PRÉVALENCE ET FACTEURS DE RISQUE DE L'INFECTION GÉNITALE A *CHLAMYDIA TRACHOMATIS* EN AFRIQUE SUBSAHARIENNE : UNE REVUE SYSTÉMATIQUE DE 1990 À 2025.

Prevalence And Risk Factors Of Genital Chlamydia trachomatis Infection In Sub-Saharan Africa: A Systematic Review From 1990 To 2025

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ABSTRACT

Objective: To systematically review published evidence on the prevalence and associated risk factors of genital Chlamydia infection in Sub-Saharan Africa (SSA) between 1990 and 2025. **Methods**: We conducted a systematic review following PRISMA guidelines using PubMed/MEDLINE, Web of Science, AJOL, and Google Scholar in English and French. Of 754 articles, 47 met inclusion criteria. Study populations included the general population, pregnant women, sex workers, people living with HIV, and infertile women. **Results**: Prevalence varied widely by study setting and diagnostic method, from 0.7% among women in Nigeria to >60% in hospitals in Cameroon. Serological tests overestimated prior exposure, whereas PCR and NAATs accurately detected active infection, with prevalence frequently below 10%. Identified risk factors included age under 25, multiple sexual partners, non-use of condoms, low socioeconomic status, and HIV co-infection, with reported associations with tubal infertility. **Discussion**: The wide variability in prevalence is partly explained by differences in study populations and diagnostic methods. Serological tests often overestimate past exposure, whereas molecular methods such as PCR and NAATs more accurately detect active infections. These findings highlight the need to expand molecular testing and target high-risk populations to prevent complications, particularly tubal infertility. **Conclusion**: Genital chlamydia remains underdiagnosed in SSA. **Keywords**: *Chlamydia trachomatis*, Sub-Saharan Africa, Genital chlamydia, prevalence, risk factors

RESUME

Objectif : Réaliser une revue systématique des données publiées concernant la prévalence et les facteurs de risque associés à la chlamydiose génitale en Afrique subsaharienne entre 1990 et 2025. **Méthodes** : Nous avons mené une revue systématique conformément aux lignes directrices PRISMA en utilisant les bases de données PubMed/MEDLINE, Web of Science, AJOL et Google Scholar, en anglais et en français. Sur 754 articles, 47 répondaient aux critères d'inclusion. Les populations étudiées comprenaient la population générale, les femmes enceintes, les travailleuses du sexe, les personnes vivant avec le VIH et les femmes infertiles. **Résultats** : La prévalence variait considérablement selon le contexte de l'étude et la méthode de diagnostic, allant de 0,7 % chez les femmes au Nigeria à plus de 60 % dans les hôpitaux au

Cameroun. Les tests sérologiques surestimaient l'exposition antérieure, tandis que la PCR et les NAAT détectaient avec précision l'infection active, avec une prévalence souvent inférieure à 10 %. Les facteurs de risque identifiés comprenaient l'âge <25 ans, le fait d'avoir plusieurs partenaires sexuels, la non-utilisation de préservatifs, un statut socio-économique faible et la co-infection par le VIH, avec des associations rapportées avec l'infertilité tubaire. **Discussion** : La grande variabilité de la prévalence s'explique en partie par les différences entre les populations étudiées et les méthodes de diagnostic. Les tests sérologiques surestiment souvent l'exposition passée, tandis que la PCR et les NAAT détectent plus précisément les infections actives. Ces résultats soulignent la nécessité d'étendre les tests moléculaires et de cibler les populations à haut risque afin de prévenir les complications, en particulier l'infertilité tubaire. **Conclusion** : La chlamydiose génitale reste sous-diagnostiquée en Afrique subsaharienne. **Mots-clés** : *Chlamydia trachomatis*, Afrique subsaharienne, prévalence, facteurs de risque, chlamydiose génitale.

INTRODUCTION

Infection with *Chlamydia trachomatis* (*C. trachomatis*) is one of the most common curable bacterial sexually transmitted infections (STIs) worldwide and represents a major public health concern because of its substantial impact on sexual and reproductive health (1,2). Transmission occurs primarily through sexual contact - vaginal, anal, or oral - but vertical transmission from mother to child during childbirth is also well documented (3). A defining characteristic of genital chlamydia is its frequently asymptomatic course: a large proportion of infected individuals, both men and women, exhibit no clinical symptoms. This silent nature facilitates ongoing transmission and makes diagnosis highly dependent on routine screening rather than symptom-driven healthcare seeking (2,3).

In the absence of early diagnosis and appropriate treatment, *C. trachomatis* infection can lead to severe and long-term complications. In women, untreated infection is associated with pelvic inflammatory disease, tubal factor infertility, and ectopic pregnancy, as well as adverse pregnancy outcomes such as preterm birth and low birth weight (2,3-5). Perinatal exposure may result in neonatal conjunctivitis or pneumonia, both of which are largely preventable through maternal screening and treatment during pregnancy (3,5). In addition, bacterial STIs, including *C. trachomatis*, have been shown to increase susceptibility to human immunodeficiency virus (HIV) acquisition and to enhance HIV transmission, highlighting the importance of integrated STI and HIV prevention strategies, particularly in high-prevalence settings (4,6).

Globally, the burden of *C. trachomatis* remains substantial. The World Health Organization (WHO) estimated that approximately 128.5 million new *C. trachomatis* infections occurred worldwide in 2020, with a global prevalence of 4.0% among women and 2.5% among men (3). More broadly, an estimated 374 million new cases of curable STIs (chlamydia, gonorrhea, syphilis, and trichomoniasis) occur annually, underscoring the scale of the problem and the urgent need to strengthen prevention, testing, and treatment efforts (4).

Low- and middle-income countries (LMIC), many of which are in SSA, bear a disproportionate share of this burden (4,7). In this region, available epidemiological data reveal marked heterogeneity in reported prevalence across countries, study populations, and diagnostic methods (2). A review by Dubbink et al. in 2018, based on 102 prevalence estimates from 24 African countries, found lower prevalence in community-based surveys (3.9%) compared with primary healthcare settings (6.0%), and 5.5% among high-risk groups such as sex workers (9). These variations reflect differences in population characteristics, healthcare access, and - critically - the diagnostic tools used to detect *C. trachomatis* infection.

Pregnant women represent a particularly vulnerable population in SSA and warrant special attention. Data from antenatal care settings indicate that *C. trachomatis* prevalence can be substantial, especially in the presence of HIV co-infection (8). Early detection and treatment during pregnancy could significantly reduce neonatal complications and prevent vertical transmission (5,6). In some settings, prevalences exceeding 10% have been reported among pregnant women or in specialized HIV clinics, with even higher levels observed in high-risk populations such as women with infertility or sex workers (5,7).

