

## Prevalence and determinants of *Chlamydia trachomatis* infection among sexually active women in Turin, Italy

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### Abstract

**Background:** According to the World Health Organisation, *Chlamydia trachomatis* (Ct) is the most common sexually transmitted bacterial agent worldwide.

The aim of the present study was to determine the prevalence and risk factors for genital infection with Ct among sexually active women (14-60 years of age), in Turin (northern Italy).

**Methods:** A cross-sectional study was performed between January 2002 and December 2007 among sexually active women in Turin. All women were tested for Ct infection using the Amplified Ct Assay (Gen-Probe) on an endocervical specimen. The prevalence was calculated as the proportion of Ct-positive women out of the total study population. Associations between Ct infection and risk factors (socio-demographic, behavioural, and clinical-gynaecological) were analyzed using the Chi-square test. The level of significance was set at 0.05. Risk factors independently associated with Ct infection were determined using a multivariate logistic regression model. The statistical analyses were performed using SPSS (version 17.0).

**Results:** The study included 25,289 women, of whom 1.8% were found to have Ct infection. The prevalence of Ct infection increased significantly from 1.5% in 2002 to 2.2% in 2007 ( $\chi^2 = 5.6$ ; p-value <0.05). The prevalence significantly increased by decreasing age ( $\chi^2$  linear trend 213.7; p-value <0.001) and was significantly higher among non-Italian women compared to Italian women (3.3% vs. 1.6%, p-value <0.001). In the multivariate analysis, Ct infection was significantly associated with an adjusted odds ratio higher than 2 for young age (14-24 years), being non-Italian, having had 2 or more lifetime sexual partners, and having had more than 1 partner in the previous six months.

**Conclusions:** Our results showed an increase in Ct prevalence in Turin between 2002 and 2007. A significant association between Ct infection and young age, multiple sexual partners, and originating from Eastern Europe was observed. To reduce the spread of the infection, women with at least one of the above mentioned risk factors, should be encouraged to undergo a free-of-charge Ct testing.

*Key words: Chlamydia trachomatis, prevalence, risk factors, sexually active women*

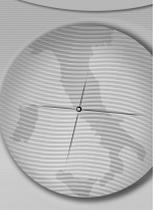
### Introduction

Infection with *Chlamydia trachomatis* (Ct) constitutes a public-health problem worldwide [1-10]. According to the World Health Organisation (WHO), Ct is the most common bacterial sexually transmitted infection (STI) worldwide, surpassing gonococcal infection and syphilis. The greatest number of new cases of Ct have been reported in less economically developed areas, such as Southern and Southeast Asia, Sub-Saharan Africa and Latin America [11]. Ct infection is also the most common bacterial STI in economically developed countries, such as the United States

and Western Europe. The highest prevalence of Ct infection is observed among female adolescents (24.1-27.0%) [1, 2].

Given that Ct infection is asymptomatic in approximately 70% of cases, it often goes untreated and, especially in women, can lead to severe complications such as cervicitis, pelvic inflammatory disease, ectopic pregnancy, and infertility [3, 4].

In Italy, Ct testing is not mandatory, not even for pregnant women, and there are no national guidelines on who should be tested; nor do screening programmes exist. Moreover, case



notification is not mandatory. However, since 1991 an STI Sentinel Surveillance System has been set up, which is managed by the Istituto Superiore di Sanità (ISS; Italy's National Institute of Public Health). According to this system, which collects information from persons with STIs, from 2000 to 2005 (the year for which the most recent data are available), Ct infection represented 5.1% of all reported STIs, and was the second most commonly reported bacterial STI, after syphilis [5].

The objective of the present study was to evaluate the prevalence of genital Ct infection among sexually active women and to determine the risk factors for Ct infection, in Turin, Italy.

### Methods

A retrospective cross-sectional study was performed between January 2002 and December 2007 among sexually active women (14-60 years of age) in Turin (northern Italy). The sample was opportunistic and included women attending the outpatient department for genitourinary infections and sexual health of the "Sant'Anna" gynaecological Hospital for the first time. These women attended the department for at least one of the following reasons: gynaecological check-up; information on contraceptives; information following at-risk sexual contact; presence of genito-urinary signs or symptoms; menstrual problems; fertility problems; information regarding sexual partners with genito-urinary symptoms. Women seen for the same reason within the six month period prior to the investigation were excluded in order to avoid double inclusion of the same case.

