

Research Article

Hepatitis B Virus Infection among Prison Inmates in Borno State: Determination of Prevalence of Surface Antigen (HBsAg) and Possible Risk Factors of Disease

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Abstract

An epidemiological study on hepatitis B virus infection among prison inmates in Borno state, Nigeria, was carried out using a questionnaire survey to determine the possible risk factors of the disease and serological method [using an Enzyme Linked Immunosorbent Assay (ELISA)] to determine the prevalence of hepatitis B surface antigen (HBsAg) among the inmates. The study was conducted in correctional facilities in Maiduguri, Biu and Bama local government area of Borno State. Out of a total of 300 sera tested, 49 (16.3%) had detectable ELISA antibody to HBsAg. A significant difference ($p < 0.001$) in seroprevalence of HBsAg among inmates of different educational qualifications was observed and those with higher education had the highest prevalence (20.9%). Although there was no significant difference in prevalence of HBsAg among the different age groups, the age group 60-69 years had the highest infection rate (33.3%). Homosexuality and duration of stay in prison are shown to be significantly associated with HBsAg infection ($P < 0.05$) among inmates. A significant gender difference was noted among inmates with the males (16.1%) having higher prevalence when compared with females (20.0%). Analysis of spatial distribution of prevalence of HBsAg showed that Maiduguri prison had (20.5%), followed by Biu prison (12.7%) and Bama prison (6.7%) and there was significant difference ($P < 0.05$) in prevalence between prisons. There was no significant ($P > 0.05$) association of prevalence of HBsAg with marital status or occupation of prison inmates. In conclusion, hepatitis b virus infection was found to be prevalent among prison inmates in Borno state with homosexuality and duration of stay in prison as risk factors.

Background

Hepatitis B infection is an acute infection of liver in which the liver cells are inflamed [1]. Viral hepatitis causes considerable mortality both from acute infection and chronic disease conditions and ranks among the ten top killer diseases world-wide [2]. Hepatitis virus lives in the blood and other body fluids and is transmitted from person to person through unprotected sexual intercourse with an infected person, sharing infected needles, or other sharp objects that break the skin [3]. Hepatitis B Virus (HBV) infection is worldwide and a serious global health problem which accounts for over two billion infected cases and 400 million suffering from chronic infections worldwide [4,5]. It has been reported that hepatitis B related illnesses cause an estimated 1-2 million deaths per year worldwide [2].

The HBV infection varies widely across the world from high (>8 %) in Africa, Asia and the Western Pacific, intermediate (2-7.9 %) in Southern and Eastern Europe to low (<2 %) in Western Europe, North America and Australia [2,6]. Nigeria, a tropical country, is highly endemic for HBV infection and about 75% of its population is likely to have been exposed to the virus at one time or the other in their lives [7]. The prevalence rate of HBV in Nigeria is high and 19 million Nigerians are infected with the virus [8] and have reached hyper-endemic levels with the sero-prevalence of Hepatitis B surface antigen estimated to range from 10 to 40% [5,9]. Hepatitis

B virus is a blood borne pathogen, which is efficiently transmitted by percutaneous or per mucosal exposure to infectious blood or other body fluids [10]. Hepatitis B virus is present in the blood, saliva, semen, vaginal secretions, menstrual blood, and to a lesser extent, perspiration, breast milk, tears, and urine of infected individuals [11]. The routes of transmission vary according to the endemicity of the HBV infection. In areas of high endemicity, perinatal transmission is the main route of transmission, whereas in areas of low endemicity, sexual contact amongst high-risk adults is predominant [12].

Unlike in Europe and America, there are limited published data on HBV infections among prison inmates in Nigeria and the rest of Africa despite its tremendous importance in public health policy formulation [13]. There is currently no periodic national survey for HBV in either the Nigerian general population or prison inmates; however, prisoners worldwide are at high risk of contracting HBV, especially those who engage in high-risk behaviours such as intravenous drug use, sharing of nail cutter, clipper and or homosexual activities [13]. Prisoners are therefore potential reservoirs of infection to the uninfected entrants and the general non-incarcerated population upon regaining freedom.

In this study, a cross-sectional survey was carried out in selected correctional facilities in Borno State, Nigeria, to determine, the seroprevalence of hepatitis B surface antigen and possible risk factors

associated with this silent and deadly viral infection.

