Detection of Hepatitis B Virus from Inmates in Correctional Facilities in Niger State

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Abstract

The aim of this study was to determine the prevalence of Hepatitis B virus infection among inmates of selected correctional facilities in Niger state, Nigeria. Blood samples were collected from inmates in three correctional facilities (Bida, Kontagora and Minna). Questionnaires were administered to get their bio-data and 5ml of blood sample was collected from a total of 344 inmates. The plasma was separated and tested for hepatitis B surface antigen (HBsAg) using rapid chromatographic immunoassay test (ICT) and enzyme linked immunosorbent assay test kits (ELISA) . All the HBsAg positive samples were subjected to further test using 5-panel HBV test card. Out of the 344 samples collected, 75 (22%) were positive by ICT for HBsAg. ELISA gave an overall prevalence rate of 25% (87/344) as additional 12 samples were positive. The result of the 5-panel showed that HBsAg, HBsAb, HBeAg, HBeAb and HBcAb were present in 87, 19, 20, 47 and 68 plasma respectively. This implies that 87 persons were infected, 19 had immunity against the virus, 20 had active viral replication, 47 with no viral replication and 68 with onset of acute infection. The HBV infection was highest in the age bracket 21-30 years (29.7%) and lowest in 61-70% (0%). Out of the associated risk factors, sharing of objects showed statistically significant association with the high prevalence of the HBV. This study showed the prevalence of HBV among inmates. As such, there is need for constant screening of the inmates for effective prevention measure and proper clinical management strategy.

Keywords: 5-panel HBV test, Correctional facilities, ELISA, hepatitis B virus, Niger State

3. Introduction

Hepatitis B is a blood borne virus (BBV) which spreads through body fluids, mainly the blood [1]. The virus is contracted through a number of means which include; body fluids (saliva and blood), HBV contaminated equipment, venereal transmission, mother to child transmission, and intravenous drug use [2]. HBV is not like AIDS at its early stage as its infection can be prevented through vaccination and 95% of adults newly infected with the virus get cleared of the virus naturally and become immune for life [3]. However, once it gets chronic, it becomes incurable; treatment will only be aimed at suppressing HBV replication and retard the progression of liver disease before the development of cirrhosis and hepatocellular carcinoma [4]. Early symptoms of the infection may include loss of appetite, vomiting, loss of weight, tiredness, dark urine, right upper abdominal pain and yellowing of skin (jaundice) [5]. If the virus is not combated at the early stage, the system of the host may be further deteriorated showing some symptoms such as fluid retention, bruising and prolonged bleeding [6]. This infection could later result into acute and chronic necroinflammatory liver diseases [1].

It is worth mentioning that the developed worlds, which have citizens with high level of literacy and governments which provide highly effective recombinant vaccine for the viruses, HBV is still a source of threat to them, talk more of the developing nations where majority of the populace are having misconceptions or bias mind towards the vaccine and where vaccination programs receive less attention from government [7][8]. This account for why the risk of contracting the virus is significantly high in the developing nations as individual and government attitudes create room for exposure of about 75% of the population to the virus [9]. Hence, the prevalence rate of the virus varies with regions. A low prevalence (<2%) is noted in some parts of North America (e.g. the United States, Canada and Mexico), European countries (e.g. Belgium, Czech Republic, Denmark, France) and in Australia [10]. In the European Region, approximately 13 million people are chronically infected with HBV, which leads to about 60,000 deaths a year from hepatitis B-related diseases such as liver cancer and cirrhosis [11].

