



# Prevalence and Associated Factors of Genital *Chlamydia trachomatis* Infection among Women of Childbearing Age in Endemic and Non-Endemic Regions of Tanzania

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## Abstract

**Background:** *Chlamydia trachomatis* is the most common sexually transmitted bacterium, affecting 128.5 million people annually worldwide, leading to reproductive sequelae in women. Despite its burden, data on genital chlamydia among childbearing age women in Tanzania remain scarce. This study determined the prevalence and factors associated with genital chlamydia among childbearing age women in *C. trachomatis* endemic and non-endemic regions.

**Materials and Methods:** A cross-sectional study was conducted from May to October 2024, where 400 women attending maternal and child health clinics in selected district hospitals were enrolled. Recruitment criteria were sexually active women aged 18 to 45 years. Sociodemographic, sexual behaviours and symptoms data were collected using a questionnaire. Endocervical specimens were tested using the polymerase chain reaction. The association between chlamydia infection and demographic factors, sexual behaviours, and symptoms was assessed using univariate logistic regression. Variables were further analysed in a multivariable logistic regression model to determine independent factors for chlamydia infection. Crude and adjusted odds ratios were calculated at 95% confidence interval and a statistical significance value at  $p < 0.05$ . Data analysis was performed using SPSS version 23.

**Results:** The prevalence of chlamydia was 2.3%. Women residing in non-endemic regions were less likely to test positive for chlamydia (AOR= 0.2; 95% CI:0.008-0.9). Women over 25 years of age had a decreased likelihood of testing positive for chlamydia (AOR=0.1;95%CI:0.01-0.71). Women who had a new sexual partner within the past six months had an increased likelihood of testing positive for chlamydia (AOR=6.1; 95%CI 1.8-34.3). Marital status, education level, employment status, age at sexual debut, number of lifetime partners, condom use, alcohol, drug use, previous infection with STIs, symptoms and knowledge of chlamydia were not associated with chlamydia.

**Conclusion:** Genital chlamydia prevalence was low among women of childbearing age. Factors associated with genital chlamydia infection were younger age, a new sexual partner in the past six months and living in endemic areas for *C. trachomatis*. These findings highlight the need for targeted screening and prevention strategies among high-risk women.

**Keywords:** *Chlamydia, Prevalence, Associated Factors, Women, Tanzania*

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## Introduction

*Chlamydia trachomatis* is an obligate intracellular gram-negative bacterium comprised of 19 genotypes<sup>1</sup>. Genotypes A-C cause ocular chlamydia, while genotypes D-K and L1-L3 cause genital chlamydia<sup>1</sup>. Genital

chlamydia is the most prevalent sexually transmitted bacterial infection, affecting 128.5 million people annually worldwide<sup>2</sup>. Highest prevalence is reported in the American region (6.8%), followed by Africa (5.5%)<sup>3</sup>, with Sub-Saharan Africa reporting rates up to 7.8%<sup>4</sup>. In Tanzania, genital chlamydia prevalence ranges



from 1.7 to 36.2%<sup>5-14</sup>. The Lake Zone reports the highest rates (2.6-36.2%)<sup>5, 6, 7</sup>, followed by the Northern Highlands Zone (1.0-17.5%)<sup>8, 9</sup>, Coastal Zone (1.7-12.5%)<sup>10, 11, 12</sup> and Southern Highlands (4.9-11%)<sup>13, 14</sup>. Data from the Central zone are limited, with existing studies focusing on ocular chlamydia as the area is endemic to ocular *C. trachomatis*.

In Tanzania, like other low-income countries, the high prevalence of chlamydia is partly attributed to limited access to sensitive diagnostic tests<sup>15</sup>. Additionally, 70-80% of infected women are asymptomatic<sup>2</sup> resulting in delayed diagnosis and sustained transmission. Untreated infection may ascend to the upper genital tract, causing pelvic inflammatory diseases (PID), infertility, chronic pelvic pain, ectopic pregnancy, premature rupture of membrane, preterm birth and neonatal infection<sup>16, 17</sup>. Furthermore, chlamydia increases the risk of *Human Papillomavirus*<sup>18</sup> and HIV acquisition<sup>19</sup>. These chlamydia features require timely and accurate diagnosis or screening.

