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Detection of Chlamydia trachomatis Antigen and Associated Risk Factors among HIV Positive Men in a Tertiary Health Institution, South-West Nigeria

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ABSTRACT

Chlamydia trachomatis (CT) infection in the genitourinary tract is the most prevalent bacterial sexually transmitted disease (STD) worldwide. Genital chlamydial infection has a huge impact on sexual and reproductive health, and it is very common in developed and developing countries. The aim of this study is to determine the prevalence of *Chlamydia trachomatis* antigen and identify associated risk factors among HIV positive and HIV negative adult male patients attending National Institute of Medical Research (NIMR),Yaba, Lagos state,Nigeria. A total of 318 male subjects (159 HIV positive and 159 HIV negative) between the aged of 18-50 years and above were recruited for the study. A structured questionnaire was administered to the study participants to collection their sociodemographic and clinical information. Urine sample was collected from each participant and were analyzed for the presence of CT antigen using One-Step Chlamydia Rapid Diagnostic Test kit (GIMA, Italy) and the results were interpreted according to the manufacturer interpretation guide. Out of the 159 test samples of the HIV positive men analyzed for uro prevalence of CT antigen, 5 (1.6%) were positive for CT antigen, while 154 (48.4%) were negative. Meanwhile, out of the 159 control samples of the HIV negative men analyzed, only 1(0.3%) person was found to be positive for CT antigen. The remaining 158 subjects (49.7%) were negative. Risk factors that are very important for the occurrence of CT antigen amongst the study participants include: marital status (P=0.013) and number of sexual partner (P=0.014). The outcome of this study shows that CT antigen (1.6%) exists among HIV positive men attending the HIV clinic at National Institute of Medical Research (NIMR), Yaba, Lagos State. Hence, the clarion calls for the facility to include *C. trachomatis* antigen testing in their routine screening for HIV patients.

Introduction

Chlamydia trachomatis, the aetiology of chlamydia, is a coccoid bacillus that is closely linked to Gram-negative bacteria [1]. The organism is a member of the Chlamydia genus, which also contains organisms formerly referred to as PLT (*Psittacosis Lymphogranuloma venerum Trachoma* group) or TRIC (*Trachoma Inclusion Conjunctivitis* group) species [2]. There are fifteen (15) serotypes of *Chlamydia trachomatis*. These include L1-L3 which causes lymphogranuloma venerum (associated with genital ulcer disease in tropical countries), D-K which causes genital tract infection and trachoma (chronic conjunctivitis common in Africa and Asia). *Chlamydia trachomatis* serovars D-K are responsible for the treatable STD Chlamydia [3]. One of the most common sexually transmitted diseases in the globe is the illness that results from an infection of the lower genital tract [4]; Beagley and Timms, 2000). The World Health Organization [5], estimates that 101 million chlamydial infections occur each year globally. According to the Centers for Disease Control and Prevention, 2.8 million Americans contract the disease annually [3]. More than 90% of the population in some third-world nations is infected with *Chlamydia trachomatis* [6]. Chlamydial infection is often without symptoms; in fact, 50% of men and 80% of women do not exhibit any symptoms, which is why it is known as the "silent disease" [3,7]. If symptoms are present, they might merely last a few days, go unnoticed, or not be given much weight. Itching in the urethra, frequent and painful urination, sores on the penis, scrotum, or anus, penile itching, and discharge that may be watery, white, or hazy are among the clinical signs in males when they are present. Infection can virtually spread to any part of the body (lungs, heart, eyes, muscles, prostate gland, etc.). Impotence is a critical complication of chlamydial infection in men [3,8].

Chlamydial infections that are symptomatic lead to a two- to five-fold increase in HIV transmission and acquisition. Chlamydial blisters and sores can worsen HIV infection, lower CD4 counts, and increase viral loads in patients who already have the virus. On the other hand, having HIV makes one more likely to get a neurochlamydial infection. It might affect chlamydial's clinical characteristics and treatment outcomes. HIV infection might be linked to treatment failure for chlamydial, particularly if neurochlamydial was diagnosed later than expected. Additionally, Chlamydia can mimic several clinical manifestations and harm HIV-positive patients' cardiovascular and neurological systems severely. Epidemiological research has also demonstrated that untreated genital Chlamydia infection increases the likelihood of heterosexual Human Immunodeficiency Virus (HIV) transmission. Consequently, CTI screening in high-risk populations can help with the development of HIV risk reduction strategies [9]. It is a known fact that Chlamydia causes localized inflammations and immunological reactions that are marked by the increase and infiltration of immune cells with C surface proteins necessary for HIV binding prior to entrance, which also makes HIV more likely to enter the body [7,9] and therefore an important risk factor for the development of genital tracts infection among the HIV infected individuals. This is not unconnected to the weak immune status of such individuals. However, since infection with *C. trachomatis* is effortlessly curable, early detection and treatment of infected sufferers is important to halt the cycle of infection among the populace [11].

