Journal of Infection and Public Health 11 (2018) 826–833

Contents lists available at ScienceDirect

Journal of Infection and Public Health

journal homepage: http://www.elsevier.com/locate/jiph

Epidemiology of HIV and Tuberculosis in pregnant women, South West Nigeria

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ARTICLE INFO

Article history:
Received 23 April 2018
Received in revised form 5 June 2018
Accepted 10 June 2018

Keywords:
HIV
Epidemiology
Pregnant
Women
Nigeria

ABSTRACT

Background: Pregnant women remain the most vulnerable high-risk population to the devastating impact of the on-going human immunodeficiency virus (HIV) generalized epidemic and co-infection with Tuberculosis in Nigeria. By the end of 2017, the country ranked the second highest in adult HIV-infected individuals and the highest population of orphans due to AIDS in sub-Saharan Africa. We assessed the epidemiology of HIV among pregnant women across ten facilities in south-west Nigeria.
Methods: This is a cross-sectional study design in which 353 pregnant women randomly selected across ten health care facilities in two states in south west Nigeria. This study was conducted between January and May 2015. HIV testing was conducted and active tuberculosis screening was implemented using the fluorescence microscopy. In addition, a structured questionnaire was administered to elicit risk factors of HIV infection and syndromic Tuberculosis in the study population.
Results: We found a 5.1% (18/353:95% CI:3.0%–8.0%) rate of HIV and 0% active tuberculosis in the study population. HIV positive pregnant women were 6 times more likely to have blood transfusion with greater odds of infection found in pregnant women with history of blood transfusion in the previous three months (OR:3.27, 95% CI:0.44–24.36). Pregnant women who tested HIV negative had 70% reduction in odds of infection (OR:0.21:95% CI:0.06–0.77).
Conclusions: This study suggests a possible strong epidemiological link between HIV infection and recent blood transfusion among pregnant women attending ante-natal clinics in south west Nigeria. We therefore recommend further study to develop a more robust estimate of blood transfusion and the risk of HIV in pregnant women in Nigeria.

Introduction

The dual burden of HIV and TB remains a major threat to all countries in sub-Saharan Africa with significant country-level progress reported at the end of 2016. According to the recent global tuberculosis report [1], Nigeria ranks fourth among the six countries that account for 60% of all new TB infections behind India, Indonesia, and China, and ahead of Pakistan and South Africa. Consequently, recent trend makes Nigeria the highest TB burdened country in sub-Saharan Africa, a position it has retained over the past five years. In 2016, an estimated 10.4 million new TB cases were reported worldwide of which 11% (1.2 million) occurred among HIV-infected populations. Evidence over the past decade has increasingly demonstrated the commitment of the country towards ending the HIV and tuberculosis epidemic campaign by 2030 with 8% performance gap reported between incident and notified cases in 2017 [1]. With the most recent estimates of 3.2 million people living with HIV/AIDS in the country (of which only 30% are on antiretroviral treatment), and a reported 220,000 incident cases of HIV infections in year 2016 alone [2], significant challenge persists to progress. The extended generalized HIV epidemic and syndemic with tuberculosis remain a significant cause of morbidity and mortality in pregnant women in Nigeria and children under five years worldwide, of which more than 70% of the attributable proportion of the burden is in sub-Saharan Africa [2]. For instance, complications due to HIV infection or TB in pregnant women have been

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https://doi.org/10.1016/j.jiph.2018.06.004

reported by several studies [3–5]. Recent intervention efforts have, therefore, been targeted at this high-risk group as maternal health is a vital indicator of overall health of the general population.

Over the past 40-year history of the HIV epidemic in Nigeria, pregnant women have been particularly vulnerable and severely affected due to the compromised state of their immunity, risk of transmission from most recent partners, and onward transmission to unborn child [6–8]. Consequent upon this, several indicators have been formulated to assess the quality of maternal health to monitor progress. Studies have shown that pregnant women living with HIV have between 2–10 times increased risk of mortality than uninfected pregnant women [9]. More worrisome, is the strong evidence for the additional risk in pregnant women in low-resourced settings such as sub-Saharan Africa with significantly higher probability of maternal (and consequently child) deaths [10].

TB reactivation in pregnant women has been found to be a significant risk factor for HIV infection with about 5–10% risk of reactivation per year [11]. This TB-triggered HIV acquisition can occur through a number of possible pathways. For instance, a pregnant woman may acquire infection during multiple heterosexual partnerships or lowered consistency in the use of condom with a high risk partner as is often the case in various parts of sub-Saharan African countries.

