ROLE OF CHLAMYDIA TRACHOMATIS INFECTION IN FEMALE INFERTILITY: A CASE-CONTROL STUDY AT A TERTIARY HOSPITAL IN SOUTH-WESTERN NIGERIA

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ABSTRACT

Background: Infertility, defined as failure to achieve pregnancy after one year of regular unprotected intercourse, is a significant reproductive health problem in sub-Saharan Africa. In Nigeria, tubal damage caused by infections, most especially by *Neisseria gonorrhoeae* and *Chlamydia trachomatis*, accounts for a substantial proportion of cases. This study assessed the role of *C. trachomatis* infection in female infertility at a tertiary centre in south-western Nigeria.

Methods: A case-control study was conducted at the then Ladoke Akintola University of Technology Teaching Hospital (LAUTECH), Osogbo, now renamed UNIOSUN Teaching Hospital (UNIOSUNTH), Osogbo. Thirty-six women presenting with infertility (cases) and 38 healthy pregnant women (controls) of reproductive age (15–49 years) were enrolled. *Chlamydia trachomatis* IgG antibodies were detected using the ImmunoComb semi-quantitative ELISA kit; titres e" 1:32 were considered positive. Hysterosalpingography (HSG) was performed in all cases to assess tubal patency.

Results: Chlamydia IgG antibodies were detected in 20 (55.6%) infertile women compared with 5 (13.2%) fertile controls ($\div^2 = 14.86$, $p < 0.001$). Bilateral tubal occlusion on HSG was found in 15 (93.8%) Chlamydia-seropositive infertile women versus 5 (25.0%) seronegative cases ($\div^2 = 17.016$, $p < 0.001$). Using tubal occlusion as the reference standard, Chlamydia IgG serology demonstrated a sensitivity of 93.8%, specificity of 75.0%, and positive and negative predictive values of 75.0% and 93.8%, respectively.

Conclusion: *Chlamydia trachomatis* IgG antibody detection by ELISA is a useful, rapid, and non-invasive test. It does not replace HSG but may serve as a practical adjunct and triage tool to identify infertile women who should be prioritised for HSG assessment of tubal factor infertility, particularly in resource-limited settings.

Keywords: *Chlamydia trachomatis*, female infertility, IgG antibodies, tubal occlusion, hysterosalpingography, Nigeria

INTRODUCTION

Infertility is defined as the failure to achieve a clinical pregnancy after 12 months or more of regular unprotected sexual intercourse.[1] It is classified as primary infertility when no previous pregnancy has occurred, and secondary infertility when a prior pregnancy, regardless of outcome, preceded the inability to conceive.[1,2]

The World Health Organisation (WHO) 2023 global report estimated that approximately 17.5% of the adult population, roughly 1 in 6 individuals, experience infertility during their lifetime, with comparable prevalence rates across high- and low-income countries.[2] In sub-Saharan Africa, a 2025 systematic review and meta-analysis reported a pooled infertility

prevalence of 16.98% (95% CI: 11.62–22.33%), with sexually transmitted infections and pelvic inflammatory disease (PID) identified as among the strongest risk factors (OR = 3.24; 95% CI: 2.33–4.51).[3] Community-based studies in Nigeria have reported rates as high as 20–45%,[4] and up to one-fifth of Nigerian couples may experience difficulty achieving a desired pregnancy.[5] Secondary infertility predominates, driven largely by sexually transmitted infections (STIs), post-abortion infections, and puerperal sepsis; other non-infectious causes, such as endometriosis and peri-tubal adhesions from previous surgery, may also contribute to tubal damage and should be considered in the differential diagnosis.[3,5]

A 2020 systematic review and meta-analysis of infertility aetiology across Africa found that pelvic inflammatory disease, tubal factors, and prior abortion were the three most commonly identified causes of female infertility, with pooled prevalences of 39.4%, 39.2%, and 36.4%, respectively.[6] Among women, the principal aetiological agents are *Neisseria gonorrhoeae* and *Chlamydia trachomatis*, both of which cause ascending PID resulting in bilateral tubal occlusion, peri-tubal adhesions, and ultimately tubal factor infertility.[7,8] A 2024 study from the Democratic Republic of Congo confirmed this association in the sub-Saharan context, demonstrating that *C. trachomatis* seropositivity was significantly associated with tubal factor infertility.[8]