Materials and Methods

Study area

The study was conducted in correctional facilities in Maiduguri, Biu and Bama local government areas of Borno state. Borno state lies between latitude 100N and 130N and longitude 120E and 150E. The state has an area of about 69,436 km² [14]. The state is located in the North eastern part of Nigeria, and has an estimated population of 4.2 million people [15]. Borno state has a hot climate with average peak daily temperature ranging between 34°C and 40°C especially in April and May. The rainy season lasts from June to September in the North which has a Sahelian vegetation and May to October in the South with Sudan vegetation [16,17].

Study population and sample size determination

Three hundred prison inmates were employed (age ranged 18 to 69 years) comprising 285 males and 15 females for this study from the total number of five hundred and seventy nine (579) inmates, out of which 404 from maximum security prison, 97 from Biu prison and 78 from Bama prison respectively in Borno state. The period of study was conducted between November through January 2012/2013. The previous prevalence used for this study was 11.6% by Harry et al. The sample size was obtained using the formula for Sample Size = $n/1-(n/\text{population size})$.

Where $n = z^2pq/d^2$;

n = number of participants required in the survey,

Z = normal standard deviation at 1.96 (which corresponds to 95% confidence interval, P = prevalence of Hepatitis B surface antigen from previous study;

q = $1-p$ and d = degree of accuracy/precision expected set at 0.05 [18].

Ethical clearance

The study was approved by the State Ministry of Health Maiduguri, Borno state, in accordance with the code of ethics for biomedical research involving human subjects. Official consent of the State's highest prison authority, the State Comptroller of prisons, was also obtained.

Questionnaire survey

Structured open ended questionnaires were prepared and administered on the spot to each of the participating inmates (Appendix A). The inmates were asked about their socio-demographic details including prison identification number, sex, age, ethnicity, residence, educational qualification, occupation and marital status. Information was also asked about the mode of imprisonment and jail term and exposure to risk factors associated with blood transfusion, intravenous drug use as well as history of sexual behaviour including sexual orientation, number of sexual partners, homosexuality and history of sexually transmitted diseases and sharing of clippers and sharp objects. Information on vaccination against HBV infection was also obtained from the inmates.

Serum sample

Venous blood samples were collected from three hundred

participants using a sterile 5 ml syringe and needle. The samples were collected into sterilised plain vacutainer tubes and conveyed to laboratory for serum separation. The blood samples were kept at room temperature to clot. Serum samples were harvested from the clotted blood by centrifuging at 2,000 revolutions per minutes for 10 minutes. The harvested serum was put into cryotubes and stored at -20°C until tested.

Assay of serum samples for HBsAg

The serum samples were analysed for the presence of HBsAg using the sandwich Enzyme Linked Immunosorbent Assay (ELISA) [Monolisa™ HBsAg ULTRA Bio-Rad-F 92430-Marnes la Coquette, LOT 2J0152, France]. The Monolisa™ HBsAg ULTRA has an analytical sensitivity of 0.2 ng/ml; assay sensitivity of 99.98%, and specificity of 100%. The test is based on the principle of the sandwich ELISA using monoclonal antibodies and polyclonal antibodies selected for their ability to bind themselves to the various subtypes of HBsAg in serum, which is a marker of acute HBV infection. The test was conducted following the manufacturer's instructions and the microtitre plates were read at a wavelength of 450 nm, using ELISA reader (E-max-reader, precision microtitre plate reader MDS -Analytical technique USA).

Principle of sandwich ELISA

Antibodies sandwich ELISA may be most useful in detecting antigen because they are frequently between 2 and 5 times more sensitive than those in which antigen is directly bound to the solid phase. To detect antigen, the wells of microtiter plates are coated with specific (captured) antibody followed by incubation with test solutions containing antigen. Unbound antigen is washed out and an antigen specific antibody conjugated enzyme (i.e. developing reagent) is added, followed by incubation. Enzyme labelled antibody can be produced in the same animal that produced passively adsorbed antibody, or from a different species immunised with the same antigen that is captured. Unbound conjugate is washed out and substrate is added. After incubation, the degree of substrate hydrolysis is measured. The amount of substrate hydrolysed is proportional to the amount of antigen in the test solution.

