International Journal of Basic, Applied and Innovative Research
IJBAIR, 2014, 3(4): 112 - 124
ISSN: 2315 - 5388 E-ISSN: 2384 - 681X
www.arpjournals.com; www.antrescentpub.com

RESEARCH PAPER

CHLAMYDIA TRACHOMATIS IgG ANTIBODIES SEROPREVALENCE AMONG STUDENTS IN TWO TERTIARY INSTITUTIONS IN ANAMBRA STATE, NIGERIA: A COMPARATIVE STUDY

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Received: 29th October, 2014 **Accepted: 15th December, 2014** **Published: 31st December, 2014**

ABSTRACT

Chlamydia infection is a common sexually transmitted infection (STI) in humans caused by the bacterium *Chlamydia trachomatis.* This study assessed the seroprevalence of *Chlamydia trachomatis* antibodies among students in two tertiary institutions in Anambra State, Nigeria. It was a comparative cross-sectional survey using enzyme immunoassay kits for the determination of IgG class antibodies, while the multistage sampling technique was used in the selection of participants for the study. The overall prevalence of *Chlamydia trachomatis* antibodies observed in this survey was 14.3%, which was higher among students from the University (21.6%) than their counterparts from the College of Education (7.4%) (χ^2=5.89, df=1p<0.015). Factors found to have significant effect on the seroprevalence of *Chlamydia trachomatis* in both institutions were: prior sexual exposure (p<0.05); unprotected sexual intercourse in the last one year (p<0.05); multiple sexual partners in the last one year (p<0.05); and presence of symptoms suggestive of STI (p<0.05). Among students in the College of Education, the place of residence significantly affected *Chlamydia trachomatis* seroprevalence with a preponderance towards students living off-campus (χ^2=4.00, df-1, p<0.05). Hence, there is need to institute appropriate prevention and control measures against the transmission of the disease especially among those at risk of contracting the disease.

Key words: Chlamydia trachomatis, seroprevalence, sexual behaviour, students, tertiary institutions.

INTRODUCTION

Chlamydia infection (from Greek word meaning "*cloak*") is a common sexually transmitted infection (STI) in humans caused by the bacterium *Chlamydia trachomatis*. The term *Chlamydia* infection can also refer to infection caused by any species belonging to the bacterial family *chlamydiaceae*. *Chlamydia trachomatis* is only found in humans (Jawetz *et al*, 2004). They are obligate intracellular bacterial pathogens of prokaryotic cells and are differentiated from other bacteria by their morphology and a unique developmental cycle involving two morphological forms adapted for extracellular survival multiplication within cytoplasmic vesicles and commonly termed inclusions. They are widely distributed in nature and are responsible for a variety of ocular, genito-urinary, and respiratory disease in man. According to World Health Organization (WHO) estimate, 340 new cases of curable STIs (*syphilis, gonorrhea, Chlamydia and trichomonas*), occur annually throughout the world especially in adults

ASN-PH-020919

aged 15-49 years (WHO, 1999). Chlamydia infection is also the commonest bacteria implicated in sexually transmitted infections reported worldwide (WHO, 1999). Owing to varied characteristics of the study populations and different methods used for *Chlamydia* detection, there is a wide variation in prevalence rates of *Chlamydia* infection (Verkoyeen *et al*., 2002; Buve *et al*., 2001).

In general practice, one in 20 sexually active women aged less than 25 years may be infected (Pippa *et al.,* 2003).In the USA, it is also the most prevalent sexually transmitted disease responsible for an estimated 3 million new infections each year (CDC, 2004). In 2006, 1,030,911, *Chlamydia* infections were reported to CDC from 50 states and the District of Columbia. Under-reporting is substantial because most people with *Chlamydia* are not aware of their infection and do not seek testing (CDC, 2004). The incidence of *Chlamydia* infection in women increased dramatically between 1987 and 2003 from 79 to 467 per 100,000. In part, this may be attributed to increased screening and improved reporting, but the burden of the disease is still significant. In Central Africa, precisely Cameroun, (Nejandio *et al.,* 2003), a prevalence of *Chlamydia trachomatis* infection of 4.0% has been reported, while in Ethiopia, a prevalence rate of 5.9% has been reported for chlamydia infection of the cervix (Buve *et al*., 2001).