While few studies have been conducted to characterize the nature of HIV and TB burden among pregnant women in Nigeria, current estimates of HIV and TB burden in Nigeria varies between the range of 5% and 10% rates of co-infection according to published studies in various parts of the country. Emerging prevalence patterns suggest that significant variation still persists across the six geopolitical zones of Nigeria, which may underlie the quality of maternal and child health services available, accessible, and affordable at various levels and point of care across the country. For example, in a recent large scale study conducted by Alan et al. [12], among HIV clients across Global Fund supported facilities in Nigeria, the prevalence of HIV among TB patients in Nigeria was reported at 22%. Co-infection rate was found to be 8.3%, 6.7% and 7.6% in 2013, 2014 and 2015 respectively. The study also reported highest rate (10.3%) of co-infection in the south-east region of the country followed by south-west region at 8.3% [12].

In a separate study by Nwabuko et al. [13], a 5.9% prevalence rate of TB co-infection was found in the Niger Delta region of Nigeria among HIV patients [13]. However, higher HIV co-infection burden has been reported by studies conducted in TB patients in the south-western region of the country. For example, a 25% HIV co-infection rate was reported by Matthew et al. in a cohort of TB patients on directly observed therapy [14]. Similarly, Odaibo et al. observed a 12.3% HIV-TB co-infection rate in a multi-DOTS center study in Oyo State [15]. A more recent four-year retrospective study in Ogun State by Koladeet al. (2016) reported a 29% prevalence of HIV co-infection in a cohort of TB patients [16]. The same authors reported a 3.5% prevalence rate of TB among a separate cohort of HIV patients in Ogun State [16]. These studies suggest a higher probability of HIV acquisition in TB patients than observed rate of tuberculosis in HIV infected patients.

The WHO End TB Strategy approved by the World Health Assembly in 2014, calls for a 90% reduction in TB deaths, and a further 80% reduction in new infections by 2030 relative to 2015 rates [1]. With regard to progress in treatment, significant evidence of success has been found across all categories of TB patients in Nigeria, over the past 15 years. However, progress remains impeded due to the problem of universal coverage as only 25% of diagnosed TB patients partly or fully have access to the appropriate treatment.

It is also worth mentioning that prominent authors have argued against the possibility of attaining the 90-90-90 UN test and treat target by 2020, especially in resource-constrained countries in sub-Saharan Africa [17]. In an attempt to assess this presumption, Levi et al. [18] conducted a systematic analysis of country-level HIV treatment cascades in both developing and developed countries. Their study revealed that of the 69 country cascades analyzed (categorized as complete for 4 stages or partial for 3 stages), none has so far achieved the 90% diagnosis target, with the highest of 87% observed in the Netherlands. The highest rate of treatment coverage and viral suppression were 71% and 68% respectively both observed in Switzerland [18].

Sadly, comparable statistical estimates are unavailable to measure any improvement or lack of it in Nigeria. Indeed, a country rarely makes any worthwhile progress until it makes the health and wellbeing of her pregnant women and nursing mothers an over-arching national health priority as demonstrated by developed countries.

From our review of the literature on HIV and TB infection and co-infection in the pregnant women population in Nigeria, few studies have been conducted especially in recent times in keeping with monitoring the trend. This study is therefore an attempt to fill this gap in knowledge in south-west Nigeria.

Materials and methods

Study design, site and study population

This study is a cross-sectional survey designed to be representative of pregnant women population visiting ten healthcare facilities for antenatal care and related services across two contiguous states (Lagos and Ogun) in south-west Nigeria between the period of August 2014 and May 2015.

These study sites were selected by their local government areas which are locations of an ongoing maternal and child health related interventions by the Redeemed Action Programme Action Committee on AIDS (RAPAC), one of the most renown non-governmental agency with intervention activities across south-west Nigeria for the past 20 years. In this study, pregnant women were randomly selected from the following locations as presented in Table 1along with the average population size of pregnant women attended to in each maternity in a year.

Lagos is a metropolitan state that shares borders with Ogun State. We considered 5 of the most affected communities in each state by the local government areas, in order to determine the HIV/TB disease burden and exposure risk among the population of pregnant women attending antenatal services. The local government areas in Lagos States include Abule Iroko, Agbado, Ipaja, Kollington and Ikorodu, while selected locations in Ogun states include Ibafo, Mowe, Shagamu, Akute-Ajuwon and the Redemption camp. Other activities conducted as part of the study include a community-wide HIV and TB awareness and sensitization programme.

Inclusion and exclusion criteria

All pregnant women between the age bracket of 15 to 49 years that gave informed consent were considered eligible to participate in this study. However, nursing mothers and pregnant women that are medical personnel as well as birth attendants in the selected maternities were excluded.

Study sample, sampling method and sample size

In order to obtain the required sample size for this study, we considered the formula:

$$\text{Samplesize} = Z_{1-\alpha/2}{}^2 p(1-p)/d^2 \quad (1)$$

as recommended by Charan and Biswas.