Procedure of sandwich ELISA (Monolisa™ HBsAg ULTRA)

The procedure of the sandwich ELISA was followed in accordance with the manufacturer's instruction. Briefly, 100µl of negative control was added into a selected wells and addition of 100µl of positive control into appropriate pre-coated wells with monoclonal antibody. This was followed by the addition of 100µl of the test sera into the remaining wells. Fifty microlitres (50 µl) of conjugate solution consist of (conjugate diluent- bovine immunoglobulin and mouse immunoglobulin, and conjugate-consist of mouse monoclonal anti HBsAg antibodies and goat polyclonal antibodies) was then dispensed into all the wells. The plate was then covered with a new adhesive film and incubated for 1 hour 30 minutes at 37°C. After the incubation the plate was emptied by aspiration and washed for a minimum of 5 times. The plate was dried by turning them upside down on absorbent paper. One hundred microlitres (100 µl) of freshly prepared substrate solution consist of (substrate buffer-citric acid and sodium acetate; containing H₂O₂ and DMSO and chromogen pink coloured solution; containing TMB), was dispensed into all the wells and incubated in the dark for 30 minutes at room temperature (16-

30°C). The reaction was stopped by the addition of 100 µl of stopping solution (1N Sulphuric acid).

Data analysis

Data obtained from the study were analysed using Statistical Package for Social Sciences (SPSS) Version 16 software. Chi-square and Fisher’s exact test were used to perform categorical comparison and level of significance at 95% confidence interval. P-value less than or equal to (P≤0.05) was considered statistically significant.

Results

Hundred (100%) response rates were recorded for the questionnaire survey. Results of the seroepidemiological survey for HBsAg among prison inmates in Borno state showed an overall prevalence rate of 49/300 (16.3%) (Table 1) The gender distribution of the HBsAg positive reactors indicated 46/285 (16.1%) males and 3/15 (20.0%) females. No significant difference (p>0.05) was observed in the gender distribution of HBsAg in prison inmates. Gender was therefore not a risk factor in this study. Analysis of the age distribution of seroprevalence of HBsAg infection among the prison inmates revealed that the age groups 53-59 and 60-69 years had the highest prevalence rates of 28.6% and 33.3% respectively, followed by the age groups 18-24 (15.0%), 25-31 (15.4%), 32-38 (19.0%) and 39-45 (18.2%) years and the least was 46-52 years (8.3%) (Table 2). There was no significant difference (p>0.05) in the prevalence of HBV infection between the different age groups. Figure 1 below represents the frequency distribution of ELISA Optical Density (OD) values of the HBsAg positive sera from prison inmates. Majority (85.7%) of the positive samples reacted with low to intermediate OD values (1-1.5, 1.6-2.0, 2.1-2.5) as compared to the 14.3% with high OD values (2.6-3.5). Optical density values that are equal to or greater than 1.0 were considered positive. Significant difference (P<0.05) was noted in the prevalence of HBsAg among the different ethnic groups of prison inmates studied (Table 3). The distribution of the prevalence in decreasing order among the different ethnic groups was as follows: Marghi (32.0%), Hausa (23.9%), Michika and Kanakuru

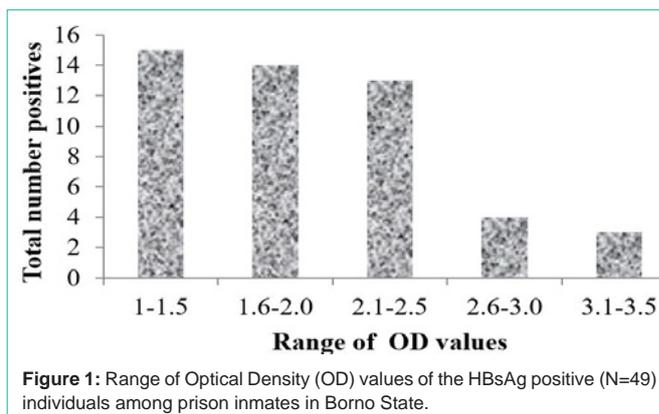


Table 3: Distribution of prevalence of HBsAg among prison inmates based on their ethnicity in Borno state.

Tribes	Total No Tested	No (%) positive
Kanuri	46	6 (13.0)
Hausa	46	11 (23.9)
Shuwa Arab	19	3 (15.8)
Marghi	25	8 (32.0)
Gwoza	6	1 (16.7)
Babur	49	5 (10.2)
Michika	5	1 (20.0)
Kanakuru	5	1 (20.0)
Fulani	44	3 (6.8)
Others	55	10 (18.2)
Total	300	49 (16.3)

P value: 0.02563, *Yoruba, Igbo, Igala, Karekare.