In Ibadan, Nigeria, Darougar *et al.* (1990) reported that the prevalence of *Chlamydia* antibodies for serotypes D – K for men and women were 18.7% and 26.7% respectively, while antibody titers suggesting active disease in these men and women were found in 11.8% and 22.7% respectively. In the South East, Nwanguma *et al.* (2009) reported a prevalence of 33% in asymptomatic volunteers from two cities, while Ikeme *et al.* (2011) in Enugu reported an overall prevalence of 29.5% with student population having a higher prevalence (36.7%) than their non-student counterparts (22.7%). The age group with the highest seroprevalence among the student population was the 20-24 years (33.3%) and 25-29 years (21.4%), but surprisingly, the highest sero-prevalence of 69.0% was observed among those without any history of infection in both study populations. In Anambra State, Chukwuma (2005) reported a seroprevalence rate of 6.0% among students of a tertiary institution (1.2% and 4.8% for males and females respectively), while in the same state, Anaghalu (2006) among a seroprevalence rate of 23.8% for males and 28.0% for females among infertile couples.

Chlamydia is known as the "silent epidemic" because in women, it may not cause symptoms in 75% of cases, and can linger for months or years before being discovered. The transmission of *Chlamydia* infections is through infected secretions only. Infections occur after direct contact with the skin or mucous membranes of an infected partner during vaginal, anal, or oral sex and can be passed from an infected mother to her baby during vaginal childbirth. It is spread mainly via sexual contact. Factors that affect transmission are age, number of sexual partners, socioeconomic status, and sexual preference (Stamn *et al*., 1983). Genital infection rates appear to be inversely related to age and positively correlated with number of sex partners, (Stamn *et al*., 1983; Thompson, 2002). In some studies, lower socioeconomic status and ethnicity have been correlated with an increased risk of Chlamydia infection (Schachter, 2000). The prevalence of urethral Chlamydia infection among homosexual men is approximately one third of the prevalence among heterosexual men, but 4% - 8% of homosexual men seen in STD clinics have rectal Chlamydia infection (Stamn *et al.,* 1983).

In women, untreated *Chlamydia* infection can lead to severe reproductive complications. *Chlamydia trachomatis* is an important causal agent in pelvic inflammatory disease with sequelae including infertility, ectopic pregnancy and chronic Pain. Up to two thirds of cases of tubal-factor infertility and one third of cases of ectopic pregnancy may be attributable to *Chlamydia trachomatis* infection (Paavonen and Eggert-Kruse, 1999). *Chlamydia infections* during pregnancy is associated with a number of adverse outcomes of pregnancy including preterm labour, premature rupture of the membranes, low birth weight, neonatal death and postpartum endometritis (Mardi 2002.; Andrews *et al.,* 2000). *Chlamydia* infection during pregnancy may be transmitted to the infant during delivery (Jain, 1999). An infant born to a mother with active infection has a 50-75 percent chance of acquiring infection at any anatomical site. Approximately 30-50 percent of infants born to *Chlamydia*–positive mothers will have conjunctivitis, and at least 50 percent of infants with *Chlamydia* conjunctivitis will also have nasopharyngeal infection. *Chlamydia* pneumonia develops in about 30 percent of infants with nasopharyngeal infection (Stamm, 1999).

In men, the most common clinical manifestation of *Chlamydia trachomatis* is nongonococcal urethritis. Other clinical syndromes in men include acute epididymitis, acute procititis, acute proctocolitis, conjunctivitis and Reiter's

syndrome. Male infertility, chronic prostatitis, and urethral strictures are possible results of infection. Reiters Syndrome and reactive tenosynovitis or arthritis has also been associated with *Chlamydia trachomatis* infection (Stamm, 1999). The aim of this study therefore, was to determine the prevalence of *Chlamydia trachomatis IgG* antibodies and factors affecting transmission among students in two tertiary institutions in Anambra State, Nigeria.

MATERIALS AND METHODS

Study area: This study was carried out among students in two tertiary institutions in Anambra State, South East, Nigeria. Anambra State has a total population of about 4.7 million and invariable one of the most populous states in the south eastern part of Nigeria with a population growth rate of 3.0 from 1999 till date. The state is the commercial hub of the south east, and also one of the top most commercial states in Nigeria. There are many tertiary institutions in the state including four Universities (two public and two private), two colleges of education, two polytechnics and five recognized school of nursing and midwifery among others. Nnamdi Azikiwe University (NAU) is a federal institution with its main campus at the state capital, Awka. NAU has two other campuses in Nnewi and Agulu in the same state while Federal College of Education Technical (FCETU) is located at Umunze in Anambra State.