Table 1
Distribution of study facilities in Lagos and Ogun States and their corresponding geographic coordinates.

Location of maternity centre	State	Local government area	Annual average population size attending antennal care at maternity	Geographic coordinates of LGA
Mowe	Ogun	Obafemi Owode	800	6.80596, 3.43803
Ibafo	Ogun	Obafemi Owode	700	6.74015, 3.42208
AkuteAjunwo	Ogun	Ifo	NA	6.67777, 3.35871
Agbado crossing	Lagos	Agbado	280	6.71380, 3.28515
Redemption camp	Ogun	Obafemi Owode	4500	6.4531, 3.3958
Sabo Ikorodu	Lagos	Ikorodu West	3000	6.61941, 3.51045
Ipaja	Lagos	Alimosho	120	6.60541, 3.27989
AgbadoKollinton	Lagos	Ifako-Ijaye	1200	6.71380, 3.28515
Shagamu	Ogun	Sagamu	200	6.77880, 3.62178
Abuleiroko	Ogun	Ado-Odo/Ota	170	6.69916, 3.26385

We estimated a sample size of 217 for the study using the formula in equation 1 above. Z is the standard normal variate at 5% type 1 error ($P < 0.05$) set at 1.96, p is the expected proportion of pregnant women with HIV and TB in South west Nigeria – 0.17 as reported in a previous study [19]. The absolute error *d* is the desired level of precision and was set to 0.05 for the study. As a final adjustment to the sample size, we accounted for a 20% non response resulting in a final sample size of 350. A random selection of 350 pregnant women was conducted across the ten health facilities using the probability proportional to size sample selection model. Each time a pregnant woman declined to participate in the survey, an appropriate replacement (matched by age and pregnancy period) was considered till the required sample size was attained. A sampling frame (defined as a list of all pregnant women attending antenatal care in each health facility) was developed.

Data collection

A structured questionnaire was utilized to elicit detail of HIV and TB exposure history from study participants that gave consent. Data was collected on key socio-demographic variables such as age, education, and marital status; Knowledge and exposure variables including knowledge of HIV transmission, prevention methods, age at first sex, casual and regular sexual partner in the past 3 months, multiple sexual partners and history of sexually transmitted infections in the last three months were considered. We interviewed participants in their first language of choice to ensure full and informed comprehension. In addition, syndromic screening for participant's risk of tuberculosis was also conducted according to the National guidelines and WHO's recommendation. These include: cough for two weeks or more, weight loss of 3 kg or more in last 4 weeks, evidence of lymphadenopathy, fever for two weeks or more and night sweats for two weeks or more. A TB risk score was subsequently generated. However, only a randomly selected 119 of 120 (1 sample could not be recovered by the laboratory) participants were tested for the active TB disease due to cost constraint. HIV, TB and HIV-TB co-infection were assessed in the study participants. All variables were close-ended in a binary format.

HIV test

The HIV status of all study participants was evaluated using rapid test diagnostic kits. Presumptive diagnosis was carried out with the use of Determine® giving its high sensitivity (100%) and specificity (99.6%). In the event of a positive presumptive diagnosis, further confirmatory diagnosis was done using Starpac® as recommended by the National Agency for Control of AIDS (NACA).

Tuberculosis test

A select sub-sample of participants with significant syndromic indicators of tuberculosis was assessed for the presence of active tuberculosis using the immune-fluorescence microscopy at the Lagos Mainland Hospital, Lagos State, Nigeria. The use of this highly sensitive and specific staining procedure allowed for the accurate detection (and otherwise exclusion) of active tubercle bacilli in the suspected cases.

Data analysis

A descriptive and analytic evaluation on the data to determine prevalence estimates and participants' risk profile was conducted. We describe the distribution of study participants according to the study locations and by prevalence of HIV infection at each location using appropriate summary statistics for both continuous and discrete responses. The significance of association was reported at 5% probability of type 1 error. Variables that attained statistical significance at a 10% p-value were considered for the multivariate logistic regression model as a potential predictor of HIV infection in the study population using a stepwise regression procedure.

Reliability and validity

In an attempt to validate the questionnaire instrument, we conducted a preliminary field assessment of its performance on 20 pregnant women in two rounds and the reliability ratio was measured so as to determine the reliability of the questionnaire. The validity of the questionnaire was evaluated by an experienced researcher in the field of HIV and TB epidemiology. We pre-tested on a small sample of 20 non-competent participants (i.e. those who were in management positions) selected across the maternity centers. The purpose of the research was explained in order to evaluate the transparency of questions, the ease of comprehension, as well as the usefulness and logistics of administration. Consequently, necessary modifications were made using this information. Participants that were used for the reliability and validity tests were exempted from the final research since they were informed already of the research questions and some of them did not qualify using the inclusion criteria.