Even though it is treatable, *Chlamydia trachomatis* genital infection is one of the most common bacterial sexually transmitted diseases [12,13]. The WHO estimates that 92 million new cases of *C. trachomatis* infection occur annually worldwide, with roughly two-thirds of these infections occurring in underdeveloped countries with limited access to diagnostic and treatment options [13]. The majority of *Chlamydia trachomatis* infection (CTI) epidemiological data comes from industrialized countries. Unfortunately, trustworthy data from resource-poor developing nations with high burden of the disease is not readily available. However, despite this challenge in data gathering, it's still crucial to scientifically document the frequency and prevalence of CTI from the poor world using laboratory tests. To the best of our knowledge, no work has been done to assess the prevalence of *Chlamydia trachomatis* antigen among HIV positive men on HAART attending the HIV clinic at the Nigerian Institute of Medical Research (NIMR), Lagos state, Nigeria. Besides there is need to identify risk factors that predispose male individuals in this setting to *Chlamydia trachomatis* infection. Scarcity of information in this regard, therefore, necessitates this study.

Materials and Methods

Study Design

This is prospective institutional-based research.

Study Area

This epidemiologic study was carried out among male HIV patients attending HIV clinic at the Nigerian Institute of Medical Research (NIMR), Yaba, Lagos State, Nigeria. NIMR is a government-own research institute which deals with human genomics studies among other things. Yaba is a geographical area located in Lagos state, Nigeria coordinates: 6.5095°N, 3.3711°

Study Duration

The research was carried out between the months of May- July 2022.

Study Population

Adult males aged 18 and older who were HIV and non-HIV positive participated in this cross-sectional institution-based study in Lagos State, Nigeria.

Sample Size Calculation

The sample size for this study was determined using the following formula [14]:

$$N = \frac{Z^2 XP(1-P)}{D^2}$$

Where:

N= minimum sample size required

Z= confidence interval (1.96)

P= prevalence rate of HIV *Chlamydia trachomatis* co-infection in a tested population

D= desired level of significance (0.05)

The minimal sample size required was calculated using a 95 percent confidence interval, a P value of 0.019, *i.e.*, a prevalence rate of 10.2 percent for HIV-*Chlamydia trachomatis* co-infection among male patients from a prior study [15], and a margin of error (d) of 0.05. To reduce errors caused by the possibility of non-compliance, 10% of the sample size was added.

$$N = \frac{Z^2 XP(1-P)}{D^2}$$

Z =1.96

= 10.2% [15].

d = 0.05

$N = 1.96^2 \text{x } 0.102 \ (1\text{-}0.102)$

$(0.05)^2$

$N = 3.8416 \text{ x } 0.102 \text{ x } 0.898$

0.0025

$N = 0.3519$

0.0025

$N = 140.76$

N=141

10% of 104: 10/100 x 1 41= 14.1 = 14

Sample size is therefore 141+ 14 = 155

The sample size is 155, based on a prevalence of 10.2% [15]. The number was scaled up to 159 for homogeneity and precision. Since the study's goal is to test for *Chlamydia trachomatis* in two groups of participants: HIV-positive (Test) and non-HIV-positive (Control), A total sample size of 318 was obtained by multiplying the computed sample size by two (2).

Sample Size

A total of 318 samples (blood and urine) were collected 159 HIV-positive and 159 HIV-negative men attending the Nigerian Institute of Medical Research in Yaba, Lagos State.

Ethical Consideration

Ethical clearance was obtained from the Babcock University Health Research Ethics Committee (BUHREC), with ethical registration number: BUHREC 547/22, while the management of the National Institute of Medical Research, Yaba, Lagos State, gave administrative approval before the commencement of the study.

Eligibility of Subjects

Inclusion Criteria

HIV positive and HIV negative males attending the National Institute of Medical Research in Yaba, Lagos State, who are at least eighteen years old and have not received antibiotic therapy in the previous two weeks were randomly selected for the research.

Exclusion Criteria

HIV positive and HIV negative males under the age of 18 who were visiting the Nigerian Institute of Medical Research, Yaba, Lagos State, and who have been on antibiotic therapy in the last two (2) weeks were excluded from the study.

Consent

Each participant was given informed consent. Following a thorough explanation of the study's objective and nature, as well as the method of sample collection, participants voluntarily completed the permission form in their own handwriting and sign it as proof of their desire to supply samples for the test. They were assured that their information is kept private.