Table 4: Distribution of prevalence of HBsAg among prison inmates based on their marital status in Borno State.

Status	Total No Tested	No (%) positive
Single	145	23 (15.7)
Married	152	25 (16.5)
Divorcee	0	0
Separated	3	1 (33.3)
Widow/Widower	0	0
Total	300	49 (16.3)

P value: 0.7191.

(20.0% each), others (Yoruba, Igbo, Igala, Karekare) (18.2%), Gwoza (16.7%), Shuwa Arab (15.8%), Kanuri (13.0%), Babur-bura (10.2%) and Fulani (6.0%) (Table 3).

Table 1: Sex distribution of HBsAg among prison inmates in Borno state.

Gender	Total No Tested	No (%) Positive
Male	285	46 (16.1)
Female	15	3 (20.0)
Total	300	49 (16.3)

P value: 0.7189.

Table 2: Age distribution of prevalence of HBsAg in Prison inmates in Borno state.

Age (Years)	Total No Tested	No (%) positive
18-24	80	12 (15.0)
25-31	104	16 (15.4)
32-38	42	8 (19.0)
39-45	33	6 (18.2)
46-52	24	2 (8.3)
53-59	14	4 (28.6)
60-69	3	1 (33.3)
Total	300	49 (16.3)

P value: 0.7072.

The prevalence of HBsAg based on marital status among prison inmates in Borno State is presented in Table 4. There was no significant difference in the prevalence of HBsAg based on the marital status of the inmates. Inmates that were separated showed higher prevalence rate 1/3 (33.3%) than those that were single 23/145 (15.9%) and married 25/152 (16.4%) while none was found to be positive among divorcees and widows. However, significant difference (p<0.05) in prevalence of HBsAg was observed among the prison inmates based on their educational backgrounds (Table 5). Highest prevalence of HBsAg [5/17 (29.4%)] was observed among those with higher

Table 5: Distribution of prevalence of HBsAg based on the educational background of Prison inmates in Borno state.

Level	Total No Tested	No (%) positive
Tsangaya	70	15 (21.4)
Primary school	47	5 (10.6)
Secondary school	82	17 (20.7)
Higher institution	17	5 (29.4)
None*	84	7 (8.3)
Total	300	49 (16.3)

P value: 0.0464 *No level of education attended.

Table 6: Distribution of prevalence of HBsAg based on occupation of prison inmates before their incarceration.

Occupation	Total No Tested	No (%) positive
Traders	44	8 (18.2)
Farmers	92	12 (13.0)
Students	15	3 (20.0)
Labourers	63	11 (17.5)
Drivers	21	0 (0)
Law enforcement agents	41	8 (19.5)
Civil servants	6	3 (50.0)
Business men	18	4 (22.2)
Total	300	49 (16.3)

P value: 0.03049.

Table 7: Distribution of prevalence of HBsAg among Prison inmates based on the location of their correctional facilities in Borno State.

Location	Total No Tested	No (%) Positive
Maiduguri	176	36(20.5)
Biu	79	10(12.7)
Bama	45	3(6.7)
Total	300	49(16.3)

P value: 0.0487.

education, followed in decreasing order of prevalence by those with tsangaya (is a type of non-formal education practiced by Muslims) education 15/70 (21.4%), secondary school education 17/82 (20.7), primary education 5/47 (10.6) and uneducated 7/84 (8.3%). Significant difference ($P < 0.05$) in prevalence of HBsAg was also noted among inmates based on their occupations before they were incarcerated. Those in civil service were most infected [3/6 (50.0%)], followed in decreasing order of prevalence by businessmen 4/18 (22.2%), students 3/15 (20.0%), law enforcement agents 8/41 (19.5%), traders 8/44 (18.2%), labourers 11/63 (17.5%), farmers 12/92 (13.0%) and drivers 0/21 (0%) (Table 6).

Significant difference ($P < 0.05$) in prevalence of HBsAg was also observed among inmates in different correctional facilities in the study locations. Maiduguri prison had the highest prevalence of 36/176 (20.5%), followed by Biu prison 10/79 (12.0%) and least in Bama prison 3/45 (6.7%) (Table 7). The distribution of prevalence of HBsAg among prison inmates in relation to other risk factors is presented in Table 4.8. Homosexuality and length of stay in prison were significant ($p < 0.05$) risk factors for HBV infections among the prison inmates in Borno State.

Table 8: Prevalence of HBsAg among prison inmates in relation to identified risk factors in Borno State.

