Original Article

Prevalence and Associated Risk Factors of *Chlamydia trachomatis* among Gynecology Clinic Attendees in a Tertiary Institution in Ogun State, Nigeria

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Abstract

Background: *Chlamydia trachomatis* is one of the most prevalent bacterial-causing urogenital infections in men and women worldwide. There have been increasing reports of the prevalence of *C. trachomatis* in Nigeria. **Aims:** This study aimed to detect the prevalence of *C. trachomatis* seromarkers immunoglobulin G (IgG) and immunoglobulin A (IgA) and also to determine their associated risk factors among gynecology clinic attendees in the Babcock University Teaching Hospital, Ilishan-Remo, Ogun State of Nigeria. **Materials and Methods:** This was a cross-sectional study involving 145 consenting attendees of gynecology clinic of the hospital. Blood samples were collected and tested for *C. trachomatis* IgG and IgA using the enzyme-linked immunosorbent assay technique. Sociodemographic and sex behavioral factors were obtained by the interviewer-based questionnaires, whereas statistical analysis was done using SPSS version 23. **Results:** Overall prevalence of combined IgG and IgA was 46 (31.7%). Among the infected, 30 (65.2%) were young women aged 15–25 years and majority, 109 (75%), had never used condom while 83 (57.2%) had only one sex partner in the preceding 3 months. Twenty-three (15.9%) had a positive history of sexually transmitted infection (STIs), whereas 75 (51.7%) had ≥2 lifetime sex partners. Factors associated with the occurrence of both seromarkers on bivariate analysis included the previous history of STI and number of lifetime sex partners ($P < 0.05$), but with further analysis, only lifetime sex partners remained statistically significant (odds ratio = 5.63, confidence interval = 1.09–29.05, $P = 0.007$). **Conclusion:** There was a high prevalence of active, chronic, and persistent *C. trachomatis* infection with number of lifetime sex partner being a significant risk factor among our clinic attendees in Ogun State. Appropriate sex education should be encouraged among young people to reduce the burden of the infection and its attendant sequelae in our community.

Keywords: *Chlamydia trachomatis,* enzyme-linked immunosorbent assay, immunoglobulin A, immunoglobulin G, seromarker

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Introduction

Chlamydia trachomatis is one of the most prevalent bacteria-causing urogenital infections in men and women worldwide.[1] The World Health Organization reported that 131 million people are infected with Chlamydia each year.[2] In Africa, 15 million new cases of *C. trachomatis* infection are reported, whereas in Southern Asia, 45 million new cases are reported every year.[3] Chlamydia infection in females can be asymptomatic or presents with subtle unnoticed symptoms that favors the undetected spread and chronicity of the infection,[4] ultimately resulting in severe complications such as pelvic inflammatory diseases (PID), chronic pelvic pain, salpingitis, ectopic pregnancy, infertility, and recurrent abortions.[4-7] In a review of Chlamydia infection among asymptomatic European women, a prevalence of 1.7%–17% was reported.[8] In Nigeria, 13.3% prevalence was reported

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in Benin city, 7.3% in Ibadan, and 33% in Kano among asymptomatic volunteers.[9-11]

Several risk factors predisposing to *C. trachomatis* have been reported, and these include number of sexual partners, previous history of sexually transmitted infections (STIs), socioeconomic factors, age at coitarche, irregular contraceptive use, previous PID, cohabitation, lifetime sex partner more than one, inconsistent use of condom, and recent change of partners.[10,12-14]

The advent of polymerase chain reaction (PCR) has allowed for better estimation of the burden of the disease,[15] but these methods of diagnosis are neither cost-effective nor readily available in developing countries. Serodiagnosis is still useful, especially in developing countries where PCR is expensive and a positive serological test may be the only indication of chlamydial infection.[16] *C. trachomatis* immunoglobulin A (IgA) because of its half-life of 5–7 days and strong antigenic stimulation has now been suggested as a better marker of active infection. It has also been reported to be very useful in monitoring treatment response for active infection after treatment,[17,18] while the presence of IgG is an indicator of chronic infection. Thus, the presence of IgG and IgA together has been suggested to be viewed as a better indicator of active chronic or persistent infection.[19,20] Most gynecological morbidities associated with Chlamydia infection in women are due to the active chronic/persistent nature of the infection.[19,20] Therefore, evaluation of the presence of IgA and IgG seromarkers and associated risk factors for *C. trachomatis* infection is a good starting point for interventions to reduce the burden of the infection. Thus, the aim of this study is to detect the prevalence of *C. trachomatis infection* using IgG and IgA seromarkers and also to determine the risk factors associated with it among gynecology clinic attendees in Babcock University Teaching Hospital.