The epidemiology of *C. trachomatis* infection in SSA is shaped by a complex interplay of individual and structural determinants. Individual-level risk factors include young age, multiple sexual partners, early sexual debut, inconsistent or non-use of condoms, and low educational attainment. Structural factors - such as poverty, population mobility, rapid urbanization, gender inequalities, socio-cultural norms limiting negotiation of safer sex, and restricted access to quality health services - further exacerbate vulnerability and hinder effective prevention and control (5,7,9).

Accurate diagnosis of genital chlamydia relies primarily on nucleic acid amplification tests (NAATs), which offer high sensitivity and specificity. However, the implementation of these diagnostic methods is constrained in many sub-Saharan African countries by limited laboratory infrastructure, shortages of trained personnel, and unreliable supply chains (10,11). As a result, syndromic management and serological testing - both of which have limited utility for detecting

active infection - remain widely used. In response, the WHO recommends strengthening people-centered health services, integrating STI testing into primary healthcare, reproductive health and HIV programs, and expanding access to reliable diagnostic tools, including validated rapid tests where appropriate (4,11).

Although several reviews have examined STIs or specific subpopulations in SSA, few provide a comprehensive synthesis of both prevalence estimates and associated risk factors for genital *C. trachomatis* infection across diverse populations and over an extended time (2,6,9). Given ongoing diagnostic advances, persistent gaps in surveillance, and evolving international recommendations, an updated and integrated review was needed to better characterize the prevalence estimates and risk factors of *C. trachomatis* in SSA.

In this context, the objective of this systematic review was to compile and critically analyze data published between 1990 and 2025 on the prevalence and risk factors of genital *C. trachomatis* infection in SSA. The review includes data from the general population, pregnant women, sex workers, and people living with HIV. It was aimed to address gaps in the existing literature and to provide evidence to support the development and adaptation of national and regional strategies for the prevention and control of *C. trachomatis* infection.

METHODOLOGY

1. Study Design and Reporting Standards: **This** study was a systematic review of published observational studies conducted to synthesize available evidence on the prevalence and risk factors of genital *C. trachomatis* infection in SSA from 1990 to 2025. The review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

2. Data Sources and Search Strategy

2.1 Data Sources:

We performed a comprehensive literature search using the following electronic databases: PubMed/MEDLINE, Web of Science, African Journals Online (AJOL), and Google Scholar. We conducted searches for articles published between January 1990 and April 2025, without restriction on countries within SSA. We developed search terms using combinations of Medical Subject Headings (MeSH) and free-text keywords related to *Chlamydia trachomatis*, prevalence, risk factors, and geographic location. The search strategy included the following Boolean combinations:

2.2 English Search Strategy:

We used the following search terms ("*Chlamydia trachomatis*" OR "chlamydia infection" OR "genital chlamydia" OR "urogenital chlamydia" OR "sexually transmitted chlamydia" OR "silent infection") AND ("prevalence" OR "risk factors" OR "epidemiology") AND ("sub-Saharan Africa" OR "Africa south of the Sahara" OR "West Africa" OR "Central Africa" OR "Southern Africa" OR "Francophone sub-Saharan Africa" OR "Anglophone sub-Saharan Africa"). Our search terms included the names of individual countries in each region in SSA. We used equivalent search terms in French. Reference lists of included articles were also manually screened to identify additional relevant studies.

2.3 Eligibility Criteria

3.1 Inclusion Criteria:

We included studies that met the following criteria:

- Reported data on the prevalence and/or risk factors of genital *C. trachomatis* infection;
- Conducted in one or more countries in SSA;
- Published in English or French between 1990 and 2025;
- Employed recognized diagnostic methods, including culture, antigen detection assays, polymerase chain reaction (PCR), or other nucleic acid amplification tests (NAATs);
- Included one or more of the following populations: general population, pregnant women, adolescents or young adults, sex workers, people living with HIV, or infertile women;
- Observational study designs (cross-sectional, cohort, or case–control studies).

3.2 Exclusion Criteria

We did not include the following studies:

- Narrative reviews, systematic reviews, editorials, letters to the editor, and non-scientific reports;
- Animal or in vitro experimental studies;
- Studies without extractable prevalence or risk factor data;
- Conference abstracts without full-text availability.

Study Selection Process:

All identified references were imported into Zotero reference management software, and duplicates were removed. Study selection was conducted in three sequential stages: (i) screening of titles, (ii) screening of abstracts, and (iii) full-text review. Each stage was independently performed by at least two (2) reviewers. Discrepancies were resolved through discussion, and when necessary, by consultation with a third reviewer. Only studies meeting all inclusion criteria after full-text assessment were included in the final review.

2.4 Data Extraction

Two (2) reviewers independently extracted data using a standardized data extraction form. Extracted information included: author(s), year of publication, country, study design, study population, sample size, diagnostic method, prevalence estimates, identified risk factors, and key outcomes related to reproductive health (e.g., infertility or pregnancy outcomes). We resolved any discrepancies in data extraction by consensus.

2.5 Quality Assessment
Two (2) reviewers independently assessed the methodological quality and risk of bias of included studies using an appropriate standardized appraisal tool for observational studies (e.g., Joanna Briggs Institute or Newcastle–Ottawa Scale). We did not include studies based on quality assessment, but we did consider study quality during the interpretation of their findings.