Screening has reduced PID, ectopic pregnancy and neonatal infections in developed countries<sup>20, 21</sup>. However, developing countries like Tanzania rely on syndromic case management<sup>22</sup>, which has low sensitivity for cervical and asymptomatic infection<sup>23</sup>. Moreover, conventional diagnostic tests for chlamydia have low sensitivity<sup>24</sup>, and many cases remain undetected. Molecular-based tests are the gold standard for chlamydia diagnosis; however, they are inaccessible in resource-limited settings<sup>15</sup>.

In Tanzania, studies on genital chlamydia have focused on high-risk populations, including women attending STI clinics<sup>5, 14</sup>, infertile women<sup>7</sup>, pregnant women<sup>10, 12</sup> and maternal and child health clinic attendees<sup>11</sup>. Additionally, the prevalence of genital chlamydia among women attending maternal and child health clinics was based on a conventional test in 2015<sup>11</sup>. This study aimed to determine the prevalence of genital chlamydia and associated factors among childbearing age women visiting maternal and child health clinics in *C. trachomatis* endemic

and non-endemic regions, using polymerase chain reaction (PCR).

## Materials and Methods

### Study design and study area

This was a cross-sectional study conducted from May to October 2024. The study was conducted in Makole and Chamwino district hospitals in Dodoma and Ubungo and Mwananyamala hospitals in Dar es Salaam. Ocular *C. trachomatis* remains a public health problem in certain areas of Dodoma. Thus, Dodoma was chosen as an endemic region for *C. trachomatis*. Dar es Salaam is a non-endemic region for ocular *C. trachomatis* and was selected as the non-endemic region.

### Study population

The study population included women of reproductive age visiting maternal and child health clinics in Chamwino and Makole hospitals in Dodoma urban districts in Dodoma region and Ubungo and Mwananyamala hospitals in Ubungo and Kinondoni districts in Dar es Salaam region. Sexually active women, aged 18 to 45 years, who signed a consent form and were willing to provide specimens were included in the study. Any woman on an antibiotic or treated with an antibiotic in the past three weeks was excluded from participating.

### Sample size

Cochran's formula<sup>25</sup> was used to calculate sample size using a 95% confidence interval, and the previous prevalence of chlamydia at 36.2%<sup>7</sup>, and a 5% margin of error. Assuming a nonresponse rate of 10%, 400 women were enrolled.

### Sampling

A multi-stage sampling approach was employed. Two districts, Chamwino and Dodoma urban, were randomly selected from *C. trachomatis*-endemic areas, and two districts, Kinondoni and Ubungo, were randomly selected from non-endemic areas. District hospitals within these districts were then selected as study sites. Eligible women attending reproductive and child health clinics at these hospitals were recruited consecutively



during routine visits. Women who met the inclusion criteria and provided written informed consent were enrolled

### Data collection

Women were interviewed on sociodemographic factors, sexual behaviours, symptoms and knowledge of chlamydia using a questionnaire. Subsequently, the gynaecologist collected endocervical specimens.

### Laboratory procedures

Extraction of chlamydia DNA from endocervical swabs was performed using ZymoBIOMICS DNA Kit (Inqaba Biotech, South Africa) following the manufacturer's instructions. The DNA templates were amplified using PCR and *C. trachomatis*-specific primers. NLO(5'ATGAAAAAAGCTCTTGAAATCG3'), NRO 5'CTCAACTGTAAGTGCATTT3'), CTP2 (5'-TTCCCCTTGTAATTCGTTGC-3') and CTP1 (5'-TAGTAACTGCCACITCATCA-3') following published protocol<sup>26</sup>. After electrophoresis in 1.5% agarose gel, we visualised the PCR products using a gel documentation system.

### Statistical analysis

Data were coded, entered and cleaned. Descriptive statistics were performed, and categorical variables were denoted as percentages and continuous variables as mean and standard deviation. The relationship between explanatory variables and the dependent variable was analysed using univariate logistic regression. Variables were further analysed in a multivariable logistic regression to determine independent predictors for chlamydia infection. The dependent variable was chlamydia infection status (positive vs. negative). Crude and Adjusted odds ratios were calculated at 95% confidence interval, and the statistical significance was set at  $p < 0.05$ . Adjusted odds ratios reflect the association between each listed predictor variable and chlamydia infection (outcome), controlling for all other variables in the model. Analysis was performed using SPSS version 23. Results were presented in tables based on

sociodemographic factors, sexual behaviour factors and symptoms.