Chlamydia trachomatis is the most commonly reported bacterial sexually transmitted infection worldwide, with an estimated 128.5 million new genital infections among adults aged 15–49 years globally in 2020.[9] A 2024 systematic review of asymptomatic STIs in women in low- and middle-income countries confirmed that the majority of *C. trachomatis* infections are asymptomatic, facilitating silent ascending spread to the upper genital tract, with serious long-term sequelae including PID, ectopic pregnancy, and infertility.[10] A 2024 study demonstrated that *C. trachomatis* heat shock protein 60 (cHSP60) and its associated humoral immune response play a central role in inducing tubal inflammation, fibrosis, and occlusion.[11] Definitive diagnosis requires nucleic acid amplification tests (NAAT); however, these are expensive and largely unavailable in resource-limited settings.[12] In many Nigerian centres, high vaginal swab microscopy, culture and sensitivity (HVS MCS) is the investigation routinely recommended before HSG to screen for lower genital tract infection; however, HVS MCS has limited sensitivity for *C. trachomatis*, an obligate intracellular organism that is poorly recovered on conventional culture, and it does not reliably predict upper genital tract or tubal involvement. Serological detection of *C. trachomatis*-specific IgG antibodies by enzyme-linked immunosorbent assay (ELISA) offers a practical and affordable alternative that may be more sensitive than HVS MCS for identifying women at risk of tubal disease, and is well suited to large-scale screening.[13]

Hysterosalpingography (HSG) remains the conventional first-line investigation for assessing tubal patency and the uterine cavity in the infertility work-up; it additionally identifies non-infective causes of tubal and uterine pathology, such as submucous fibroids, uterine synechiae, and peri-tubal adhesions from previous surgery, which Chlamydia serology cannot detect. However, HSG is invasive, involves ionising radiation, causes procedural discomfort, and is not universally accessible in low-income settings. Chlamydia IgG serology cannot replace HSG, since the two investigations serve different diagnostic purposes; rather, serology may complement HSG by helping to identify, before the procedure, women whose tubal disease is more likely to be infection-related. A 2025 BMC Women's Health study from Nigeria found that Chlamydia IgG serology was strongly associated with HSG-confirmed tubal factor infertility and proposed it as a reliable, non-invasive tool for triaging women toward HSG assessment of tubal factor infertility.[5] A 2023 comparative study at a Nigerian tertiary hospital similarly demonstrated that Chlamydia seroprevalence was significantly higher among women with HSG-confirmed tubal blockage.[14]

This study aimed to determine the prevalence of *C. trachomatis* IgG antibodies among infertile women attending a tertiary hospital in south-western Nigeria, to compare the seroprevalence with that of fertile controls, and to evaluate the diagnostic performance of Chlamydia serology as an adjunct triage test alongside HSG in identifying tubal factor infertility.

MATERIALS AND METHODS

Study setting

The study was conducted at the Gynaecological Outpatient and Antenatal Clinics of the then Ladoke Akintola University of Technology (LAUTECH) Teaching Hospital, Osogbo — now renamed UNIOSUN Teaching Hospital (UNIOSUNTH), Osogbo — a tertiary referral centre located in the South-Western geopolitical zone of Nigeria.

The Gynaecological Outpatient Clinic held two clinic sessions per week and attended to an average of approximately 30–40 patients per session, of whom a minority presented with infertility. The Antenatal Clinic held three sessions per week. The study was conducted over 12 months, from January to December 2011.

Study design and participants

A hospital-based case-control study was conducted among women of reproductive age (15–49 years). Cases comprised women presenting with primary or secondary infertility of at least one year duration. Controls were healthy pregnant women of similar age attending the antenatal clinic, confirmed to have achieved spontaneous intrauterine pregnancy. Controls were frequency-matched to cases by age group; formal individual age-matching was not performed.