An intermediate prevalence (2–7.9%) is present in some regions of the Eastern Mediterranean (e.g., Tunisia), Central Asia (e.g., Kazakhstan), Southeast Asia (e.g. Thailand, Bhutan and Bangladesh), China, parts of South America (e.g. Colombia) and in some European countries (e.g. Albania, Bulgaria, Romania and Turkey). According to the [11], Africa has the second largest number of individuals with chronic

HBV infection, approaching 58 million with over 90% of the population in some countries in Western Africa. The virus infection is widespread in West African countries particularly, Burkina Faso, Ivory Coast, Gambia, Ghana, Guinea, Liberia, Mali, Mauritania, Niger, Senegal, Sierra Leone, Togo—Southern Sudan, Angola, Uganda, Somalia and Nigeria, with a prevalence of >8% [12]. Till recent time, Hepatitis B virus is a major public health concern worldwide, due to its high chronicity rate in liver disease morbidity and mortality in spite of the accessibility of the populace to the effective vaccination [13]. On the global scene, HBV accounts for over 360 million cases of chronic hepatitis and claim the lives of about 620,000 persons per year [14]. More than 8% of the populations in the Sub- Sahara Africa are infected with the virus with about 44% of cirrhotic liver disease and 47% of hepatocellular carcinoma cases linked to it [9].

Research has shown that Intravenous Drug Users (IDUs) are at high risk for HBV infection as with other blood-borne pathogens (such as hepatitis C and human immunodeficiency virus) [2]. It is a common knowledge that correctional facilities often comprise of inmates who are IDUs and those who are not but relate freely with them. Hence, transmission of blood-borne diseases among inmates is higher than the general population due to over congestion, high presence of IDUs with high-risk addiction-related behaviors, with some having past history of multiple sexual partners and homosexuality, as well as limited educational opportunities and probable intra-prison spread ([2]; [15]; [16]; [17]. The health implication of this on the larger society is highly detrimental as they become potential reservoirs of infection to the non-incarcerated and uninfected individuals upon regaining their freedom [18]. The risk of free intermingling, unprotected sex and injecting drug use, commonly known with inmates do not stop at correctional facilities as that is continued after the release of inmate from the facilities. These make inmates who have become reservoir for virus (such as hepatitis B virus) to be sources of threat not only to their families but also to the society at large [19]. Hence, understanding the prevalence rate of hepatitis B virus in correctional facilities will aid in recommending appropriate method to prevent its further transmission among the inmates, the staff of the facility and to the outer world.

Evidences have shown high transmission of HBV among inmates across the globe ([6] [20] [17]; [21]. However, the prevalence rate of the virus varies not only with regions but also from general population to incarcerated, homosexual, heterosexual and pregnant woman [11]. Research has shown that Nigeria with HBV prevalence of 13.6% can be classified as a highly endemic country [22]. Approximately eighteen million of the populace are said to be carriers of the virus in recent time [23]. The percentage distribution of the adults and children over the entire populace between 2000 and 2013 were about 13.6% and 11.5% respectively [9]. A number of independent researchers have reported a high prevalence rate of 16.3%, 23.4% and 11% for blood donors, infants, surgeons and pregnant women respectively [24] [25] [26]. However, the values (e.g. 42.2%) reported by [20] for the inmates are comparatively higher than other groups. Nevertheless, just as inmates in correctional facilities bear a greater burden of chronic viral infections and sexually transmitted diseases, the impact of screening programmes and vaccination has significantly reduced viral prevalence [27] [28]. Though, a number of researches have been conducted on HBV in some parts of developing nations, including Nigeria, limited work has been documented on transmission of HBV within correctional facilities particularly in north central region of Nigeria. Thus, this study aimed at the detection of Hepatitis B Virus among inmates in some correctional facilities in Niger State.

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2. Materials and Methods

2.1 Study Area

Niger state is situated in the North central part of Nigeria (Figure 1). The capital of the state is Minna, which is located on latitude 9.58 ^{0}N, latitude 6.55 ^{0}E and it is situated at an altitude of 243 m above the sea level. The State has an estimated population of 3,950,249 based on the 2006 Census [29]. The correctional facilities in the state housed about 500 inmates. The facilities form part of the criminal justice system and it is estimated that over nine million people are in penal institutions worldwide, with 74, 000 incarcerated in Nigeria in about 250 correctional facilities [20]. Niger state has seven correctional facilities which are Minna Old Prison, Kagara Prison, Lapai Prison, Agaie Prison, Kontagora Prison, Nigeria Prison Services, Bida and Medium Security Prison, Minna. Niger State is divided into three geopolitical zones (Zone A, B and C) and the correctional facilities were built across the zones. In this study, a correctional facility was selected from each zone.