RESULTS
1. Study Selection: The literature search across PubMed/MEDLINE, Web of Science, Google Scholar, and African Journals Online identified a total of 754 articles. After removal of duplicates and initial screening of titles according to the inclusion criteria, 57 articles were retained for abstract review. Following abstract screening, four (4) articles were excluded due to the absence of abstracts and three (3) were excluded for failure to meet the inclusion criteria. Consequently, we assessed 50 articles for full-text eligibility. Of these, one (1) article was excluded due to unavailability of the full text and two were excluded because their full content did not meet the inclusion criteria. In total, 47 studies were included in the final systematic review (**Figure 1**).
2. Geographic Distribution of Included Studies : Among the 47 included studies, Nigeria contributed the largest number of articles, accounting for nearly half of all publications (22/47; 46.8%). Cameroon and South Africa each contributed five (5) studies (5/47; 10.6%), followed by Kenya with three studies (3/47; 6.4%). Gabon and Ghana each contributed two (2) studies (2/47; 4.3%). The remaining countries - Benin, Chad, Côte d'Ivoire, Guinea Conakry, Rwanda, Senegal, Tanzania, and Zimbabwe - were each represented by one (1) study (1/47; 2.1%) (**Figure 2**). This distribution highlights substantial geographic disparities in the availability of published data on genital *C. trachomatis* infection across SSA, with a concentration of studies in a few countries.
3. Characteristics of Included Studies : Table I summarizes the methodological and geographical characteristics of the 47 studies (12-58) included in this systematic review. The studies demonstrate substantial heterogeneity in terms of study design, populations investigated, biological samples collected, and diagnostic methods used to detect *C. trachomatis* infection across SSA.
A wide range of biological specimens were used, including urine, vaginal, cervical, endocervical, urethral, anal, blood, serum, and plasma samples. Earlier studies, particularly those conducted in the 1990s and early 2000s, predominantly relied on conventional diagnostic approaches such as cell culture, direct immunofluorescence, antigen detection assays, and serological methods (ELISA). Over time, there has been a gradual shift towards more sensitive and specific molecular techniques, including polymerase chain reaction (PCR), real-time PCR (RT-PCR), strand displacement amplification (SDA), and other nucleic acid amplification tests (NAATs), especially in studies published after 2010.
Women of reproductive age constituted the most frequently studied population, reflecting the public health importance of genital *C. trachomatis* infection in relation to reproductive outcomes, pregnancy complications, and infertility. Several studies focused specifically on pregnant women, infertile women, sex workers, or people living with HIV. Although men were less frequently included, a growing number of recent studies have investigated *C. trachomatis* infection in male populations, using urine, urethral, or anal specimens.
Geographically, the distribution of studies was uneven. Nigeria (N=22) accounted for nearly half of all included publications, followed by Cameroon (N=5) and South Africa (N=5). Other countries were represented by only one (1) or two (2) studies. This uneven distribution highlights substantial gaps in published epidemiological data on genital *C. trachomatis* infection across many countries in SSA.
Table IIa presents the prevalence estimates of *C. trachomatis* infection reported in the included studies between 1990 and 2025. We observed considerable heterogeneity across countries, populations, and diagnostic methods. Prevalence ranged from less than 1% in studies using antigen-based tests to over 60% in serological studies conducted among women in healthcare settings. Higher prevalences were consistently reported among younger age groups, women with infertility, people living with HIV, and key populations such as sex workers and men who have sex with men. Studies employing molecular diagnostics generally reported lower prevalence estimates than those relying on serological assays.
Table IIb summarizes studies reporting associations between *C. trachomatis* infection and infertility, HIV infection, or adverse reproductive and pregnancy outcomes between 1990 and 2025. Several studies documented significantly higher prevalence or seropositivity rates among infertile women compared with fertile controls, as well as increased odds of tubal pathology. Elevated prevalence was also reported among people living with HIV and among key populations, including sex workers and men who have sex with men, with some studies noting frequent co-infection with other sexually transmitted infections. Additionally, selected studies identified associations between *C. trachomatis* infection and adverse pregnancy outcomes, including preterm birth.

Table III summarizes the main risk factors associated with infection by *Chlamydia trachomatis* in SSA between 1990 and 2025. Across several countries, the most consistently reported factors include young age (particularly <25 years old), multiple sexual partners, early sexual debut, non-use of condoms, and single marital status. Clinical factors such as HIV co-infection and tubal pathology were also associated with chlamydia infection.

4. Regional Prevalence of *C. trachomatis* in SSA (1990–2025)

4.1 West Africa : In Nigeria, reported prevalence estimates of *C. trachomatis* varied widely, from very low (3.5% (30), 3.5% (34), 0.7% (45), 2% (47)) to very high (29.4% (29), 31.7% (31), IgG 38.7% / PCR 7.3% (32), 40.7% (33)). Prevalence was notably higher among women with infertility or tubal pathology (IgG 74.0% vs. 51.0% controls (37), 38.3% vs. 13.3% controls (38), 49.8% (39)). Younger age groups (15 - 29 years old) consistently demonstrated higher prevalence. In Benin, a low prevalence of 3.3% was reported among men aged 24 - 61 years old by RT-PCR (12), while in Côte d'Ivoire, 10.8% of symptomatic women were infected (18). In Guinea Conakry, prevalence was 25.8% among participants aged 17-67 years old (23), and Senegal recorded 28.5%, largely among asymptomatic women (50). In Ghana, prevalence was 20.4% among adults ≥17 years old (21), whereas PCR-detected prevalence was low (2.4% vs. 1.6%), with higher seroprevalence in infertile women (IgG 39.0% vs. 19.0%; IgA 14.0% vs. 3.0%) (22).

4.2 Central Africa: Cameroon displayed substantial heterogeneity in prevalence estimates. Lower rates were reported (3.8%; females 4.0%, males 3.6% among participants ≤25 years old and >25 years old) (13) and 7.0% IgM seropositivity in 18–35 years old (14). Higher rates were observed in 45.7% (IgG 42.5%, IgM 15.4%; peak 28.3% among 18–24 years old) (15), 62.3% IgG/IgM in 18–55 years old (16), and 38.3% in 17 – 66 years old (17). In Gabon, a 24% decrease in prevalence from 2007-2010 followed by a 14.0% increase in 2011 was reported (19), while 15.8% prevalence among 21-40 years old was observed (20). In Chad, a prevalence of 10.7% was reported, with the highest burden observed among individuals aged 25 - 35 years old (57).

4.3 East Africa: In Tanzania, prevalence was moderate at 4.6%, with 7.3% of participants presenting co-infections with other STIs (56). In Zimbabwe, a relatively low prevalence of 5.8% was detected using strand displacement amplification (SDA) (58). In Rwanda, prevalence remained low and stable, with no significant difference between infertile and fertile women (3.3 - 3.8%) (49).

4.4 Southern Africa: In South Africa, high prevalence levels were reported, particularly among women, with marked variation according to fertility and pregnancy status. A case–control study reported prevalence rates of 35.9% among cases compared with 7.3% among controls (51). More recent studies reported 10.0% prevalence using PCR (52) and an overall prevalence of 32.1%, with higher rates in women (39.2%) than in men (15.5%) (53). A prospective cohort study identified LGV biovars in approximately 20.0% of infections (54). Additionally, a significant association between *C. trachomatis* infection and adverse pregnancy outcomes was observed, with higher prevalence among women who delivered preterm compared with those delivering at term (22.2% vs. 10.4%, p = 0.037) (55).

Across all regions in SSA, *C. trachomatis* infection was strongly associated with high-risk sexual behaviors, including multiple sexual partners, inconsistent condom use, and coexisting STIs. Odds ratios reported in Cameroon (OR = 3.89 and OR = 2.62) (13) highlight the impact of insufficient prevention practices.