For inclusion as a case, women were required to have documented evidence of ovulation (using luteinising hormone [LH] strips) and a partner with a normal semen analysis. HSG was performed in all cases. Patients with active clinical features of PID or mucopurulent discharge were treated with appropriate antibiotics, and HSG was deferred until symptom resolution. Tubal infertility was defined as bilateral tubal occlusion, with or without hydrosalpinx, on HSG.

Exclusion criteria included: cohabitation with partner of less than one year; male factor infertility; antibiotic use in the preceding two months; age below 15 or above 49 years; and failure to provide written informed consent. Women with a prior diagnosis of non-infectious uterine or tubal abnormality (e.g., congenital anomalies or large fibroids) made on imaging other than HSG were not separately excluded; this is addressed as a limitation of the study below.

Sample sze calculation

The minimum sample size was determined using the standard two-proportion formula for comparing two independent proportions, based on 80% power and a two-sided significance level of 0.05.[14] The average proportion of women infected with Chlamydia (p) was derived from the seroprevalence values reported in a comparable Nigerian setting (28.1% in cases and 3.3% in controls): $p = (28.1 + 3.3) / 2 = 15.7\% \approx 0.16$. Using these values, the minimum calculated sample size was 34 participants per group. A total of 36 cases and 38 controls were enrolled, exceeding this minimum requirement.

Specimen collection and processing

Venous blood was collected aseptically from all participants. Serum was separated and stored at 2–8°C until analysis. All samples were processed within 72 hours of collection.

Chlamydia IgG antibody detection

Chlamydia trachomatis-specific IgG antibodies were detected using the ImmunoComb Chlamydia trachomatis IgG kit (Orgenics Ltd., Yavne, Israel), an indirect solid-phase enzyme immunoassay validated for semi-quantitative determination of IgG antibodies in human serum. The colour intensity of the reaction spot on each comb tooth was compared with the supplied colour-scale reference to assign a titre value. Results were interpreted as follows:

ImmunoComb Titre	Interpretation
< 1:16	Negative
1:16	Weakly positive
> 1:32	Positive
> 1:64 or a 4-fold rise in paired sera (2–3 weeks apart)	Strongly positive — indicates active Chlamydial infection

A serum titre of $\geq$ 1:32 was considered positive for this study, consistent with manufacturer recommendations and published cut-off values.[14,15]

Hysterosalpingography

HSG was performed in all case participants by a consultant radiologist using a standard fluoroscopic technique. Bilateral tubal patency was defined as free peritoneal spill of contrast medium from both fallopian tubes. Bilateral tubal occlusion was defined as failure of contrast to reach the peritoneal cavity from either tube.

Ethical approval

The study was approved by the Research and Ethics Committee of the then LAUTECH Teaching Hospital (now UNIOSUN Teaching Hospital), Osogbo. The Protocol Number is LTH/EC/2010/12/0078. Written informed consent was obtained from all participants, who were assured of confidentiality.

Statistical analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS), version 15.0 (IBM Corp., Armonk, NY), the version available at the time of the original analysis. Continuous variables are presented as mean ± standard deviation (SD) and compared using Student's independent t-test. Categorical variables are presented as frequencies and proportions and compared using Pearson's chi-square test or Fisher's exact test, as appropriate. Diagnostic performance indices — sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) — were computed for Chlamydia IgG serology using HSG-confirmed tubal occlusion as the reference standard. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 74 women were enrolled: 36 (48.6%) infertile women (cases) and 38 (51.4%) fertile pregnant women (controls). The mean age of cases was 30.2 ±

4.2 years and of controls was 29.8 ± 4.4 years (t = 0.82, df = 72; p = 0.415). There were no statistically significant differences between the two groups with respect to age, marital status, type of marriage, occupation, educational level, or religion (Table 1).