Ethical considerations

As part of ethical considerations, participants were asked to sign a consent form following a preliminary awareness and sensitization (general and confidential) activity. Participants were taken through the purpose and details of the study in accordance with the Belmont Report for ethical conduct of research involving human subjects. The consent form visibly stated the voluntary nature of the research indicating that participants could withdraw from the survey should they decline to further participate in the study. Participants were identified by means of an identification number printed on the questionnaire instrument in order to ensure anonymity. Permis-

Table 2
Distribution of study participants across the ten facilities by socio-demographic characteristics.

Variable	Ibafo (N = 39) n(%)	Shagamu (N = 29) n(%)	Abule Iroko (N = 20) n(%)	Agbado crossing (N = 20) n(%)	Akute Ajuwon (N = 40) n(%)	Camp (N = 51) n(%)	Ipaja (N = 26) n(%)	Kollington (N = 45) n(%)	Mowe (N = 43) n(%)	Sabo Ikorodu (N = 40) n(%)	Total (N = 353) n(%)
Age											
15–24	1(2.6)	2(6.9)	4(20.0)	1(5)	2(5)	3(5.9)	4(15.4)	2(4.4)	10(23)	6(15)	35(10)
25–34	29(74.4)	23(79.3)	15(75)	15(75)	31(77.5)	36(70.6)	15(57.7)	31(68.9)	26(61)	24(60)	245(69)
>=35	9(23.1)	4(13.8)	1(5)	4(20)	7(17.5)	12(23.5)	7(26.9)	12(26.7)	7(16)	10(25)	73(21)
Marital status											
Single	3(7.7)	0(0.0)	2(10)	0(0)	1(2.5)	0(0)	0(0)	2(4.4)	7(16)	2(5)	17(5)
Married	36(92.3)	29(100)	18(90)	20(100)	39(97.5)	51(100)	26(100)	43(95.6)	36(84)	38(95)	336(95)
State of residence Ogun Lagos											
Ogun	39(0.0)	29(100)	12(60)	14(70)	40(100)	50(98)	0(0.0)	0(0)	43(100)	0(0)	227(64)
Lagos	0(0.0)	0(0.0)	8(40)	6(30)	0(0)	1(2)	26(100)	45(100)	0(0)	40(100)	126(36)
Education											
None	1(2.6)	0(0.0)	0(0)	2(10)	2(5.1)	0(0)	1(4)	1(2.2)	0(0)	0(0)	7(2)
Primary	18(46.2)	12(41.4)	6(30)	3(15)	18(46.2)	36(73.5)	6(24)	22(48.9)	12(29)	12(31)	145(42)
Second	6(15.4)	2(6.9)	3(15.0)	5(25)	4(10.3)	3(6.1)	8(32)	10(22.2)	3(7)	4(10)	48(14)
Higher	14(35.9)	15(51.7)	11(55)	10(50)	15(38.5)	10(20.4)	10(40)	12(26.7)	27(64)	23(59)	147(42)

sion to conduct this study was also obtained from the Management of all health facilities prior to the study.

Results

Description of study facilities

The distribution of the ten health facilities considered for this study is presented in Table 1 along with their geographic coordinates in Lagos and Ogun States. The annual average of antenatal visits across these facilities ranges from a 120 patients to 4500 patients with an overall estimated average of 1219 patients per year. (This excludes the Akute Ajuwon centre with no information available). The overall response rate for this study was 100%.

Brief description of study participants

The distribution of study participants across the ten facilities by socio-demographic characteristics is presented in Table 2. A total of 353 patients gave consent to participate in the study with 100% response rate. Highest rate of participation was found among pregnant women in the middle age category (25–34 years) comprising of at least 60% of respondents across all the health facilities (Table 2). Highest rate of respondents in between the age of 15 and 24 years was observed in the Mowe health centre (23%). On the other hand, the highest percent of respondents age 35 years and above was found in Kollington and Ipaja centres respectively. A significant number of the respondents (≥80%) were married with at least primary or higher education. This trend was consistently observed across the ten facilities.

HIV prevalence in study population

Table 3 shows the distribution of HIV seropositivity status of the survey respondents tested across the ten facilities. Findings showed that of the 353 pregnant women tested for HIV antibodies, 18 tested positive giving an overall prevalence estimate of 5.1% (95% CI:3.0%–7.9%) in the study population. The highest prevalence rate was observed in the Redemption camp while the lowest rate of 0% was observed across six health facilities.

