

Seroprevalence and Co-infections of Human Immunodeficiency Virus, Hepatitis B virus and Hepatitis C Virus among Prison Inmates in Security Challenged Yobe State of North-Eastern Nigeria

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Abstract: Background: Correctional facilities are crucial integral of the criminal justice system and represents a potential breeding ground for infectious diseases such as HIV/AIDS, Hepatitis B, Hepatitis C and tuberculosis. It is therefore, imperative to determine the sero-prevalence and coinfection of these infectious diseases agents among prison inmates. **Methods:** From February- March 2014, 352 prison inmates of which 343 were males and nine females from three prisons in Yobe State were consensually recruited for this study. Blood samples were collected and screened for HIV, HBV and HCV using Trinity Biotech Uni-gold HIV test kit, one step HBV test kit and HCV ELISA. Socio-demographic data were collected using a structured questionnaire. Data were subjected to statistical analysis using SPSS version 13.0. P values < 0.05 were considered significant. **Results:** Out of the 352, 1.7%, 13% and 3.98% were seropositive for HIV, HBV and HCV respectively. 0.6%, 0.3%, 0.9% and 0% were co-infected with HIV/HBV, HIV/HCV, HBV/HCV and HIV/HBV/HCV respectively. Those within the age brackets 18-24, 39-45 and 46-52 years had the highest prevalence rate for HIV, HBV and HCV respectively (P < 0.05 for HBV and HCV). Homosexuality and intravenous drug use were significantly associated with infections of HIV, HBV and HCV (P < 0.05), history of venereal diseases was associated with HIV and HBV, undergoing surgery and dental procedure was associated with HCV, multiple sexual partners, sharing of tooth brush and history of tattooing/ tribal mark was significantly associated with HBV (P<0.05). **Conclusions:** The outcome shows the need for government driven policies in providing care for the infected prisoners thereby protecting the larger society.

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Keywords: Coinfection, HIV, HBV, HCV, Sero-prevalence, Yobe State.

Introduction

Globally, literatures have explicitly documented the relationship between incarceration and the transmission of infectious diseases leading to the latter been more prevalent in remand facilities than in the general population (Vescio *et al.*, 2008, Gough *et al.*, 2010, Fazel and Baillargeon, 2011). This phenomenon has been credited to factors such as intravenous drug use and paraphernalia, tattooing and scarification high-risk sexual behaviors before and after incarceration (Skoretz *et al.*, 2004, Nelwan *et al.*, 2010). Common among the etiologies of these infectious diseases are life threatening pathogens such as HIV, hepatitis B and C viruses. Infection with one of these viruses constitutes a major public health concern not only due to its high global prevalence but also because of the potentially (mainly HCV and HBV) severe complications of persistence and exceptional high risk of co-infection resulting in an accelerated progression of diseases (Macalino *et al.*, 2005, Hennessey *et al.*, 2009).

As a result of the similar routes of transmission, coinfection of either HCV and HIV, or HBV and HCV

or HBV and HIV or the three at the same time constitutes a growing course of concern particularly the so called “twin epidemics” HCV/HIV (Pontali and Ferrari, 2008, Hennessey *et al.*, 2009).

With over 10 million people incarcerated worldwide (Seena and Jacque., 2011) and over 56,785 prison inmates in 155 prisons, 83 satellite facilities, 10 prison farms spread across Nigeria (NPS, 2015, Omoleye *et al.*, 2012), with no history of blood screening for infectious diseases prior to admission into correctional facilities, low literacy level among inmates, transfer of inmates from one correction facility to another and the eventual release of inmates, there is a considerable movement between the correction system and the general population (Mohammed *et al.*, 2012, Adoga *et al.*, 2009). Therefore, the prison communities serves as convenient breeding ground for infectious agents with infected inmates representing a major public health risk as they are reservoirs for further spread in the general population.

We, therefore, designed this cross-sectional study to determine the prevalence and coinfection of HIV, HBV and HCV among prison inmates in Yobe State.

