Systematic Review and Meta-Analysis

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

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Abstract

Background: *Chlamydia trachomatis* (CT) is the cause of genital tract infections in women. Some evidence has shown the role of this infection with CT in spontaneous abortions. The purpose of this study is to study the frequency of CT infection in Iranian women.

Methods: This study was performed based on PRISMA guidelines. A total of 75 articles published in Google Scholar, PubMed, ISI Web of Science, Biological abs, Iranmedex, SID, and Scopus databases were found (1986–2015) 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 preterm labor in Iran, CT and fertility in Iran, CT and infertility in Iran, and CT and abortion in Iran. Finally, 40 studies from different regions of Iran were included. Statistical analyses were performed using R3 and STATA 12.

Results: From 1986 to 2015, the lowest rate of prevalence was from 2010 to 2011 (3.9%) and the highest prevalence rate was in 2009 (69.39%) in northern Iran. Fixed effects for different parts of Iran (North, South, East, and West) were Pooled proportion: 0.13 (95% confidence interval [CI] = 0.12–0.14) and for samples (cervical, vaginal, urine, and blood) the pooled proportion was = 0.14 (95% CI = 0.12–0.14).

Conclusion: CT infection in this study was prevalent in urine samples and the rate of CT was observed from culture methods in comparison to other methods. Because women with CT play an important role because of sexual activity for transmission and untreated women are at risk of developing sequels. Also, most studies in Iran use sensitive polymerase chain reaction tests for the detection of genital CT infections.

Abbreviations: CI = confidence interval, CT = *Chlamydia trachomatis*, EIA = enzyme immunoassay, PCR = polymerase chain reaction, STD = sexually transmitted disease.

Keywords: *Chlamydia trachomatis*, infection, Iranian women, meta-analysis

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 epidemically unrevealed, 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 epididymis.[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

Editor: Mehmet Bakir.

The authors have no funding and conflicts of interest to disclose.

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Medicine (2018) 97:16(e0335)

Received: 19 August 2017 / Received in final form: 10 March 2018 / Accepted: 15 March 2018

http://dx.doi.org/10.1097/MD.0000000000010335

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.[9] 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 preterm labor in Iran; CT and preterm birth in Iran; CT and premature delivery in Iran; CT and prematurity in Iran; CT and premature child birth in Iran; CT and fertility 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).

Table 1

Data were extracted from published documents about publication year, place of study, method, sample type, sample size, and prevalence of *Chlamydia trachomatis* infections among Iranian women.