HIV prevalence estimates distribution by socio-demographic characteristics

We further characterize prevalence rate distribution by socio-demographics of study participants as presented in Table 3. Highest prevalence rate was observed in pregnant women age 35 years and above (6.9%) closely followed by those in the middle age group (5.3%). However, no significant association was found between age group and the likelihood of HIV infection in the study population. In addition, pregnant women from Ogun State are almost 3 times as likely to test HIV positive compare to their counterparts from Lagos State (Table 3) with a marginal evidence of significant difference observed between these two study sub-populations. On the other hand, a dose-response relationship was found between the likelihood of HIV infection and the number of previous children reported. Highest rate of 10.6% was observed in pregnant women who have had at least 2 children previously and this relationship was statistically significant (Table 3). Consequently, the higher the number of children reported, the higher the likelihood of HIV infection. In contrast, while the highest rate of HIV infection was observed in pregnant women with higher education (6.1%), this was not found to be statistically different from prevalence rates observed in pregnant women with primary (4.8%) or secondary education (4.2%).

Results of TB test and syndromic screening for tuberculosis

The overall estimate of tuberculosis rate in the study population was 0% as none of the pregnant women tested positive to the immunofluorescence assay test. This study also conducted a syndromic assessment of tuberculosis in the study population according to WHO guidelines. The results are presented in Table 4. The rates of cough more than 3 weeks and weight loss were estimated at 4% and 2% respectively. On the other hand a statistically significantly higher rate of lymphadenopathy (20%) was observed notably across six of the ten health facilities (Table 4). An estimated 24% of the study population reported having fever that lasted more than 3 weeks. However this did not attain statistical significance.

A comparative assessment of HIV knowledge and exposure

In order to further our understanding and characterization of the observed patterns in this population of pregnant women, we assessed the knowledge and exposure profile of HIV positive and negative pregnant women as presented in Table 4. We found highly statistically significant evidence in the difference between the two study sub-populations with respect to previous negative HIV test (Table 4). Findings showed that 49.5% of HIV negative pregnant women had had previous negative HIV test compared to 16.7% of HIV positive pregnant women ($p = 0.007$). On the other hand, a relatively high proportion of both populations had knowledge of HIV transmission routes and risk factors (>90%). A similar high percentage of both HIV positive and negative pregnant women were informed about the test results (Table 5).

Table 3
Statistical comparison of HIV seropositivity status with regard to socio-demographic variables.

Variable	N	HIV positive n (%)	HIV negative n (%)	p-value
Age				0.307; chi2(2) = 2.364
15–24	35	0(0)	35(100)	
25–34	245	13(5.3)	232(94.7)	
≥35	73	5(6.9)	68(93.2)	
State of origin				0.084; Chi2(1) = 2.992
Lagos	126	3(2.4)	123(97.6)	
Ogun	227	15(6.6)	212(93.4)	
Parity				0.007; Chi(2) = 9.846; Fisher's exact = 0.012
0	74	1(1.4)	73(98.7)	
1	135	4(3.0)	131(97.0)	
≥2	104	11(10.6)	93(89.4)	
Education				0.853; Chi2(3) = 0.784
None	7	0(0)	7(100)	
Primary	145	7(4.8)	138(95.2)	
Secondary	48	2(4.2)	46(95.8)	
Higher	147	9(6.1)	138(93.9)	
Total	353	18(5.1)	335(94.9)	

Table 4
Distribution of syndromic indicators of tuberculosis among study participants by study locations.

Indicator	1 N = 39 n(%)	2 N = 29 n(%)	3 N = 20 n(%)	4 N = 20 n(%)	5 N = 40 n(%)	6 N = 51 n(%)	7 N = 26 n(%)	8 N = 45 n(%)	9 N = 43 n(%)	10 N = 40 n(%)	Total N = 353 n(%)
Cough >3 weeks?											
No	38(97)	29(100)	19(95)	17(85)	38(95)	49(96)	25(96)	43(96)	43(100)	38(95)	339(96)
Yes	1(3)	0(0)	1(5)	3(15)	2(5)	2(4)	1(4)	2(4)	0(0)	2(5)	14(4)
p-val: 0.361											
Weight loss											
No	39(100)	29(100)	20(100)	20(100)	39(98)	49(96)	26(100)	44(98)	43(100)	38(95)	347(98)
Yes	0(0)	0(0)	0(0)	0(0)	1(2)	2(4)	0(0)	1(2)	0(0)	2(5)	6(2)
p-val: 0.583											
Lymphadenopathy											
No	26(67)	29(100)	16(80)	20(100)	30(75)	37(73)	25(96)	35(78)	34(79)	32(80)	284(80)
Yes	13(33)	0(0)	4(20)	0(0)	10(25)	14(27)	1(4)	10(22)	9(21)	8(20)	69(20)
p-val: 0.005											
Fever >3 weeks?											
No	29(74)	28(97)	13(65)	13(65)	32(80)	37(73)	20(77)	35(78)	36(84)	27(68)	270(76)
Yes	10(26)	1(3)	7(35)	7(35)	8(20)	14(27)	6(23)	10(22)	7(16)	13(32)	83(24)
p-val: 0.148											
Sweat >3 weeks?											
No	37(95)	29(100)	20(100)	20(100)	40(100)	50(98)	25(96)	44(98)	43(100)	38(95)	346(98)
Yes	2(5)	0(0)	0(0)	0(0)	0(0)	1(2)	1(4)	1(2)	0(0)	2(5)	7(2)
p-val: 0.594											