Materials and Methods

This was a cross-sectional, hospital-based study conducted among females presenting with various gynecology conditions between November 2017 and July 2018 at the Gynecologic Unit of the Babcock University Teaching Hospital, Ilisan-Remo, Ogun State of Nigeria. A total of 145 clinic attendees were randomly recruited for the study after filling the consent forms, and blood samples were collected for *C. trachomatis* seromarkers IgG and IgA. Pretested interviewer-based structured questionnaires were used to obtain the sexual history of women. Ethical approval was obtained from the Babcock University Ethical Review Committee before commencing the study. The exclusion criteria were females who were on antibiotics or who used antibiotics within the previous 6 months and also those who were not willing to provide consent, whereas the inclusion criteria were females within the reproductive age group attending the gynecology clinic and willing to give consent for the study. The samples were analyzed using the qualitative sandwich third-generation enzyme-linked immunosorbent assay (ELISA) that is type-specific for IgG and IgA against polypeptide derived from *C. trachomatis* major outer-membrane antigen (Diagnostic Bioprobes Milano, Italy). Statistical analysis was performed using standard descriptive and inferential statistical analysis from the Statistical Package for the Social Sciences, version 23.0 (IBM Inc., NYC, USA). Means and standard deviations were derived for quantitative variables, whereas proportions were derived for qualitative variables. Association between categorical variables was determined using the Chi-square test at statistical significance level set at 5%, while logistic regression was also performed as appropriate.

Results

The data from the 145 respondents were complete for the analysis, and the overall prevalence of combined *C. trachomatis* infection was 46 (31.7%). The mean age of the respondents was 23.7 years (range = 15–45 years). Majority of the participants, 109 (75%), never used condoms, 83 (57.2) had one sex partner in the preceding 3 months, and 122 (84.1) have no history

Table 1: Sociodemographic characteristics and sexual behaviors of respondents (*n*=145)

Variables	Frequency (%)
Age	
15-20	70 (48.3)
21-25	35 (24.1)
26-30	15 (10.3)
31-35	8 (5.5)
36-40	10 (6.9)
41-45	7 (4.8)
Sexual partner in the preceding 3 months	
0 or 1	132 (91)
≥2	13 (9)
Number of sex partners at present	
0 or 1	138 (95.2)
≥2	7 (4.8)
Number of lifetime sex partners	
1	70 (48.3)
≥2	75 (51.7)
Past history of STI	
Yes	21 (14.5)
No	124 (85.5)
Use of condom	
Yes	15 (10.3)
No	109 (75.2)
Occasionally	21 (14.5)
Use of hormonal contraceptive	
Yes	18 (12.4)
No	127 (87.6)
Smoking	
Yes	1 (0.7)
No	144 (99.3)
HIV status	
Yes	1 (0.7)
No	1 (0.7)
Unknown	143 (98.6)

STI: Sexually transmitted infection

of STIs. Sociodemographic factors and sexual behaviors are further illustrated in Table 1. Factors that were associated with being positive for both *C. trachomatis* IgG and IgA on the bivariate analysis included the history of STIs and the number of lifetime sex partners [Table 2]. In multivariate analysis, only the number of lifetime sex partners was associated with *C. trachomatis* IgG and IgA (odds ratio = 5.63, confidence interval = 1.09–29.05, $P = 0.039$). Of the total patients that presented, majority of them 44 (30.3%) had PID, out of this, 14 (31.8%) were positive for *C. trachomatis* IgG and IgA, and they had the highest percentage of the seromarkers. |None of the clinical diagnosis of the participants was significantly associated with *C. trachomatis* IgG and IgA, as shown in Table 3.

