LP, College Station, TX, USA).

Ethical approvals

Institutional Review Boards at the University of California, Los Angeles; the University of California, San Francisco; Cayetano Heredia University, Peru; and the U.S. Naval Medical Research Center Detachment approved this study, which is in compliance with all applicable U.S. federal regulations governing the protection of human subjects.

RESULTS

The study yielded 2 440 participants (2 145 marginalized men and 295 marginalized women). The overall prevalence of chlamydial infection in the study sample was 162/2 440 or 6.6% (95% CI, 5.6–7.6%):

118 or 5.5% (95% CI, 4.5–6.5%) of the 2 145 male study participants and 44 or 14.9% (95% CI, 11.7–27.1%) of the 295 female study participants.

Demographic characteristics and risk behaviors are outlined in Table 1. The men were younger than the women, and both populations had low rates of high school graduation (although the men were more likely to have graduated than the women). The majority of the men were single, whereas only one-third of the women were single. While the majority of men and women reported only one sex partner in the last three months, some participants (more men versus women) reported two or more partners. Unprotected sex with at least one non-stable partner in the last three months was also reported by men more frequently than women. All comparisons between men and women in Table 1 were significant, with *p*-values (not shown) less than 0.01.

Several factors were associated with chlamydial infection in bivariate analysis, and those factors differed between men and women (Table 2). Among the men, CT infection was inversely associated with age and positively associated with HIV status and dysuria. Having sex with another man showed no strong association with prevalence of chlamydia among men. Among the women, CT infection was inversely associated with age and positively associated with being single. CT infection was also inversely associated with having graduated from high school, although this association was only borderline significant. Infection was positively associated with various sexual risk behaviors—including an increase in number of sex partners, and having unprotected sex with non-stable partner(s)—and inversely associated with number of sexually active years. There was no strong association between chlamydial infection and either of the reported STI symptoms (dysuria and discharge) among the women. Prevalence of CT infection varied with age of participants: among women, the highest prevalence was in the youngest age group (18–21 years), which comprised 27.6% of the women and 6.9% of the men (Figure 1). Infection was higher among women compared to men in every age group except the oldest (≥34 years).

Evaluation of risk factors using multivariate analysis is illustrated in Table 3. Among the men, chlamydial infection was associated with being HIV-infected (adjusted odds ratio (AOR) = 4.90; 95% CI, 1.14–21.13) and having dysuria in the last six months (AOR = 1.53; 95% CI, 0.99–2.38), and analysis by age group indicated infection rates tended to drop with age. Among the women, in multivariate analysis, younger age and increased sexual activity were strongly associated with higher risk of CT infection.

The majority of participants with laboratory-diagnosed chlamydial infection were asymptomatic. Among the 44 women and 118 men infected with CT, 29 (56.8%) and 74 (61.9%), respectively, reported "no genitourinary symptoms during last six months."

TABLE 1. Demographic and behavioral characteristics of a low-income marginalized urban population in three coastal cities in Peru (Chiclayo, Lima, and Trujillo), 2003–2005

Variables	Men (*n* = 2 145)		Women (*n* = 295)	
	No.	%	No.	%
Demographics				
Age (years)				
18–21	976	45.5	87	29.5
22–25	597	27.8	69	23.4
26–29	284	13.2	48	16.3
30–33	152	7.1	36	12.2
≥34	136	6.3	55	18.6
Graduated high school				
No	1 095	51.0	180	61.0
Yes	1 050	49.0	115	39.0
Marital status				
Single	1 428	66.6	94	31.9
Married/living with spouse	608	28.4	161	54.6
Widowed, separated, divorced	109	5.1	40	13.6
Risk behaviors				
No. sex partners, last 3 months				
0	173	8.1	18	6.1
1	1 142	53.2	216	73.2
2	417	19.4	32	10.9
≥3	413	19.3	29	9.8
Unprotected sex, last 3 months				
No	518	18.5	46	11.1
Yes	1 627	81.5	249	88.9
Unprotected sex with non-stable partner, last 3 months				
No	683	31.8	169	57.3
Yes	1 462	68.2	126	42.7
Sex with another man, last 6 months				
No	1 877	87.5	NA[a]	NA
Yes	268	12.5	NA	NA
Age at sexual debut (years)[b]				
>10	44	2.1	3	1.0
11–15	1 153	53.9	123	41.7
16–20	896	41.9	152	51.5
≥21	46	2.2	17	5.8
No. sexually active years[b]				
>1–5	776	36.3	86	29.2
6–10	773	36.1	87	29.5
11–15	371	17.3	56	19.0
≥16	219	10.2	66	22.4
Biological and syndromic				
HIV status[b]				
Negative	2 120	99.3	294	99.7
Positive	15	0.7	1	0.3
Dysuria, last 6 months				
No	1 552	72.3	169	57.3
Yes	593	27.7	126	42.7
Discharge, last 6 months				
No	2 078	96.9	201	68.0
Yes	67	3.1	94	32.0

[a] NA = not applicable.
[b] Sample size for male respondents does not equal 2 145 due to missing data.