Blood Sample Collection for HIV Detection

Two (2) ml of venous blood samples were collected into plain bottles and allowed to clot to obtain the sera from the patients.

Urine Sample Collection for Chlamydia trachomatis Detection

Five milliliters (5 ml) of first catch morning urine were obtained from the HIV and non-HIV patient and taken to the laboratory for the detection of *Chlamydia trachomatis* antigen.

Specimen Transportation and Storage

The blood and urine samples were sent to the Department of Medical Laboratory Science, Babcock University, Ilishan-Remo, Ogun State and evaluated within two hours after collection. All samples were transferred to the laboratory as quickly as feasible and processed on the same day they were collected. Each participant's sample was taken and labeled on the specimen container with their unique identification number. The samples were pro-

cessed as quickly as possible, they were not stored. But where delay was envisaged, they were kept in the refrigerator at 2-8^{0}C.

Laboratory Analyses

HIV Detection

The current National HIV sero-diagnosis methodology was used for HIV detection. This entails using three rapid diagnostic kits in accordance with the manufacturer's recommendations. Each patient's serum was examined using Determine (Alere Medical Co. Japan) and Unigold HIV to determine whether they had HIV antibodies (Trinity Biotech Plc Bray, Co. Wicklow, Ireland). The patient is regarded as HIV positive if both kits test positive, and vice versa. A third kit, the Tie Breaker 1/2 Stat Pak (Chembio Diagnostic Systems, New York, USA), is used when test results are ambiguous. One of the first two kits that is compatible with the third kit was used to determine the patient's HIV serostatus [16,17].

Detection of Chlamydia trachomatis antigen using rapid diagnostic kits

Chlamydia trachomatis antigen in participant's urine (if present) was identified *using DIAGNOSTIC AUTOMATION, INC, Calabasas' Chlamydia trachomatis* rapid test kit. It uses the *Chlamydia trachomatis* LGV type 2 widely responding antigen. It detects for antigen to *Chlamydia trachomatis*, *Chlamydia psittaci*, and *Chlamydia pneumonia* (TWAR). The test was carried out as directed by the manufacturer.

Principle

Each kit contains a qualitative immunochromatographic lateral flow test in cassette format for detecting *C. trachomatis* Antigen in urine. The anti-*C. trachomatis* antibody test is a one-step Chlamydia immunoassay based on the immunochromatographic principle for the rapid, qualitative detection of anti-*C. trachomatis* Antigen (a clinical specimen is gotten and placed into an extraction tube containing extraction solution in the assay procedure). On the surface of the *C. trachomatis* test cassette, the letters "T" and "C" stand for "Test Line" and "Control Line," respectively. Before applying any sample that works successfully, the "Test Line" and "Control Line" in the result are not visible. Procedural control is handled by the "Control Line." If the test procedure is followed correctly and the control line's test reagents are operational, the "Control Line" should always appear. If there are enough Antigen against *C. trachomatis* in the urine sample, a pink "Test Line" will appear in the result window. No colour shows in the "Test Line" if Antigen against *C. trachomatis* are detected in the sample.

Procedure

All samples and reagents were warmed to room temperature prior to testing (15-30oC). The urine sample were measured in milliliters (mL) and placed in the centrifuge tube. The urine sample was centrifuged at 3000 rpm for 15 minutes. The sediments of the urine were obtained, and the supernatant was discarded. Reagent B of the Chlamydia kit was added to the sediment and was allowed to stand for 5 minutes after mixing them together. After 5 minutes regent A was added to the sediments solution and was allowed to stand for 5 minutes. When it was time to start the test, the sealed pouch was opened by tearing along the notch. A pipette was used to pour the urine sediment (60l-80l, roughly 2-3 drops) to the sample well on the cassette. After 10-15 minutes, the results were read by observing the pink color migrate across the Result Window in the center of the test cassette. The result was not read after half an hour.

Interpretation of Results

Positive Result

A positive result is indicated by the appearance of two-color bands both in the test and control line regardless of which band emerges first.

Negative Result

A negative result is indicated by the existence of only one pink color band in the control line

Invalid Result

A complete lack of color in either region or the appearance of only one band on the test region suggests a technique error and/or deterioration of the test reagent.

Statistical Analysis

Microsoft Excel was used to enter the raw data. Statistics software package was used to conduct the data analysis (version 20.0). Significant variations in the prevalence of *Chlamydia trachomatis* antigen among the study participants was determined using one way analysis of variance (ANOVA). P values of less than 0.05 were deemed significant. Statistical significance is defined as a *P-value* of less than 0.05. Tables and charts were used to present the results.