5. Risk Factors of C. trachomatis Infection: Limited knowledge about the infection was also identified as an important factor contributing to ongoing transmission (Table III).

Across the studies included in this review, several demographic, behavioral, and clinical factors were consistently associated with *C. trachomatis* infection (**Table III**).

Age emerged as a key determinant, with young women - particularly those under 25 years old - at the highest risk. A 2- to 5-fold increased risk was reported among women aged 15–24 years old, while being single was associated with nearly a fourfold higher risk (OR = 3.83) (20). Similarly, a cohort study among female sex workers reported an incidence of 27.6 per 100 person-years in women younger than 25 years old, compared with 8.4 and 2.6 per 100 person-years in older age groups, confirming that sexually active young women constitute the primary risk population (24).

Behavioral factors also played a significant role. Multiple sexual partnerships, early sexual debut, and irregular or non-use of condoms were consistently associated with increased infection risk in studies conducted in Cameroon (13,14) and Nigeria (31,34). In addition, limited knowledge and awareness of sexually transmitted infections contributed to vulnerability, as demonstrated in Cameroon, where low awareness of chlamydia was significantly associated with infection (16).

Clinical and reproductive factors were particularly prominent in Nigeria, where *C. trachomatis* infection showed a strong association with tubal infertility. OR of 4.0 and 3.52 indicate a robust relationship between infection and infertility, with prevalence among affected women reaching 63.9% (27,43). Marital status - including being divorced, married, or

single - also modulated risk across multiple settings (35,39).

Co-infections with other sexually transmitted pathogens were frequently reported. A Tanzanian study documented a co-infection prevalence of 7.3%, underscoring the need for integrated STI screening strategies, as chlamydia often occurs alongside other infections (56). In Chad, the highest prevalence (5.4%) was observed among individuals aged 25-35 years old, suggesting that *C. trachomatis* infection risk may persist beyond adolescence and early adulthood in certain contexts (57).

Overall, the risk of *C. trachomatis* infection is shaped by a complex interplay of age, marital status, sexual behavior, reproductive health status, and co-existing infections. These findings highlight the need for targeted prevention strategies, routine screening, and comprehensive sexual health education, particularly among young women and populations at risk of infertility or STI co-infection.

This review highlights the **heterogeneous epidemiology of** *Chlamydia trachomatis* **infections across SSA**, with prevalence estimates ranging from less than 1.0% to over 60.0%, depending on the sub-region, population studied, and diagnostic method (**Tables I–III**). Variability reflects not only geographical differences but also methodological heterogeneity, including the use of culture, serology, rapid tests, and molecular methods such as PCR and NAAT.

DISCUSSION

1. Regional Prevalence Patterns

1.1 West Africa: In West Africa, prevalence estimates vary widely. In Benin, Azonbakin et al. (2025) report 3.3% by RT-PCR among men, with infections linked to sperm abnormalities such as leukocytospermia and necrozoospermia, potentially leading to epididymitis and obstructive infertility (12). Côte d'Ivoire shows a prevalence of 10.8% among symptomatic women (18), lower than in Senegal and Guinea, reflecting differences in diagnostic sensitivity (18,59,60). In Guinea, Mamadou et al. (2022) report 25.8% seroprevalence among 17–67 years old, with approximately one-third showing subfertility associated with sperm abnormalities (23). Senegalese sex workers exhibit a high prevalence of 28.5%, with genotypes D and E predominating and many infections being asymptomatic (50,60–62). In Ghana, hospital-based studies show a 20.4% overall prevalence, with serology indicating 39% IgG positivity among infertile women, while PCR detection remains low, suggesting that many cases represent prior or persistent infections rather than active infection (21,22,63,64).

Nigeria is the most extensively studied country, displaying **substantial heterogeneity**. Seroprevalence among women, especially those with tubal infertility, frequently reaches 30 - 40.0%, whereas PCR-based studies generally report lower rates but confirm ongoing active transmission (37-39,43). Some studies report extremely high rates (up to 49.8% in infertile women), while others show very low prevalences (<1.0 - 3.5%), underscoring regional and methodological differences (44 – 47).

1.2 Central Africa: In Cameroon, prevalence ranges from 3.8% among students to over 40% in certain cohorts of women, with genotype E predominating (13,15–17). Gabonese women of childbearing age show 15.8% seroprevalence, with young age (15–24 years old) and single marital status significantly increasing risk (19,20). Chad reports a prevalence of 10.7% among sexually active adults, highlighting a substantial burden in young adults (57).

1.3 East Africa: Data were more limited but indicated ongoing transmission. In Tanzania, Juliana et al. (2020) report 4.6% prevalence among pregnant women, often occurring as co-infections with other STIs (~7.3%) (56). In Kenya, sex workers have a high incidence of 5/100 person-years, whereas prevalence in the general female population is around 6%, mostly asymptomatic (24–26). Rwanda shows low and stable prevalence (3.3–3.8%) between fertile and infertile women, with serology poorly predictive of tubal pathologies (49).

1.4 Southern Africa: Southern Africa reports some of the highest prevalence rates. In South Africa, nearly 40% of women are infected compared to approximately 15% of men, with high rates among infertile women (51,53). LGV strains contribute to disease burden; despite effective single-dose azithromycin therapy, reinfections and untreated partners limit overall cure rates (54). In Zimbabwe, prevalence among pregnant women is relatively low at 5.8%, highlighting the need for early detection in this group (58).

2. Risk Factors

Demographic and behavioral factors consistently associated with infection include **young age, single marital status, multiple sexual partners, early sexual debut, and inconsistent condom use** (**Tables IIa–III**). Studies in Cameroon, Gabon, and Kenya confirm that sexually active young women (<25 years old) are at highest risk (20,24). In Nigeria, tubal infertility strongly correlates with infection, with OR of 4.0 and 3.52, and prevalence reaching 63.9% in affected women (27,43). Co-infections with other STIs have occurred in approximately 7.0% of cases, emphasizing the importance of integrated screening (56). While young women are typically the main risk group, Chad shows a peak in prevalence among adults aged 25–35 years old (57). Other risk factors include socio-economic determinants (low education, low income) and history of STIs, abortion, or ectopic pregnancy. Evidence regarding hormonal

contraception and HIV remains inconsistent (16,24,50,53).

3. Diagnostic Methods

Molecular techniques, including PCR and NAAT, are substantially more sensitive than culture or serology for detecting active infections, making them the preferred tools in both clinical and epidemiological settings (17,22,32,49). Serology remains valuable for assessing cumulative exposure and risk of tubal sequelae, particularly in infertile women. Rapid tests offer practical advantages in resource-limited settings, though sensitivity varies (25,52,58). Many studies emphasize an **integrated approach combining serology and molecular diagnostics** to obtain both reliable prevalence estimates and accurate detection of active cases.