Study design and study population: The study is a descriptive cross-sectional survey of *Chlamydia trachomatis* seroprevalence among male and female students of two tertiary institutions (Nnamdi Azikiwe University and Federal College of Education Technical) in Anambra State, Nigeria.

Sample size determination and sampling technique: Sample size was determined using the sample size formula (Cochran) for cross sectional or prevalence studies in populations greater than 10,000. Using a seroprevalence of C. trachomatis antibodies among tertiary Students reported in a previous study which stood at 6.0%, (Chukwuma, 2005), the total sample size of 182 was used for this study. Thus 88 and 94 participants were enrolled from the university and college of education respectively. The formula below was used for this calculation (Onwasigwe, 2010).

$$n = \frac{Z^2P\,(1-P)}{d^2}$$

Where n= sample size to be estimated, z= the standard normal deviate corresponding to level of significance at 95% (≈1.96), p=the prevalence rate=6.0%, d=the degree of accuracy desired, set at 0.05 or 95%.

The sampling techniques used for this study was the multistage random sampling technique. The first stage involved the stratification of the schools into two groups: group one comprising Universities, while group two comprised Polytechnics, Monothecnics, and Colleges of education. Second stage involved the selection of the schools that were studied. The schools were selected using simple random sampling by balloting; thus a university (Nnamdi Azikiwe University, Awka) and a college of education (Federal College of Education Technical, Umunze) were selected. The third and fourth stages involved the selection of Faculties, Departments and Study Participants. The participants were selected using quota sampling technique. Eighty eight students and ninety four students were studied in NAU and FCETU respectively.

Ethical considerations: Ethical approval was gotten from the Ethics Committee of Nnamdi Azikiwe University Teaching Hospital, Nnewi, (NAUTHEC). Also before the questionnaires were administered, the concept of the study was carefully explained to the participants and written consent were obtained from all the participants before any sample was collected.

Exclusion and Inclusion and Criteria: Only students of the selected higher institutions who were willing to participate in this survey were studied. Those living or working in the selected schools who are not students of these institutions, were not enrolled in this survey.

Materials used and test procedure: A semi structured questionnaire was used to obtain information on the socio-demographic characteristics of respondents and their sexual behaviours. Blood was collected aseptically from consenting individuals who met the inclusion criteria above by venepuncture, was allowed to cloth and serum was separated by centrifugation at room temperature and capped in non-sterile serum containers, stored at -20^{0}C.

Materials used for the study included IgG serodiagnostic kit for both organisms, a micro plate calibrated reader, manual and automatic equipment for rinsing, vortex tube mixer, deionized water, timer, absorbent paper springs, gloves, serum collection bottles and test tubes.The *Chlamydia trachomatis*kits (by DRG instruments GmBH, Germany) were used. The DRG Chlamydia trachomatis IgG Enzyme Immunoassay kit provides materials for the qualitative and semi-quantitative determination of IgG class antibodies to *Chlamydia trachomatis* in serum.

RESULTS

Table 1 shows that there were significant variations in all the socio-demographic characteristics among respondents in both institutions, $p<0.05$. The mean age of respondents in NAU (24.2 ± 5.6 years) was significantly higher than that of their FCETU counterpart (21.5 ± 1.5 years; $t = 7.10$; $p = 0.0000$). The total mean age of respondents in both institutions was 22.9 ± 3.6, with 15-24 years age group occurring more in FCETU (85; 85.0%), while >24 years occurring more in respondents from NAU (45; 45.0%).There were more males among NAU respondents than their FCETU counterparts (26.0% and 8.0%) respectively ($\chi^2 = 13.24$; $p = 0.0003$). Majority of the respondents were single in both institutions (NAU = 78; 78.0% and FCETU = 94; 94.0%) but there were more married respondents in NAU (10; 10.0%) than FCETU (0; 0.0) ($F= 11.30$; $p = 0.0008$). More people were living off campus in NAU (71; 71.0%) than in FCETU (44; 44.0%), while more people were living inside the school hostel in FCETU (45; 45.0%) than NAU (5; 5.0%) ($\chi^2 = 40.13$; $p = 0.0000$).