Materials and Methods

Study Area

Yobe State is located in Northern Nigeria and it lies between 12°00'N11°30'Ecoordinates. The state has estimated area of 45,502 km² (17,568 sq mi) (www.wekepedia.com, 2013). The state shares borders with Borno State to the east, Gombe State to the south,

Bauchi and Jigawa States to the west and Niger Republic to the north. The state is dry and hot for most of the year except in the southern part of the state which has a milder climate. Yobe has estimated population of: 2,532,395 as of 2006 (<http://www.yobestate.gov.ng>, 2013), with March and April having temperature ranges of 38-40° Celsius. In the rainy season, June-September, temperatures fall to 23-28° Celsius and rainfall of 500 to 1000mm (Sunday Tribune, 2009). Below is map of Yobe State with arrow indicating the study locations.

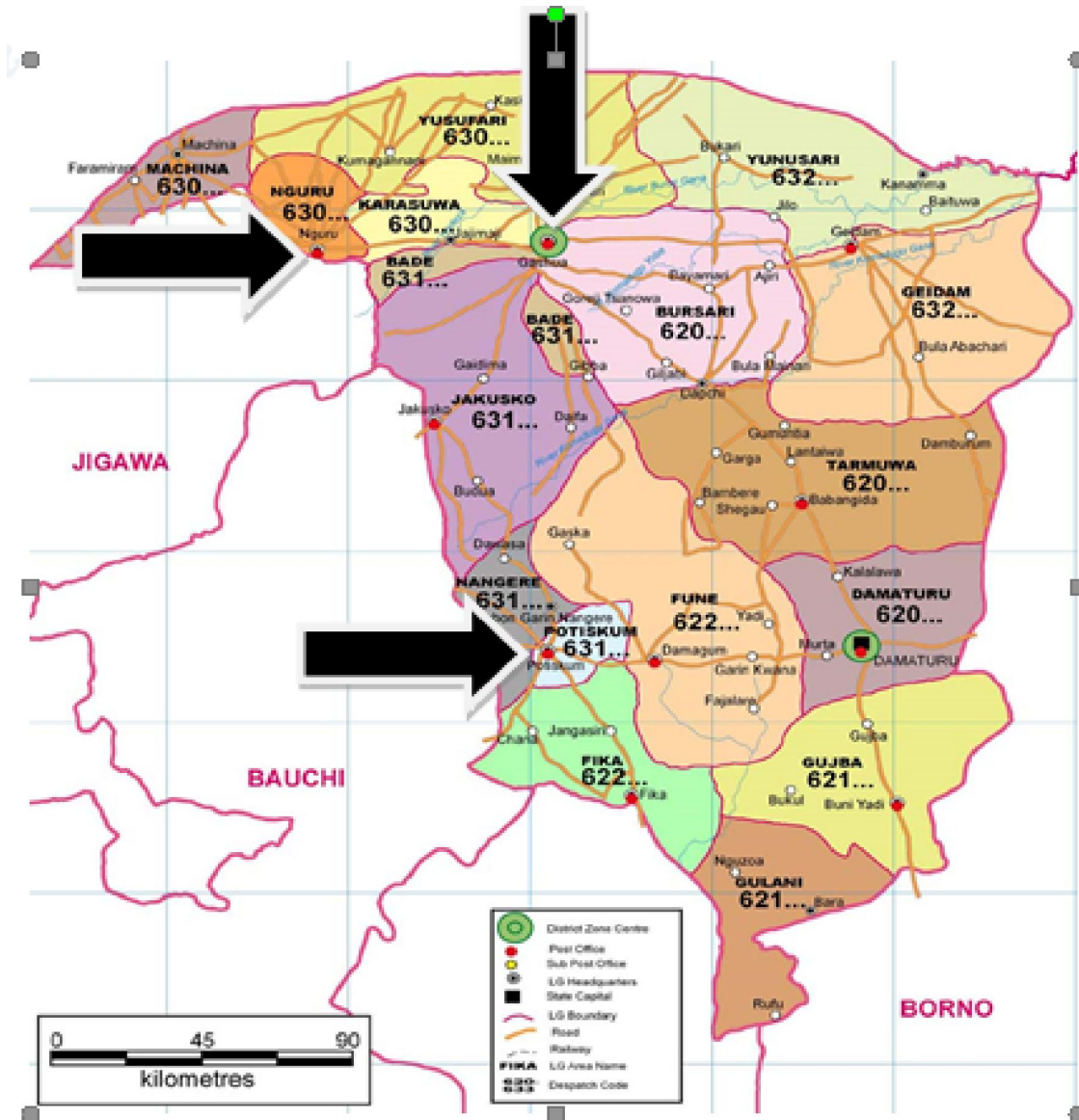


Figure 1. Map of Yobe State with arrow indicating the study area (www.yobestategovt.org).