### Ethical considerations

National Health Research Ethics Committee provided Ethical clearance (NIMR/HQ/R.8a/Vol. IX 3720). Women signed consent forms before data collection, and data were kept on a password-protected computer.

## Results

### Participants characteristics

The study enrolled 400 participants with a mean age of 28.0 years (SD  $\pm 6.8$ ). Of these, 51.0% were from non-endemic regions, 56.0% were aged over 25 years, 52.0% had attained secondary education or higher, 41.0% were married, and 66.8% were employed (Table 1).

The mean age at sexual debut was 18 years (1.85 SD), although most women (58.8%) had their first sex after 18 years, 30.3% of the participants had more than two life partners, 21.3% had a new sexual partner in the past six months. Additionally, 26% reported condom use, while 26.5% had intercourse under the influence of alcohol. A very small proportion 1.3% were drug users, 28% had a history of STI, 2.3% were HIV positive, and 87.5% did not know chlamydia (Table 2).

Symptoms reported by the participants included abnormal vaginal discharge (29.7%), dysuria (28.8%), vaginal itch (22.8%), lower abdomen pain (10.0%) and post-coital bleeding (19.8%) (Table 3).

### Prevalence of genital chlamydia

Prevalence of genital chlamydia was 2.3% (9/400) (95% CI: 2.27–2.33). The prevalence was 1.8% in the endemic region and 0.5% in the non-endemic region.

### Factors associated with genital chlamydia

In multivariable logistic regression, age and residence area were independently associated with *C. trachomatis* infection. Women residing in a non-endemic region had significantly lower odds of infection compared to those in an endemic region (AOR = 0.2; 95% CI:0.008-0.9). Similarly, women over 25 years



had a decreased likelihood of testing positive for chlamydia compared to women  $\leq 25$  years (AOR = 0.1;95%CI:0.01-0.71). Other demographic factors, such as marital status,

education level and employment status, were not associated with chlamydia infection (Table1).

**Table 1**

*Association Between Sociodemographic Factors and Genital Chlamydia among Childbearing Age Women Attending Maternal and Child Health Clinics in Tanzania*

Variables		N 400	Ct positive n (%)	Genital chlamydia			
				COR 95% CI	p-value	AOR 95%CI	p-value
Residence	Ct endemic region	196	7(3.6)	1			
	Non-endemic region	204	2(0.9)	0.3(0.05-1.3)	0.10	0.2(0.008-0.9)	0.04*
Age group	$\leq 25$ years	175	8(4.5)	1			
	$>25$ years	225	1(0.4)	0.1(0.01-0.7)	0.01	0.2(0.01-0.71)	0.02*
Education level	Secondary and above	193	4(2.0)	1			
	No education and primary	207	5(2.4)	1.2(0.3-4.42)	0.81	3.5(0.48-24.8)	0.22
Employment	Not employed	133	4(3.0)	1			
	Employed	267	5(1.9)	0.6(0.16-2.3)	0.48	0.46(0.06-32)	0.43
Marital status	Married/cohabiting	158	5(3.2)	1			
	Single	242	4(1.7)	1.9 (0.5-7.35)	0.32	1.5(0.02-12.2)	0.73

**Key:** COR-Crude Odds Ratio, AOR-Adjusted Odds Ratio, CI-Confidence Interval, \* Independent factors for genital chlamydia

**Table 2**

*Association between Sexual Behaviour Factors and Genital Chlamydia among Childbearing Age Women Attending Maternal and Child Health Clinics in Tanzania*

