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The Sero-prevalence and Risk Factors of Chlamydiosis among Women of Reproductive Age in Port Harcourt, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Authors OEO, IRA, NCU developed the concept of the study. Authors IRA, OEO and NL participated in the design of the study. Authors OEO, IRA, NL supervised and participated in sample collection and laboratory analysis. IRA, NCU drafted the first manuscript and was reviewed by authors OEO, UBC, NCU. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This study is aimed to determine the association between chlamydiosis and some selected risk factors among women of reproductive age in Port Harcourt, Nigeria.
Study Design: The study was a cross-sectional study conducted at Rivers State University teaching hospital.
Place and Duration of the Study: The study was conducted at Rivers State University teaching hospital, Rivers State, Nigeria between March, 2022 and August, 2022.

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Methodology: This cross-sectional study included 450 women who ranged in age from 15 to 55 years and met the inclusion criteria after obtaining ethical approval from Rivers state teaching hospital ethics committee. The women were divided into four subgroups: outpatients, immunocompromised patients (HIV clinic patients), pregnant women, and healthy volunteers. Well-structured questionnaires were used to obtain data on risk factors of chlamydiosis on consultancy basis. Healthy volunteers were those who showed no symptoms otherwise regarded as apparently healthy volunteers. The data obtained were analyzed using *Chlamydia trachomatis* IgG Enzyme Immunoassay test kit.
Results: Out of the 450 samples examined, 45 (10%) tested positive to chlamydia antibodies with the highest prevalence among the immunodeficiency virus subjects (4.2%) and this was followed by the outpatient (2.4%) and healthy volunteers (2.2%). Pregnant women had the lowest seroprevalence rate of 1.1%. The study further revealed that about 78% of the study population heard about chlamydiosis while 22% had no knowledge of it. Statistically, there was no association (p=.06) between awareness parameters and sero-prevalence of chlamydiosis. Similarly, there was no association (p=.08) between person hygiene parameters and sero-prevalence of chlamydiosis. The study equally revealed that there was an association between self-screening for sexually transmitted infection and ever screened for *Chlamydia trachomatis* as life styles for chlamydiosis (p=.05).
Conclusion: The results of this study indicate a strong correlation between self-screening for Sextually transmitted infections and chlamydia infection and those who have ever had a *Chlamydia trachomatis* screening. In order to lessen the harmful effects chlamydiosis has on society, particularly among those who are of reproductive age, awareness of the risk factor associated with the disease should also be increased.

Keywords: Chlamydia trichomatis; gram-negative; infection; bacteria.

1. INTRODUCTION

Chlamydiae are obligate, aerobic, intracellular parasites of eukaryotic cells. They are small Gram-negative coccoid or rod shaped, non-motile bacteria [1]. Chlamydiae exhibit characteristics intermediate between bacteria and viruses. They are widespread in the natural world, being parasites of people, animals and birds with tropism for squamous epithelial cells and macrophages of the respiratory and gastrointestinal tract. However, they differ from most true bacteria in that they have no peptidoglycan in their cell wall, and differ from viruses by possessing both DNA and RNA, cell wall, (that resembles that of Gram negative bacteria), ribosome, replicate by binary fission, and are susceptible to antibiotics. The structure consists of a major outer membrane protein cross-linked with disulphate bonds. They also contain cystein rich protein (CRP) that may be functional equivalent to peptidoglycan. This unique structure allows for intracellular division and extracellular survival [2]. They are split into various species, three of which are *C. pneumoniae, C. psittaci*, and *C. trachomatis.* Among these, *C. trachomatis* causes illnesses in humans. The host range, clinical expression, antibiotic susceptibility (due to folate biosynthesis), staining features (due to glycogen inclusion), inclusion morphology, form of the elementary body, and minimal DNA sequence homology are the distinguishing factors between the three species [3].

The two major species that are most commonly contracted by people are *Chlamydia trachomatis* and *Chlamydia pneumoniae*, while other species are always zoonotic and spread from animals to humans [4]. *Chlamydia trachomatis*, being a Gram-negative bacteria can only multiply inside of a host cell according to [1]. The bacterium is a member of the Chlamydiaceae family, which also includes the genera *Chlamydia* and *Chlamydiophilia*. Round *C. trachomatis* cells range in diameter from 0.3 to 1 depending on the stage of replication. Trilaminar outer membrane with lipopolysaccharide and proteins resembling those of Gram-negative bacteria make up the envelope that surrounds the cells. The absence of the thin peptidoglycan layer between the two membranes in Chlamydiae is a significant distinction.