Study Design and Population

Three hundred and fifty two prison inmates of which 343 were males and nine females were recruited

for this study from three correctional facilities in Yobe state mainly Potiskum, Gashua and Nguru prisons from February- March 2014. The subjects were

verbally informed of the study and consent was granted. Demographic data were obtained using structured questionnaires. For the risk factors, participants were asked to indicate whether they had any history of previous or current blood transfusion, intravenous drug use tattooing/ scarification, history of sexual behaviors including sexual orientation, exposure to multiple sex partners, sharing of clippers and sharp objects, homosexuality and past history of sexually transmitted diseases. Ethical clearance was obtained from Yobe State prison authorities.

Sample Collection

Five milliliters of blood were aseptically collected in plain tubes from each of the 352 consenting participant by venipuncture of the cubital vein using sterile disposable needles and syringes. Samples were centrifuged at 2000 revolutions per minutes for five minutes and the sera kept at -20°C until analyzed.

Serological assays for HIV, HBV and HCV antibodies

To detect anti-HIV, sera were screened for presence HIV antibody using Trinity Biotech Uni-gold HIV test kit for rapid immune assay based on the immunochromatographic sandwich principal for detection of anti-HIV in human serum and plasma (Trinity Biotech Plc Bray, Co. Wicklow, Ireland, www.trinitybiotech.com) according to manufacturer's instruction. Sera were screened for HBV antibodies using one step HBV test strip for rapid immune assay based on the immunochromatographic sandwich principal for detection of HBV antibody in human serum and plasma (Chembio Diagnostic System, Inc. U.S.A) using manufacturer's instruction. HCV ELISA (DIA. PRO Diagnostic Bioprobes Srl Via G. Carducci n° 27 20099 Sesto San Giovanni, Milano) Italy was used for the detection of antibodies against HCV according to manufacturer's instruction. It is an

indirect ELISA procedure based on the HCV specific antigens derived from core and NS regions coated in microplates to bind with antibodies against HCV.

Ethical Consideration

Ethical approval for the study was obtained from the prison authorities all due processes were followed.

Statistical Analysis

Data were subjected to statistical analysis using the statistical software SPSS version 13.0. Pearson chi-squares were calculated at a 95% confidence interval. P values ≤ 0.05 were considered statistically significant.

Results

From February- March 2014, 352 prison inmates (343 males and 9 females) aged 18-66 with a mean age of $30.1 \pm 2.59(\text{SD})$ were recruited for this study. Six (1.7%) were positive for HIV, all of which were males $P > 0.05$, 46 (13%) were HBV positive of which 44(12.8%) and 2(22%) were of the male and female population respectively $P > 0.05$, while 14 (3.98%) were positive for HCV of which 13(3.8%) and one (11%) were of the male and female population respectively $P > 0.05$ (Tables 1). Single individuals had the highest presence of anti-HIV 2.2%, with sub-urban population (location) having the highest prevalence rate of 4.1%, while for HBV the highest prevalence of 14.4% was seen among married individuals and based on location the sub-urban population had 20.4% (Table 1). Furthermore, 25% were separated while rural location had 4.5% prevalence rate for HCV (Table 1). Two (0.6%) were co-infected with HIV/HBV, one (0.3%), three (0.9%) and none (0%) were co-infected with HIV/HCV, HBV/HCV and HIV/HBV/HCV respectively (Table 2). The age brackets 18-24, 39-45 and 46-52 years had the highest prevalence rate for HIV, HBV and HCV respectively (Table 3) ($P < 0.05$ for HBV and HCV).

Table 1: Socio-demographic characteristics of prison inmates in Yobe State in relation to distribution of HIV, HBV and HCV infection

Characteristics	No screened	No. HIV+ (%)	P-value	No. HBV+	P-value	No. HCV+	P-value
Sex							
Male	343	6 (1.7)	1.000	44 (12.5)	0.58	13 (3.8)	0.309
Female	9	0 (0.0)		2 (22.0)		1 (11.0)	
Marital status							
Single	180	4 (2.2)	0.87	22 (12.2)	0.0001	8 (4.4)	0.15
Married	160	2 (1.3)		23 (14.4)		5 (3.1)	
Divorced	8	0 (0.0)		1 (12.5)		0 (0.0)	
Separated	4	0 (0.0)		0 (0.0)		1 (25.0)	
Location							
Urban	102	3 (2.9)	0.11	18 (17.6)	0.03	3 (2.9)	0.81
Sub-Urban	49	2 (4.1)		10 (20.4)		2 (4.1)	
Rural	201	1 (0.5)		18 (8.9)		9 (4.5)	