All of the women were tested for Ct infection using the Amplified Ct Assay (Gen-Probe Inc. San Diego Calif.), which uses Transcription-Mediated Amplification (TMA) and Hybridation Protection Assay (HPA) procedures to detect Ct ribosomal RNA on an endocervical specimen.

The following data were collected from each participant, using a structured questionnaire, administered by trained personnel, during an interview: socio-demographic information (i.e., age, nationality, level of education, and marital status); behavioural information (i.e., age at first sexual intercourse, number of lifetime sexual partners, number of sexual partners in the previous six months, contraceptive use in the previous six months, and other pertinent information on lifestyle, in particular, drug use, voluntary abortion, HIV testing, and current partner with symptoms of urethritis); and clinical-gynaecological information (i.e., previous STIs and current pregnancy).

The women provided informed consent to use this information for research purposes. To guarantee data privacy, the information was rendered anonymous, codified and then stored in a restricted access database.

This study was conducted in conformance with applicable national or local requirements regarding ethical committee reviews.

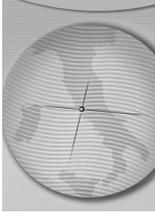
The prevalence of Ct infection was calculated as the proportion of Ct-positive women out of the total study population.

To identify possible associations between Ct infection and risk factors (age, nationality, level of education, marital status, age at first sexual intercourse, number of lifetime sexual partners, number of sexual partners in the previous six months, contraceptive use in the previous six months, drug use, voluntary abortion, HIV testing, current partner with symptoms of urethritis, previous STIs, and current pregnancy), we used the Chi-square test. To calculate the crude odds ratio (cOR) for each factor, we used the univariate logistic regression model.

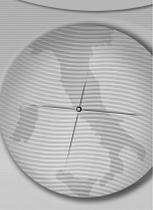
Multivariate analyses (adjusted OR, aOR) were conducted using a binary logistic regression model. The outcome variable was positivity or negativity to Ct infection, and the variables included in the model were those that were statistically significant in the univariate analysis (p-value of less than 0.05). Women for whom data on the specific variable were not available were considered as "missing". However, we also calculated the prevalence of infection among missing women, so as to determine whether or not it differed from the prevalence among women included in the analysis. The statistical analyses were performed using SPSS software (version 17.0).

### Results

The characteristics of the 25,289 women included in this study are shown in Table 1. The mean age of women was 33.1 years (standard deviation: 6.9 years; range: 14-60 years); 21,806 (86.2%) women were Italian, and most of the 3,483 (13.8%) non-Italian women were from Eastern Europe (40.1%) and Africa (34.1%). The mean age at first sexual intercourse was 19.2 years (standard deviation: 3.7 years); 32.0% of the women reported that they had had only one lifetime partner, and 95.0% reported that they had had one partner in the previous six months. In the six months prior to the interview, 78.4% of the women had not used contraceptives; 8.5% used oral contraceptives; and 5.5% always used a condom; 14.5% had had at least one voluntary abortion in their lifetime.

Table 1. Characteristics of 25,289 sexually active women (14-60 years of age) tested for *Chlamydia trachomatis* in Turin, Italy 2002-2007.