Variable		N 400	Ct positive n (%)	Genital chlamydia			
				COR 95% CI	p-value	AOR 95%CI	p-value
Age at first sex	$<18$ years	168	4(2.4)	1			
	$\geq 18$ years	232	5(2.2)	0.3(0.04-2.4)	0.24	0.1(0.004-1.8)	0.12
Lifetime partners	One	109	2(1.8)	1			
	Two	170	4(2.4)	1.3(0.2-7.1)	0.77	3.3(0.2-53.8)	0.4
	$>Two$	121	3(2.5)	1.4(0.2-8.2)	0.74	4.9(0.24-104.3)	0.3
New partner in past 6 months	No	236	2(0.8)	1			
	Yes	164	7(4.3)	5.2(1.1 -25.4)	0.04	6.1(1.8-34.3)	0.02*
Condom use	No	298	5(4.9)	1			
	Yes	102	4(1.3)	0.42(0.11-1.5)	0.20	0.5(0.09-2.96)	0.45
Sex under alcohol influence	No	254	6(2.4)	1			
	Yes	146	3(2.1)	1.4(0.4-5.3)	0.60	1.6(0.1-4.1)	0.64
Drug use	No	395	8(2.0)	1			
	Yes	5	1(20.0)	1.2(1.2-120.6)	0.13	1.6(3.9-648.2)	0.11
Chlamydia knowledge	No	350	9(2.3)	1			
	Yes	50	0(0.0)	0.9(0.95-0.97)	0.61	0.29(0.04-2.08)	0.21
History of STIs	Yes	290	8(2.0)	1			
	No	110	1(0.3)	0.3(0.04-2.65)	0.29	0.15(0.007-3.2)	0.22

**Key:** COR-Crude Odds Ratio, AOR-Adjusted Odds Ratio, CI-Confidence Interval, \* Independent factors for genital chlamydia

Regarding sexual behaviour, having a new sexual partner in the past six months was independently associated with genital *C. trachomatis* infection. Women who had a new sexual partner in the past six months were 6 times more likely to test positive for chlamydia compared to women who did not have a sexual partner in the past six months (AOR =6.1;95% CI 1.8-34.3). Other sexual behaviour factors (age at sexual debut, number of lifetime partners, condom use, alcohol and drug use, history of STI and knowledge of chlamydia) were not significant. (Table 2). None of the signs or symptoms reported by participants were independently associated with genital *C. trachomatis* infection (Table 3).

## Discussion

The prevalence of genital chlamydia was low, and it was attributed to the advanced age of the participants (mean age 28 years). Evidence suggests that women aged 15 to 25 years are at high risk of chlamydia infection due to anatomical susceptibility and risky sexual behaviours compared to women over 25years<sup>27</sup>. Women between 15 and 17 years were excluded from the study, and this may have contributed to the low prevalence.

In this study, chlamydia prevalence was high compared to the prevalence reported by Majigo *et al* using an antigen test<sup>11</sup>. However, our findings were consistent with findings from

Masatu *et al* (2.6%)<sup>6</sup> and Chiduo *et al* (3.0%)<sup>10</sup> and prevalence reported in other countries, such as the USA (2.0%)<sup>28</sup> and Belgium (1.5%)<sup>29</sup>.

In contrast, chlamydia prevalence in this study was lower than the prevalence reported in Northwestern Tanzania at 14%,<sup>5</sup> and 36.2% in Mwanza city<sup>7</sup> The difference in prevalence between previous studies and our study is attributed to the difference in the diagnostic tests used and the population studied. Previous studies were conducted among high-risk women, including STI clinic attendees<sup>5</sup> and infertile women<sup>7</sup>. Infertile women have been reported to have a higher prevalence of chlamydia than the general population<sup>30</sup>. Additionally, a higher prevalence of chlamydia was reported among STI clinic attendees<sup>31</sup>.

The prevalence in this study was lower than the prevalence of 7.5% reported in Kenya,<sup>32</sup> 26% in Nigeria<sup>33</sup>, 18.9% in Ethiopia<sup>34</sup> and 26.5% in Uganda<sup>35</sup>. Differences in the risk factors, diagnostic tests used, and availability and access to chlamydia interventions in individual countries may have contributed to the difference in prevalence between countries.

In this study, women aged  $\leq 25$  years had an increased likelihood of testing positive for chlamydia compared to women over 25 years old. The finding aligns with the report that young adults and adolescents are more likely to be infected with chlamydia<sup>36</sup>.

**Table 3**

*Association between Symptoms and Genital Chlamydia among Childbearing Age Women Attending Maternal and Child Health Clinics in Tanzania*

Variables		N 400	Ct positive n (%)	Genital chlamydia			
				COR 95% CI	p-value	AOR 95%CI	p-value
Vaginal discharge	No	281	7(2.5)	1			
	Yes	119	1(0.8)	0.67(0.13-3.26)	0.62	0.52(0.04-5.94)	0.60
Lower abdominal pain	No	360	7(1.9)	1			
	Yes	40	2(5.0)	2.8(0.5-14.7)	0.21	1.12(0.02-5.6)	0.96
Post-coital bleeding	No	321	7(2.2)	1			
	Yes	79	2(2.5)	1.18(0.2-5.7)	0.84	1.13(0.22-6.34)	0.95
Dysuria	No	286	8(2.8)	1			
	Yes	114	1(0.8)	0.31(0.43-2.51)	0.27	0.11(0.004-2.99)	0.18
Vaginal itch	No	309	5(1.6)	1			
	Yes	91	4(4.4)	2.8(0.7-10.6)	0.13	2.83(0.44-18.28)	0.27