4. Study Limitations: Despite a rigorous methodology and comprehensive search across multiple databases from 1990 to 2025, this review has several limitations. Relevant publications, particularly from local or unindexed African journals, may have been missed, and restricting the search to English and French may have introduced language bias. The long study period covers substantial changes in diagnostics, health policies, and risk behaviors, complicating longitudinal comparisons. Variations in study populations, definitions, and diagnostic methods, along with heterogeneous study quality, sampling, and incomplete data, limit comparability. The exclusion of grey literature and the lack of formal meta-analysis further constrain the generalizability and statistical precision of the findings, particularly across underrepresented SSA.

CONCLUSION

Available data from SSA confirm that *C. trachomatis* infection represents a major reproductive health problem, particularly in the occurrence of tubal infertility and male sperm abnormalities. The reported prevalences vary considerably from region to region, ranging from low rates observed in Ghana and some Nigerian cohorts, to intermediate levels in East Africa, to very high values in Southern Africa. These differences reflect both distinct epidemiological realities and notable methodological limitations, related to the heterogeneity of diagnostic techniques, the small sample sizes and the frequent lack of confirmation by molecular reference tests. In sum, the results highlight that asymptomatic C. *trachomatis* infections, often misunderstood and underdiagnosed, contribute significantly to the burden of female infertility. STIs, multiple partners and low condom use appear to be recurrent risk factors. However, the diversity of social and cultural contexts, as well as the scarcity of longitudinal studies, limit the scope of the conclusions.

RECOMMENDATIONS AND FUTURE DIRECTIONS

Based on the findings of this systematic review, several research and public health priorities are recommended. First, future studies should include a formal meta-analysis of genital Chlamydia trachomatis prevalence in SSA as a whole or in a specific region in SSA, with particular attention to trends before and after the COVID-19 pandemic, to assess potential disruptions in screening and care. Second, standardized multicenter studies and longitudinal cohort designs are needed to better document the natural history of asymptomatic *C. trachomatis* infection and its long-term consequences, particularly tubal infertility.

From a public health perspective, routine screening for *C. trachomatis* should be strengthened within gynaecology, reproductive health, antenatal, and premarital care services, especially for young women and other high-risk groups. Diagnostic accuracy should be improved through increased use of molecular tests, such as nucleic acid amplification tests, which better detect active infections. In parallel, targeted awareness and education programs should be expanded to inform adolescents and women of reproductive age (15-49 years) about the reproductive health consequences of untreated chlamydia infection. Finally, the systematic integration of *C. trachomatis* screening, treatment, and partner management into national sexual and reproductive health policies is essential to sustainably reduce the burden of infection and protect fertility in SSA.

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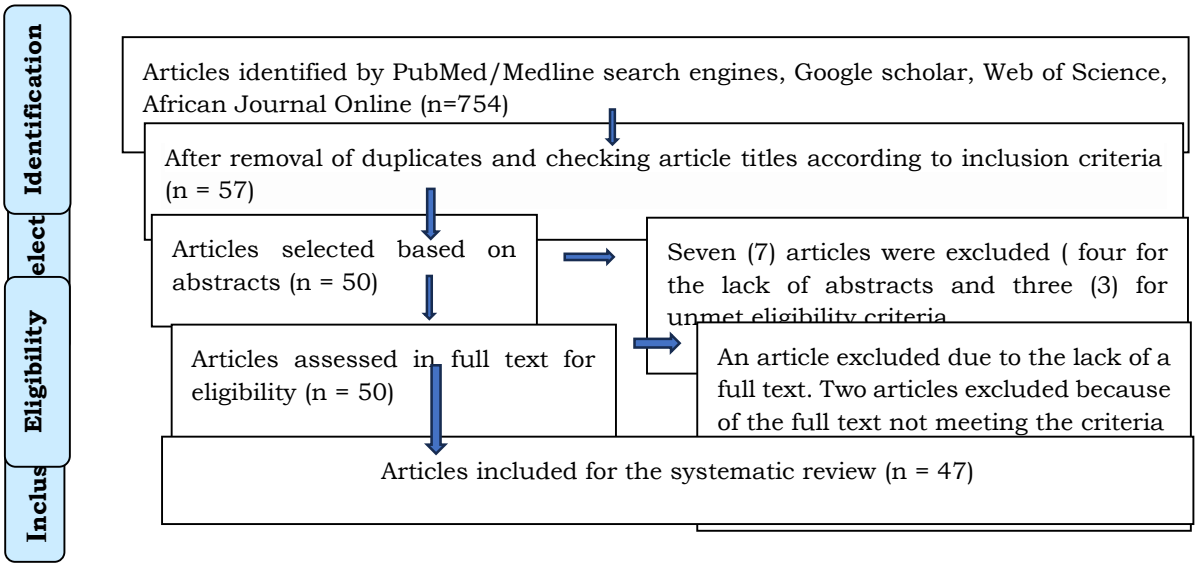