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	Moaiedmohseni et al[12]	2008	1	2	4	160	8 (12.7%)
5	Afrakhteh et al[13]	2008	1	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	1	3	1052	129 (12.3%)
8	Hashemi et al[16]	2007	1	1	1	131	30 (24.4%)
9	Akya et al[17]	2013	4	1	1	255	8 (3.1%)
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	Zaeimi Yazdi et al[21]	2006	1	1	1	142	22 (15.5%)
14	Zaeimi Yazdi et al[21]	2006	1	2	1	142	20 (14.1%)
15	Salari et al[22]	2002	1	2	1	375	11 (8%)
16	Naserpour Farivar et al[23]	2012	1	1	1	234	3 (1.28%)
17	Hassanzadeh et al[24]	2012	2	1	3	210	0
18	Dabbaghi Ghaleh et al[25]	2012	1	2	4	160	49 (30.62%)
19	Behrouzi et al[26]	2004	1	2	1	400	8 (2%)
20	Hajikhani et al[27]	2012	1	1	1	51	6 (11.7%)
21	Hajikhani et al[27]	2012	1	3	1	51	2 (3.9%)
22	Hossein Rashidi et al[28]	2012	1	1	3	458	48 (20.9%)
23	Hossein Rashidi et al[28]	2012	1	2	1	458	38 (16.7%)
24	Nazer et al[29]	2008	1	1	3	140	31 (22.1%)
25	Samarbaf-Zadeh et al[30]	2007	4	1	2	202	33 (16.3%)
26	Kalantar et al[31]	2007	2	1	2	91	0
27	Kalantar et al[31]	2007	2	2	4	91	0
28	Peivandi et al[32]	2009	1	2	4	110	27 (24.5%)
29	Hadi et al[33]	2010	2	2	1	402	32 (8%)
30	Taheri Beni et al[18]	2012	2	1	1	80	17 (21.25%)
31	Haghighi Hasanabad et al[34]	2011	3	1	3	196	27 (13.77%)
32	Eslami et al[35]	2012	1	1	1	121	16 (13.25%)
33	Jenab et al[36]	2010	2	1	1	80	17 (21.25%)
34	Baghchesaraei et al[37]	2011	1	2	2	328	34 (10.3%)
35	Tabasi et al[38]	2001	2	2	1	323	33 (10.2%)
36	Naderi et al[39]	2012	2	1	3	129	5 (3.88%)
37	Afrakhteh et al[40]	2013	1	1	3	49	17 (34.69%)
38	Kajbaf et al[41]	1998	4	2	4	151	21 (23.8%)
39	Fatholahzadeh et al[42]	2012	1	1	3	260	27 (20.76%)
40	Marashi et al[43]	2014	1	1	1	350	61 (40.7%)
41	Marashi et al[43]	2014	1	2	4	350	30 (18.8%)
42	Khalili et al[44]	2008	2	1	1	64	4 (6.25%)
43	Bakhtiari et al[45]	2007	1	2	4	550	64 (11.6%)
44	Khezerdost et al[46]	2009	1	2	4	1114	32 (2.9%)
45	Sohrabi et al[47]	2007	1	2	4	79	8 (10.1%)
46	Mohammadzadeh et al[48]	2013	1	1	1	130	6 (4.6%)
47	Mohammadzadeh et al[48]	2013	1	2	1	130	5 (3.8%)
48	Hassanzadeh et al[24]	2012	2	1	3	210	0
49	Khajeh Karamdini et al[49]	2011	3	3	1	588	408 (69.39%)
50	Khajeh Karamdini et al[49]	2011	3	3	3	273	189 (69.23%)

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.

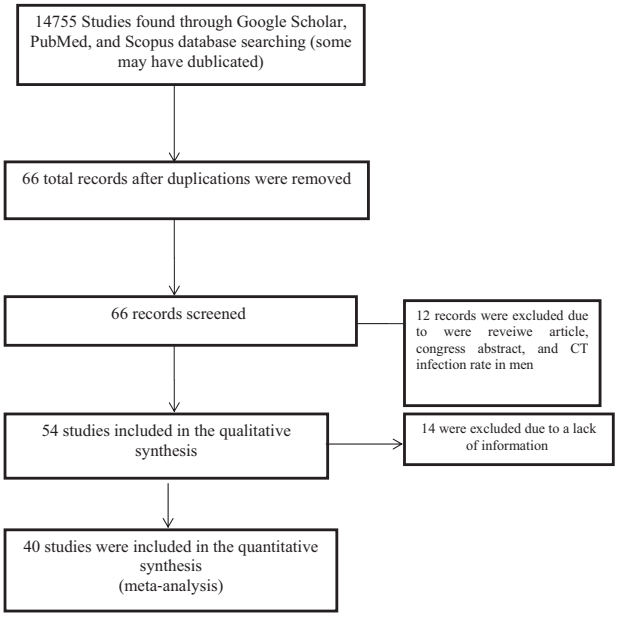

Figure 1. PRISMA flow diagram: Study selection process.