Results

The present study investigated the prevalence of *Chlamydia trachomatis* antigen among HIV positive and HIV negative adult male patients attending National Institute of Medical Research, Yaba, Lagos State, Nigeria. A total of 318 subjects (159 HIV positive and 159 HIV negative) were enrolled and screened in the study. All study participants underwent a *Chlamydia trachomatis* test using a One-Step Chlamydia Test kit (GIMA). The sociodemographic characteristics of the study individuals is presented in Table 1. Most of the HIV positive participants (30.8%) were over the age of 50 Years, Whereas only 0.6% of them were between the ages of 18 and 25 Years. The same table also reveals that the majority (17.0%) of the HIV-negative participants were between the ages of 26-33 Years, While the minorities (6.3%) were between the ages of 42-49 Years.

Table 1: Socio-demographic characteristics of the study participants.

Variable	Categories	HIV status		Total	Pearson Chi-Square (χ^2)	P-value
		Negative N (%)	Positive N (%)			
Age Range	>50yrs	37(11.6)	98(30.8)	135(42.5)	102.35	0
	18-25yrs	22(6.9)	0(0.0)	22(6.9)		
	21-25 yrs	0(0.0)	2(0.6)	2(0.6)		
	26-33yrs	54(17.0)	6(1.9)	60(18.9)		
	34-41yrs	26(8.2)	12(3.8)	38(11.9)		
	42-49yrs	20(6.3)	41(12.9)	61(19.2)		
	Total	159	159	318		
Marital Status	Divorced	2(0.6)	0(0.0)	2(0.6)	27.741	0
	married	113(35.5)	140(44.0)	253(79.6)		
	separated	0(0.0)	2(0.6)	2(0.6)		
	Single	44(13.8)	13(4.1)	57(17.9)		
	Widower	0(0.0)	4(1.3)	4(1.3)		
	Total	159	159	318		
Religion	Christianity	134(42.1)	143(45.0)	277(87.1)	2.268	0.132
	Islam	25(7.9)	16(5.0)	41(12.9)		
	Total	159	159	318		
Tribe	Hausa	2(0.6)	2(0.6)	4(1.3)	48.269	0
	Igbo	18(5.7)	71(22.3)	89(28.0)		
	Yoruba	107(33.6)	55(17.3)	162(50.9)		
	Others	32(10.1)	31(9.7)	63(19.8)		
	Total	159	159	318		
Educational status	None	10(3.1)	8(2.5)	18(5.7)	37.449	0
	Primary	10(3.1)	35(11.0)	45(14.2)		
	secondary	35(11.0)	62(19.5)	97(30.5)		
	Tertiary	104(32.7)	54(17.0)	158(49.7)		
	Total	159	159	318		

In respect to marital status, majorities of the HIV negative subjects were married (35.5%),while the rest were either singles (13.8%) or divorced (0.6%). similarly,most of the HIV-positive participants were married (44.0%), followed by the singles (4.1%), widowes (1.3%) and then the separated (0.6%).Regarding religion,majority of the HIV-negative subjects were christians(42.1%),while Muslims were in the minority (7.9%). similarly most of the HIV-positive individuals were christians (45.0%), while Muslims were in the minorities (5.0%). Based on the educational status of the study participants, majority of the HIV-negative individuals have the tertiary education(32.6%),whereas the minorities have primary education or none at all (3.1% in each case). On the other hand , the majority of the HIV-Positive subjects have secondary education (19.5%), while the minority has no formal education (2.5%). The prevalence of *Chlamydia trachomatis* antigen among the study participants is presented using a bar chart (Figure 1). Overall, regardless of their HIV status, only six (1.9%) out of the 318 of the study participants examined tested positive to *Chlamydia trachomatis* antigen.

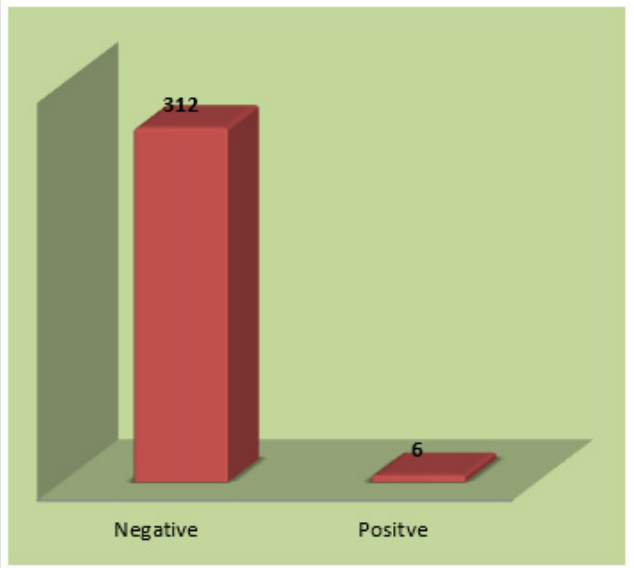

Figure 1: Prevalence of Chlamydia trachomatis antigen among the study participants.