Table 2: Distribution of HIV co-infection with HBV or HCV in correctional facilities in Yobe State

Infection type	No. Screened	No. Positive (%)	P-value	RR	95% CI
HIV	352	6(1.7)	-	-	-
HBV	352	46(13.1)	-	-	-
HCV	352	14(3.98)	-	-	-
*HIV/HBV	352	2(0.6)	<0.0001	0.1304	0.0063-0.37
HIV/HCV	352	1(0.3)	0.111	0.043	0.0063-0.0367
*HBV/HCV	352	3(0.9)	<0.0001	3.29	1.84-5.87
HIV/HBV/HCV	352	0(0)	0	0	0

*= significant variables

Table 3: Age distribution of human immunodeficiency virus, hepatitis B and hepatitis C virus infection among prison inmates in Yobe State.

Age (Years)	NO. Screened (%)	HIV + (%)	HBV + (%)	HCV + (%)
18-24	115	3 (2.6)	8 (6.9)	3 (2.6)
25-31	120	2 (1.7)	12 (10)	4 (3.3)
32-38	50	1 (2.0)	13 (26)	2 (4)
39-45	41	0 (0.0)	13 (31.7)	2 (4.9)
46-52	16	0 (0.0)	0 (0.0)	3 (18.7)
53-59	8	0 (0.0)	0 (0.0)	0 (0)
60-66	2	0 (0.0)	0 (0.0)	0 (0)
Total	352	6 (1.7)	46 (13)	14 (4)

HIV ($X^2 = 1.75$, P-value = 0.94, df = 6)

HBV ($X^2 = 23.5$, P-value = **0.0006**, df = 6)

HCV ($X^2 = 9.64$, P-value = **0.0469**, df = 4)

Table 4 shows that 27.2% of the HIV positive inmates practice homosexuality P<0.05, 12.5% use intravenous drug P<0.05, 12.5% had history of venereal diseases P<0.05, 4.6% had multiple sexual

partners P>0.05, 1.8% and 2.1% shared sharp object and had tribal marks or tattoo respectively P> 0.05, none had history of blood transfusion, sharing of tooth brush and surgical or dental procedure.

Table 4: Distribution of HIV and its associated risk factors in Yobe State.

Risk factor	No screened	No. Positive (%)	P-value	RR	(95% CI)
*Homosexual practice					
Yes	11	3 (27.2)	0.0004	31.0	7.030-136.70
No	341	3 (3.2)			
* Intravenous drug use					
Yes	24	3 (12.5)	0.005	13.67	2.912-64.139
No	328	3 (0.914)			
*Hx of venereal disease					
Yes		6 2 (12.5)	0.004	28.83	6.475-128.40
No		346 4 (0.914)			
Multiple sex partners					
Yes	152	5 (4.6)	0.089	6.58	0.78-55.8
No	200	1 (3.5)			
Blood transfusion					
Yes	31	0 (0.00)	1.000	0.00	0.00-0.00
No	321	6 (19.4)			
Sharing of tooth brush					
Yes		37 0 (0.00)	1.000	0.00	0.00-0.00
No	315	6 (1.9)			
Surgical or dental procedures					
Yes	21	0 (0.00)	1.000	0.00	0.00-0.00
No	331	6 (1.8)			
Sharing of sharp object					
Yes	333	6 (1.8)	1.000	0.00	0.00-0.00
No	19	0 (0.00)			
Hx of tattoo or tribal mark					
Yes	142	3 (2.1)	0.688	1.48	0.303-7.23
No	210	3 (1.4)			

Hx=history

*=significant variables

For HBV the result of the statistical analysis have shown that intravenous drugs use, homosexual practice, history of venereal diseases, multiple sex partners and tribal mark was common among 66.7%, 54.5%, 8%, 18.4% and 4.9 % of the HBV positive inmates respectively $P < 0.05$ while blood transfusion,

surgical or dental procedure and history of sharing sharp objects was seen among 9.7%, 4.8% and 13.5% of the HBV positive inmates respectively $P > 0.05$ and none of the inmates had history of sharing tooth brush (Table 5).