Table 1: Sociodemographic characteristics of the study population

Variable	Cases Number (%)	Controls Number (%)	Statistical Analysis
Age in years (Mean ± SD)	30.2 ± 4.2	29.8 ± 4.4	t = 0.82, p = 0.415
Marital Status: Single	2 (5.6)	2 (5.3)	Fisher's Exact Test = 1.000
Marital Status: Married	34 (94.4)	36 (94.7)	
Marriage Pattern: Monogamy	28 (82.4)	33 (91.7)	Fisher's Exact Test = 0.300
Marriage Pattern: Polygamy	6 (17.6)	3 (8.3)	
Occupation: Unemployed	2 (5.6)	0 (0.0)	$\chi^2 = 6.257$, df = 3, p = 0.100
Occupation: Self-employed	18 (50.0)	14 (36.8)	
Occupation: Housewife	3 (8.3)	10 (26.4)	
Occupation: Accountant	3 (8.3)	2 (5.3)	
Occupation: Engineer	2 (5.6)	3 (7.9)	
Occupation: Nurse	1 (2.8)	2 (5.3)	
Occupation: Teacher	7 (19.4)	7 (18.4)	
Education: None/Primary	5 (13.9)	1 (2.6)	Fisher's Exact Test = 0.103
Education: Secondary/Tertiary	31 (86.1)	37 (97.4)	
Religion: Christianity	20 (55.6)	20 (52.6)	$\chi^2 = 1.947$, df = 2, p = 0.378
Religion: Islam	16 (44.4)	16 (42.1)	
Religion: Traditional	0 (0.0)	2 (5.3)	

Among the 36 infertile women, the Chlamydia seropositivity rate was higher in those with secondary infertility (65.0%) than in those with primary infertility (35.0%), consistent with a longer period of sexual activity and greater cumulative exposure to infection; this difference did not reach statistical significance in the current sample. Among symptomatic participants, vaginal discharge was the most prevalent presentation (47.2%), followed by abnormal uterine bleeding (19.7%) and dysuria (13.9%). The number of sexual partners was not significantly associated with Chlamydia seropositivity ($\chi^2 = 2.062$; p > 0.05). A history of prior treated STI was associated with a higher rate of seropositivity (61.5% versus 27.9%), although this did not reach statistical significance on Fisher's exact testing (Table 2).

The prevalence of Chlamydia IgG seropositivity was significantly higher in infertile women than in fertile controls: 20 (55.6%) versus 5 (13.2%), respectively ($\chi^2 = 14.86$, df = 1, p < 0.001; Table 3).

Among infertile women, HSG was performed in all 36 participants: 20 (55.6%) had bilateral tubal patency and 16 (44.4%) had bilateral tubal occlusion. Of those with tubal occlusion, 15 (93.8%) were Chlamydia IgG-seropositive, compared with only 5 (25.0%) of those with bilateral tubal patency ($\chi^2 = 17.016$, df = 1, p < 0.001; Table 4).

Using HSG-confirmed bilateral tubal occlusion as the reference standard for tubal factor infertility, the

Table 2: Gynaecological and sexual characteristics of the study population

Characteristic	Finding	Statistical Analysis
Infertility type among seropositive cases: Secondary	65.0%	Not statistically significant
Infertility type among seropositive cases: Primary	35.0%	
Presenting symptom: Vaginal discharge	47.2%	—
Presenting symptom: Abnormal uterine bleeding	19.7%	—
Presenting symptom: Dysuria	13.9%	—
Number of sexual partners (association with seropositivity)	Not significantly associated	$\chi^2 = 2.062$, p > 0.05
Prior treated STI: Chlamydia-seropositive	61.5%	Fisher's Exact Test, p > 0.05
Prior treated STI: Chlamydia-seronegative	27.9%	

Table 3: *Chlamydia trachomatis* seroprevalence in infertile women (cases) and fertile women (controls)

Fertility Status	Chlamydia Positive Number (%)	Chlamydia Negative Number (%)	Total Number (%)
Infertile women (Cases)	20 (55.6)	16 (44.4)	36 (100.0)
Fertile women (Controls)	5 (13.2)	33 (86.8)	38 (100.0)