Risk factor	No Tested	No (%) positive	RR	95% C.I	χ^2	p-value
Blood Transfusion						
Yes	16	4 (25)	1.578	0.6478-3.843	0.95	0.3079
No	284	45 (15.8)				
Intravenous drug use						
Yes	63	9 (14.3)	0.8464	0.4341-1.650	0.2	0.7046
No	237	40 (16.9)				
Use of sharp objects						
Yes	261	45 (17.2)	1.681	0.6399-4.416	0.065	0.3559
No	39	4 (10.2)				
Homosexuality						
Yes	97	39 (40.2)	8.162	4.255-15.656	39.9	0.0001
No	203	10 (4.9)				
No of sex partner (s)						
1	55	5 (9.1)	0.5062	0.2104-1.218	2.5	0.1558
≥ 2	245	44 (17.9)				
Knowledge of mode of transmission						
Yes	11	2 (18.2)	1.118	0.3106-4.025	0.037	0.6968
No	289	47 (16.3)				
Sexually transmitted infection						
Yes	200	31 (15.5)	0.8611	0.5074-1.462	0.82	0.6204
No	100	18 (18.0)				
Duration of stay in prison						
0-<2 yrs.	207	17 (8.3)	0.2387	0.1398-0.4076	32.17	0.0001
≥ 2 yrs.	93	32 (34.4)				

$P < 0.05$ = Significant.

Discussion

Prison is a place used in holding a wide spectrum of persons, including persons awaiting arraignment, trial, conviction, sentencing or serving short sentences or convicted criminals [19]. It may serve as incubators where people of unknown health status, could spread infectious diseases [20]. In this study a prevalence rate of 16.3% of HBsAg was observed among prison inmates in Borno State. This result is lower than the prevalence rate of 23% previously reported among prison inmates in Nasarawa State [13]. The disparity could be due to differences in the geographical location of the two studies and relative abundance of risk factors such as homosexuality, Intravenous drug used and sharing of sharp objects. On the other hand the result of this study is higher than the 6.7% observed among inmates in Lagos [21]. This could be due to the fact that inmates in Lagos are better informed about the practice of preventive measures against HBV infections. In sub-Saharan Africa the endemic rates of HBV infection are highest, with as many as 20% of the population being infected. In North America and Western Europe the infection is not common (0.1-0.2%) [22]. Nigeria, a tropical country, has been documented as highly endemic for HBV infection and about 75% of its population is likely to have been exposed to the virus at one time or the other in their lives [7]. The prevalence rate in Nigeria is high and 19 million Nigerians

are considered to be infected with HBV [8] and have reached hyper-endemic levels with the seroprevalence of HBsAg estimated to range from 10 to 40% [5]. Besides, the prevalence rate obtained in the present study is lower than the 25.5% prevalence observed in Ghanaian prisons [23]. This may be due to the difference in population size between the two studies and the possibility of risky behavioral practices among the Ghanaian prison inmates. The 16.3% prevalence observed in this study is also lower than the 20.0% observed in Greece prisons [24]. The possible reasons for this difference may be due to difference in geographical locations and relative risk behaviours of the prison inmates in the two studies. Conversely, the prevalence rate of HBsAg observed in this study is higher than that (0.9%) reported for prison inmates in USA [19]. This may possibly be because the Americans have institutionalized infection control measures and implemented harm reduction intervention in their prisons. The present study also revealed higher prevalence of HBsAg than the 13.1% reported among prison inmates in Taiwan [25]. The only possible risk factor reported in the Taiwan study was the practicing of tattooing. However, the result of the current study is similar to the findings of Abdulelah [26] who reported an overall prevalence rate of 16.7% among the general population in Saudi Arabia. The prevalence rate of 16.3% observed in this study is higher than the 11.6% reported among pregnant women in Maiduguri Nigeria [27] and the 8.22% HBV carrier rates reported among the general populace in Nigeria [28]. The observed difference between the results of this study and the previous ones could be as a result of the high risk behavioural practices (homosexuality and long stay in the prison) of inmates in the correctional facilities in this study. The current study has also revealed a gender difference in the prevalence of HBV infection. Females had higher seroprevalence rate of 20.0% than the male (16.1%). This tally with the findings of Taura et al. [29] who found that, females had the higher prevalence of HBsAg. This as a result of large sample size and engaged themselves in practicing of illegal behaviors such as Male having sex with Male and heterosexual. However, the results of the present study disagreed with the reports of Ataie et al. [10], Abdul et al. [20], Lawal et al. [30], Bukbuk et al. [12], who all reported that males had higher percentage prevalence of HBsAg than the females. The difference observed could be attributed to the sample size and the sociocultural backgrounds of the persons sampled. It was observed in this study that HBsAg was more prevalent among the prisoners within the age groups of 53-59 and older than 60 years. This is inconsistent with earlier reports among the general population in Nigeria, Brazil and Ghana which spans the generally accepted sexually active age group of 15-45 years [23]. The difference observed in the present study could be due to the sample size and lowered immunity among the older age groups. There was no significant association between HBsAg prevalence and the ethnic backgrounds of the subjects under study. Furthermore, it was observed that separated inmates from their spouse were more likely to be infected with the HBV when compared to the single or married inmates. This could be attributed to the polygamous practice that is common among people in the study area and the likelihood of separated individuals to be engaged in high risk behaviors including sexual promiscuity. The inmates who attended higher education, Tsangaya education or secondary education were observed to be significantly associated with HBsAg infection than those who had no educational background. This may be as a result of sexually active aged group and they are likely to be exposed in illegal behavior such