Table 5: Distribution of HBV and its associated risk factors in Yobe State.

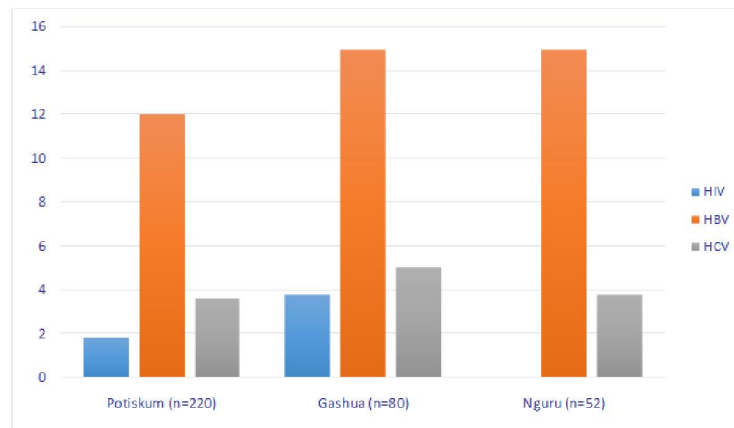
Risk factor	No screened	No. Positive (%)	P-value	RR	(95% CI)
*Homosexual practice					
Yes	11	6 (54.5)	0.0010	4.65	2.52-8.56
No	341	40 (11.7)			
* Intravenous drug use					
Yes	24	16 (66.7)	0.0001	7.29	4.68-11.35
No	328	30 (9.1)			
*Hx of venereal disease					
Yes	62	18 (8)	0.0002	3.01.6	1.78-5.08
No	290	28 (3.8)			
*Multiple sex partners					
Yes	152	28 (18.4)	0.0107	2.047	1.18-3.56
No	200	18 (9.0)			
Blood transfusion					
Yes	31	3 (9.7)	0.78	0.72	0.24-2.19
No	321	43 (13.4)			
*Sharing of tooth brush					
Yes		37 0 (0.00)	0.0001	6.85	5.24-8.95
No	315	46 (14.6)			
Surgical or dental procedures					
Yes	21	1 (4.8)	0.333	0.35	0.05-2.42
No	331	45 (13.6)			
Sharing of sharp object					
Yes	333	45 (13.5)	0.49	2.57	0.37-17.6
No	19	1 (5.3)			
*Hx of tattoo or tribal mark					
Yes	142	7 (4.9)	0.0002	0.27	0.122-0.58
No	210	39 (18.6)			

Hx=history

*=significant variables

Of the risk factors analyzed for HCV infection, Table 6 shows that only intravenous drugs use, homosexual practices and history of surgical or dental procedures with 41.7%, 27.2% and 14.2% of HCV positive inmates had $P < 0.05$ while other risk factors such as history of sexually transmitted disease,

multiple sex partners, blood transfusion, sharing of tooth brush, sharing of sharp object and history of tattoo or tribal marks had 8%, 4.6%, 9.7%, 5.4%, 4.2% and 6.2% of the HCV infected inmates respectively with $P > 0.05$.



Prison

Figure 2: Seroprevalence of HIV, HBV and HCV infections by prison location in Yobe State.

Table 6: Distribution of HCV and its associated risk factors in Yobe State.

Risk factor	No screened	No. Positive (%)	P-value	RR	(95% CI)
*Homosexual practice					
Yes	11	3 (27.2)	0.007	8.46	2.74-26.09
No	341	11 (3.2)			
* Intravenous drug use					
Yes	24	10 (41.7)	<0.0001	34.17	11.57-100.9
No	328	4 (2.1)			
Hx of venereal disease					
Yes	6	5 (8)	0.08	2.6	0.090-7.49
No	346	9(3.8)			
Multiple sex partners					
Yes	152	7(4.6)	0.6	1.32	0.47-3.67
No	200	7 (3.5)			
Blood transfusion					
Yes	31	3 (9.7)	0.12	2.82	0.83-9.59
No	321	11 (3.4)			
Sharing of tooth brush					
Yes	37	2 (5.4)	0.65	1.42	0.33-6.10
No	315	12 (3.8)			
*Surgical or dental procedures					
Yes	21	3 (14.2)	0.04	4.30	1.30-14.25
No	331	11 (3.4)			
Sharing of sharp object					
Yes	333	14 (4.2)	1.0	0.0	0.00-0.00
No	19	0 (0.00)			
Hx of tattoo or tribal mark					
Yes	142	6 (6.2)	1.0	1.11	0.39-3.13
No	210	8(3.8)			