Table 1: Socio-demographic Characteristics of Participants

Socio-demographic characteristics	**NAU n = 88** Freq **(%)**	**FCETU n = 94 Freq (%)**	**Total n= 182 Freq (%)**	**Statistics**	**p-value**
AGE (yrs)					
15-24yrs **>24yrs** **Total**	43 (48.9) 45 (51.9) 88 (100.0)	85 (90.4) 9 (9.6) 94 (100.0)	128 (70.3) 54 (29.7) 182 (100.0)	Z-test= 7.10	0.0000*
SEX					
Male **Female** **Total**	26 (29.6) 62 (70.4) 88 (100.0)	8 (8.5) 86 (91.5) 94 (100.0)	34 (18.7) 148 (81.3) 182 (100.0)	χ^2=13.24 df = 1	0.0003*
MARITAL STATUS					
Married **Single** **Total**	10 (11.4) 78 (88.6) 88 (100.0)	0 (0.0) 94 (100.0) 94 (100.0)	10 (5.5) 172 (94.5) 182(100.0)	F=11.30 df=1	0.0008*
PLACE OF RESIDENCE					
Off campus **School hostel** **With relatives** **Total**	71 (80.7) 5 (5.7) 12 (13.6) 88 (100.0)	44 (46.8) 45 (47.9) 5 (5.3) 94 (100.0)	115 (63.2) 50 (27.5) 17 (9.3) 182 (100.0)	χ^2= 40.13 df = 2	0.0000*

The pattern of sexual characteristics was similar, though favouring an increase in high risk sexual behaviours in both institutions (*See* Table 2 below). The pattern of presentation of symptoms of STI among the respondents in both institutions were similar ($P>0.05$), with those who have ever had symptoms suggestive of STI were higher than those who have not had any symptoms suggestive of STI (NAU =61; 61.0% and FCETU =57; 57.0%). On those who have had symptoms before, more participants in NAU presented with one symptom (36; 59.0%) while the reverse was the case with participants in FCETU, where those with more than one symptoms were more (30;

52.6%). The commonest symptoms included itching around the private part (NAU = 63.9% and FCETU =61.4%), lower abdominal pain (37.7%) and rashes in the private part (32.8%) in NAU, and discharge (54.4%) and lower abdominal pain (49.1) in FCETU (Table 3). The overall prevalence of *Chlamydia trachomatis* IgG antibodies was (26; 14.3%). The prevalence was higher among students in NAU (19; 21.6%) than FCETU (7; 7.4%). The difference was statistically significance (χ^2 = 5.89;df=1 p = 0.015) (*See* Table 4 below).

Age of respondents has no significant effect on seroprevalence in both institutions even though it was slightly higher among participants in the age group of 25 and above (NAU = 12; 26.7% and FCETU = 5; 22.2%). In NAU, the prevalence was slightly higher in males (26.9%) than females (19.4%) but the difference was not statistically significant (p>0.05). The reverse was the case in FCETU, where all the positive cases were females only (8.1%). Among NAU students, there was a slight difference in seropositivity among the married and unmarried respondents (20.0% and 21.8% respectively; p>0.05). In FCETU, seropositivity was significantly higher among participants living off-campus (13.6%), when compared with their counterparts living in school hostels (χ^2 = 4.00; p = 0.04) (*See* Table 5 below).

Table 2: Sexual Behaviours of Participants in Both Institutions

Sexual behaviours	NAU n = 88 Freq (%)	FCETU n = 94 Freq (%)	Total n = 182 Freq (%)	χ^2	p-value
Ever had sexual intercourse before (vaginal/penile)					
Yes	72 (81.8)	71 (75.5)	143 (78.6)		
No	16 (18.2)	23 (24.5)	39 (21.4)	0.7261	
Total	88 (100.0)	94 (100.0)	182 (100.0)	df = 1	0.3941
Had unprotected sexual intercourse in the last 1 year					
Yes	61 (69.3)	55 (58.5)	116 (63.7)		
No	27 (30.7)	39 (41.5)	66 (36.3)	1.8531	
Total	88 (100.0)	94 (100.0)	182 (100.0)	df = 1	0.1754
Number of sexual partners in the last 1 year					
None	27 (30.7)	32 (34.0)	59 (32.4)		
1-2	50 (56.8)	47 (50.0)	97 (53.3)		
>2	11 (12.5)	15 (16.0)	26 (14.3)	3.13	
Total	88 (100.0)	94 (100.0)	182 (100.0)	df = 2	0.3717

Participants in both institutions who practiced high risk sexual behaviours had higher *Chlamydia trachomatis* seroprevalence than their counterparts with less risky behaviours (P<0.05). Those who had sexual intercourse before in both institutions had higher seroprevalences than those who have never had sex before (NAU, 19[26.4%]; F = 5.38; p = 0.017; and FCETU, 7[9.9%]; F = 4.52; 0.042). Also those who had unprotected sexual intercourse in the last one year had higher seroprevalences in both institutions than those who used any form of barrier methods (NAU, 18 [29.5%]; F = 7.36; p = 0.015 and FCETU, 7 [12.7%]; F = 5.36; p = 0.019}. In both institutions, those with multiple sexual partners in the last one year have higher seroprevalences (NAU, 5[45.5%]; χ^2 = 7.08; p = 0.029; and FCETU, 5 [33.3%]; χ^2 = 17.85; p = 0.000}. These differences in both institutions were statistically significant (*See* Table 6 below).