<b>Characteristic</b>	<b>n (n= 25,289)</b>	<b>%<sup>a</sup></b>
<b>Age (in years)</b> [Missing=3]		
14-24	2,524	10.0
> 24	22,762	90.0
<b>Nationality</b> [Missing=21]		
Italian	21,806	86.2
Non- Italian	3,483	13.8
East Europe	1,397	5.5
Africa	1,188	4.7
South America	691	2.7
Asia	186	0.7
<b>Education</b> [Missing=1,625]		
Primary school	6,737	28.5
High school diploma	11,936	50.4
University degree	4,991	21.1
<b>Marital status</b> [Missing=1,780]		
Single	5,546	23.6
Married/Cohabitation	16,745	71.2
Separated/divorced	1,218	5.2
<b>Age at first sexual intercourse (in years)</b> [Missing=4,567]		
< 15	668	3.2
≥ 15	20,054	96.8
<b>Number of sexual partners (lifetime)</b> [Missing=5,350]		
1	6,450	32.2
2-3	7,029	35.3
≥ 4	6,460	32.4
<b>Number of sexual partners (previous 6 months)</b> [Missing=2,668]		
0	405	1.8
1	21,400	94.8
≥ 2	816	3.6
<b>Contraceptive use (previous six months)</b> [Missing=766]		
None	19,235	78.4
Oral contraceptive	2,074	8.5
Condom always	1,347	5.5
Condom seldom	1,105	4.5
Other	762	3.1
<b>Drug use (lifetime)</b> [Missing=5,100]		
Yes	545	2.7
No	19,644	97.3
<b>Voluntary abortion (lifetime)</b> [Missing=1,714]		
Yes	3,415	14.5
No	20,160	85.5
<b>HIV infection</b> [Missing=8,585]		
Positive	342	2.0
Negative	16,362	98.0
<b>Partner currently with urethritis symptoms</b> [Missing=4,537]		
Yes	1,417	6.8
No	19,335	93.2
<b>Previous STIs (lifetime)</b> [Missing=564]		
Yes	3,961	16.0
No	20,764	84.0
<b>Current pregnancy</b> [Missing=54]		
Yes	9,085	36.0
No	16,150	64.0
<b>Ct infection</b> [Missing=0]		
Positive	454	1.8
Negative	24,835	98.2
<sup>a</sup> Percentages based upon total known value		



A total of 16,704 (66.1%) women had undergone HIV testing in their lifetime; for 16,362 (98.0%) of these women, the test result was negative; for 342 women (2.0%) it was positive. Among the women tested for HIV, the HIV prevalence was significantly higher among non-Italian women (6.0%) compared to Italian women (1.5%) ( $\chi^2$  186.6;  $p$ -value  $<0.001$ ). With regard to clinical characteristics, 16.0% of the women had had a previous STI, and 6.8% currently had a partner with symptoms of urethritis.

The overall prevalence of Ct infection between 2002 to 2007 was 1.8%, and it significantly increased from 1.5% in 2002 to 2.2% in 2007 ( $\chi^2$  5.6;  $p$ -value  $<0.05$ ). The prevalence significantly increased by decreasing age group ( $\chi^2$  linear trend 213.7;  $p$ -value  $<0.001$ ), ranging from 6.5% among 14-24 year-old women, to 1.3% among 25-44 year-old women, and 0.6% among 45-60 year-old women. The prevalence of infection was significantly higher among non-Italian women compared to Italian women (3.3% vs. 1.6%,  $p$ -value  $<0.001$ ); women from Eastern Europe showed the highest prevalence (3.9%) (Figure 1).

The risk factors that were significantly associated with Ct infection are shown in Table 2. In the multivariate analysis, factors independently associated with Ct positivity were (Table 2): young age (14-24 years vs.  $>24$  years; aOR 2.8, 95% CI: 2.1-3.7), foreign nationality (Non-Italian vs. Italian; aOR 2.3, 95% CI: 1.7-3.1), being single (yes vs. no; aOR 2.0, 95% CI: 1.5-2.7), having had multiple lifetime sexual partners ( $\geq 4$  vs. 1; aOR 2.6, 95% CI: 1.8-3.7), having had more than one sexual partner in the previous six months ( $\geq 2$  vs.  $\leq 1$ ; aOR 2.7, 95% CI: 1.9-3.9), having a partner currently with symptoms of urethritis (yes vs. no; aOR 1.6, 95% CI: 1.1-2.2), being currently pregnant (yes vs. no; aOR 1.4, 95% CI: 1.1-2.0), and having used oral contraceptives in the previous six months (yes vs. no; aOR 1.4, 95% CI: 1.1-2.0).

## Discussion

In our study, the prevalence of Ct infection among sexually active women between the ages of 14 and 60 years was 1.8%. This is similar to the prevalence reported in another Italian study, and in studies conducted in the United Kingdom and Slovenia [6-8], yet it is lower than the prevalence reported from studies in Greece, Finland, France, and the Netherlands [9, 10, 12, 13].

The association of Ct with young age (14-24 years), which has also been reported in other countries [14, 15], is probably related to the fact that genital tissues in young women are still immature and thus more receptive to pathogens [7, 16].