DISCUSSION

This study reports the prevalence and correlates of chlamydial infection in select marginalized urban men and women in

TABLE 2. Prevalence of *Chlamydia trachomatis* (CT) by participant characteristics among low-income marginalized urban men and women in three coastal cities in Peru (Chiclayo, Lima, and Trujillo), 2003–2005

Variables	Men (n = 2 145)	Women (n = 295)
	% (no. of CT cases / total no. of subjects per variable)	
Overall prevalence	5.5 (118/2 145)	14.9 (44/295)
Demographics		
Age (years)[a]		
18–21	6.9 (67/976)	27.6 (24/87)
22–25	5.4 (32/597)	14.5 (10/69)
26–29	3.9 (11/284)	12.5 (6/48)
30–33	2.6 (4/152)	8.3 (3/36)
≥34	2.9[b] (4/136)	1.8[c] (1/55)
Graduated high school		
No	5.9 (65/1 095)	17.8 (32/180)
Yes	5.0 (53/1 050)	10.4 (12/115)
Marital status		
Single	5.7 (81/1 428)	23.4 (22/94)
Married/living with spouse	5.1 (31/608)	10.6 (17/161)
Widowed, separated, divorced	5.5 (6/109)	12.5[d] (5/40)
Risk behaviors		
No. sex partners, last 3 months[a]		
0	4.0 (7/173)	5.6 (1/18)
1	5.2 (59/1 142)	13.0 (28/216)
2	6.0 (25/417)	15.6 (5/32)
≥3	6.5 (27/413)	34.5[b] (10/29)
Unprotected sex, last 3 months		
No	2.9 (15/518)	8.7 (4/46)
Yes	5.7 (92/1 627)	15.3 (38/249)
Unprotected sex with non-stable partner, last 3 months		
No	5.0 (34/683)	9.5 (16/169)
Yes	5.7 (84/1 462)	22.2[b] (28/126)
Sex with another man, last 6 months		
No	5.4 (102/1 877)	NA[e]
Yes	6.0 (16/268)	NA
Age at sexual debut (years)[a,f]		
≤10	9.1 (4/44)	33.3 (1/3)
11–15	6.2 (71/1 153)	15.4 (19/123)
16–20	4.6 (41/896)	14.5 (22/152)
≥21	4.3 (2/46)	11.8 (2/17)
No. sexually active years[a,f]		
<1–5	6.3 (49/776)	20.9 (18/86)
6–10	6.0 (46/773)	20.7 (18/87)
11–15	3.8 (14/371)	8.9 (5/56)
≥16	4.1 (9/219)	4.5[b] (3/66)
Biological and syndromic		
HIV status[f]		
Negative	5.4 (114/2 120)	15.0 (44/294)
Positive	20.0[d] (3/15)	0.0 (0/1)
Dysuria, last 6 months		
No	4.8 (74/1 552)	17.2 (29/169)
Yes	7.4[d] (44/593)	11.9 (15/126)
Discharge, last 6 months		
No	5.5 (114/2 078)	15.4 (31/201)
Yes	6.0 (4/67)	13.8 (13/94)

[a] *P*-values for age, number of sex partners, age at sexual debut, and number of sexually active years are testing for a statistical trend; all other *p*-values were calculated using the chi-square test, using Fisher's exact tests when required.
[b] *P*-value <0.01.
[c] *P*-value <0.001.
[d] *P*-value <0.05.
[e] NA = not applicable.
[f] Sample size for male respondents does not equal 2 145 due to missing data.

coastal Peru. According to the results, CT infection was more common in women than in men (Table 2), corroborating other studies (24–27). While the prevalence of chlamydia in men was very similar to that found elsewhere (24, 27, 28), the prevalence in women was much higher compared to other studies done in Latin America (8, 13, 14, 27). In comparison with a study among women in the general population of Peru, the rate of chlamydial infection among the marginalized women in this analysis was twice that of women in the general population (1, 12).