**Key:** COR-Crude Odds Ratio, AOR-Adjusted Odds Ratio, CI-Confidence Interval



Similar findings were reported in China<sup>27</sup>, Kenya<sup>32</sup>, Uganda<sup>35</sup>, Fiji Island<sup>37</sup> and Brazil<sup>38</sup>. The high prevalence among younger women could be because they are sexually active and are more likely to engage in risky sexual practices that predispose them to chlamydia<sup>39</sup>. Additionally, the presence of ectopy in the cervix of young women predisposes them to chlamydia acquisition<sup>40</sup>.

On the other hand, some studies have reported high prevalence of chlamydia among women over 25 years<sup>33,41</sup>. Socioeconomic status, availability and access to preventive services have been reported to influence chlamydia prevalence<sup>26,42</sup>. In addition, research indicates that sexual debut at a younger age is more likely to lead to a high number of lifetime sexual partners, which puts these women at risk of chlamydia acquisition<sup>9</sup>. Thus, chlamydia control interventions should target young and older women with known risk factors to reduce transmission and the financial burden associated with chlamydia sequelae.

Having a new sexual partner has been reported to increase the risk of chlamydia acquisition<sup>43</sup>. Although the number of lifetime sexual partners, age at first sex, condom, alcohol and drug use were not associated with chlamydia in this study, interventions addressing inconsistent condom use and factors contributing to sexual activity at a young age, such as excessive use of alcohol and drug abuse, are crucial in controlling chlamydia and other STIs.

Reported symptoms were not associated with chlamydia infection, and this aligns with findings in Ethiopia<sup>34</sup>, Uganda<sup>35</sup>, and Fiji Island<sup>37</sup>. The lack of association between symptoms and chlamydia could be because chlamydia infection occurs in the endocervical, and interviewed women may have subclinical infections that could not display any symptoms. Studies show that over 70% of chlamydia infected women are asymptomatic resulting in delayed diagnosis and continued transmission<sup>28,37</sup>. This highlights

the importance of aetiologic diagnosis and screening for chlamydia.

Knowledge of chlamydia was low, as most women did not know what chlamydia was. This finding conforms with that of Oreh and Ekwunife<sup>44</sup>, who found low levels of chlamydia knowledge among women in Nigeria. The lack of health education on genital chlamydia could have contributed to low knowledge levels among participants in this study. Notably, campaigns on chlamydia in Tanzania have focused on ocular chlamydia, indicating the need for health education on genital chlamydia.

### Study Limitations

Due to the nature of this study, some women may have responded based on societal expectations rather than the actual sexual behaviour, and they may have introduced social desirability bias, particularly for sensitive questions like recent STIs and the number of sexual partners. Additionally, participants are often reluctant to provide information on sensitive issues like drug abuse; hence, reporting bias may have occurred. Despite limitations, the study is valuable and provides information to the Ministry of Health and other stakeholders for chlamydia control interventions.

### Conclusions

Genital chlamydia prevalence among women of childbearing age in both endemic and non-endemic areas for *C. trachomatis* in Tanzania was low. Young age ( $\leq 25$  years), residing in a *C. trachomatis* endemic area, and having a new partner in the past six months were independent factors associated with genital *C. trachomatis* infection. Signs and symptoms were not associated with genital chlamydia infection.

### Recommendations

We recommend targeted sexual and reproductive health interventions, including routine screening of sexually active young women and health promotion emphasising safer sexual practices, to address asymptomatic infections and prevent reproductive health



complications. Future studies should include women aged 15-18 years and other risk factors

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### Authors' contributions

RHS, LAN, and JHM designed the study and developed the protocol. RHS collected data and performed laboratory tests. JHM and RHS performed data entry, cleaning, and analysis. RHS, LAN, and JHM prepared the initial draft of the manuscript, reviewed it, and approved the final version through collaboration.

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