Table 2 shows the prevalence of *Chlamydia trachomatis* infection based on the socio-demographic details of the study participants. Only one (0.3%) of the 159 study participants who tested negative for HIV had positive *Chlamydia trachomatis* antigen results, compared to six (1.6%) of the 159 people who tested positive for HIV. Out of 318 study participants, 4 (1.3%) of the participants are 50 years and older, 1 (0.3%) of the participants in the age ranges 26 to 33, and 1 (0.3%) of the participants in the age ranges 42 to 49, tested positive for *Chlamydia trachomatis* antigen. One widower (0.3%) and five (1.6%) of the study's participants who were married both tested positive for *Chlamydia trachomatis* antigen. The married study participants are significantly higher than the widower study participant. Only the Christians with 6(1.9%) out of the study participant tested positive to *Chlamydia trachomatis* antigen. *On the basis of tribe* 4(1.3%) of Igbos tested positive to *Chlamydia trachomatis* antigen, 1(0.3%) Yoruba tested positive to *Chlamydia trachomatis* antigen and then one person which is neither Yoruba, Igbo nor Hausa tested positive to *Chlamydia trachomatis antigen.* On the bases of educational status, 4 participants (1.3%) with secondary education tested positive to *Chlamydia trachomatis* antigen, 1 participant (0.3%) with primary education tested positive to *Chlamydia trachomatis* antigen and then 1 participant (0.3%) with tertiary tested positive to *Chlamydia trachomatis* antigen.

Table 2: Prevalence of Chlamydia trachomatis infection according to the socio-demographic characteristics of the study participants.

Variables	Variable	*Chlamydia trachomatis* antigen		Total	Pearson Chi-Square (χ^2)	P-value
		Negative N (%)	Positive N (%)			
HIV status	Negative	158(49.7)	1(0.3)	159(50.0)	2.718	0.099
	positive	154(48.4)	5(1.6)	159(50.0)		
	Total	312(98.1)	6(1.9)	318 (100.0)		
Age Range (Years)	>50	131(41.2)	4(1.3)	135(42.5)	2.073	0.839
	18-25	22(6.9)	0(0.0)	22(6.9)		
	21-25	2(0.6)	0(0.0)	2(0.6)		
	26-33	59(18.6)	1(0.3)	60(18.9)		
	34-41	38(11.9)	0(0.0)	38(11.9)		
	42-49	60(18.9)	1(0.3)	61(19.2)		
	Total	312(98.1)	6(1.9)	318 (100.0)		
Marital Status	Divorced	2(0.6)	0(0.0)	2(0.6)	12.727	0.013*
	married	248(78.0)	5(1.6)	253(79.6)		
	separated	2(0.6)	0(0.0)	2(0.6)		
	Single	57(17.9)	0(0.0)	57(17.9)		
	Widower	3(0.9)	1(0.3)	4(1.3)		
	Total	312(98.1)	6(1.9)	318 (100.0)		
Religion	Christianity	271(85.2)	6(1.9)	277(87.1)	0.905	0.341
	Islam	41(12.9)	0(0.0)	41(12.9)		
Religion	Total	312(98.1)	6(1.9)	318 (100.0)		

Tribe	Hausa	4(1.3)	0(0.0)	4(1.3)	4.787	0.188
	Igbo	85(26.7)	4(1.3)	89(28.0)		
	Others	62(19.5)	1(0.3)	63(19.8)		
	Yoruba	161(50.6)	1(0.3)	162(50.9)		
	Total	312(98.1)	6(1.9)	318 (100.0)		
Educational status	None	18(5.7)	0(0.0)	18(5.7)	4.337	0.227
	Primary	44(13.8)	1(0.3)	45(14.2)		
	secondary	93(29.2)	4(1.3)	97(30.5)		
	Tertiary	157(49.4)	1(0.3)	158(49.6)		
	Total	312(98.1)	6(1.9)	318 (100.0)		

Table 3: Indications of Chlamydia trachomatis infection among the study participants