Chlamydial infection was significantly associated with age in both men and women. The prevalence among young women was especially high and deserves attention, given the amount of asymptomatic infection and the adverse health effects known to be associated with untreated CT infection (25, 29). The association with younger age is consistent with other studies (9, 13, 14, 28). In addition, the study results show that marginalized urban populations in Peru have high rates of sexual risk behavior. Chlamydial infection among marginalized women in this study was strongly associated with an increase in the number of sex partners in the last three months. Therefore, interventions aimed at preventing and treating chlamydial infection in those subpopulations should focus on the younger age groups and on increasing safer sex practices.

The higher prevalence of CT infection in women compared to men in this study could be related to the fact that female chlamydial infections take longer to develop and are more often asymptomatic than male infections, which may contribute to reduced treatment-seeking in women (30, 31). In addition, as shown in other studies, the sexual networks of marginalized urban women often extend outside of their local communities (32), which may increase their chance of infection by exposing them to larger populations of high-risk individuals (e.g., people they meet in bars and clubs).

In this study, the association between dysuria and chlamydial infection is counterintuitive; women reporting dysuria in the last six months (11.9%) had lower prevalence than those who did not report this symptom (17.2%). This result may be attributed to health-seeking behavior among symptomatic individuals and high rates of medication acquisition at Peruvian pharmacies, where antibiotic treatment is available without a prescription (11). However, self-treatment among individuals with symptomatic infection does not address the issue of asymptomatic infection.

The need for universal screening of CT infection among young people has been demonstrated in developed countries (28, 33–35). In developing countries, the need

for screening is complicated (even among high-risk populations) by the limited budget and resources of the public health system (3, 16). However, given the high prevalence of chlamydial infection and the amount of asymptomatic infection among the high-risk women in this study, a renewed debate regarding the appropriate use of screening is needed, especially given the advent of molecular testing. This discussion should include additional study of the feasibility of implementing screening programs for high-risk women, including non-traditional high-risk groups such as the marginalized women included in this analysis.

Limitations

This study has several limitations. These include the small number of women studied, and the fact that the PCR test that was used detects not only active infection but also remnants of a cured infection. An additional limitation is the lack of data collection on specific sexual network patterns between *esquineros* and *movidas* apart from the initial formative research.

Recommendations

Genital chlamydial infection was not uncommon among selected socially marginalized subpopulations in low-income urban Peru. Molecular screening of urogenital specimens allowed for accurate and high-throughput testing of samples, improving the laboratory diagnosis of this STI. To reduce the population burden of chlamydial infection, increasing opportunities should be made available for CT screening and treatment in high-risk communities, particularly among young people less than 25 years of age. Lack of attention to chlamydia control will result in the continued spread of this infection and associated adverse reproductive health complications such as PID, chronic pelvic pain, and infertility. The Peruvian Ministry of Health should consider policies to improve the diagnosis and treatment of chlamydial infection in female marginalized urban youth in Peru. Finally, to address the socioeconomic disparities in the burden of STIs, more research and evaluation programs should be directed toward low-income populations.

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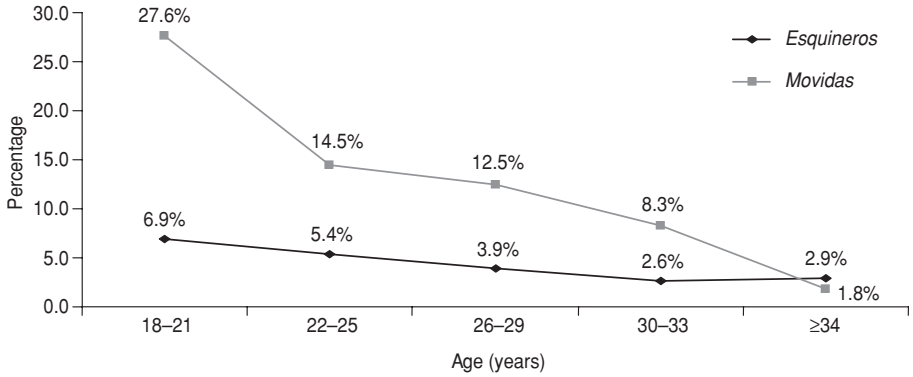
FIGURE 1. Prevalence of *Chlamydia trachomatis* infection by age group among low-income marginalized urban men (*esquineros*[a]) and women (*movidas*[b]) in three coastal cities in Peru (Chiclayo, Lima, and Trujillo), 2003–2005



[a] Young, unemployed men who spend time socializing on street corners, the majority of whom belong to local gangs.
[b] Young women who defy societal norms by socializing and engaging in casual sex with *esquineros*.