Table 3: Symptoms of STI among Participants in Both Institutions

Variable	NAU n = 88 Freq (%)	FCETU n = 94 Freq (%)	Total n = 182 Freq (%)	χ^2	p-value
Ever had symptoms suggestive of STI					
Yes	61 (69.3)	57 (60.6)	118 (64.8)		
No	27 (30.7)	37 (39.4)	64 (35.2)	1.15	
Total	88 (100.0)	94 (100.0)	182 (100.0)	df = 1	0.2845
No of symptoms	**n = 61**	**n = 57**	**n = 118**		
1	36 (59.0)	27 (47.4)	63 (53.4)		
>1	25 (41.0)	30 (52.6)	55 (46.6)	1.61	
Total	61 (100.0)	57 (100.0)	118 (100.0)	df = 1	0.2049
Symptoms experienced (multiple response)					
Itching	39 (63.9)	35 (61.4)	74 (62.7)		
Lower abdominal pain	23 (37.7)	28 (49.1)	51 (43.2)		
Discharge	18 (29.5)	31 (54.4)	49 (41.5)		
Rashes	20 (32.8)	14 (24.6)	34 (28.8)		
Sores	8(13.3)	6(10.5)	14(11.9)		
Menstrual pain	3 (4.9)	6 (10.5)	9 (7.6)	5.38	
Dysuria	4 (4.6)	4 (7.0)	8 (6.8)	df = 5	0.4961
Others	3 (4.9)	1 (1.8)	4 (3.4)		

Table 4: *Chlamydia trachomatis IgG*Seropositivity in Both Institutions

Test result	NAU n = 88 Freq (%)	FCETU n = 94 Freq (%)	Total n = 182 Freq (%)	χ^2	p-value
Positive	19 (21.6)	7 (7.4)	26 (14.3)		
Negative	69 (78.4)	87 (92.6)	156 (85.7)		
Total	88 (100.0)	94 (100.0)	182 (100.0)	5.89 df=1	0.015*

Those who have had symptoms suggestive of STI previously had higher seroprevalence in both institutions (NAU, 17 [29.9%], F = 4.63; p = 0.031, and FCETU, 7 [12.3%], F = 4.91; p =0.025), than those who have not had any symptoms suggestive of STI. This difference was statistically significant. Also those with greater than one symptom in both institutions had higher prevalence's than their counterparts that presented with only one symptom in NAU (36.0%) and FCETU (20.0%); though the difference was not statistically significant (p>0.05) (*See* Table 7 below).

When both institutions were compared in some of the characteristics -males, singles, those who have ever had sex, those who have had unprotected sexual intercourse in the last one year, those with multiple sexual partners, those with symptoms suggestive STIs, all respondents had higher seroprevalences in NAU than their FCETU counterparts ($p<0.05$).

Table 5: Socio-demographic Characteristics of Participants and Pattern of *Chlamydia Trachomatis*Seropositivity by Institution