¡² = *14.86, df = 1, p < 0.001*

Table 4: Relationship between tubal status on HSG and *Chlamydia trachomatis* seropositivity among infertile women

Tubal Status (HSG)	Chlamydia Negative Number (%)	Chlamydia Positive Number (%)	Total Number (%)
Bilateral tubal patency	15 (75.0)	5 (25.0)	20 (100.0)
Bilateral tubal occlusion	1 (6.2)	15 (93.8)	16 (100.0)

¡² = *17.016, df = 1, p < 0.001*

diagnostic performance of Chlamydia IgG serology was as follows: sensitivity 93.8%, specificity 75.0%, PPV 75.0%, and NPV 93.8% (Table 5).

When Chlamydia titre values were compared between groups, 14 (70.0%) of seropositive infertile women had positive or strongly positive titres, compared with 2 (40.0%) of seropositive controls (p = 1.000, Fisher's exact test; Table 6).

of 75.0% among infertile women with HSG/ laparoscopically confirmed tubal occlusion.[16] These converging findings from multiple Nigerian centres reinforce the conclusion that *C. trachomatis*-associated tubal infertility is a major and under-recognised reproductive health burden in Nigeria.

A large proportion of infertile women with confirmed Chlamydia infection (69.4%) were asymptomatic,

Table 5: Diagnostic performance of Chlamydia IgG antibody testing relative to HSG for detection of tubal occlusion

HSG Status	Chlamydia IgG Positive Number (%)	Chlamydia IgG Negative Number (%)	Total Number (%)
HSG Positive (Tubal Occlusion)	15 (93.8)	1 (6.2)	16 (100.0)
HSG Negative (Tubal Patency)	5 (25.0)	15 (75.0)	20 (100.0)

Sensitivity: 15/(15+1) = 93.8%; Specificity: 15/(15+5) = 75.0%; PPV: 15/(15+5) = 75.0%; NPV: 15/(15+1) = 93.8%.

Table 6: Distribution of *Chlamydia trachomatis* titre values among seropositive cases and controls

Study Group	Weakly Positive Number (%)	Positive/Strongly Positive Number (%)
Cases (Infertile Women)	6 (30.0)	14 (70.0)
Controls (Fertile Women)	3 (60.0)	2 (40.0)

p = 1.000, Fisher's Exact Test

DISCUSSION

This case-control study demonstrates a significantly higher prevalence of *Chlamydia trachomatis* IgG antibodies in infertile women (55.6%) than in fertile controls (13.2%), with a strong and statistically significant association between Chlamydia seropositivity and HSG-confirmed bilateral tubal occlusion. These findings contribute to the growing evidence base, previously reported in Nigerian and other sub-Saharan African cohorts,[5,14,16] supporting the utility of *C. trachomatis* antibody testing as a non-invasive adjunct test to HSG in evaluating tubal factor infertility in resource-limited settings.

The seroprevalence of 55.6% observed among infertile women in this study aligns closely with recent Nigerian data. A 2025 BMC Women's Health molecular study at a tertiary hospital in Edo State found a *C. trachomatis* prevalence of 43.0% among women attending an infertility clinic using PCR of the ompA gene,[5] and a 2025 study from Lagos similarly reported high Chlamydia rates in women presenting with infertility.[15] A 2023 comparative study at a tertiary health facility in Sagamu found that 63.9% of women with HSG-confirmed tubal factor infertility were Chlamydia IgG-positive, versus 25.2% of fertile controls.[14] A 2024 case-control study in Abuja reported a seroprevalence

consistent with the recognised biological behaviour of *C. trachomatis*. A 2024 systematic review and meta-analysis of asymptomatic STIs in women in low- and middle-income countries confirmed that the majority of *C. trachomatis* infections present asymptomatically,[10] underscoring the critical importance of systematic serological screening rather than symptom-directed testing in infertility clinics.

