A PRISMA systematic review and meta-analysis on Chlamydia trachomatis infections in Iranian women (1986–2015)

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1. Introduction

Sexually transmitted diseases (STDs) are the most common infectious diseases in the community and cause a financial burden on patients and communities. The World Health Organization estimates that there are 330 million new cases of STDs, most of these are in developing countries, each year. The causes of STDs are bacteria, viruses, fungi, and protozoa. STDs are a major threat to the health of human society.[1,2] These diseases are epidemiologically unreported, which is why early diagnosis is of great importance for their control.[2] Chlamydia trachomatis (CT) is a gram-negative bacterium with a diameter of 0.2 to 1.4 mm. This bacterium is an intracellular parasite for humans and animals that tend to proliferate in epithelial cells.[3,4] This is the most common bacterial infection that can be transmitted via sexual contact.[5] Complications from infection in women include infertility, ectopic pregnancy, vaginal discharge, dysuria, lower abdominal pain, pain during intercourse, and pelvic inflammation; and in men, it causes epididymitis.[1,6] Infections in infants include pneumonia and conjunctivitis. Pregnant women who are infected with CT and diagnosed in time are typically treated between weeks 16 to 29.[7,8] Given the importance of different CT infections in women, the identification of this bacterium using an appropriate method in the population and obtaining a statistical result and general overview for prevention, and control and treatment are necessary. This study is interested in the frequency of CT infection among Iranian women using a systemic review.

2. Materials and methods

2.1. Data source

The research was approved by the scientific and ethical review committee at the Kurdistan University of Medical Sciences and the ethical code IR.MUK.REC1394.21. Also, in this study, patients were not directly examined and considered, only related
articles were reviewed that were related with our aim and scope, so patient consent was not explicitly given. This study was done according to PRISMA guidelines. Literature searches were applied using the following keywords CT in women; CT and Iranian women; CT and infection in Iran; CT and pregnancy in Iran; CT and preterm delivery in Iran; CT and prematurity in Iran; CT and premature child birth in Iran; CT and infertility in Iran; and CT and abortion in Iran. The search was done using the medical literature published in databases including Google Scholar, PubMed, ISI Web of Science, Biological abs, Iranmedex, SID, and Scopus from 1986 to 2015. The initial literature search showed studies based on the guidelines. In the first search, 40 studies that were published between 1986 and 2015 were selected. Publication bias was checked using the Begg test. To reduce the possibility of selection bias in this study, criteria were clearly defined with the studies and data collection in each study was done by 2 researchers independently with the final list chosen by consensus. Information checklists for the papers consist of the following: first author’s last name, year of publication, sample size, study period, method, the type of study, and place of study (Table 1).  

### 2.2. Study selection

Inclusion criteria were research articles with full text and articles with abstracts in English. Excluded studies were review articles, congress abstracts, studies in languages other than English, and studies with unclear data (Fig. 1).

| No. | Authors            | Publication | Place of study | Method | Sample type | Sample size | Prevalence     |
|-----|--------------------|-------------|----------------|--------|-------------|-------------|----------------|
| 1   | Jenab et al[10]    | 2009        | 2              | 1      | 1           | 80          | 17 (21.25%)    |
| 2   | Jenab et al[10]    | 2009        | 2              | 2      | 1           | 80          | 8 (9.9%)       |
| 3   | Jahromi et al[11]  | 2010        | 2              | 2      | 4           | 450         | 168 (30.65%)   |
| 4   | Mozamirkhani et al[12] | 2008        | 1              | 1      | 4           | 160         | 6 (12.7%)      |
| 5   | Afrakhteh et al[13] | 2008        | 2              | 2      | 2           | 265         | 59 (22.26%)    |
| 6   | Sattari et al[14]  | 2008        | 1              | 1      | 1           | 220         | 33 (24.37%)    |
| 7   | Chamani et al[15]  | 2006        | 1              | 3      | 1           | 1052        | 129 (12.3%)    |
| 8   | Hashemi et al[16]  | 2007        | 1              | 1      | 1           | 131         | 30 (24.4%)     |
| 9   | Aky et al[17]      | 2013        | 4              | 1      | 1           | 255         | 68 (2.6%)      |
| 10  | Taheri et al[18]   | 2010        | 4              | 1      | 1           | 620         | 112 (18.1%)    |
| 11  | Badami et al[19]   | 2001        | 1              | 2      | 1           | 375         | 13 (9.6%)      |
| 12  | Fallah et al[20]   | 2005        | 1              | 1      | 3           | 122         | 14 (11.47%)    |
| 13  | Beherouz et al[21] | 2008        | 1              | 1      | 1           | 142         | 22 (15.5%)     |
| 14  | Moaiedmohseni et al[22] | 2008        | 1              | 2      | 1           | 142         | 20 (14.1%)     |
| 15  | Asadi et al[23]    | 2006        | 1              | 1      | 1           | 234         | 3 (1.28%)      |

Place of study: 1 = northern Iran, 2 = southern Iran, 3 = eastern Iran, 4 = western Iran. Method: 1 = molecular, 2 = serology, 3 = culture. Sample type: 1 = cervical, 2 = vaginal, 3 = urine, 4 = blood.
2.3. Data extraction

A total of 40 Iranian studies were chosen for analysis. Prevalence and the 95% confidence interval (CI) were calculated. The variance of each study was calculated using binomial distribution. Studies were combined based on sample sizes and the variances of samples. Due to the heterogeneity in the studies, meta-analysis with the random-effect model was applied to combine the prevalence among studies and to assess heterogeneity. The Cochrane Q test and I² statistics were used. A P value <0.05 was considered a significant heterogeneity test. The Freeman–Tukey double arcsine transformation was used to stabilize variances and a Forest plot was performed. Depending on the analyzed data, to examine publication bias, a Begg plot was used. Stratified analysis was subsequently performed with respect to sample types, methods, and regions. Statistical analysis was performed using the statistical software package Meta in R3 and STATA 12.