Discussion

C. trachomatis is known to cause "silent" infections, leading to various gynecological morbidities in women. Its chronic and persistent nature has been implicated as a reason for some of the morbidities.[19,20] The statistically significant relationship between the number of lifetime sex partners and active chronic/persistent *C. trachomatis* infection implies that having more than one-lifetime sex partners increased the risk of having chronic or persistent Chlamydia infection. The reason for this risk might be because having more than one lifetime sex partners predisposes individuals to reinfection. In addition, there is an increased chance of having sex with an infected partner without knowing due to the asymptomatic nature of Chlamydia. This finding is in tandem with previous studies which have equally identified lifetime sex partners as being associated with chronic or persistent *C. trachomatis* infection.[21,22]

In the index study, 12 (57.1%) of the 21 participants who had the past history of STIs were positive for the two seromarkers. Although prior history of STIs lost its significance on

Table 2: Factors associated with *Chlamydia trachomatis* infections (n=145)

Variables	*Chlamydia trachomatis* IgA + IgG		Statistics		
	Yes (%)	No (%)	χ^2	df	P
Age (grouped in years)					
15-20	18 (25.7)	52 (74.3)	3.445	5	0.632
21-25	12 (34.3)	23 (65.7)			
26-30	6 (40)	9 (60)			
31-35	3 (37.5)	5 (62.5)			
36-40	5 (50)	5 (50)			
41-45	2 (28.6)	5 (71.4)			
Sexual partner in the past 3 months					
0 or 1	39 (29.5)	93 (70.5)	3.226	1	0.072
≥2	7 (53.8)	6 (46.2)			
Number of sex partners at present					
0 or 1	44 (31.9)	94 (68.1)	0.034	1	0.854
≥2	2 (28.6)	5 (71.4)			
Number of lifetime sex partners					
1	13 (18.6)	57 (81.4)	10.809	1	0.001
≥2	33 (44)	42 (56)			
Past history of STI					
Yes	12 (57.1)	9 (42.9)	7.325	1	0.007
No	34 (27.4)	90 (72.6)			
Use of condom					
Yes	3 (20.0)	12 (80.0)	5.371	2	0.068
No	32 (29.4)	77 (70.6)			
Occasionally	11 (52.4)	10 (47.6)			
Use of hormonal contraceptive					
Yes	8 (44.4)	10 (55.6)	1.535	1	0.215
No	38 (29.9)	89 (70.1)			
Smoking					
Yes	0 (0.0)	1 (100)	0.468	1	0.494
No	46 (31.9)	98 (68.1)			
HIV status					
Yes	0 (0.0)	1 (100)	2.621	2	0.270
No	45 (31.5)	98 (68.5)			
Unknown	1 (100)	0 (0.0)			

STI: Sexually transmitted infection, IgG: Immunoglobulin G, IgA: Immunoglobulin A

Table 3: The relationship between clinical diagnosis of participants and the seromarkers for *Chlamydia trachomatis*

Variables Clinical diagnosis	*Chlamydia trachomatis* IgA + IgG		Total	Statistics
	Yes (%)	No (%)		*P*
Primary infertility	6 (42.9)	8 (57.1)	14	0.357
Secondary infertility	3 (42.9)	4 (57.1)	7	0.516
Recurrent abortion	2 (33.3)	4 (66.7)	6	0.931
PID	14 (31.8)	30 (68.2)	44	0.987
Cervicitis	5 (45.5)	6 (54.5)	11	0.827
Dysmenorrhea	5 (27.7)	17 (77.3)	22	0.325
Others	11 (29.9)	30 (73.1)	41	0.500
Total	46 (31.7)	99 (68.3)	145	

PID: Pelvic inflammatory disease, IgG: Immunoglobulin G, IgA: Immunoglobulin A

multivariate analysis, past reports in Nigeria by Wariso *et al*. in Port Harcourt and Mawak *et al*. in Jos have documented the association between *C. trachomatis* and history of STI.[23,24] In Japan, Hatori *et al*. reported a significant association between *C. trachomatis* antibodies and history of the infection.[25] In India, Choudhry *et al*. reported that the presence of one STI increases the chance for another.[26]

Although condom use did not reach statistically significant level, our findings indicate a higher prevalence of Chlamydia trachomatis infection among those participants with either lack or inconsistent usage of condom. The lack of or an inconsistent use of condom might be one of the reasons why they were infected. While some other studies have found significant association between lack and inconsistent condom use and *C. trachomatis*,[21,27,28] some studies did not.[29,30] The difference in the study population may be a reason for the observed variance.