Key: 1—Ibafo; 2— Sagamu; 3— AbuleIroko; 4— Agbado crossing; 5—Akute Ajuwon; 6—Camp; 7—Ipaja; 8—Kollington; 9—Mowe; 10—Sabo Ikorodu.

In addition, a statistically significant association was found between blood transfusion in the past 3 months and HIV infection. HIV positive pregnant women were 6 times more likely to have blood transfusion in the past 3 months than HIV negative pregnant women. We also noted the marginal association between sexually transmitted infection (STI) in the past 3 months and HIV infection as HIV positive pregnant women had 2 times higher rate of STI than HIV negative pregnant women (Table 5).

Inferential analysis of HIV risk in the study population

As a further step, we examined any evidence for differences between HIV positive and negative sub-populations with regard to HIV knowledge and exposure profile as presented in Table 5. Results showed a statistically significant difference between pregnant women that tested HIV positive compared to those tested negative with respect to previously tested negative result ($p < 0.01$). Similarly, statistical evidence was found between blood transfusion in the past three months and likelihood of HIV infection. The results showed that 11.1% (n = 2/18) of HIV positive patients had blood transfusion in the previous three months compared to 1.8% (n = 6/333). It is also worth mentioning that we found no evidence of association between HIV infection and having unprotected sex with casual partner as all HIV positive participants had no unprotected sex with a casual partner in the previous 3 months. A marginal evidence was found between sexually transmitted infection in the past 3 months and the risk of HIV infection. The result showed that HIV positive pregnant women are two times more like to be diagnosed of STI in the past three months.

We fitted a binary logistic regression model to estimate adjusted effect of significant factors that may increase the likelihood of HIV infection in this study population. The result is presented in Table 6. Pregnant women from Ogun State had 4.72 greater odds of HIV infection compared to those from Lagos State. A dose-response effect of parity on the risk of HIV infection was also observed with pregnant women who had had at least 2 children previously having 9.8 greater odds of HIV compared to those who did not have any child. On the other hand, pregnant women with previously tested HIV negative status had significantly lower odds of HIV infection (OR:0.21, 95% CI:0.06–0.77). A three times greater odds of HIV infection was also observed in pregnant women with history of blood transfusion in the previous three months.

Table 5
Assessment of the differences between HIV positive and negative participants with respect to HIV knowledge and exposure profile.

Variable	N	HIV positive n (%)	HIV negative n (%)	p-value
Previously tested HIV negative				0.007; chi2(1) = 7.400 exact; 0.007
No	183	15(83.3)	168(50.5)	
Yes	168	3(16.7)	165(49.5)	
Awareness of HIV transmission routes				0.194; chi2(1) = 1.688 exact; 0.271
No	6	1(5.6)	5(1.5)	
Yes	347	17(94.4)	330(98.5)	
Risk factors awareness				0.195; chi2(1) = 1.679 exact; 0.272
No	6	1(5.6)	5(1.5)	
Yes	346	17(94.4)	329(98.5)	
Awareness of transmission methods				0.127; chi2(1) = 2.327 exact; 0.231
No	5	1(5.6)	4(1.2)	
Yes	348	17(94.4)	331(98.8)	
Informed about test result				0.127; chi2(1) = 2.327 exact; 0.231
No	5	1(5.6)	4(1.2)	
Yes	348	17(94.4)	331(98.8)	
Blood transfusion in the past 3 months				0.010; chi2(1) = 6.645 exact; 0.058
No	343	16(88.9)	327(97.6)	
Yes	8	2(11.1)	6(1.8)	
Non-response	2	0(0)	2(0.6)	
Unprotected sex with casual partner in the past 3 months				0.640; chi2(1) = 0.219 exact; 1.000
No	347	18(100.0)	329(98.2)	
Yes	4	0(0.0)	4(1.2)	
Unprotected sex with regular partner <=3 months				0.480; chi2(1) = 0.499 exact; 1.000
No	9	0(0.0)	9(2.7)	
Yes	342	18(100.0)	324(96.7)	
Non-response	2	0(0)	2(0.6)	
STI in the past 3 months				0.050; chi2(1) = 3.856 exact; 0.094
No	292	12(66.7)	280(83.6)	
Yes	58	6(33.3)	52(15.5)	
Non-response	3	0(0)	3(0.9)	
More than one sex partner in the past 3 months				0.640; chi2(1) = 0.219 exact; 1.000
No	347	18(100.0)	329(98.2)	
Yes	4	0(0.0)	4(1.2)	
Non-response	2	0(0)	2(0.6)	
HIV risk score				0.003
Mean ± SD	351	2.50 ± 0.71	2.15 ± 0.47	
Age at first sex				0.785
Mean ± SD		21.4 ± 3.8	21.7 ± 4.6	