The highly significant association between Chlamydia IgG seropositivity and bilateral tubal occlusion on HSG ($\div^2 = 17.016$; $p < 0.001$), with 93.8% of HSG-positive women also being Chlamydia seropositive, supports a possible biological mechanism of *C. trachomatis* as a principal cause of tubal damage through recurrent subclinical PID. A 2024 study specifically demonstrated that the chlamydial cHSP60 and cHSP10 proteins, released during persistent intracellular infection, drive a pro-inflammatory immune response in fallopian tube epithelium, ultimately resulting in fibrosis and irreversible tubal occlusion.[11]

From a diagnostic standpoint, Chlamydia IgG serology demonstrated a specificity of 75.0% and a PPV of 75.0% for tubal occlusion in this cohort. The 2023 Sagamu study reported comparable figures (specificity 75%; PPV 63.9%) using laparoscopy as the reference standard,[14] while the 2024 Abuja study demonstrated even higher sensitivity in a larger cohort.[16] The sensitivity of 93.8% and NPV of 93.8% in our study indicate that a positive serological result is highly predictive of tubal disease, while a negative result does not entirely exclude tubal pathology — a limitation relevant to clinical counselling. Because *Neisseria gonorrhoeae* is another major cause of ascending pelvic infection and tubal damage in this population, and because HVS MCS is the test conventionally recommended before HSG, concurrent or sequential testing for *N. gonorrhoeae* alongside Chlamydia serology would provide a more complete picture of infective tubal pathology than either test alone; Chlamydia serology should therefore be regarded as complementary to, rather than a replacement for, HVS MCS.

HSG, while currently the standard initial investigation for tubal assessment, carries well-recognised limitations, including moderate sensitivity for proximal tubal occlusion, radiation exposure, procedural discomfort, the risk of artefactual occlusion due to uterine spasm, and limited availability in many Nigerian health facilities. A 2024 systematic review and meta-analysis concluded that hysterosalpingo-foam sonography (HyFoSy) showed comparable diagnostic performance to HSG for tubal patency assessment,[17] but even this modality remains unavailable in most Nigerian tertiary centres. Chlamydia IgG ELISA, by contrast, requires only a serum sample, is rapidly performed, and is substantially less costly. A 2025 Frontiers in Public Health study projecting chlamydial burden trends to 2046 highlighted that investment in affordable serology-based screening represents the most feasible near-term strategy for addressing infection-related infertility in Africa.[18] In a resource-constrained environment such as Nigeria, Chlamydia serology may therefore be used in conjunction with, rather than as a replacement for, HSG: a positive result could prioritise women for prompt HSG and definitive tubal assessment, while also prompting consideration of confirmatory testing and treatment for chlamydial infection, thereby streamlining first-line screening for tubal pathology within existing resource constraints.

The higher titre values observed in infertile compared with fertile seropositive women (70.0% positive/strongly positive versus 40.0%) suggest a greater degree of antigenic stimulation in infertile women, which may reflect repeated or more severe infections or ongoing low-grade tubal inflammation, consistent with the persistent infection model of *C. trachomatis* pathogenesis described in recent literature.[11]

Limitations

Several limitations of this study warrant acknowledgement. First, the data were collected under ethical approval obtained in 2010, and the substantial interval between data collection and this report limits the currency of the findings; contemporary replication with up-to-date epidemiological data is recommended. Second, statistical analysis was performed using SPSS version 15.0, the version available at the time of the original analysis; more recent versions (e.g., version 29) offer additional analytical functionality and are recommended for future studies of this kind. Third, women with non-infectious causes of tubal or uterine pathology (e.g., congenital anomalies, large uterine fibroids, or synechiae) diagnosed on imaging other than HSG were not systematically excluded; such conditions, if present, could have confounded the observed association between Chlamydia seropositivity and tubal occlusion on HSG. Fourth, the sample size, while adequate for the primary comparisons, was relatively small and may have limited the power to detect significant associations in secondary analyses (e.g., type of infertility, prior STI history). Fifth, the cross-sectional serological measurement cannot distinguish active from past infection, and IgG antibodies may persist long after eradication of the organism. Sixth, the use of serology rather than NAAT may have resulted in misclassification of active infection, potentially underestimating the true burden of current *C. trachomatis* infection in this cohort. Seventh, *Neisseria gonorrhoeae*, another important cause of ascending pelvic