The seroprevalence of Chlamydia antibodies was the highest among the participants' age 15–20 years and the second highest was among 20–25 years. This result is at variance with the finding in another study in Enugu, Nigeria, in which the highest antibodies level was found in the age group of 20–24 years.[31] Both age groups are classified as girls and young women, and studies have reported that the prevalence of genital *C. trachomatis* infection is higher among them.[32] Reasons proffered included age at first sexual intercourse, increased likelihood of unprotected sex, and increased sexual activities.[33] This might explain the reason why participants in this age group have the higher percentage of *C. trachomatis* IgG and IgA.

In this study, the combined prevalence of *C. trachomatis* IgG and IgA was 46 (31.7%). This is at variance with the prevalence of 80.8% reported in Japan by Teruko and 80% by Morré *et al*.[34,35] The reason for this variance is not clear; however, different study population, diagnostic tools, and statistical analytical method may attribute to the variance. The high prevalence suggests a high rate of active Chlamydia infection, which makes sex partners and newborn at risk of being infected.

Of the 44 participants who presented with PID, 14 (31.8%) were positive for *C. trachomatis* IgG and IgA. This finding is similar to a study in Enugu, Nigeria.[30] Chronic and persistent Chlamydia infection will result in PID, which is a known preventable cause of chronic pain, infertility, and adverse pregnancy outcomes.[23,36]

Limitation of the study

This study is not without a limitation as C-reactive protein, which is also a marker of active persistent infection,[20] and quantitative ELISA were not used.

Recommendation

Considering the gynecology morbidity caused by active chronic and persistent Chlamydia infection, screening of women of reproductive age group is advocated by the use of both *C. trachomatis* IgA and IgG unlike IgM which is acute-phase antibody that is not produced in persistent or recurrent infection.[37]

Conclusion

There was a high prevalence of *C. trachomatis* IgA and IgG among the participants of the study, and lifetime sex partner was a significantly associated risk factor. Majority of those infected never used condom. Screening, sex education, and encouraging condom use may help to control and reduce the burden of the infection and its attendant sequelae.

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Conflicts of interest

There are no conflicts of interest.

References

1. Cuffini C, Bottiglieri M, Kigwen X, Carlos E, Romina A, Deimundo V, *et al*. Molecular epidemiology of genital *Chlamydia trachomatis* infection in asymptomatic adolescent young people. J Microbiol Res 2012;2:114-7.
2. World Health Organization. WHO Library Cataloguing in Publication Data: Report on Global Sexually Transmitted Infection Surveillance 2015. Switzerland: World Health Organization; 2016. p. S3-5.
3. Caro Vergara M, Buendía AJ, Marín L, Del Río Alonso F, Cuello G, Hernandez NO, *et al*. *Chlamydia trachomatis* genital infection: Immunity and prospects for vaccine development. Immunología 2005;24:298-312.
4. Sturm-Ramirez K, Brumblay H, Diop K, Guèye-Ndiaye A, Sankalé JL, Thior I, *et al.* Molecular epidemiology of genital *Chlamydia trachomatis*