The bacterium, *C. trachomatis* go through two different phases of their life cycles, initial or reticulate bodies and elementary bodies. A stiff cell wall surrounds the spherical elementary body, which is the extracellular infective form and is 200–400 nanometers across. This permits it to

persist outside of a host cell. If it comes into contact with a susceptible host cell, this form has the ability to start a fresh infection. Reticulate bodies are only present inside host cells and range in size from 600 to 1500 nanometers. Both forms are immobile [5]. The genome is substantially smaller than that of many other bacteria at approximately 1.04 megabases, encoding approximately 900 genes. Several important metabolic functions are not encoded in the *C. trachomatis* genome, and instead, are likely scavenged from the host cell [1].

C trachomatis is a strict human pathogen. It is found in the conjunctiva and urogenital tract of an infected host. It also inhabits the respiratory and gastrointestinal tracts of humans [6]. Occular discharges from infected cases are the common source of eye infection for trachoma. Occasionally, respiratory discharge and human feces can be a source of infection. Trachoma is transmitted through eye-eye contact through droplets, contaminated hands, and contaminated clothing. These methods facilitate the transmission of ocular discharges from the eyes of infected children to those of normal children. Trachoma is also transmitted by inoculation of respiratory droplets or by ingestion of food and water contaminated with the feces of an infected human. Genital discharges are the source of infection for adult inclusion conjunctivitis. Adult inclusion conjunctivitis is usually transmitted by orogenital contact and also by autoinoculation. Inclusion conjunctivitis in newborns is acquired by the infants born vaginally from mothers who are infected with *C. trachomatis* [7]. Three times as many women are diagnosed with genitourinary *C. trachomatis* infections than men. Women aged 15–19 have the highest prevalence, followed by women aged 20–24, although the rate of increase of diagnosis is greater for men than for women. Risk factors for genitourinary infections include unprotected sex with multiple partners, lack of condom use, and low socioeconomic status living in urban areas [8]. *Chlamydia trachomatis* infection is one of the neglected sexually transmitted disease of mostly woman in sub- Sahara Africa and across the globe in general. Nevertheless, the development of signs and symptoms such as vagina discharge and genital pain is very rare among the infected subjects. Hence, the infected subjects may live with it for so long without being aware that they are carriers, there by constituting a public health risk to the general public [9]. Henrich reported that marriage frequently conveys the cultural assumption of monogamy and lowers the risk of sexually transmitted diseases in many cultures [10]. Also, according to the research carried out by [11] and [12], compared to their single counterparts, married adults report having fewer sexual partners and are less likely to participate in dangerous sexual activities. The research carried out by [13] on the relationship between knowledge and personal hygiene and the occurrence of sexually transmitted diseases, the proportion of teenagers with STDs who practiced poor personal hygiene was found to be greater (case group) than those who practiced personal hygiene. *Chlamydia trachomatis* risk factors also include: having sexual contact before the age of 25, multiple sexual partners, not routinely using condom and had history of sexually transmitting the diseases [14]. This study is aimed at discussing the sero-prevalence of *Chlamydia trachomatis* and the associated risk factors.

2. MATERIALS AND METHODS

2.1 Study Area

The research was conducted in Rivers State University Teaching Hospital (RSUTH), located at 5-8 Harley Street, Old GRA 500101, in Port-Harcourt, Nigeria. RUSTH is a tertiary hospital and serves as a reference for many other healthcare facilities in the state.

2.2 Study Design and Population

This cross-sectional study included 450 women who ranged in age from 15 to 55 and met the inclusion criteria. The women were divided into four subgroups: outpatients (hospital patients who were not residents), immunocompromised patients (HIV clinic patients), expectant women, and healthy volunteers. By means of well-structured questionnaires data were collected from the participants and their risk factor parameters were obtained. The association between the risk factors and sero-prevalence of chlamydiosis was determined.

2.3 Ethical Approval and Informed Consent

The Rivers State Ministry of Health, the Rivers State Hospital Management Board ethics committees, and PAMO University of Medical Science all provided approval for the study. Written consent to participate in the study was obtained from participants.

2.4 Eligibility Criteria

Inclusion criteria: Women between the ages of 15 and 55 who are not taking antibiotics were included in the study. Also, all consenting participants who were registered with the hospital were included.

Exclusion criteria: the study excluded women of age below 15 and those above 55 and those who did not meet the inclusion criteria.