Variable	Categories	Chlamydia trachomatis antigen		Total	Pearson Chi-Square ($\chi 2$)	P-value
		Negative N (%)	Positive N (%)			
HIV status	Negative	158(49.7)	1(0.3)	159(50.0)	2.718	0.099
	Positive	154(48.4)	5(1.6)	159(50.0)		
	Total	312(98.1)	6(1.9)	318(100.0)		
Body rashes	NO	300(94.3)	4(1.3)	304(95.6)	12.162	0.000*
	YES	12(3.8)	2(0.6)	14(4.4)		
	Total	312(98.1)	6(1.9)	318(100.0)		
Mild fever	NO	85.5)	4(1.3)	276(86.8)	2.161	0.142
	Yes	40(12.6)	2(0.6)	42(13.2)		
	Total	312(98.1)	6(1.9)	318(100.0)		
Sore throat	NO	304(95.6)	6(1.9)	310(97.5)	0.158	0.691
	YES	8(2.5)	0(0.0)	8(2.5)		
	Total	312(98.1)	6(1.9)	318(100.0)		
Discharge in the penis	NO	304(95.6)	4(1.3)	308(96.9)	18.299	0.000*
	YES	8(2.5)	2(0.6)	10(3.1)		
	Total	312(98.1)	6(1.9)	318(100.0)		
Penis sore	NO	302(95.0)	2(0.6)	304(95.6)	56.332	0.000*
	YES	10(3.1)	4(1.3)	14(4.4)		
	Total	312(98.1)	6(1.9)	318(100.0)		
Anal sore	NO	311(97.8)	5(1.6)	316(99.4)	25.168	0.000*
	YES	1(0.3)	1(0.3)	2(0.6)		
	Total	312(98.1)	6(1.9)	318(100.0)		
Oral sore	NO	311(97.8)	5(1.6)	316(99.4)	25.168	0.000*
	Yes	1(0.3)	1(0.3)	2(0.6)		
	Total	312(98.1)	6(1.9)	318(100.0)		

Table 3 lists the signs of *Chlamydia trachomatis* infection among the research subjects. Out of the 318 study participant some indicated some signs and symptoms, 2(0.6%) of the study participant indicated that have body rashes, 2(0.6%) indicated that they have mild fever, 2(0.6%) indicated to have discharge in penis, 4(1.3%) indicated to have penis sore, 1(0.3%) indicated to have anal sore, 1(0.3%) indicated to have oral sore this study participants all tested positive to *Chlamydia trachomatis* antigen, none of the study participant which tested positive to *Chlamydia trachomatis* antigen indicated to having sore throat.

Table 4 shows the risk factors connected to the presence of *Chlamydia trachomatis* antigen among the study participants. Only 5 (1.6%) of the 6 study participants out of 318 who are positive

always take their HAART medication. One person (0.3%) has heard about *Chlamydia trachomatis* out of the 6-study participant that tested positive to the bacterial. 4(1.3%) out of the 6-study participant which tested positive to *Chlamydia trachomatis* antigen share sanitary facilities without the other 2(0.6%) that tested positive do not share sanitary facilities. Out of the 6-study participant that tested positive to *Chlamydia trachomatis* antigen none of them shares underwear with others. Four (1.3%) out the study participant which tested positive to *Chlamydia trachomatis* antigen change their underwear everyday while 2(0.6%) that tested positive to *Chlamydia trachomatis* antigen change their underwear every two days. Three, 3(0.9%) out of the 6-study participant that tested positive to *Chlamydia trachomatis* antigen have history of sexually transmitted infection. Only 1(0.3%) out of the study participant that tested positive to *Chlamydia trachomatis* antigen engages in unprotected sex. 3(0.9%) out of the study participant that tested positive to *Chlamydia trachomatis* antigen have 1 sexual partner,1 (0.3%) has 3 sexual partner and 2(0.6%) have no sexual partner. None of the study participant that tested positive to *Chlamydia trachomatis* antigen have changed sexual partner recently. 4(1.3%) out of the study participant that tested positive to *Chlamydia trachomatis* antigen go for medical checkup very often, 1(0.3%) go for medical checkup often, 1(0.3%) go for their medical checkup less often.

Table 4: Risk factors connected to Chlamydia trachomatis antigen prevalence among study participants