Variable	Chlamydia Test Result					
	NAU n = 88			FCETU n = 94		
	+ve (%)	-ve (%)	Total (%)	+ve (%)	-ve (%)	Total (%)
Age range (yrs)						
15 – 24	7 (16.3)	35 (83.7)	43 (100.0)	5 (5.9)	(94.1)	85 (100.0)
25 and above	12 (26.7)	33 (73.3)	45 (100.0)	2 (22.2)	7 (77.8)	9 (100.0)
Total	19 (21.6)	69 (79.4)	88 (100.0)	7 (7.4)	87 (92.6)	94 (100.0)
χ^2 = 1.40; df=1, p = 0.26, F = 1.228; df=1, p= 0.133						
Sex						
Male	7 (26.9)	19 (73.1)	26 (100.0)	0 (0.0)	8 (100.0)	8 (100.0)
Female	12 (19.4)	50 (80.6)	62 (100.0)	7 (8.1)	79 (91.9)	86 (100.0)
Total	19 (21.6)	69 (78.4)	88 (100.0)	7 (7.4)	87 (92.6)	94 (100.0)
χ^2 = 0.62; p = 0.431, df = 1 F = 0.79; df=1, p = 0.522						
Marital status						
Married	2 (20.0)	8 (80.0)	10 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
Single	17 (21.8)	61 (78.2)	78 (100.0)	7 (7.4)	87 (92.6)	94 (100.0)
Total	19 (21.6)	69 (78.4)	88 (100.0)	7 (7.4)	87 (92.6)	94 (100.0)
F = 0.02, df=1, p= 0.896 χ^2 = na						
Place of residence						
Off campus	17 (24.3)	54 (75.7)	70 (100.0)	6 (13.6)	38 (86.4)	44 (100.0)
School hostel	4 (33.3)	3 (66.7)	5 (100.0)	1 (2.2)	44 (97.8)	45 (100.0)
Family house	1 (9.8)	11 (91.7)	12 (100.0)	0 (0.0)	5 (100.0)	5 (100.0)
Total	19 (21.6)	61 (78.4)	88 (100.0)	7 (7.4)	87 (92.6)	94 (100.0
χ^2 = 1.05, df=1 p = 0.305, F= 4.00, df=1, p = 0.046*						

Keys: F=Fisher's Exact, *= Significant, na= Not applicable

DISCUSSION

The mean age of respondent in both institutions fell within the World Health Organization definition of youths and young adults and this age bracket is associated with higher likelihood of exposure to and transmission of STIs (WHO, 2004).The pattern of sexual behaviours in both institutions were similar and this is likely due to the fact that most of the respondents were young adults and adolescent, and studies have shown that the pattern of sexual behaviours and practices among people in this age bracket tend to be similar in most regions of the world; tilting towards risky sexual behaviours (WHO, 2004; Guttmacher Institute Report, 2009). Our findings were suggestive of high sexual activity with a sizable number of respondents having multiple sexual partners and unprotected sexual

intercourse in both institutions. This could lead to increased risk of STI transmission including *Chlamydia trachomatis* as observed in this study. In this age bracket most people want to have sex due to peer group influence, curiosity and experimentation as well as financial reasons and other personal factors, without first assessing the consequences of unprotected sexual intercourse.

Table 6: Sexual Behaviours of Participants and Pattern of *Chlamydia Trachomatis* Seropositivity by Institution

Variable	Chlamydia test result					
	NAU n = 88			FCETU n = 94		
	+ve (%)	-ve (%)	Total (%)	+ve (%)	-ve (%)	Total (%)
Ever had sexual intercourse before						
Yes	19 (26.4)	53 (73.6)	72 (100.0)	7 (9.9)	64 (90.1)	71 (100.0)
No	0 (0.0)	16 (100.0)	16 (100.0)	0 (0.0)	23 (100.0)	23 (100.0)
Total	19 (21.6)	69 (78.4)	88 (100.0)	7 (7.4)	87 (91.6)	94 (100.0)
F = 5.38; df = 1, p = 0.019*			**F = 4.52; df=1, p = 0.04***			
Unprotected sexual intercourse in the last 1 year						
Yes	18 (29.5)	43 (70.5)	61 (100.0)	7 (12.7)	48 (87.3)	55 (100.0)
No	1 (3.7)	26 (96.3)	27(100.0)	0 (0.0)	39 (100.0)	39 (100.0)
Total	19 (21.6)	69 (78.4)	88 (100.0)	7 (7.4)	87 (91.6)	94 (100.0)
F = 7.36; df = 1, p = 0.015*			**F = 5.36; df = 1, p = 0.019***			
No of sexual partners in the last 1 year						
None	2 (7.4)	25 (92.6)	27 (100.0)	0 (0.0)	32 (0.0)	32 (100.0)
1-2	12 (24.0)	38 (76.0)	50 (100.0)	2 (4.4)	45 (95.6)	47 (100.0)
>2	5 (45.5)	6 (54.5)	11 (100.0)	5 (33.3)	10 (66.7)	15 (100.0)
Total	19 (21.6)	69 (78.4)	88 (100.0)	7 (7.4)	87 (91.6)	94 (100.0)
χ^2 = 7.08; df = 1, p = 0.029*			**F= 17.85; df = 2, p = 0.000***			