Hx=history

*=significant variables

Figure 2 shows seroprevalence rates by prison location, Gashua prison was the most affected by HIV (3.8%) followed by Potiskum prison with 1.8% and none of the prison inmates in Nguru prison was infected with HIV (Fig 2). However, Gashua prison and Nguru prison were the most affected by HBV (15%) each while 12% of the Potiskum prison inmates tested were infected with HBV. Furthermore, for HCV Gashua prison was most affected (5%), followed by 3.8% and 3.6% for Nguru and Potiskum prisons respectively.

Discussion

Correctional facilities are crucial integral of the criminal justice system. With over 10 million people in incarceration worldwide (Weinbaum *et al.*, 2005) and possibilities of considerable movement between the correctional system and the general population, knowledge on the burden of blood borne viral infections in prisons is essential for the planning of preventive measures and the development and improvement of vaccination programmes. This study investigated the prevalence and co-infection of HIV, HBV and HCV among the inmates of three correctional facilities in Yobe State, Nigeria with the aim of providing data on the viral burden on Nigerian prisons for policy formation on disease preventive measures and vaccination. High prevalence rate of

HBV (13%) was found in prisons in Yobe State while, prevalence rate for HIV and HCV were 1.7% and 3.98% respectively. This finding with relation to HBV concurs with previous studies amongst inmates in Ghana, Dakar and Lome, where high prevalence of 17.4%, 14.1%, and 10.9% respectively were reported (Adjei *et al.*, 2006, Jaquet *et al.*, 2016). This, however, is slightly lower compared to reports by Adoga *et al.*, 2009 and higher compared to reports by Nelwan *et al.*, 2010 who reported a seroprevalence rate of 23% and 5.8% among inmates in Nasarawa State, Nigeria and Indonesia respectively. This variance can be possibly attributed to different levels of infection in the general population, types of prison and prisoners and difference in cultural practices. However, this study confirms to a higher prevalence of HBV among correctional population compared to that of general population in Yobe State with reports by Anyanwu, (2013) and El-ishaq and Liman (2015) showing a HBV sero-prevalence of 7.1%, and 11% amongst blood donors in Nguru and Potiskum respectively. Lower HBV prevalence of 5.2% was also seen amongst student population in Osun State Nigeria (Babalola *et al.*, 2013). 3.98% and 1.7% seroprevalence rate were found for HCV and HIV respectively. The HCV prevalence from this study also confirms a higher prevalence amongst prison inmates relative to the general population. WHO reported a

worldwide prevalence of 3% for HCV among the general population in 1999 (WHO, 2000); 1% was reported by Isa *et al.*, (2016) among students of University of Maiduguri, Achinge *et al.*, (2013) reported 2.3% HCV prevalence in Makurdi and Onakewhor and Okonofua (2009) reported 1.8% in Benin City. However, other studies in the general population reported a HCV prevalence similar to the findings from this study with slight differences notwithstanding. Egah *et al.*, (2007), reported a HCV prevalence of 4.3% amongst blood donors in Jos, Nigeria, Ojule *et al.*, (2008), also reported 4.3% prevalence among pregnant women in Port Harcourt, Nigeria, Omatola *et al.*, (2016) reported a HCV prevalence of 4.5% amongst student of Kogi State University. The similarity in prevalence could be due to similar socio-cultural practices and environmental factors between the inmates and the general population. Howbeit, Adjei *et al.*, (2006), Adoga *et al.*, (2009) and Jovanovska *et al.*, (2014) reported HCV prevalence of 19.2%, 12.3%, and 20% amongst inmates in Ghana, Nigeria and Macedonia respectively. This distinctiveness could be due to high use of intravenous drugs and cultural differences amongst the inmates as prevalence of HCV varies geographically, both within and between countries. The HIV prevalence rate in this study concurs with findings by Mohammed *et al.*, (2012) who reported a prevalence of 2.4% amongst prison inmates in Ogun State, Nigeria and 2% in Pakistan by Passadouro (2004). However, the prevalence of HIV from this study is similar to that of the general population, Abubakar *et al.*, (2016) reported 2.4% among pregnant women in Maiduguri and 4.0% was reported by Anyanwu, (2013) among blood donors in Nguru. Notwithstanding, this is relatively lower to reports by Adoga *et al.*, (2009) and Abubakar *et al.*, (2015) (in a study conducted in 2014) who reported a prevalence of rate of 18% and 42% amongst prison inmates in Nasarawa State and adult population in Maiduguri respectively. However, increase awareness and change in sexual behavior among inmates over the years could be responsible for these variations. From this study, co-infection rates of 0.6%, 0.3% and 0.9% were observed for HIV/HBV, HIV/HCV and HBV/HCV respectively while none of the inmates was co-infected with HIV/HBV/HCV. The 0.9% HBV/HCV co-infection rate observed is higher than 0.6%, 0.3% reported by Ojide *et al.*, (2015) and Harania *et al.*, (2008). This is due to the obvious reason of higher infection rate among correctional population than the general population. This is lower compared to 1.1% HBV/HCV co-infection among intravenous drug users reported by Norouzian *et al.*, (2016) in Iran, obviously due to the difference in study population. 0.6% and 0.3% were co-infected with HIV/HBV and HIV/HCV