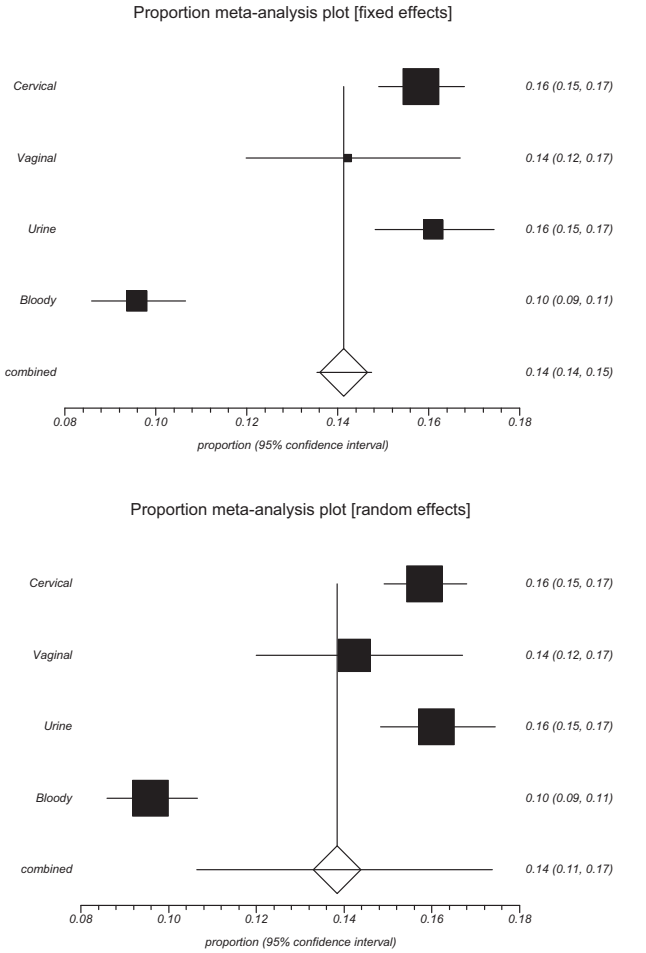

Figure 2. Forest plot of proportion of *Chlamydia trachomatis* infection with 95% confidence interval in Iranian women based on the samples (fixed and random effects).

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 I^2 statistics were used. A P value $<.05$ 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, $I^2 = 96.5\%$ (95% CI: 94.4–97.6); heterogeneity chi-squared test = 86.81 with 3 degrees of freedom and a P value $<.0001$; 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, $I^2 = 99.9\%$ (95% CI: 99.8–99.9), heterogeneity chi-squared test = 1334.51 with 2 degrees of freedom, and P value $<.00$, and moment-based estimate of between-study variance = 0.181.

Table 2

Proportion of *Chlamydia trachomatis* infection with 95% confidence interval in Iranian women based on the samples.

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.

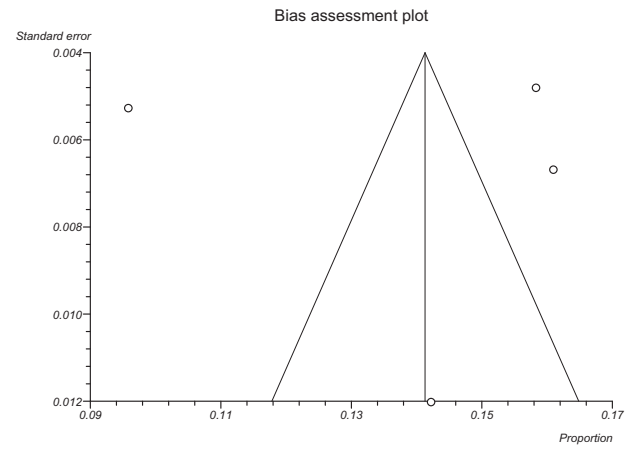

Figure 3. Funnel plot detecting biases in the identification and selection of studies.

3.3. CT infection in Iranian women-based different parts of Iran

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, $I^2 = 99.7\%$ (95% CI: 99.7–99.8), heterogeneity chi-squared test = 1198.73 with 3 degrees of freedom and P value <.0001, and moment-based estimate of between-study variance =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.[1] 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 systemic 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).[50] In another systematic review by Adams et al on the female CT infections, prevalence was 8.1% (95% CI: 6.5–9.9).[51] In a systemic 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 65%, respectively. Meta-analysis demonstrated that DNA amplification techniques are the best for urine and swabs in populations with a low prevalence.[52] In another systemic 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.[53] 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 difference 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.

Acknowledgments

The authors would like to thank Deputy of Research of Kurdistan University of Medical Sciences for financial support. The authors also appreciate of Social Determinants of Health Research Center and Cellular and Molecular Research Center, Department of Genecology of Kurdistan University of Medical Sciences in Iran.

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