Table 6
Binary Logistic Regression Model of HIV infection in the study population of pregnant women.

Variable	Odds ratio (95% CI)	S.E	P-value(<0.05)
Age at first sex	0.96 (0.84–1.09)	0.07	0.502
State of origin			
Lagos	Ref		
Ogun	4.72 (0.99–22.59)	3.8	0.052
Parity			
0	Ref		
1	2.43 (0.25–23.42)	2.81	0.442
≥2	9.77 (1.17–81.80)	10.59	0.036
Previously tested HIV negative			
No	Ref		
Yes	0.21 (0.06–0.77)	0.14	0.019
Blood transfusion in the past 3 months			
No	Ref		
Yes	3.27 (0.44–24.36)	3.35	0.248
Complaints of genital sore/swollen of inguinal lymph			
No	Ref		
Yes	2.52 (0.24–26.26)	3.01	0.440

LR Chi2(7) = 25.00; Prob > chi2 = 0.0008; N = 296; 95% CI = 95% Confidence Interval; S.E = Standard error.

Assessment of impact measures of risk factors for HIV infection on the pregnant women population

In order to evaluate the public health impact associated with risk reduction within exposure risks groups, we implemented two measures of impact of exposure group on HIV infection. These are the attributable proportion (often described as attributed fraction) which measures proportion of cases attributable to the exposure risk, as well the population attributable fraction, a similar measure that extends the attributable proportion in the entire study population. The important caveat here is that we considered the odds of infection, rather than risk as commonly applied in cohort studies in recognition of the cross-sectional study design of the study. The results of this assessment are presented in Table 7.

Three exposure risk factors were found to have a statistically significant impact on the attributable fraction and population attributable fraction respectively. They are parity (at least two previous children), blood transfusion in the previous three months

Table 7
Attributable proportion and population attributable fraction of key HIV socio- demographic and exposure variables.

Exposure	OR (95%CI)	AF_{exp}/AP_{exp}(95%CI)	PFexp (95%CI)	PAF/PFpop	p-value(exact)
Education					
Primary	0.91(0.34–2.40)	–	0.09(−1.40 to 0.66)	0.038	1.000
Secondary	0.79(0.18–3.52)	–	0.22(−2.52 to 0.82)	0.029	1.000
Higher	1.43(0.55–3.68)	0.30(−0.80 to 0.73)	–	0.150	0.472
Parity					
0	0.21(0.03–1.35)	–	0.79(−0.35 to 0.97)	0.172	0.137
1	0.44(0.15–1.35)	–	0.56(−0.35 to 0.85)	0.217	0.213
2	4.09(1.64–10.20)	0.76(0.39–0.90)	–	0.462	**0.006**
Age group					
25–34	1.15(0.40–3.32)	0.13(−1.50 to 0.70)	–	0.097	1.000
>= 35	1.51(0.52–4.36)	0.34(−0.91 to 0.77)	–	0.094	0.548
State of Origin					
Lagos	0.34(0.10–1.15)	–	0.66(−0.15 to 0.90)	0.241	0.128
Ogun	2.90(0.87–9.71)	0.66(−0.15 to 0.90)	–	0.546	0.128
Previously tested HIV negative	0.20(0.06-0.64)	–	0.80(0.36–0.94)	0.395	**0.007**
Blood transfusion in the past 3 months	6.81(1.58–29.36)	0.853(0.37–0.97)	–	0.095	0.058
STI in the past 3 months	2.69(1.00–7.24)	0.629(0.00–0.86)	–	0.210	0.094

Bold values are the probability that the population attributable fraction (PAF) or preventive fraction in the population (PF_{pop}) for the exposure attained statistical significance at 5% alpha level.

and having previously tested negative. The attributable proportion of all cases of HIV infection in pregnant women with at least 2 previous children was 76%, and this was found to be statistically significant after adjusting for socio-demographic factors. Similarly, 85% of all cases exposed to blood transfusion in the previous three months are due to the effect of blood transfusion in the study population. While we obtained 80% preventive fraction in pregnant women who tested negative compared to those who tested positive in previous test.