F= Fishers Exact, *=Significant

The overall seroprevalence of *Chlamydia trachomatis* antibodies observed in this study was 14.3% but higher among NAU students (21.6%) than FCETU (7.4 %) ($p< 0.05$). It was similar to that reported among patients attending family planning clinics in correctional facilities in the USA (6 to 20%), and among young women in United Kingdom (10.0%) (Tobin, 2002; Hardick*et al.,* 2003); but slightly higher than that reported in some other studies - 4% among Cameroonian students (Ngadijo*et al.*, 2003), 6% among students at Nnamdi Azikiwe University (Chukwuma, 2005), 7% by Scholes *et al.* (1996), 9.2% among US Military Recruit by Gaydos*et al.*(1998), 4.6%by Armando *et al.* (2002), 8.5% among cross border drivers in Hong Kong by Leung *et al.*(2008), and 5 to 8.0% in routinely screened young women in the USA (CDC, 2004).

This was found to be lower than the seroprevalence rates reported in some other studies. In Ibadan, Nigeria, Darougan *et al*. (1990) reported a seroprevalence of 18.7% for males and 26.7% for females, while in Anambra State, Nigeria, Anaghalu (2006) reported a seroprevalence of 28.2% among infertile couples. Nwanguma *et al*. (2009) reported a seroprevalence of 33.0% among volunteers with unknown HIV status; 50% among HIV positive patients; and 17.6% among HIV negative young adult students in Enugu, Nigeria. The main reason for this high

seroprevalence rates reported in our study could likely be due the concurrent high risk sexual behaviours observed among the students who participated in this study. The seroprevalence was found to be higher among NAU students than FCETU students, which could be explained partly by the marked difference in socio-demographic status of students in the two schools. Most students studying in NAU were significantly older than their FCETU counterparts, (P< 0.05) and as such, there is a likelihood of long exposure to risky sexual behaviours that could encourage *Chlamydia trachomatis* infection transmission and possibly account for the difference in seroprevalence in the two institutions, despite both of them having the same pattern of sexual behaviours as at the time this study was carried out. Other factors that might have played some significant roles in this difference include location of the institution, place of residence of students and sex distribution of the students studied.

Table 7: Presence of STI Symptoms and Pattern of *Chlamydia Trachomatis*Seropositivity by Institution

Variable	Chlamydia trachomatis result					
	NAU n = 88			FCETU n = 94		
	+ve (%)	-ve (%)	Total (%)	+ve (%)	-ve%)	Total (%)
Ever had symptoms of STI before						
Yes	17 (27.9)	44 (72.1)	61 (100.0)	7 (12.3)	50 (87.7)	57 (100.0)
No	2 (7.4)	25 (92.6)	27 (100.0)	0 (0.0)	37 (100.0)	37 (100.0)
Total	19 (21.6)	69 (78.4)	88 (100.0)	7 (7.4)	87 (91.6)	94 (100.0)
F = 4.63; df = 1, p = 0.031*			**F = 4.9, df = 1; p = 0.025***			
No of symptoms present						
1	8 (22.2)	28 (77.8)	36 (100.0)	1 (3.8)	26 (96.2)	27 (100.0)
>1	9 (36.0)	16 (64.0)	25 (100.0)	6 (20.0)	24 (80.0)	30 (100.0)
Total	17 (2.79)	44 (72.1)	61 (100.0)	7 (12.30	50 (87.7)	57 (100.0)
χ^2 = 1.66, df = 1; p = 0.198			**F = 3.50, df = 1; p = 0.068**			

F=Fisher's Exact, *= Significant

Chlamydia trachomatis seroprevalence was found to increase with increase in age of respondents in both institutions with respondents that are 25 years and above, having higher seroprevalence in the institutions (26.7% and 22.2% in NAU and FCETU respectively). This finding was not in agreement with reports by Armando *et al.* (2002) in Portugal where seroprevalence was slightly higher in female patients aged below or equal to 19 years of age. It is also contrary to the findings by Gaydos *et al.* (2005), which revealed that young age is a factor that is most strongly associated with infection and by CDC report (2005), which reported that persons aged 14-24 years have the highest rates of *Chlamydia trachomatis* infection. It was however consistent with the seroprevalence reported by Anaghalo, (2006) among infertile couples and highest among those aged between 26-30 years.