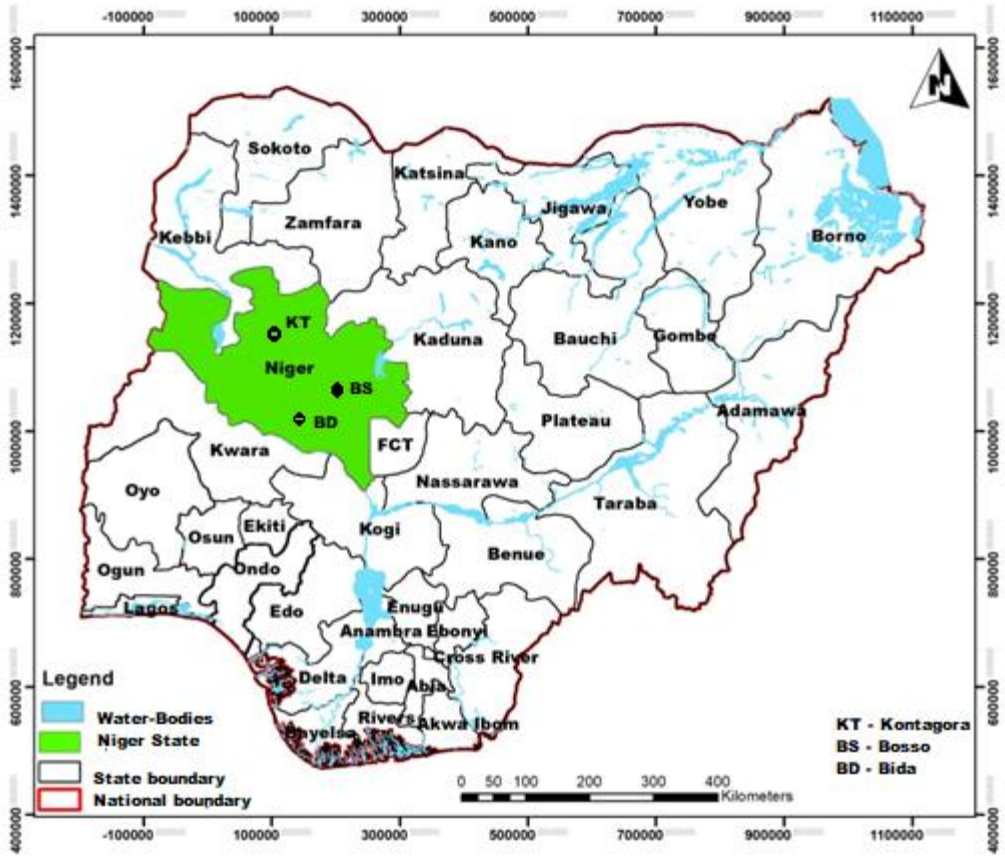

Figure 1: Study Area

2.2 Methods

2.2.1 Study design

For the study on the detection of the prevalence of HBV in correctional facilities in Niger State, all the blood samples collected from the inmates were carefully characterized using ICT and ELISA to detect HBsAg seropositive inmates in the correctional facilities. All the HBV infected inmates were further tested with serological markers, since markers suggest the level of infections (chronic or acute) as well as evidence of being immune to HBV. Data such as duration of incarceration, risk behaviours, and nature of the prison environment obtained through a standardized questionnaire were documented. These thus formed the cross-sectional study basis for this study.