TABLE 3. Multivariate analysis of risk factors for *Chlamydia trachomatis* infection among low-income marginalized urban men (*esquineros*[a]) and women (*movidas*[b]) in coastal Peru (Chiclayo, Lima, and Trujillo), 2003–2005

	OR[c] (95% CI[d])	*P*-value	AOR[e] (95% CI)	*P*-value
Esquineros (*n* = 2 145)				
Age (years)		0.002		0.002
18–21	Ref[f]		Ref	
22–25	0.77 (0.54–1.09)		0.76 (0.52–1.10)	
26–29	0.55 (0.27–1.09)		0.57 (0.28–1.13)	
30–33	0.37 (0.17–0.80)		0.35 (0.16–0.74)	
≥34	0.41 (0.16–1.09)		0.43 (0.16–1.16)	
HIV status		0.001		0.002
Negative	Ref		Ref	
Positive	4.40 (1.14–16.98)		4.90 (1.14–21.13)	
Dysuria, last 6 months		0.018		0.026
No	Ref		Ref	
Yes	1.60 (1.08– 2.35)		1.53 (0.99–2.38)	
Movidas (*n* = 295)				
Age (years)		<0.001		<0.001
18–21	Ref		Ref	
22–25	0.44 (0.23–0.85)		0.33 (0.14–0.80)	
26–29	0.38 (0.13–1.08)		0.27 (0.09–0.77)	
30–33	0.24 (0.05–1.10)		0.20 (0.05–0.74)	
≥34	0.05 (0.01–0.39)		0.04 (0.00–0.29)	
No. sex partners, last 3 months		0.028		0.022
0	0.39 (0.05–3.20)		0.37 (0.05–3.02)	
1	Ref		Ref	
2	1.24 (0.50–3.11)		1.23 (0.42–3.64)	
≥3	3.53 (1.81–6.88)		5.64 (2.12–14.99)	

[a] Young, unemployed men who spend time socializing on street corners, the majority of whom belong to local gangs.
[b] Young women who defy societal norms by socializing and engaging in casual sex with *esquineros*.
[c] OR = odds ratio.
[d] CI = confidence interval.
[e] AOR = adjusted odds ratio (adjustment for all other variables in the model and confidence intervals calculated taking clustering into account).
[f] Ref = reference value (1).

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RESUMEN

Infección por *Chlamydia trachomatis* y factores de riesgo asociados en una población marginal urbana de bajos ingresos de la costa peruana

Objetivos. Estimar la prevalencia de la infección por *Chlamydia trachomatis* y los factores de riesgo asociados en una población marginal urbana de bajos ingresos de Perú.

Métodos. Entre abril de 2003 y abril de 2005 se captaron hombres y mujeres con alto riesgo de contraer infecciones de transmisión sexual, en áreas urbanas de bajos ingresos de tres ciudades costeras de Perú (Chiclayo, Lima y Trujillo). Los participantes que aceptaron colaborar respondieron una encuesta seroepidemiológica y se analizaron muestras de orina de los hombres y exudados vaginales de las mujeres mediante la reacción en cadena de la polimerasa con el sistema para *C. trachomatis* COBAS® AMPLICOR (Roche Molecular Diagnostics, NJ, EE.UU.)

Resultados. En el estudio participaron 2 440 personas (2 145 hombres y 295 mujeres). La prevalencia general de infección por *C. trachomatis* fue de 6,6% (intervalo de confianza de 95% [IC95%]: 5,6 a 7,6%): 5,5% (IC95%: 4,5 a 6,5%) en hombres y 14,9% (IC95%: 11,7 a 27,1%) en mujeres. La infección por clamidia se asoció inversamente con la edad y directamente con la infección por VIH y la disuria en los hombres. En las mujeres, esta infección se asoció inversamente con la edad y directamente con el número de parejas sexuales.

Conclusiones. La infección por *C. trachomatis* fue frecuente en los hombres y mujeres con alto riesgo en las zonas urbanas costeras de Perú. Como esta infección está asociada con complicaciones que afectan la salud reproductiva de las mujeres, como infertilidad y embarazos ectópicos, se deben realizar intervenciones para prevenir y tratar la infección por *C. trachomatis* y se deben emprender estudios para determinar la factibilidad del tamizaje general de esta infección en la población femenina de alto riesgo.

Palabras clave *Chlamydia trachomatis*, enfermedades de transmisión sexual, poblaciones vulnerables, mujeres, Perú.