2.5 Sample Collection and Preparation

Each individual had 2 ml of blood drawn from them via venipuncture into an uncomplicated tube under aseptic conditions. Sample was centrifuged to obtain serum which was used for laboratory analysis using enzyme linked immunosorbent assay (ELISA) for chlamydia IgG antibodies determination, catalogue number BC-1071 purchased from Bio check with MAP LAB plus microwell reader [15,16]. The sensitivity and specificity of IgG antibody test for *Chlamydia trachomatis* is 100% and 97.6% respectively, [17].

2.6 Quality Assurance

To ensure accuracy, positive and negative controls were added.

2.7 Statistical Analysis

The data produced for this study was examined using the Statistical Program for Social Sciences (SPSS). Prevalence was represented as a percentage. Using Pearson chi-square, the relationship between risk factor characteristics and variables was examined. The threshold for statistical significance was set at p=.05 (95% confidence intervals).

3. RESULTS

Table 1 shows the Sero-prevalence of chlamydiosis in the study population in relation to the subgroups. The highest seroprevalence of Chlamydiosis is observed among HIV subjects, (4.2%) while the pregnant women had the lowest prevalence of 1.1%. Out Patients and Healthy Volunteers have intermediate seroprevalence rates of (2.4%) and (2.2%) respectively.

Table 2 shows the association between awareness and sero-prevalence of chlamydiosis. Among those who have heard of STIs, the highest number of positive cases for Chlamydiosis is among those who are HIV positive (10 positive cases out of 250 examined, accounting for 2.2%). The p-value of 0.06 is slightly above the conventional significance level of 0.05, indicating a weak association between awareness of STIs and sero-prevalence of Chlamydiosis. Among those who have heard of Chlamydiosis, the highest number of positive cases for Chlamydiosis is among Healthy Volunteers (8 positive cases out of 99 examined, accounting for 1.8%). The Chi-square test statistic (X^2) is 0.968 with a p-value of 0.62. The p-value is much higher than .05, indicating no significant association between awareness of Chlamydiosis and sero-prevalence of the infection.

Table 3 shows the association between personal hygiene and sero-prevalence of chlamydiosis. Five parameters (“hand washing”, “vaginal washing”, and “clean after urination”, “wear tight undies and repeated undies) under personal hygiene were studied. There was no significant association (p=.08) between the parameters and chlamydiosis.

Table 4 shows the association between lifestyle and sero-prevalence of chlamydiosis. Sexual Activity: There is no significant association between sexual activity and sero-prevalence of Chlamydiosis (X^2 = 0.009, p = 0.93). Number of Sexual Partners: Similarly, there is no significant association between the number of sexual partners and sero-prevalence of Chlamydiosis (X^2 = 2.769, p = 0.84). Unprotected Sex: Unprotected sex also shows no significant association with sero-prevalence of Chlamydiosis (X^2 = 0.227, p = 0.89). Type of Protection: There is no significant association between the type of protection used (condoms, medication, or none) and sero-prevalence of Chlamydiosis (X^2 = 6.252, p = 0.44). Self-STI Screening: Self-STI screening shows a significant association with sero-prevalence of Chlamydiosis (X^2 = 1.117, p = 0.00). STI Screening for Partner: There is no significant association between the frequency of STI screening for partners and sero-prevalence of Chlamydiosis (X^2 = 0.16, p = 0.93). Screening for Chlamydiosis: screening for Chlamydiosis shows a significant association with sero-prevalence of the infection (X^2 = 1.117, p = 0.00).

Table 1. Seroprevalence of Chlamydiosis in the study population in relation to subgroups

Subgroups	Number Examined (%)	Number Positive (%)	Number Negative (%)
HP	150(33.3)	19(4.2)	131(29.1)
PTW	100(22.2)	5(1.1)	95(21.1)
OP	100(22.2)	11(2.4)	89(19.8)
HV	100(22.2)	10(2.2)	90(20.0)
Total	450(100.0)	45(10.0)	405(90.0)

Table 2. Association between Sero-prevalence of Chlamydiosis and Awareness

Awareness	Responses	NE (%)	NP (%)					
							X^2	p-value
Heard of STI	YES	250(55.5)	10(2.2)	2(0.4)	9(2.0)	10(2.2)	3.600	0.06
	NO	200(44.5)	9(2.0)	3(0.7)	2(0.4)	0(0.0)		
Heard of Chlamydiosis	YES	99(22.0)	3(0.7)	0(0.0)	1(0.2)	8(1.8)		
	NO	351(78.0)	16(3.5)	5(1.1)	10(2.2)	2(0.4)	0.968	0.62
Total		450(100)	19(4.2)	5(1.1)	11(2.4)	10(2.2)		