2.2.2 Study population

During the study, a random selection procedure was used in selecting correctional facilities within the state. The selection was first stratified by size of correctional facility and thereafter three (3) out of seven (7) available correctional facilities were deliberately selected. The selection was done in a way that each of the senatorial districts of the state was adequately represented. More so, the choice of the chosen correctional facilities was informed by the size of the inmates. Hence, correctional facilities that best satisfied the conditions were chosen. The three correctional facilities have about 500 inmates, out of which 344 consented to participate in the study. The inmates involved in the study consist of a total of 328 male and 16 female. Thus, the study population comprised of HBV infected individuals in the three correctional facilities considered; the Minna Old Prison, Nigeria Prison Services, Bida and Kontagora.

2.2.3 Sample size

Sample size estimation is fundamental in the design of a prevalence studies. To estimate the prevalence of HBV in the three correctional facilities, determination of sample size was done since it is not realistic to simply perform the diagnostic test on the whole population. In this study, sample size estimation was done using the equation reported in [30].

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

Where n = sample size,
z is the z statistic for the level of confidence and the value = ±1.96;
P is the expected prevalence and based on the previous study the value = 30% and;
d is the allowable error, which is 5%

$$n = \frac{(1.96^2) * 0.3 * (1 - 0.3)}{0.05^2}$$

n = 323

2.2.4 Ethical clearance
Approval was sought from the Ethical Committee of General Hospital, Minna and correctional facility authority.

2.2.5 Inclusion criteria
Inclusion criteria include inmates' willingness to give an informed consent to partake in the study. However, those who did not consent to partake were excluded.

2.2.6 Samples Collection and Transportation

Five milliliters (5ml) of venous blood samples was collected from each inmate using a sterile 5 ml Syringe and needle. The blood samples were collected and transferred into clean EDTA samples bottles and transported to the laboratory where plasma was separated from cells within an hour. The plasma was transferred to red-top plain sample bottles. The plasma were refrigerated for further use and parts of the specimen that will be stored longer than 24 hours was frozen at ≤ –20 °C. During sample collection, about 350 structured questionnaires on the general awareness of HBV infection were administered to the inmates.

2.2.7 Storage and Stability

All reagents except the concentrated wash buffer are ready to use as supplied. All components were stored at 2-8^{0}C in the refrigerator. However, it was ensured that all the reagents were brought to room temperature before opening. The microwells were resealed after removing the desired number of wells. The unused wells were placed in the re-sealable plastic bag provided and stored at 2-8^{0}C.

3.1 Detection of HBV in blood samples using ELISA and serological markers

All the collected blood samples were first analysed for HBV using rapid immunochromatography kit after which the negative samples were further screened using ELISA. All the positive HBV positive samples were further tested with the serological markers (micropoint rapid diagnostic test kit). The analyses were done at General Hospital Minna and Center for Genetic Engineering, FUTMinna. The manufacturers' instructions were strictly followed for the reagent preparation and the interpretation of results

2.4 Statistical Analysis
Data was analysed using Microsoft Excel. Comparative analysis was performed using the Student's t-test and Chi square test.

3.0 Results and Discussion
3.1 Results
3.1.1 Overall prevalence rate in the correctional facilities

A total of 344 inmates participated in the study. Out of the participants, there were 328 males (95.35%) and 16 females (4.65%). The participants fell in the age group 11-70 years. Rapid chromatographic immunoassay test (ICT) showed that HbsAg was present in 75 (22%) of the inmates. ELISA showed that additional 12 samples were positive making an overall prevalence rate of 25% (Table 2). The overall percentage of the positive to negative samples in the three correctional facilities is presented in Figure 2.

Table 2: Sensitivity of ICT and ELISA methods

Method	Positive samples	% Positive
ICT	75	22
ELISA	87	25

(P= 0.0049)