Generally, seropositivity is slightly higher among males (20.6%) than females (12.8%) (P>0.05) and this coincides with the pattern observed among NAU students -26.9% and 19.4% respectively, but differs greatly among FCETU students which was 0.0% and 8.1% respectively (P<0.05). This pattern of having more males being seropositive differs from most reviewed studies (Darougan, 1990; Chukwuma, 2005; CDC, 2004 and 2005; Anaghalu, 2006), but

the finding is consistent with CDC report in 1993 that even though fewer screening studies have been done on men, the prevalence has been in excess of 5% among young men seeking health care in hospitals.

On the other hand, seroprevalence was slightly higher among unmarried students in NAU than the married -21.8% and 20.0% respectively. This pattern is consistent with that reported in most reviewed studies (Herman *et al*., 1995; Gale *et al*., 1998; Gaydos, 1998; USPSTF, 2001; Tobin, 2002; Hardick *et al*., 2003; CDC, 2004 and 2005). These studies have reported that unmarried status is a risk factor in the transmission of *Chlamydia trachomatis*. This is likely to be true in that most unmarried people are likely to be at risk of having multiple sexual partners and being young, could likely indulge in risky sexual behaviours.

Furthermore, students staying off-campus (20.0%) where found to have higher prevalence than their counterparts living inside the school hostels (4.0%), or at home i.e. living with parents or relatives (5.9%). Reports from CDC, (2004 and 2005), USPSTF (2001) and other studies reviewed, show great variability in *Chlamydia* prevalence among people at different ages and locations or place of residents.

Nevertheless, the sexual behaviours of students in both institutions were similar and found to be associated with high *Chlamydia trachomatis* seroprevalence. Those with previous history of sexual exposure, unprotected sexual intercourse in the last one year preceding the study, and having greater than one sexual partner in the last one year were all found to be significantly associated with increased *Chlamydia trachomatis* seroprevalence in both institutions ($P<0.05$). This finding that risky sexual behaviours are associated with increased seroprevalence of *Chlamydia trachomatis* was consistent with the findings in several other studies (Darougan *et al*., 1990; Ngandjo *et al.,* 1998; USPSTF, 2001; 2007; Gaydos *et al.*1998 and 2003; Armando *et al.,* 2002). The reason for the above can be explained by the fact that *Chlamydia trachomatis* is sexually transmitted and risky sexual behaviours will lead to its increased transmission; thus leading to an increased seroprevalence of the disease as observed. Also, the presence of symptoms suggestive of having had sexual transmitted disease before was seen to have increased seroprevalence of *Chlamydia trachomatis* in both institutions ($P<0.05$). This finding is in keeping with many of the reviewed studies in which it was reported that the presence of other sexually transmitted diseases or having ever had sexually transmitted diseases before was associated with increased rate of Chlamydia trachomatis infection, (Gaydos *et al.,* 1998; Ngandjo *et al*., 1998; Armando *et al.,* 2002; CDC, 2004; 2005; USPSTF, 2007). This is mainly due to inflammation or distortion of the epithelial cells caused by the presence of STI's which could lead to easy attachment and progression of new infections. It is important to note that a seroprevalence of 7.2% was found among students in NAU who had asymptomatic presentation as at the time of this survey. It has been reported by CDC (1993) that infection by this organism is insidious and symptoms may be absent or minor among infected men and many women. *Chlamydia* is known as the "silent epidemic" because in women, cases can linger for months or years before being discovered (Belland, 2004).

CONCLUSION

The overall *Chlamydia trachomatis* seroprevalence reported in this study was high with prevalent risky sexual behaviours which are consistent with the trend in most reviewed studies within the country, but no serious plan in place to check it. Our findings may have far reaching implications on public health policies and programs especially in those associated with reproductive health and sexually transmitted diseases at the grass roots and the country at large.So there is need to institute appropriate preventive measures in order to reduce the magnitude of the infection and its complications in the entire population. This will involve government and authorities concerned to provide free screening programs for women and young men at risk and provision of continuous health or sex education in order to change the attitude of adolescents concerning sex.

ACKNOWLEDGMENT

We want to appreciate all the research assistants who helped us in the collection of data and blood for laboratory analysis. We are also grateful to the staff and students of Nnamdi Azikiwe University Awka and Federal College of Education Technical Umunze for permitting us to conduct the study.

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AUTHORS' CONTRIBUTIONS:

Authors DCB, EFE, AED, and ICO designed the study, wrote the first draft, and managed the literature review and data collection/analysis while DCB, UKA, OAO, OBO and AC managed the literature review and data collection/analysis. All authors read, reviewed, and approved the final draft. No external finding was received for this research and the authors declare that there is no competing interest.