NE = Number Examined; NP = Number Positive HP = HIV Patients; PTW = Pregnant Women; OP = Out Patients; HV = Healthy Volunteers
p-value < 0.05=Significant, X^2 = Chisquare

Table 3. Association between Sero-prevalence of chlamydiosis and personal hygiene

Personal hygiene	Response	NE (%)	NP (%)					
			HP	PT (%)	OP	HV	X^2	p-value
Hand washing	Regularly	341(75.8)	16(3.6)	4(0.9)	8(1.8)	10(2.2)	5.26	0.08
	Occasionally	101(22.4)	2(0.4)	1(0.2)	3(0.6)	0(0.0)		
	Rarely	8(1.8)	1(0.2)	0(0.0)	0(0.0)	0(0.0)		
Vaginal wash with	Water only	330(73.3)	14(3.1)	4(0.9)	7(1.6)	8(1.8)	3.869	0.28
	Soap and water	93(20.7)	3(0.7)	1(0.2)	2(0.4)	2(0.4)		
	Water and antiseptics	25(5.6)	2(0.4)	0(0.0)	1(0.2)	0(0.0)		
	Others	2(0.4)	0(0.0)	0(0.0)	1(0.2)	0(0.0)		
Clean after urination	Regularly	283(62.9)	13(2.9)	3(0.7)	5(1.1)	10(2.2)	4.341	0.14
	Occasionally	148(32.9)	6(1.3)	2(0.4)	6(1.3)	0(0.0)		
	Rarely	19(4.2)	0(0.0)	0(0.0)	0(0.0)	0(0.0)		
Wear air-tight undies	Regulaly	24(5.3)	2(0.4)	0(0.0)	2(0.4)	0(0.0)	1.691	0.43
	Occasionally	146(32.4)	7(1.6)	2(0.4)	3(0.7)	4(0.9)		
	Rarely	280(62.2)	10(2.2)	3(0.7)	6(1.3)	6(1.3)		
Repeat undies	Regularly	8(1.8)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0.914	0.63
	Occasionally	51(11.3)	2(0.4)	1(0.2)	2(0.4)	0(0.0)		
	Rarely	391(86.9)	17(3.8)	4(0.9)	9(2.0)	10(2.2)		
Total		450(100)	19(4.2)	5(1.1)	11(2.4)	10(2.2)		

NE = Number Examined; NP = Number Positive HP = HIV Patients; PTW = Pregnant Women; OP = Out Patients; HV = Healthy Volunteer
p-value < 0.05=Significant, X^2 = Chisquare

Table 4. Association between Chlamydiosis and Lifestyle

Lifestyle	Responses	NE (%)	NP (%)					
			HP	PTW	OP	HV	X^2	p-value
Sexually Active	Yes	392(87.1)	18(4.0)	5(1.1)	10(2.2)	6(1.3)	0.009	0.93
	No	58(12.9)	1(0.2)	0(0.0)	1(0.2)	4(0.9)		
No. of sexual partner	One	357(79.3)	17(3.8)	5(1.1)	10(2.2)	4(0.9)	2.769	0.84
	Two	26(5.8)	0(0.0)	0(0.0)	0(0.0)	0(0.0)		
	Multiple	7(1.6)	0(0.0)	0(0.0)	1(0.2)	0(0.0)		
	None	60(13.3)	2(0.4)	0(0.0)	0(0.0)	6(1.3)		
Unprotected sex	Yes	350(77.8)	16(3.6)	5(1.1)	10(2.2)	4(0.9)	0.227	0.89
	No	100(22.2)	3(0.6)	0(0.0)	1(0.2)	6(1.3)		
Type of protection	Condom	96(21.3)	8(1.8)	0(0.0)	2(0.4)	6(1.3)	6.252	0.44
	Medication	3(0.7)	0(0.0)	0(0.0)	0(0.0)	0(0.0)		
	None	351(78.0)	11(2.4)	5(1.1)	9(2.0)	4(0.9)		
Self STI screening	Yes	57(12.7)	9(2.0)	0(0.0)	4(0.9)	0(0.0)	1.117	0.00
	No	393(87.3)	10(2.2)	5(1.1)	7(1.5)	10(2.2)		
STI screening for partner	Regularly	7(1.6)	1(0.2)	0(0.0)	0(0.0)	0(0.0)		
	Occasionally	78(17.3)	3(0.7)	0(0.0)	5(1.0)	0(0.0)	0.16	0.93
	Rarely	365(81.1)	15(3.3)	5(1.1)	6(1.4)	10(2.2)		
Screened Ever for C.T		393(87.3)	10(2.2)	5(1.1)	7(1.5)	10(2.2)		
	Yes						1.117	0.00
	No	57(12.7)	9(2.0)	0(0.0)	4(0.9)	0(0.0)		