infection in high-risk women in Senegal, West Africa. J Clin Microbiol 2000;38:138-45.
5. Siemer J, Theile O, Larbi Y, Fasching PA, Danso KA, Kreienberg R, *et al.* *Chlamydia trachomatis* infection as a risk factor for infertility among women in Ghana, West Africa. Am J Trop Med Hyg 2008;78:323-7.
6. Atalabi OM, Fayemiwo SA, Oladokun AA, Bakare RA. Pattern of asymptomatic sexually transmitted infections in women undergoing hysterosalpingography for infertility evaluation in Ibadan Nigeria. Trop J Obstet Gynaecol 2013;30:91-8.
7. Nsonwu-Anyanwu AC, Charles-Davies MA, Oni AA, Taiwo VO, Bello FA. *Chlamydial infection*, plasma peroxidation and obesity in tubal infertility. Ann Ib Postgrad Med 2011;9:83-8.
8. Wilson JS, Honey E, Templeton A, Paavonen J, Mårdh PA, Stray-Pedersen B, *et al.* A systematic review of the prevalence of *Chlamydia trachomatis* among European women. Hum Reprod Update 2002;8:385-94.
9. Isibor JO, Ugbomoiko D, Nwobu GO, Ekundayo AO, Eweani IB, Okogun GR. Detection of *Chlamydial* antigen in cervical specimens from antenatal clinic in Benin city, Nigeria. Afr J Clin Exp Microbiol 2005;6:208-11.
10. Ajani TA, Fayemiwo SA, Oluwasola TA, Anaedobe CG, Ajani MA, Bakare RA. Prevalence of asymptomatic genital *Chlamydia trachomatis* infection among infertile women in Ibadan, Nigeria using polymerase chain reaction. Indian J Med Res Pharm Sci 2017;4:13-24.
11. Nwankwo EO, Sadiq MN. Prevalence of *Chlamydia trachomatis* infection among patients attending infertility and sexually transmitted diseases clinic (STD) in Kano, North Western Nigeria. Afr Health Sci 2014;14:672-8.
12. Haar K, Bremer V, Houareau C, Meyer T, Desai S, Thamm M, *et al.* Risk factors for *Chlamydia trachomatis* infection in adolescents: Results from a representative population-based survey in Germany, 2003-2006. Euro Surveill 2013;18. pii: 20562.
13. León SR, Konda KA, Klausner JD, Jones FR, Cáceres CF, Coates TJ, *et al. Chlamydia trachomatis* infection and associated risk factors in a low-income marginalized urban population in coastal Peru. Rev Panam Salud Publica 2009;26:39-45.
14. Kucinskiene V, Sutaite I, Valiukeviciene S, Milasauskiene Z, Domeika M. Prevalence and risk factors of genital *Chlamydia trachomatis* infection. Medicina (Kaunas) 2006;42:885-94.
15. Rashidi BH, Chamani-Tabriz L, Haghollahi F, Jeddi-Tehrani M, Naghizadeh MM, Shariat M, *et al.* Effects of *Chlamydia trachomatis* infection on fertility; A case-control study. J Reprod Infertil 2013;14:67-72.
16. Joyee AG, Thyagarajan SP, Vikram Reddy E, Rajendran P, Venkatesan C, Ganapathy M, *et al.* Diagnostic utility of serologic markers for genital *Chlamydial* infection in STD patients in Chennai, India. J Assoc Physicians India 2007;55:777-80.
17. Samra Z, Soffer Y. IgA antichlamydia antibodies as a diagnostic tool for monitoring of active chlamydial infection. Eur J Epidemiol 1992;8:882-4.
18. Mazzoli S, Cai T, Rupealta V, Gavazzi A, Castricchi Pagliai R, Mondaini N, *et al.* Interleukin 8 and anti-*Chlamydia trachomatis* mucosal IgA as urogenital immunologic markers in patients with *C. trachomatis* prostatic infection. Eur Urol 2007;51:1385-93.
19. Fresse AS, Sueur JM, Hamdad F. Diagnosis and follow-up of genital *Chlamydial* infection by direct methods and by detection of serum IgG, IgA and secretory IgA. Indian J Med Microbiol 2010;28:326-31.
20. den Hartog JE, Land JA, Stassen FR, Kessels AG, Bruggeman CA. Serological markers of persistent *C. trachomatis* infections in women with tubal factor subfertility. Hum Reprod 2005;20:986-90.