Discussion

In the present study, we conducted an epidemiological assessment of the HIV and tuberculosis co-burden in pregnant women population in two south-western states in Nigeria. The overall prevalence estimate of HIV was 5.1% while tuberculosis was 0% in this high risk population (ḦIV prevalence in study population̈).

A comparison of these findings to the most recent National HIV prevalence estimate of 2.9% in 2016 shows relatively higher rate observed among pregnant women in Lagos and Ogun states [20]. HIV prevalence estimate in our study was slightly higher than the 2010 National ANC average HIV prevalence rate of 4.1% in pregnant women [21]. A comparison of this result to other similar studies show evidence of a relatively lower rate than the 8.2% and 8.3% reported by Sagay et al. [22] and Charles et al. [23] in Jos; 7.7% and 11.5% reported by Adeyemo et al. [24] and Agboghoroma and Illiyasu [25] reported in Ogun state and Abuja respectively. On the other hand, prevalence estimate from this study was slightly higher than similar studies conducted in Port Harcourt [26], the Nigeria Delta region of the country [27,28] and south-eastern Nigeria (Umeononihu et al. [29] with estimates ranging from 3%–4.9%. We also reported a high prevalence rate among pregnant women from Ogun state 6.6% compared with pregnant women from Lagos State (2.2%). The observed higher rate in Ogun state may be due to the higher demands, availability, and affordability of antenatal health care services both at the government level and private centers.

The relatively higher education and exposure to preventive measures, and easy access to treatment regimen in teaching hospitals in the metropolitan city of Lagos may account for the effectiveness of interventions and subsequent reduction in HIV transmission particularly in between regular partners. In addition, the observation of highest rate of HIV infection in pregnant women in the middle (26–34 years) age group was expected and consistent with reports from various studies [7,30]. Women of reproductive age tend to peak in their sexual activity in the middle age years (25–34 years) and hence with higher transmission probability of HIV particularly with non-use or inconsistent use of protective measures.

Another notable finding from this study is the observed dose-response relationship between parity and the likelihood of HIV infection in the pregnant women population. This likelihood is significantly amplified with increasing number of parity (Ïnferential analysis of HIV risk in the study population̈). This may be due to the fact that women with multiple parity are particularly prone to pregnancy-related immune-suppression which makes them more predispose with each new episode of pregnancy [9]. On the other hand, longer history of parity invariably translates to higher frequency of antenatal care visit to health centers which is another key source of HIV exposure through unsterilized medical instruments, blood and blood products as found in our study.

Furthermore, we found a 6 times higher rate of blood transfusion in the previous 3 months in HIV positive pregnant women (Ïnferential analysis of HIV risk in the study population̈). This provides evidence for the possibility of the transmission (epidemiological) link between recent blood transfusion and HIV positivity in this population. This is not uncommonly reported as it has been shown that despite the low probability of HIV infection through contaminated blood products, this route of transmission can be greatly enhance and a likely persisting cause for concern across developing countries particularly in sub-Saharan Africa with an ongoing and highly heterosexual generalized HIV epidemic in multi-organism transmission complex environment [30–32]. The 85% of all cases attributed to blood transfusion within the study population demonstrate the protective impact of ensuring adequate screening of blood and blood products in healthcare settings particularly prior to antenatal care.

There is therefore little evidence of a declining HIV burden in pregnant women population.

This may be due to a number of factors that we assessed in the current study which more often than not predispose pregnant women to HIV exposure such as unprotected sex with regular partners who may or may not be faithful. The second is related to hospital-acquired HIV infection through infected blood and blood

products, a frequent occurrence in developing countries with poor healthcare infrastructure.

We further assessed the tuberculosis situation in the same population as the most ranked opportunistic infection and risk factor for HIV due to the immune-suppressed state of pregnant women. However, we found no case of active tuberculosis (0%) in this population despite the high prevalence of HIV. This may be due to the positive impact of DOTS intervention over the years as part of the routine antenatal care services across Nigeria.

Limitations of the study

This study was designed to be a cross-sectional study of the pregnant women population in south west Nigeria. As a result, both exposure and outcome measures were collected at the same point in time which makes risk estimates difficult with regard to the temporal nature of exposure and outcome. This is a well-known limitation to all cross-sectional studies and thus result of such studies must be interpreted with caution. The second limitation of the study relates to the representativeness of the total sample size obtained for the study. Due to funding limitation, we only screened 353 pregnant women across ten health facilities. Consequently, this may affect the external validity of this study and thus renders the estimates of HIV prevalence burden obtained less generalizable to other parts of the country; hence, we consider this an improved estimate.

Funding

No funding Sources.

Competing interests

None declared.

Ethical approval

Not required.

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