Figure 1: Flow diagram of articles included in the systematic review

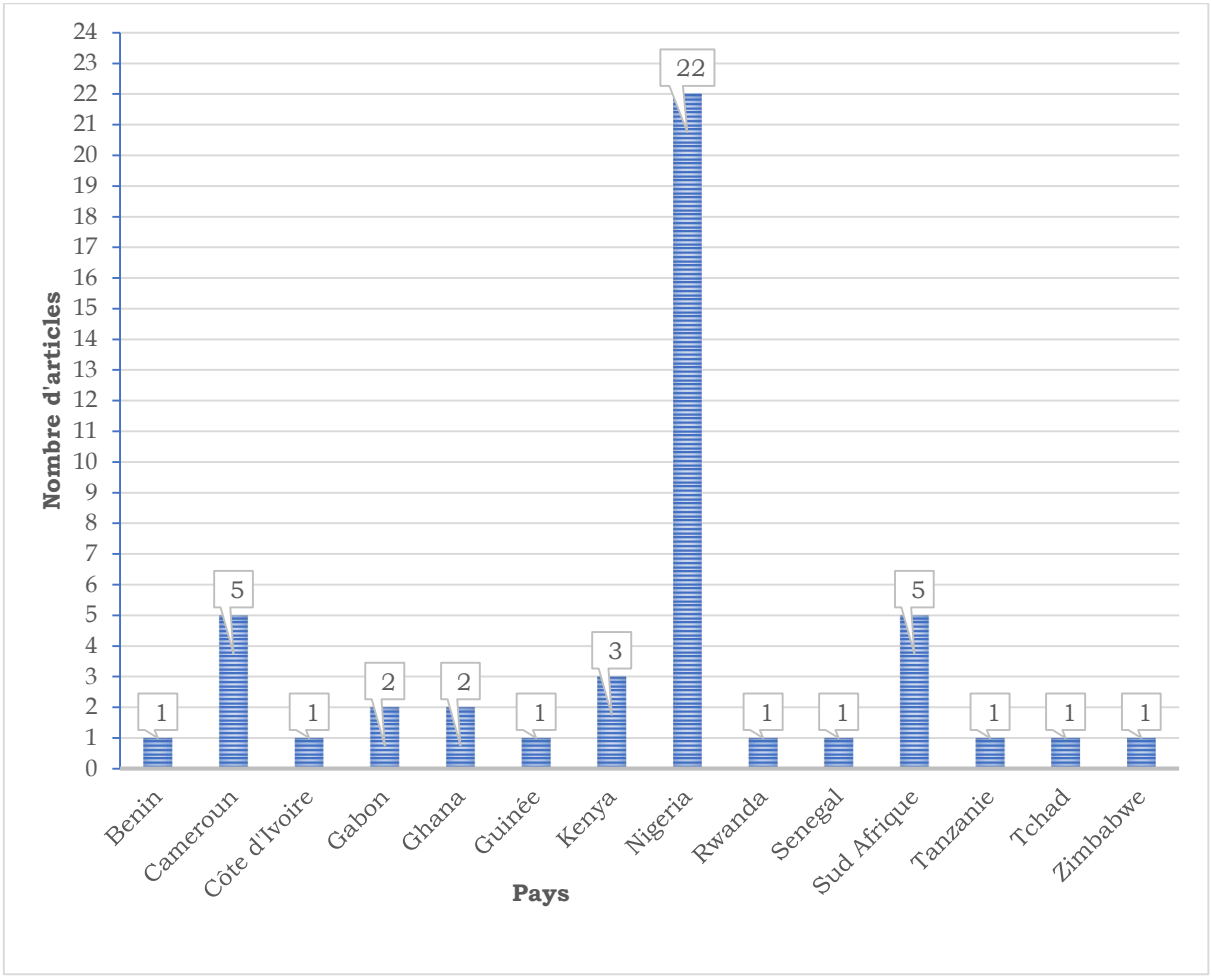


Figure 2: Number of Selected Articles by Country in SSA

Table I. Characteristics of Studies Included in the Systematic Review of Genital *C. trachomatis* infection in SSA (1990 - 2025)

Country	Author(s), Year	Study Design	Study Period	Study Population	Specimen Type	Diagnostic Method	Ref.
Benin	Azonbakin et al., 2025	Cross-sectional	Mar.–Dec. 2023	Men	Urine	RT-PCR	[12]
Cameroon	Ngandjio et al., 2003	Not specified	May–Jul. 2001	Men and women	Cervical, urethral	Direct immunofluores-cence, PCR (Cobas)	[13]
Cameroon	Shalanyuy et al., 2025	Cross-sectional	Feb.–Mar. 2025	Men and women	Serum	Rapid IgM/IgG cassette test	[14]
Cameroon	Bobga et al., 2025	Cross-sectional	Not specified	Men and women	Serum	ELISA (IgG/IgM)	[15]
Cameroon	Sama et al., 2021	Cross-sectional	Nov. 2016–Jun. 2017	Women	Serum	ELISA	[16]
Cameroon	Tadongfack et al., 2021	Analytical cross-sectional	Jul.–Sep. 2020	Women	Serum	ELISA	[17]
Côte d'Ivoire	Bankolé et al., 2001	Cross-sectional	Not specified	Women	Endocervical	Cell culture	[18]
Gabon	Djoba Siawaya et al., 2014	Cross-sectional	2007–2013	Men and women	Serum	ELISA	[19]
Gabon	Massolou Makaya et al., 2025	Retrospective cross-sectional	Jan. 2022–Dec. 2024	Women (15–49 years old)	Serum, plasma	RT-PCR	[20]
Ghana	Nyarko et al., 2014	Cross-sectional	Oct. 2005–Mar. 2006	Women (15–49 years old)	Endocervical swab	PCR	[21]
Ghana	Siemer et al., 2008	Case-control	Nov. 2002–Feb. 2003	Women	Urine, serum	PCR, ELISA	[22]
Guinea	Mamadou et al., 2022	Prospective descriptive	Jan.–Dec. 2019	Men	Serum	ELISA	[23]
Kenya	Masese et al., 2013	Cohort	Aug. 2006–Dec. 2010	Female sex workers	Endocervical swab	NAAT (Aptima GC/CT)	[24]
Kenya	Kohli et al., 2013	Cross-sectional	Jul.–Nov. 2010	Sexually active women	Vaginal swab	Rapid test	[25]
Kenya	Nyakambi et al., 2023	Cross-sectional	Jun. 2021	Women	Vaginal swab	Rapid diagnostic test	[26]
Nigeria	Olamijulo & Olaleye, 2018	Case–control	Mar.–Sep. 2012	Fertile and infertile women	Serum, endocervical	ELISA, antigen test	[27]
Nigeria	Crowell et al., 2018	Cohort	Apr. 2014–Jul. 2016	Men	Anal swab	PCR	[28]

Table I. Characteristics of Studies Included in the Systematic Review of Genital *C. trachomatis* infection in SSA (1990 - 2025)