21. Jeremiah I, Okike O, Akani C. The prevalence of serum immunoglobulin g antibody to *Chlamydia trachomatis* in subfertile women presenting at the university of port Harcourt teaching hospital, Nigeria. Int J Biomed Sci 2011;7:120-4.
22. Ogbu JI, Anzaku SA, Aimakhu C. Burden of *Chlamydia trachomatis* infection amongst infertile women compared with pregnant controls in North-central Nigeria. Int J Res Med Sci 2017;5:3819-26.
23. Wariso KT, Jodigie J, Eyaru S. Prevalence of *Chlamydia trachomatis* infection among female undergraduates of the University of Port Harcourt using Strand Displacement and Amplification (SDA) technique. Niger Health J 2012;12:35-8.
24. Mawak JD, Dashe N, Agabi YA, Panshak BW. Prevalence of genital *Chlamydia trachomatis* infection among gynaecology clinic attendees in Jos, Nigeria. Shiraz E Med J 2011;12:22.
25. Hatori T, Nakamura T, Tsukui S. The importance of using a test to detect *Chlamydia trachomatis* infection in patients undergoing counseling and testing for sexually transmitted diseases at a public health center. Nihon Koshu Eisei Zasshi 2013;60:691-6.
26. Choudhry S, Ramachandran VG, Das S, Bhattacharya SN, Mogha NS. Pattern of sexually transmitted infections and performance of syndromic management against etiological diagnosis in patients attending the sexually transmitted infection clinic of a tertiary care hospital. Indian J Sex Transm Dis AIDS 2010;31:104-8.
27. Arinze AU, Onyebuchi NV, Isreal J. Genital *Chlamydia trachomatis* infection among female undergraduate students of university of Port Harcourt, Nigeria. Niger Med J 2014;55:9-13.
28. Ngandjio A, Clerc M, Fonkoua MC, Thonnon J, Njock F, Pouillot R, *et al.* Screening of volunteer students in yaounde (Cameroon, central Africa) for *Chlamydia trachomatis* infection and genotyping of isolated *C. trachomatis* strains. J Clin Microbiol 2003;41:4404-7.
29. Bakhtiari A, Firoozjahi A. *Chlamydia trachomatis* infection in women attending health centres in Babol: Prevalence and risk factors. East Mediterr Health J 2007;13:1124-31.
30. Ikeme AC, Ezegwui HU, Ikeako LC, Agbata I, Agbata E. Seroprevalence of *Chlamydia trachomatis* in Enugu, Nigeria. Niger J Clin Pract 2011;14:176-80.
31. Navarro C, Jolly A, Nair R, Chen Y. Risk factors for genital chlamydial infection. Can J Infect Dis 2002;13:195-207.
32. Obasi AI, Balira R, Todd J, Ross DA, Changalucha J, Mosha F, *et al.* Prevalence of HIV and *Chlamydia trachomatis* infection in 15–19-year olds in rural Tanzania. Trop Med Int Health 2001;6:517-25.
33. Kang M, Rochford A, Skinner SR, Mindel A, Webb M, Peat J, *et al.* Sexual behaviour, sexually transmitted infections and attitudes to *Chlamydia* testing among a unique national sample of young Australians: Baseline data from a randomised controlled trial. BMC Public Health 2014;14:12.
34. Komoda T. Kinetic study of antibodies (IgG, IgA) to *Chlamydia trachomatis*: Importance of IgA antibody in screening test for *C. trachomatis* infection by peptide-based enzyme immunosorbent assay. Jpn J Infect Dis 2007;60:347-51.
35. Morré SA, Munk C, Persson K, Krüger-Kjaer S, van Dijk R, Meijer CJ, *et al.* Comparison of three commercially available peptide-based immunoglobulin G (IgG) and IgA assays to microimmunofluorescence assay for detection of *Chlamydia trachomatis* antibodies. J Clin Microbiol 2002;40:584-7.
36. Ghosh M, Choudhuri S, Ray RG, Bhattacharya B, Bhattacharya S. Association of genital *Chlamydia trachomatis* infection with female infer-tility, study in a tertiary care hospital in Eastern India. Open Microbiol J 2015;9:110-6.
37. Piura B, Sarov B, Sarov I. Persistence of antichlamydial antibodies after treatment of acute salpingitis with doxycycline. Eur J Obstet Gynecol Reprod Biol 1993;48:117-21.