Variable	Categories	Chlamydia trachomatis antigen		Total N (%)	Pearson Chi-Square ($\chi 2$)	P-value
		Negative	Positive			
		N (%)	N (%)			
How often do you adhere to HAART medication?	Always	148(46.5)	5(1.6)	153(48.1)	3.051	0.218
	Often	6(1.9)	0(0.0)	6(1.9)		
	Not applicable	158(49.7)	1(0.3)	159(50.0)		
Have you heard of Chlamydia trachomatis before?	No	271(85.2)	5(1.6)	276(86.8)	0.064	0.801
	Yes	41(12.9)	1(0.3)	42(13.2)		
Do you share sanitary facilities with others?	No	133(41.8)	2(0.6)	135(42.5)	0.208	0.648
	Yes	179(56.3)	4(1.3)	183(57.5)		
Do you share under wear with others?	No	304(95.6)	6(1.9)	310(97.5)	0.158	0.691
	Yes	8(2.5)	0(0.0)	8(2.5)		
How often do you change your underwear?	Everyday	220(69.2)	4(1.3)	224(70.4)	0.199	0.905
	Everyday 2 days	86(27.0)	2(0.6)	88(27.7)		
	Neither of the options	6(1.9)	0(0.0)	6(1.9)		
Sexually transmitted disease history?	No	195(61.3)	3(0.9)	198(62.3)	0.391	0.532
	Yes	117(36.8)	3(0.9)	120(37.7)		
Do you have sex without protection?	No	154(48.4)	5(1.6)	159(50.0)	2.718	0.099
	Yes	158(49.7)	1(0.3)	159(50.0)		
How many sexual partner do you have?	1	250(78.6)	3(0.9)	253(79.6)	10.612	0.014*
	2	6(1.9)	0(0.0)	6(1.9)		
	3	4(1.3)	1(0.3)	5(1.6)		
	None	52(16.4)	2(0.6)	54(17.0)		
Have you change sexual partner recently?	No	300(94.3)	6(1.9)	306(96.2)	0.24	0.887
	Yes	11(3.5)	0(0.0)	11(3.5)		
How often do you go for medical checkup?	Less often	92(28.9)	1(0.3)	93(29.2)	3.714	0.294
	Often	125(39.3)	1(0.3)	126(39.6)		
	very often	94(29.6)	4(1.3)	98(30.8)		

Discussion

Chlamydia trachomatis (CT) infection is been known as the most prevalent bacterial sexually transmitted disease (STD) worldwide with huge impact on sexual and reproductive health, and because of failure to provide screening and treatment of *Chlamydia trachomatis* (CT) infection for HIV-infected population the infection begun to spread gradually and become clinically consequential as well as to fuel HIV transmission which makes it common in developed and developing countries [18,19].

In this study, we assessed the prevalence of CT antigen and associated risk factors among HIV positive men on HAART in Lagos State, Nigeria using One-Step Chlamydia Test kit (GIMA, Italy). The prevalence rate of 1.6% found in this study is lower than the 5.5% reported by Silva-Santisteban et al. [20] utilizing polymerase chain reaction among HIV-positive men in Central Peru (PCR). A higher prevalence rate reported by Silva-Santisteban et al. [20] may be due to differences in geographical location and methodology used. PCR has been reported to be more sensitive and precise than rapid diagnostic test kits. However, the 1.6% prevalence rate observed in this study is closely like the result of Monteiro, et al. [21] who reported 1.8% among HIV positive women in São Paulo, Brazil.

Comparing the 1.6% identified in this study utilizing the One-Step Chlamydia Test kit (GIMA) to the 45% found by Dangana, et al. [22] using the solid-phase EIA method and an immunocomb Chlamydia IgG kit among HIV men in Abuja, North Central Nigeria, the 1.6% was determined to be extremely low. However, compared to states in other parts of the country, the south-west states have a lower prevalence of HIV, according to the National Agency for the Control of AIDS (NACA, 2000). This helps to explain why there was such a low prevalence of CT in this study.

Furthermore, the 0.3% prevalence rate among HIV negative males in this study was discovered to be much lower than the 62.25% prevalence rate among HIV negative female sex workers reported by Sama, et al. [19] in a study conducted in Cameroon utilizing enzyme-linked immunosorbent test. The study participants' socioeconomic features, including their gender and occupation, the prevalent environmental conditions in their local environment, and the methods utilized (sensitivity and specificity of the test kits used) could all be contributing factors to this disparity. Most times, especially in females, chlamydia infection has been observed to be asymptomatic. This helps to partially explain the high frequency among female sex workers found by Sama, et al. [19].

Additionally, it was discovered that the 0.3% seen among HIV negative guys in this study was marginally lower than the 2.0% reported by Martin, et al. [23] among University of Dschang, Western Region of Cameroon students using similar rapid diagnostic test kits. With regards to their age, men who are 50 years and above had the highest prevalence rate (1.3%), while the highest prevalence reported by Silva-Santisteban, et al. [20] were within the age range of 18-21 years, owing to their multiple sexual partners. Similarly, highest prevalence rate was reported among 26–45 years (35.6%) and 25-35years (35.29%) in a separate study both carried out in Vhembe District of South Africa by Mafokwane and Samie [24], and Sama, et al. [19], respectively, using real time PCR on urine samples. Likewise, in a study carried out by Okoror, et al. [25], a high prevalence rate of 43.9 % was also reported among women within the age range of 26–30 years, attending gynecological clinics in Southeastern Nigeria.