Country	Author(s), Year	Study Design	Study Period	Study Population	Specimen Type	Diagnostic Method	Ref.
Nigeria	Ikeme et al., 2011	Not specified	2010	Women	Serum	ELISA	[29]
Nigeria	Ige et al., 2018	Not specified	Feb.–Jul. 2013	Women (15–49 years old)	Endocervical swab	PCR	[30]
Nigeria	Ajani et al., 2019	Cross-sectional	Nov. 2017–Jul. 2018	Women	Serum	ELISA	[31]
Nigeria	Ajani et al., 2018	Cross-sectional	Jan.–Nov. 2015	Women	Serum, endocervical	ELISA, PCR	[32]
Nigeria	Okoror et al., 2007	Not specified	Not specified	Men & women	Blood, genital samples	CCFA, Giemsa staining	[33]
Nigeria	Bello et al., 2019	Cross-sectional	Jun. 2014–Apr. 2015	Women	Endocervical	Rapid antigen test	[34]
Nigeria	Nwankwo & Magaji, 2014	Not specified	Jun.–Dec. 2012	Men & women	Urine, genital swabs	Rapid test	[35]
Nigeria	Garba et al., 2018	Not specified	Jul.–Sep. 2017	Women	Serum	ELISA	[36]
Nigeria	Jeremiah et al., 2011	Case–control	Sep. 2008–Feb. 2009	Women	Serum	ELISA	[37]
Nigeria	Tukur et al., 2006	Case–control	May–Aug. 2002	Women	Endocervical	Rapid antigen test	[38]
Nigeria	Lawal et al., 2021	Cross-sectional	Sep. 2018–Feb. 2019	Women	Serum	Quantitative ELISA	[39]
Nigeria	Abiodun et al., 2025	Cross-sectional	May–Sep. 2021	Women	Urine, vaginal	NAAT	[40]
Nigeria	Ogedengbe et al., 2020	Analytical cross-sectional	Feb.–Oct. 2009	Women	Blood	IgG immunoassay	[41]
Nigeria	Ajani et al., 2017	Cross-sectional	Jan.–Nov. 2015	Women	Blood, endocervical	PCR	[42]
Nigeria	Odelola & Akadri, 2023	Comparative cross-sectional	Mar. 2018–Jul. 2020	Women	Serum	ELISA	[43]
Nigeria	Akinnibosun & Onyemekeihia, 2018	Not specified	Jan.–Mar. 2015	Women	Serum	ELISA	[44]
Nigeria	Adesiji et al., 2020	Not specified	Not specified	Women	Endocervical	Rapid test	[45]

Table I. Characteristics of Studies Included in the Systematic Review of Genital *C. trachomatis* infection in SSA (1990 - 2025)

Country	Author(s), Year	Study Design	Study Period	Study Population	Specimen Type	Diagnostic Method	Ref.
Nigeria	Aliyu et al., 2023	Cross-sectional	Jan.–Apr. 2018	Women 15-49 years old	Serum	ELISA	[46]
Nigeria	Ekpiwre et al., 2020	Cross-sectional	Not specified	Women	Endocervical	Rapid test	[47]
Nigeria	Morhason-Bello et al., 2014	Observational	Not specified	Women	Blood	IgG immunoassay	[48]
Rwanda	Muvunyi et al., 2012	Not specified	Nov. 2007–Mar. 2010	Women	Serum, vaginal	ELISA, PCR	[49]
Senegal	Sturm-Ramirez et al., 2000	Cohort	Jun. 1996–Jan. 1997	Female sex workers	Endocervical swab	PCR	[50]
South Africa	Wessels et al., 1991	Case-control	Not specified	Women	Endocervical	Immunofluorescence	[51]
South Africa	Abbai-Shaik et al., 2016	Pilot study	Jun.–Jul. 2015	Men	Urine	Rapid test, PCR	[52]
South Africa	Mafokwane & Samie, 2016	Not specified	Apr.–Nov. 2010	Women	Urine	RT-PCR	[53]
South Africa	Peters et al., 2021	Prospective cohort	Not specified	Women	Vulvovaginal swab	NAAT (CT & LGV)	[54]
South Africa	Odendaal et al., 2006	Cross-sectional	Pregnancy (16–23 weeks)	Pregnant women	Endocervical	PCR	[55]
Tanzania	Juliana et al., 2020	Retrospective cohort	Mar. 2018–Jan. 2019	Pregnant women	Vaginal swab	RT-PCR	[56]
Chad	Ossoga et al., 2023	Cross-sectional	Oct.–Dec. 2021	Women 15-49 years old	Serum	Rapid IgG test	[57]
Zimbabwe	Stephen et al., 2017	Cross-sectional	Jan.–Apr. 2012	Women	Endocervical	Rapid test, SDA	[58]

*"Not specified" indicates insufficient methodological detail in the original publication CT: C. trachomatis
ELISA : Enzyme-Linked Immunosorbent Assay GC : *Neisseria gonorrhoeae* IgG: Immunoglobulin G,
LGV: lymphogranuloma venereum NAAT: nucleic acid amplification test PCR: Polymerase Chain Reaction
Ref.: Reference, RT-PCR: Real time – PCR, SDA: strand displacement amplification Reproductive age : 15–49 years old

*"Not reported" indicates insufficient methodological detail in the original publication CI : Confidence Interval
IgG: Immunoglobulin G, IgM: Immunoglobulin M, PCR: Polymerase Chain Reaction RT-PCR: Reverse Transcriptase – PCR,
SDA: strand displacement amplification Y.O : Years old

Table IIa. Prevalence of Genital *C. trachomatis* infection in SSA (1990–2025)

Country	Author(s), Year	Age Range	Sample Size	Prevalence Estimate	Reference
Benin	Azonbakin et al., 2025	24–61 y.o	90	3.3% (RT-PCR)	[12]
Cameroon	Ngandjio et al., 2003	≤25 y.o, >25 y.o	1,277	3.8% overall (women 4.0%; men 3.6%)	[13]
Cameroon	Shalanyuy et al., 2025	18–35 y.o	100	7.0% (IgM seropositivity)	[14]
Cameroon	Sama et al., 2021	18–55 y.o	204	62.3% seroprevalence (IgG/IgM)	[16]
Cameroon	Tadongfack et al., 2021	17–66 y.o	154	38.3% seroprevalence	[17]
Côte d'Ivoire	Bankolé et al., 2001	Not reported	1,522	10.8% among symptomatic women	[18]
Gabon	Djoba Siawaya et al., 2014	13–85 y.o	14,667 / 9,542	Temporal variation: −24% (2007–2010), +14% (2011)	[19]
Gabon	Massolou Makaya et al., 2025	21–40 y.o	594	15.8% (95% CI)	[20]
Ghana	Nyarko et al., 2014	≥17 y.o	186	20.4% prevalence	[21]
Guinea	Mamadou et al., 2022	17–67 y.o	469	25.8% prevalence	[23]
Kenya	Kohli et al., 2013	18–45 y.o	300	6.0% (95% CI 3.3–8.7)	[25]
Kenya	Nyakambi et al., 2023	18–49 y.o	385	7.5% (18–25 yrs: 5.7%)	[26]
Nigeria	Ikeme et al., 2011	20–34 y.o	286	29.4% (highest in 20–24 yrs)	[29]
Nigeria	Ige et al., 2018	15–49 y.o	400	3.5% prevalence	[30]
Nigeria	Ajani et al., 2019	15–45 y.o	145	31.7% seroprevalence	[31]
Nigeria	Ajani et al., 2018	20–40 y.o	150	IgG: 38.7%; PCR: 7.3%	[32]
Nigeria	Okoror et al., 2007	6–45 y.o	565	40.7% culture-positive	[33]
Nigeria	Bello et al., 2019	15–49 y.o	400	3.5% prevalence	[34]
Nigeria	Nwankwo & Magaji, 2014	14–55 y.o	125	9.6% prevalence	[35]
Nigeria	Garba et al., 2018	≤25–45 y.o	200	9.5% prevalence	[36]
Nigeria	Adesiji et al., 2020	20–45 y.o	140	0.7% (antigen test)	[45]
Nigeria	Aliyu et al., 2023	15–44 y.o	150	6.7% prevalence	[46]
Nigeria	Morhason-Bello et al., 2014	20–44 y.o	132	20.5% prevalence	[48]
Rwanda	Muvunyi et al., 2012	21–45 y.o	615	3.5% overall	[49]
Senegal	Sturm-Ramirez et al., 2000	22–58 y.o	722	28.5%; mostly asymptomatic	[50]
South Africa	Abbai-Shaik et al., 2016	≥18 y.o	100	10.0% (PCR)	[52]
South Africa	Mafokwane & Samie, 2016	19–72 y.o	243	32.1% overall	[53]