3. Results

3.1. CT infection in Iranian women based on the sample types

The data for 4 groups were analyzed for sample type and the lowest rate for CT samples was in the blood 9.5% (95% CI: 8.5–10) and the highest prevalence rate for CT samples was in urine 16.1% (95% CI: 14.8–17.4) (Table 2). As for heterogeneity, I² = 96.5% (95% CI: 94.4–97.6); heterogeneity chi-squared test = 86.81 with 3 degrees of freedom and a P value <0.00; and moment-based estimates of between-study variance = 0.009, Kendall tau = −0.33, and P = .33 (Fig. 2).

3.2. CT infection in Iranian women based on the method

The data for 3 groups were analyzed for method. The lowest rate of CT samples was for serology 8.7% (95% CI: 8.08–9.4) and the highest prevalence rate of CT samples was for culture 65.6% (95% CI: 62.4–68.7). The heterogeneity, I² = 99.9% (95% CI: 99.8–99.9), heterogeneity chi-squared test = 1334.51 with 2 degrees of freedom, and P value <0.00, and moment-based estimate of between-study variance = 0.181.

Table 2

| Samples  | Total   | Responding | Proportion | 95% CI     | Weights (fixed, random) |
|----------|---------|------------|------------|------------|-------------------------|
| Cervical | 5882    | 931        | 0.15       | (0.14, 0.16) | (44.95, 25.77)          |
| Vaginal  | 886     | 126        | 0.14       | (0.11, 0.16) | (6.77, 23.44)           |
| Urine    | 3099    | 499        | 0.161      | (0.148, 0.174) | (23.68, 25.37)        |
| Blood    | 3215    | 308        | 0.09       | (0.085, 0.10) | (24.57, 25.40)         |

CI = confidence interval.
The data for 4 area were analyzed (North, South, East, and West), the lowest rate of CT prevalence rate was in southern Iran 8.8% (95% CI: 7.6–10.07) and the highest CT prevalence rate was in eastern Iran 59.03% (95% CI: 56–62.01). Regarding heterogeneity, \( P^2 = 99.7\% \) (95% CI: 99.7–99.8), heterogeneity chi-squared test \( t = 1198.73 \) with 3 degrees of freedom and \( P \) value \(< 0.0001\), and moment-based estimate of between-study variance \( \hat{\tau}^2 = 0.171 \), Kendall \( \tau \) = 1, and \( P \) value = .08.

### 3.4. Publication bias
Begg funnel plot was used to evaluate publication bias the included studies. The appearance of the shape of funnel plot did not show any evidence of publication bias among included studies (Fig. 3).

### 4. Discussion
CT is a bacterial infection of the genital tract affecting men and women. During pregnancy, chlamydial genital infection increases the risk of spontaneous abortion, premature delivery, and ectopic pregnancy. Infertility is a complication of these infections. In this study, we performed a systemic review and meta-analysis on the frequency of CT infections among Iranian women in different regions of Iran. The results showed that from 1986 to 2015, the lowest rate of prevalence was in 2010 to 2011 (3.9%) and the highest prevalence rate was in 2009 (69.39%) in northern Iran. The fixed-effects model that was used for different parts of Iran (North, South, East, and West) had a pooled proportion = 0.13 (95% CI = 0.12–0.14) and when used on the samples (cervical, vaginal, urine, and blood) it had a pooled proportion = 0.14 (95% CI = 0.12–0.14). In a systematic review study conducted by Lewis et al in Australia, the pooled prevalence estimates of CT infections for indigenous women under 25 years was reported to be 22.1% (95% CI: 19.0–25.3). In another systematic review by Adams et al on the female CT infections, prevalence was 8.1% (95% CI: 6.5–9.9). In a systematic review study by Watson et al screening tests for CT performed, the pooled sensitivities for ligase chain reaction, polymerase chain reaction (PCR), gene probe, and enzyme immunoassay (EIA) on urine were 96.5%, 85.6%, 92%, and 38%, respectively; while on cervical swabs, the corresponding sensitivities of PCR, gene probe, and EIA were 88.6%, 84%, and 63%, respectively. Meta-analysis demonstrated that DNA amplification techniques are the best for urine and swabs in populations with a low prevalence. In another systematic review study by Robert et al for noninvasive testing for CT performed, pooled study sensitivities for the PCR, transcription mediated amplification, and strand displacement amplification assays were 83.3%, 92.5%, and 79.9%, respectively, for CT infections in women, so that nucleic acid amplification tests for CT infections in urine samples are nearly identical to those obtained on samples collected directly from the cervix or urethra. The results of our study agree with other review studies that most studies in Iran are due to sensitive tests based on molecular methods used for the detection of genital CT infections and less invasive because of urine sampling, because this method is used more for sampling. Also, the reason for the difference in the prevalence of CT infection in different regions is probably due to the socioeconomic situation of the family, health status, and the differences in population distribution in each region, which leads to the lack of proper referral of women to gynecologists and obstetricians as well as situation may be the climate of Iran.

### 5. Conclusion
This study proved CT infection among women in different regions of Iran. Infected women play an important role as sexual activity is responsible for transmission and untreated women are at risk of developing sequels. Different articles and results are performed in this field in Iran. So further studies are needed to be done about CT infection. Most studies in Iran are due to the sensitive nature of PCR tests used for the detection of genital CT infections and less invasive because of urine sampling, because this method is used for sampling.

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