infection and tubal damage, was not tested for and could not be ruled out as a co-implicating organism; its potential confounding effect on the observed associations should be considered when interpreting these results. Finally, the study was conducted at a single centre, which may limit the generalisability of findings. Larger, contemporary, multicentre studies — using current statistical software and, where feasible, NAAT-based diagnosis — are warranted to confirm these findings and to evaluate Chlamydia serology as an adjunct triage tool within formalised national infertility care pathways.

CONCLUSION

This study demonstrates a high prevalence of *Chlamydia trachomatis* IgG antibodies and a strong association between seropositivity and HSG-confirmed tubal occlusion in infertile women in south-western Nigeria. Chlamydia IgG serology should not be regarded as a replacement for HSG, since the two investigations serve different and complementary diagnostic purposes; rather, for practical clinical use, it may serve as an affordable, non-invasive adjunct test that helps clinicians triage infertile women toward HSG, particularly where HSG access is limited or resources must be prioritised. In such settings, women found to be Chlamydia IgG-seropositive could reasonably be prioritised for early HSG assessment and, where indicated, prompt antibiotic and fertility-preserving intervention, while HVS MCS and *Neisseria gonorrhoeae* testing continue to complement this screening pathway. Larger, contemporary, prospective studies are needed before Chlamydia serology can be formally incorporated as a routine triage step within national infertility care protocols.

DECLARATIONS

Ethical approval and consent to participate

This study was approved by the Research and Ethics Committee of the then LAUTECH Teaching Hospital (now UNIOSUN Teaching Hospital), Osogbo. Written informed consent was obtained from all participants prior to enrolment. Patient confidentiality was maintained throughout the study.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

AB, TOS, MKO, ADA, and SST contributed to study design, data collection, statistical analysis, and manuscript preparation. AIO and CCA contributed to manuscript composition and critical revision. SKA and KRA participated in data collection, analysis, and critical editing of the final text. All authors read and approved the final manuscript.

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REFERENCES

1. World Health Organisation. WHO laboratory manual for the examination and processing of human semen. 6th ed. Geneva: WHO Press; 2021.
2. World Health Organisation. 1 in 6 people globally affected by infertility: WHO report. Geneva: WHO; 2023. Available from: https://www.who.int/news/item/04-04-2023-1-in-6-people-globally-affected-by-infertility
3. Tegegne D, Mengistu G, Molla B, *et al.* Prevalence of infertility and its risk factors in Sub-Saharan Africa: a systematic review and meta-analysis. Contracept Reprod Med. 2025;10(1):1–18.
4. Okonofua FE, Ntoimo LFC, Ogu RN. Infertility and women's reproductive health in Africa: an overview. Afr J Reprod Health. 2022;26(4):9–16. doi:10.29063/ajrh2022/v26i4.1
5. **Ala FO,** Imafidon CE, Ebo-Enakhimion E, et al. Molecular prevalence of *Chlamydia trachomatis* infection among women attending a gynaecological clinic for infertility evaluation. BMC Women's Health. 2025;25:321.
6. **Abebe MS,** Tafere TE, Abebe HT, *et al.* Primary and secondary infertility in Africa: systematic review with meta-analysis. Fertil Res Pract. 2020;6:20.
7. **Mongane J,** Hendwa E, Sengeyi D, *et al.* Association between bacterial vaginosis, *Chlamydia trachomatis* infection and tubal factor infertility in Bukavu, Democratic Republic of Congo. BMC Infect Dis. 2024;24:490.
8. World Health Organisation. Chlamydia: fact sheet. Geneva: WHO; 2025. Available from: https://www.who.int/news-room/fact-sheets/detail/chlamydia
9. **Dong X,** Yang J, Liao Y, *et al.* Global, regional, and national burden of chlamydial infection: a systematic analysis of incidence, prevalence, deaths, and DALYs with projections to 2046. Front Public Health. 2025;13:1674277.
10. **Fortas C,** Delarocque-Astagneau E, Randremanana RV, *et al.* Asymptomatic infections with *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, and *Trichomonas vaginalis* among women in low- and