NE = Number Examined; NP = Number Positive HP = HIV Patients; PTW = Pregnant Women; OP = Out Patients; HV = Healthy Volunteers

4. DISCUSSION

The present study indicated a prevalence of 10% and this is in agreement with [18,19] though other researchers got quite higher prevalence rates [20,21]. HIV Patients appear to have the highest risk of Chlamydiosis infection compared to the other subgroups studied [22,23]. Pregnant Women, on the other hand, show the lowest seroprevalence, which could be due to differences in healthcare-seeking behaviour, sexual activity, or other factors specific to this subgroup. Out Patients and Healthy Volunteers show intermediate seroprevalence rates, indicating a moderate risk of Chlamydiosis infection within these groups. These findings suggest the importance of targeted interventions and screening programs, especially among high-risk groups such as HIV Patients. Healthcare providers should be aware of these variations in seroprevalence rates among different subgroups to effectively allocate resources and tailor prevention strategies.

The findings suggest that awareness of STIs might have a slightly stronger association with sero-prevalence of Chlamydiosis compared to awareness of Chlamydiosis specifically. This could be attributed to increased education on the topic of STI and/or Chlamydiosis in the society. This report is in consonance with the report of [7,19]. However, the association is not strong enough to be statistically significant at the conventional level ($p = .05$).

The differences in sero-prevalence across different respondent groups indicate potential variations in risk factors or exposure levels to Chlamydiosis among these groups. Among those who have heard of Chlamydiosis, the highest number of positive cases for Chlamydiosis is among Healthy Volunteers. This could be attributed to the fact that Chlamydia infection is not always accompanied by symptoms especially in the early stage.

In all, the analysis suggests that the personal hygiene practices examined in this study do not have a significant association with the sero-prevalence of Chlamydiosis among the studied population. This however, is contrary to the research of [13], which reported that the level of hygiene practice can lead to a reduced risk of chlamydia infection in the population that was studied. It is essential to note that while there may not be a significant association, maintaining good personal hygiene practices remains important for overall health and well-being, including the prevention of various infections.

The prevalence of chlamydiosis based on lifestyles such as self STI screening and screening for *Chlamydia trachomatis* showed significant relationship. This is in agreement with the report of [14] where the risk factors that may lead to chlamydiosis are reported. This implies that women who go for regular screening for STI and *Chlamydia trachomatis* are at a lower risk of contracting chlamydial infection than women who do not. This follows that the exercise should be strengthened [21]. Other life style factors such as sexually active, number of sexual partners, unprotected sex, type of protection and STI screening for partners showed no significant association with the seroprevalence of chlamydiosis in the study population. It is essential to note that while there may not be a significant association in some of these life styles and chlamydiosis in the study area, practicing safer sexual behaviors remain important for preventing Chlamydiosis transmission and other sexually transmitted infections, [24, 25].

The highest risk factor for contraction of chlamydiosis by very young women as reported by many researchers is the risk of having multiple sexual partners as the cervix and vagina undergo dramatic histological changes due to exposure to oestrogen. Hence, the cervix in adolescent girls still displays area of exposed columnar epithelium, a condition known as cervical ectopy [9]. However, data from this study showed no association between chlamydiosis and number of sexual partners.

5. CONCLUSION

This study showed a strong correlation between the number of people who have ever undergone *Chlamydia trachomatis* screening and the number of people who self-screened for STIs. Women of reproductive age should embrace such self-screening. For the purpose of early diagnosis and effective treatment, sexually active individuals in the study area should be offered free screening for *Chlamydia trachomatis* and STIs. Increased awareness of chlamydiosis as a risk factor is also necessary to lessen the threat the infection poses to the society, particularly to women who are fertile.

CONSENT AND ETHICS APPROVAL

Ethical clearance was sought and obtained from the Ethics committee of the Rivers State Ministry

of Health with the reference number RSUTH/REC/2022147. Written informed consent was obtained from all the participants and they participated voluntarily. All the participants were informed of the objectives of the study and the protocol for sample collection.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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