The finding that the prevalence of infection was significantly higher among non-Italian women (3.3%), compared to Italian women (1.6%), and in particular among women from Eastern Europe, is consistent with the findings of other studies and can probably be attributed to a higher prevalence of Ct infection in these areas of origin [6, 17].

The associations between a high number of lifetime sexual partners, a high number of sexual partners in the previous six months, and being single suggest that repeated sexual exposure with diverse partners, in most cases without a condom, constitutes a risk factor, as confirmed by the greater risk of infection among women whose partner currently had symptoms of urethritis [6-8, 10, 18-22].

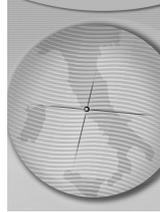
A greater risk of Ct infection among women who had used oral contraceptives in the previous six months had been reported in the literature and could be related to the alteration of the epithelial structure of the genital tract or to an effect on the genital tract's immune system [23, 24]. Our study also showed an increased risk of Ct infection in women taking oral contraceptives.

The association between Ct infection and pregnancy is controversial: some studies, including the present one, observed a higher risk of infection, probably due to a lower immune defence during pregnancy, whereas other studies conclude that pregnancy is not a risk factor [25].

Some limitations of this study should be mentioned. First of all, the fact that this was a cross-sectional study did not allow us to evaluate causality between the variables studied and positivity to Ct infection, but only to describe general correlations. Furthermore, the study population consisted of only women attending a public gynecology Hospital, who are not necessarily representative of the entire female population in Italy, and we have no information regarding Ct infection among women attending private health care. Regarding socio-demographic, behavioural and clinical-gynaecological information too, we cannot exclude either recall bias or, given that an interview was performed, response bias.

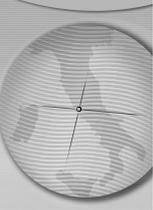
In conclusion, this study constitutes one of the few existing analyses of the prevalence of Ct infection among sexually active women in Italy. The prevalence of infection, which increased between 2002 and 2007, is not particularly high when considering the overall study population, though, worryingly, rather high among women younger than 24 years of age, non-Italian women, and women with multiple partners.

These results suggest that women with at least

Table 2. Risk factors for *Chlamydia trachomatis* infection among sexually active women (14-60 years of age) in Turin, Italy 2002-2007.

<i>Characteristic</i>	<i>N</i>	<i>Ct positive/ Ct negative</i>	<i>Prevalence (%)</i>	<i>cORa (95% CI)</i>	<i>aORb (95% CI)</i>
<b>Total</b>	25,289	454/24,835	1.8	-	-
<b>Age (in years)</b> [Missing=3]					
14-24	2,524	165/2,359	6.5	2.1 (1.7-2.6)	2.8 (2.1-3.7)
> 24	22,762	289/22,473	1.3	1	1
<b>Nationality</b> [Missing=0]					
Non-Italian	3,483	114/3,369	3.3	2.1 (1.7-2.6)	2.3 (1.7-3.1)
Italian	21,806	340/21,466	1.6	1	1
<b>Education</b> [Missing=1,625]					
Primary school	6,737	142/6,595	2.1	1.6 (1.2-2.2)	0.9 (0.6-1.3)
High school diploma	11,936	222/11,714	1.9	1.4 (1.1-1.9)	0.9 (0.7-1.3)
University degree	4,991	66/4,925	1.3	1	1
<b>Marital status</b> [Missing=1,780]					
Single	6,764	256/6,508	3.8	3.7 (3.1-4.5)	2.0 (1.5-2.7)
Married/Cohabitation	16,745	174/16,571	1.0	1	1
<b>Number of sexual partners (lifetime)</b> [Missing=5,350]					
1	6,450	54/6,396	0.8	1	1
2-3	7,029	121/6,908	1.7	2.1 (1.5-2.9)	1.5 (1.1-2.2)
≥ 4	6,460	206/6,24	3.2	3.9 (2.9-5.3)	2.6 (1.8-3.7)
<b>Number of sexual partners (previous 6 months)</b> [Missing=2,668]					
≤ 1	21,805	331/21,474	1.5	1	1
≥ 2	816	75/741	9.2	6.6 (5.1-8.5)	2.7 (1.9-3.9)
<b>Age at first sexual intercourse (in years)</b> [Missing=4,567]					
< 15	668	35/633	5.2	3.1 (2.2-4.4)	1.4 (0.9-2.2)
≥ 15	20,054	350/19,704	1.7	1	1
<b>Current pregnancy</b> [Missing=54]					
Yes	9,085	119/8,966	1.3	0.6 (0.5-0.8)	1.4 (1.1-2.0)
No	16,150	335/1,815	2.1	1	1
<b>Voluntary abortion (lifetime)</b> [Missing=1,714]					
Yes	3,415	84/3,331	2.5	1.4 (1.1-1.8)	1.1 (0.8-1.5)
No	20,160	347/19,813	1.7	1	1
<b>Drug use (lifetime)</b> [Missing=5,100]					
Yes	545	25/520	4.6	2.7 (1.8-4.0)	0.9 (0.5-1.5)
No	19,644	348/19,296	1.8	1	1
<b>Partner currently with urethritis symptoms</b> [Missing=4,537]					
Yes	1,417	69/1,348	4.9	3.1 (2.3-4.0)	1.6 (1.1-2.2)
No	19,335	318/19,017	1.6	1	1
<b>Previous STIs (lifetime)</b> [Missing=564]					
Yes	3,961	85/3,876	2.1	1.3 (1.0-1.6)	-
No	20,764	353/20,411	1.7	1	-
<b>Condom use (previous 6 months)</b> [Missing=766]					
No or sometimes	23,176	417/22,759	1.8	0.8 (0.6-1.2)	
Always	1,347	29/1,318	2.2	1	
<b>Oral contraceptive use (previous 6 months)</b> [Missing=766]					
Yes	2,074	89/1,985	4.3	2.8 (2.2-3.5)	1.4 (1.1-2.0)
No	22,449	357/22,092	1.6	1	1