as sexual promiscuity. Distribution of HBsAg among prison inmates in Borno State in relation to occupation showed higher prevalence rate among civil servants. This may be due to the fewer number of this category of prisoners tested. Higher prevalence of HBsAg was observed in Maiduguri maximum security prison, followed by Biu and Bama medium prison. It is observed in this study that there is significant association of HBsAg prevalence and location of the prison. The higher prevalence found in Maiduguri prison is possibly due to congestion and criminality of inmates with possibility of higher tendency for high risk behavioral practices. Homosexual and length of incarceration are two risk factors observed to be significant in this study. Long period of incarceration is significantly associated with HBV infection. This is consistent with previous reports from Australia [31], Italy [32], England [33] and Wales [33]. This may be due to the fact that inmates are coming from different locations and ethnic backgrounds and can serve as carriers of the virus and capable of spreading it to their fellow colleagues engaged in practicing high risk behaviors such as homosexuality.

No association was observed between blood transfusion and prevalence of HBsAg. This tally with the reports of Adoga et al. [13] and Adekanle et al. [34] who reported insignificant association of HBV with blood transfusion. The result of the present study however contradicts the report of Agbede et al. [35] who observed significant association between the HBV infection and blood transfusion. Similarly, Intravenous Drug Use (IDU) was not significantly associated with the prevalence of HBsAg among prison inmates in Borno State. This is similar to the report of Abdul et al. [20]. This could be as a result of prohibition of IDU practice among the prison inmates in the study area. In addition, the results of this study did not reveal significant association of this practice with prevalence of HBsAg among prison inmates in Borno State. It may be due to the minimal usage of contaminated sharp objects among the inmates. This is in contrast with the reports of Samuel et al. [36], Ray and Hunter [37], who reported significant association between the sharp objects and infection with the HBV. The present finding could be due to the health awareness and restrictions on the use of sharp objects imposed on the inmates. Poor knowledge of the modes of transmission and spread of HBV infection among the inmates was observed in this study. This agrees with the study of Butler et al. [38] who reported that in Australia there was poor knowledge of hepatitis risk factors among their study subjects. Although most of the inmates in this study had responded yes to having experienced sexually transmitted disease, there was no significant association between this risk factor and prevalence of HBsAg.

Conclusion

In conclusion, this study has shown that HBV (16.3%) infection is prevalent among prison inmates in Borno state Nigeria with the females, the elderly (>50 years) and those with higher education having the highest infection rates. Homosexuality and duration of stay under incarceration are the observed risk factors in the transmission of the HBsAg infection among the prison inmates in the study area.

Recommendations

The following recommendations are:

- The use of other HBV infection serological markers such

as anti-HBs, anti-HBc, HBeAg, and anti-HBe is advocated in future studies.

- Hepatitis B virus infection continues to be associated with high mortality, morbidity, relapses due to drug resistance and economic burden, hence, there is need to maintain active and continuous surveillance to determine the occurrence and prevalence of the disease for effective formulation of preventive and control measures.

- There is need for Nigerian government to impose a policy that would make screening or test for HBV infection of prisoners prior to incarceration, and vaccinate against the disease. This practice would drastically reduce the rate of spread of infection among inmates and to the general population upon regaining freedom.

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