However, compared to HIV-negative patients, there is evidence that HIV patients are more susceptible to *Chlamydia trachomatis* infection because of immunosuppression. But, based on the outcome of this study only 1(0.3%) of the participant which tested positive to *Chlamydia trachomatis* infection engage in unprotected sex and other do use protection which could also made the prevalence of this infection to be less and this could mean that the prevalence of Chlamydia is not always associated with the reported HIV status and also the use of antiretroviral (ARV) may likely appear to reduce the risks and sequelae of Chlamydia infection [19]. The co-infection of HIV and *Chlamydia trachomatis* in the same person is not unusual because both infections are sexually transmitted. *Chlamydia trachomatis*' principal symptoms may change because of HIV infection, making it difficult for sufferers to communicate their symptoms.

According to the findings of previous epidemiological studies, *Chlamydia trachomatis* prevalence among infertile women in Nigeria ranged from 9.6% to 51% [26], which is greater than the prevalence found in this study. Though, Dangana, et al. [22] in his study "*Prevalence of Chlamydia trachomatis IgG antibodies within the HIV positive women tested when compare to that of the HIV negative women*", no significant increase was observed and buttress his findings by suggesting that it is unlikely that previous exposure to HIV induce a higher prevalence of *Chlamydia trachomatis infection*, but rather *Chlamydia trachomatis* infection facilitate the transmission of HIV which is in support with the findings of Mamodou, et al. [27] who also reported that *Chlamydia trachomatis* infection increases the risk of HIV transmission and acquisition as well further reported that that the invasive intracellular pathogenesis of *Chlamydia trachomatis* can cause substantial damage to the genital epithelia layer which may facilitate HIV infection [28] Though, another author reported that sexually transmitted pathogens, including non-ulcerative agent such as *Chlamydia trachomatis* may serve as biological cofactor for Human Immunodeficiency Virus (HIV) [29].

In general, no significant difference was observed between socio-demographical characteristics of the participate and the

prevalence of *C. trachomatis,* except with marital status where significant different was observe regard the present of the infection (X^2=12.727, P= 0.013) with high prevalence found among patients who are married. Different from the result of Mafokwane and Samie, [24], whose prevalence rate was found among secondary level of education in Vhembe District of South Africa and different from the result obtain from study conducted in in New Caledonia [30]. One (1) sex partner only research participant showed a significant difference in risk factors related with *Chlamydia trachomatis* antigen incidence (X^2=10.612, P=0.014), whereas other risk factors remained non-significant.

Also, indications of *Chlamydia trachomatis* infection among the study participants significant difference was seen from the response given by the participant on the sign such as Body rashes (X^2=12.162, P=0.000), Discharge in the penis (X^2=18.299, P=0.000), Penis sore (X^2=56.332, P=0.000), Anal sore (X^2=25.168, P=0.000) and Oral sore (X^2= 25.168, P=0.000). The results of this study, however, demonstrate that regardless of HIV status, every infected person with *Chlamydia trachomatis* infection exhibited symptoms. History of STIs and having unprotected sex do not significantly increase the risk of contracting *Chlamydia trachomatis* in HIV-positive individuals. Additionally, it was found that HIV subjects with a history of STDs had a 0.391 lower chance of contracting *Chlamydia trachomatis* infection, whereas those who engaged in unprotected sex had a 2.718 higher risk [31,32].

Conclusion

The outcome of this study shows that CT antigen (1.6%) exists among HIV positive men attending the HIV clinic at National Institute of Medical Research (NIMR), Yaba, Lagos State. Hence, the clarion calls for the facility to include *C. trachomatis* antigen testing in their routine screening for HIV patients.

Ethical Approval

The Babcock University Health Research Ethics Committee (BUHREC), granted ethical approval for the project with registration number BUHREC 547/22.

Declaration of Interest

The authors report no conflict of interest. The authors alone are responsible for the content of this manuscript.

Data Availability

The data that support the findings of this study are available from the corresponding author, [Enitan S. S.], upon reasonable request.

Figure 2: Picture showing an unused Chlamydia trachomatis antigen GIMA One Step Rapid Diagnostic Test Cassette.

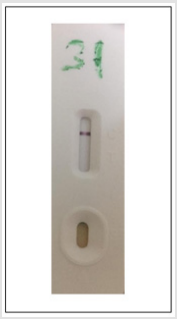

Figure 3: Picture showing a GIMA One Step Rapid Diagnostic Test Cassette negative for Chlamydia trachomatis antigen.

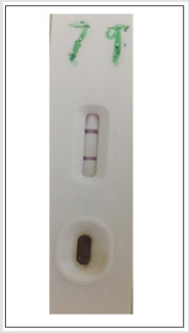

Figure 4: Picture showing a GIMA One Step Rapid Diagnostic Test Cassette positive for Chlamydia trachomatis antigen.

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