<sup>a</sup> Percentages based upon total known value

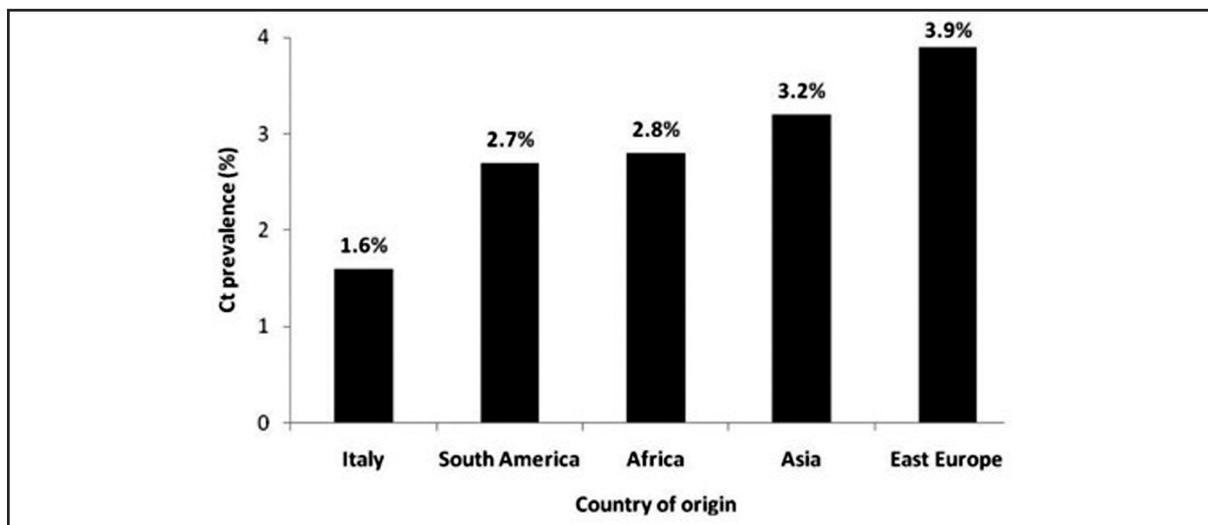


one of the above mentioned risk factors should be encouraged to be tested for Ct; in these cases, a free-of-charge testing policy could be cost-effective in reducing the spread of Ct infection.

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Figure 1. Prevalence of *Chlamydia trachomatis* among sexually active women (14-60 years of age) by country of origin, Turin, Italy 2002-2007.



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