indicating a reoccurring finding in most studies in Nigeria where HIV/HBV co-infection rate is usually higher than HIV/HCV in the general population. The reason for this is not obvious but it could be as a result of difference in the extent of endemicity of the two viruses. Worthy of note is the fact that in this study we were able to reveal co-infection of HIV/HCV among prison inmates in Nigeria. However, previous study by Adoga *et al.*, (2009) did not find HIV/HCV. Notwithstanding, in accordance with Adoga *et al.*, (2009), this study was not able to find coinfection of HIV/HCV/HBV, howbeit, 3.9% coinfection of HIV/HCV/HBV was reported in Lagos, Nigeria and Tanzania (Balogun *et al.*, 2012, Nagu *et al.*, 2008). It is known that HIV coinfection greatly influences the clinical outcome of individuals infected with either HBV or HCV thus, accelerating the progression of liver disease among such individuals.

From the current study a statistical significant association exist between marital status, location of prison and the transmission of HBV (P-value = 0.0001 and 0.03 respectively) with no association between HBV and sex. While no association exist between sex, marital status, location of prison and transmission of HIV and HBV. This is in consonance with findings by (Balogun *et al.*, 2012, Ojide *et al.*, 2015 and Nagu *et al.*, 2008). We found that age is significantly associated with transmission of HBV and HCV (P-value=0.0006 and 0.0469 respectively) with inmates within the age group 32-38 and 25-31 more likely to be infected with HBV and HCV respectively corroborating findings of Ojide *et al.*, 2015. While inmates within the age group 18-24 had the highest prevalence of HIV due to the obvious reason of active, explorative and indiscriminate sexual behaviors (Dada *et al.*, 2006, Omatola *et al.*, 2016). Our discovery that homosexuality and intravenous drug use were significantly associated with infections of HIV, HBV and HCV (P < 0.05) is consistent with reports by Adjei *et al.*, 2006, Jovanovska *et al.*, 2014 and Jaquet *et al.*, 2016. The current study also relays a significant association between history of venereal diseases and infection with HIV and HBV but not HCV. We also found out that inmates that have undergone surgery or dental procedure stands a higher chance of been infected with HCV. It was discovered from the current study that multiple sexual partners, sharing of tooth brush and history of tattooing/ tribal mark was significantly associated with HBV infection among prison inmates. This corroborates reports by Allwright *et al.*, (2000) and Miranda *et al.*, (2000). Boredom has been associated with tattooing among prison inmates and in the process sharing of needles and ink thereby increasing the risk of infection with blood borne viruses.

Conclusion:

The seroprevalence rates of HIV, HCV and HBV in our correctional facilities calls for great concern on the urgent need for preventive and containment measures, such as compulsory screening of all prisoners against blood borne viral infections before incarceration, education, condom distribution, vaccination or immunization. It is obvious from our study that a great deal of drug use and discriminate sexual activity occurs in our prisons. This is incriminated in the monitoring and control of the infection in the general population. Therefore, the government needs to set up policies in providing care for the infected prisoners thereby protecting the larger society.

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