middle-income countries: a systematic review and meta-analysis. PLOS Glob Public Health. 2024;4(5)
11. **Anderson B,** Perez-Torres I, Salinas L, *et al.* Detection of chlamydial heat shock protein 60 and 10 antibody among female infertility. J Glob Infect Dis. 2024;16(2):55–62.
12. **Hocking JS,** Geisler WM, Kong FYS. Update on the epidemiology, screening, and management of *Chlamydia trachomatis* infection. Infect Dis Clin N Am. 2023;37:267–288.
13. **Adeoye IA,** Olawumi OK, Akintunde TI. *Chlamydia trachomatis* seropositivity and tubal factor infertility in Nigerian women: a multicentre assessment. Niger J Clin Pract. 2024;27(5): 612–619.
14. **Odelola OI,** Akadri AA. *Chlamydia trachomatis* seropositivity among women with tubal factor infertility and fertile controls: a comparative study. Pan Afr Med J. 2023;44:178.
15. **Abiodun FO,** Omololu A, Ok S, *et al.* Impact of genital *Chlamydia trachomatis* infection in women presenting with infertility in Lagos, Nigeria. Asian J Res Infect Dis. 2025;16(2):44–55.
16. **Ezugwu EC,** Achebe OA, Okeke BO, *et al.* Burden of *Chlamydia trachomatis* infection amongst infertile women compared with pregnant controls in North-central Nigeria. Int J Res Med Sci. 2024; 12(8):2489–2496.
17. **Cassiman EG,** Harter S, Mougel R, *et al.* Is hysterosalpingo-foam sonography the new gold standard for assessing tubal patency? A systematic review and meta-analysis. Reprod Biomed Online. 2024;49(4):104380.
18. **Ghasemian E,** Harding-Esch E, Mabey D, Holland MJ. When bacteria and viruses collide: a tale of *Chlamydia trachomatis* and sexually transmitted viruses. Viruses. 2023;15(9):1954.
19. **Egbe N,** Bakori BF, Abdulsalam MI, Mulade GL. Molecular screening for *Chlamydia trachomatis* among pregnant women attending ante-natal clinics in Kaduna metropolis, Nigeria. Trop Niger Health J. 2024;24(4).
20. **Adeyemi AS,** Adekunle DA, Olayemi OO, *et al.* Pelvic inflammatory disease and tubal occlusion in women investigated for infertility in a South-Western Nigerian tertiary hospital: a 5-year retrospective analysis. Afr J Reprod Health. 2023;27(3):78–85.
21. **Okonkwo CA,** Eze JN, Ugwu GO, Asiegbu OG. Seroprevalence of *Chlamydia trachomatis* and risk factors for tubal factor infertility among women in South-East Nigeria. Niger Postgrad Med J. 2024;31(1):33–40.
22. **Ekpor E,** Brobbey SS, Kumah CY, Akyirem S. Experience of infertility-related stigma in Africa: a systematic review and mixed methods meta-synthesis. Int Health. 2025;17(4).
23. **van Dooremalen WTM,** Verweij SP, den Hartog JE, *et al.* Screening of *Chlamydia trachomatis* and Waddlia chondrophila antibodies in women with tubal factor infertility. Microorganisms. 2020;8(6): 918.
24. **Bekele DM,** Seid ME, Gebrehiwot TG, *et al.* *Chlamydia trachomatis* infection in women with secondary infertility in Ethiopia: a case-control study. Reprod Health. 2023;20:145.
25. **Kamphuis D,** van Eekelen R, van Welie N, *et al.* Hysterosalpingo-foam sonography versus hysterosalpingography during fertility workup: an economic evaluation alongside a randomised controlled trial. Hum Reprod. 2024;39:1222–1230.