Table IIa. Prevalence of Genital *C. trachomatis* infection in SSA (1990–2025)

Country	Author(s), Year	Age Range	Sample Size	Prevalence Estimate	Reference
Tanzania	Juliana et al., 2020	16–48 y.o	439	4.6% (95% CI 2.8–6.9)	[56]
Chad	Ossoga et al., 2023	14–70 y.o	168	10.7% prevalence	[57]
Zimbabwe	Stephen et al., 2017	≥18 yrs	242	5.8% (SDA)	[58]

*"Not reported" indicates insufficient methodological detail in the original publication CI : Confidence Interval ; IgG: Immunoglobulin G, IgM: Immunoglobulin M; PCR: Polymerase Chain Reaction RT-PCR: Reverse Transcriptase – PCR, SDA: strand displacement amplification Y.O : Years old

Table IIb. *C. trachomatis* Infection Associated with Infertility, HIV infection, and Pregnancy Outcomes in SSA

Country	Author(s), Year	Population	Sample size	Key Outcomes	Ref.
Ghana	Siemer et al., 2008	Infertile vs fertile women	439	PCR: 1.6–2.4%; IgG: 39% infertile vs 19% controls	[22]
Kenya	Masese et al., 2013	Female sex workers	865	Incidence 5.0/100 PY; 5.9% NG co-infection	[24]
Nigeria	Olamijulo & Olaleye, 2018	Infertile vs fertile women	180	OR CT infection = 4.0; OR tubal infertility = 3.52	[27]
Nigeria	Crowell et al., 2018	MSM	420	15.7% anorectal CT; 5.2% LGV; frequent HIV co-infection	[28]
Nigeria	Jeremiah et al., 2011	Subfertile vs fertile women	100	IgG: 74% vs 51% (p<0.001)	[37]
Nigeria	Tukur et al., 2006	Infertile vs fertile women	120	38.3% vs 13.3% controls	[38]
Nigeria	Lawal et al., 2021	Infertile women	273	49.8% CT prevalence; tubal pathology	[39]
Nigeria	Abiodun et al., 2025	Infertile vs fertile women	120	10% vs 1.7% (p=0.057)	[40]
Nigeria	Ogedengbe et al., 2020	HIV-positive vs HIV-negative	120	45.0% vs 43.3%	[41]
Nigeria	Odelola & Akadri, 2023	Infertile vs fertile women	147	63.9% vs 25.2% (p=0.001)	[43]
Nigeria	Akinnibosun & Onyemekeihia, 2018	Infertile women	50	24–52% prevalence	[44]
Nigeria	Ekpiwre et al., 2020	HIV-positive vs HIV-negative	100	4.5% vs 0%	[47]
Rwanda	Muvunyi et al., 2012	Infertile vs fertile women	615	3.3% vs 3.8%	[49]
South Africa	Wessels et al., 1991	Cases vs controls	81	35.9% vs 7.3%	[51]
South Africa	Peters et al., 2021	Women	85	LGV biovar detected	[54]
South Africa	Odendaal et al., 2006	Pregnant women	343	22.2% preterm vs 10.4% term (p=0.037)	[55]

Table III: Risk Factors Associated with *C. trachomatis* Infection in SSA (1990–2025)

Country	Author / Year	Associated Risk Factors	Measure (OR / CI / p-value / Prevalence)	Reference
Cameroon	Ngandjio et al., 2003	Non- or irregular condom use (women); history of STI (men)	OR = 3.89 (1.15–13.21), p = 0.026; OR = 2.62 (1.16–6.01), p = 0.023	[13]
Cameroon	Hubert Shalanyuy, 2025	Multiple sexual partners; early sexual activity; risky sexual practices	p = 0.005; p = 0.02	[14]
Cameroon	Sama et al., 2021	Marital status; low knowledge of Chlamydia	p = 0.03; p = 0.001	[16]
Gabon	Massolou Makaya et al., 2025	Age 15–19 years old; age 20–24 years old; single status	OR = 2.32 (1.26–4.18), p = 0.004; OR = 4.74 (2.78–8.1), p ≤ 0.001; OR = 3.83 (2.3–6.55), p ≤ 0.001	[20]
Kenya	Masese et al., 2013	Age <25 years old	Incidence 27.6/100 person-years (<25) vs. 8.4 (25–34) and 2.6 (≥35)	[24]
Nigeria	Olamijulo & Olaleye, 2018	Chlamydia infection & tubal infertility	OR = 4.0 (1.47–10.88); OR = 3.52 (1.46–8.49)	[27]
Nigeria	Ajani et al., 2019	Age 15–25 years old; non-use of condoms; ≥2 lifetime partners	Prevalence 65.2% in 15–25 years old, p < 0.05	[31]
Nigeria	Bello et al., 2019	Age <29 years old; early sexual debut; marital status	High risk (p not specified)	[34]
Nigeria	Nwankwo & Magaji, 2014	Age 20–29 years old; married/divorced vs. single	Prevalence 16.7–17.1% (age); divorced 33.3%	[35]
Nigeria	Lawal et al., 2021	Tubal pathology (tubal blockage)	66.2% vs. 33.8%, p < 0.05	[39]
Nigeria	Odelola & Akadri, 2023	Tubal infertility	63.9% vs. 25.2%, p = 0.001	[43]
Tanzania	Juliana et al., 2020	Co-infections with other pathogens	Co-infection prevalence 7.3%	[56]
Chad	Ossoga et al., 2023	Age 25–35 years old	Prevalence 5.36%	[57]