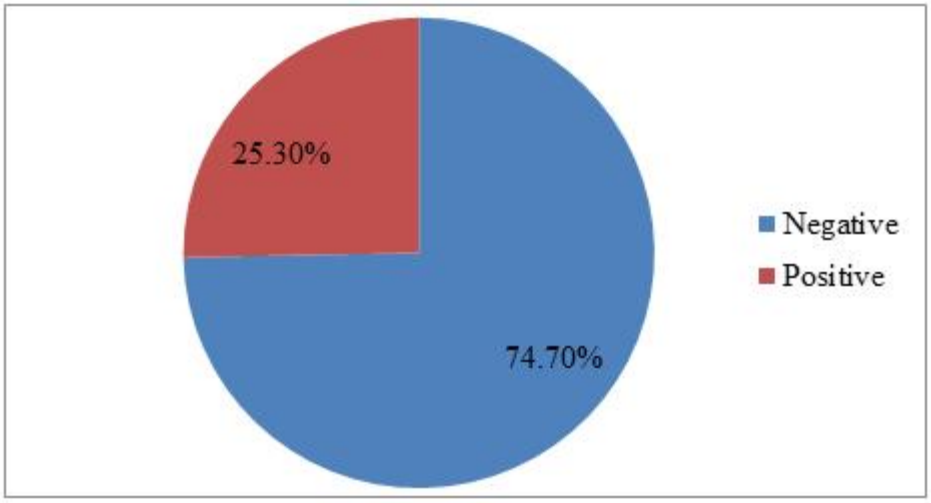

Figure 2: Percentage of inmates that tested positive and negative to HBsAg

3.1.2 Prevalence of HBV infection based on locations of correctional facilities

Figure 3 showed the sample population of each correctional facility with number of inmates who were infected with the virus. Out of the 201 inmates in Minna, 57 were found to be infected. In Kontagora, 17 out of the 70 inmates screened were infected. However, in Bida, 73 inmates were screened, out of which 13 were found to be positive.

The prevalence rate varied with locations. The highest prevalence rate (28.4%) was recorded in Minna old prison (Table 3) while the least was in Nigeria Prison Service, Bida (17.8%). Though, Minna old prison has the highest population and the highest prevalence rate, Median Security prison, Kontagora had the least population but not the least prevalence rate.

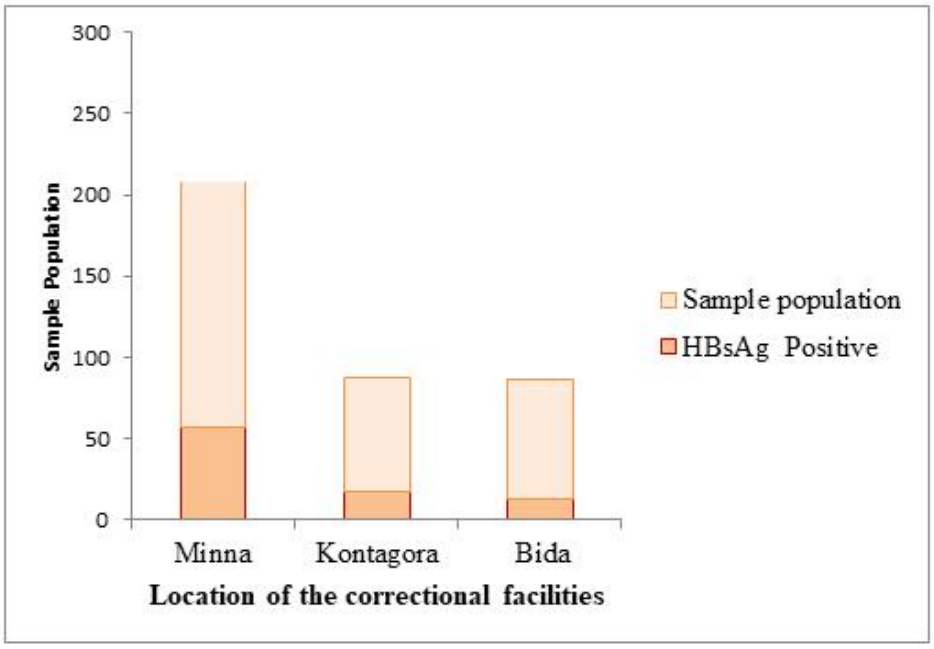

Figure 3: Sample population and the number of infected inmates in each location

Table 3: Percentage prevalence rate of HBV infection based on location

Correctional facility	Total number	No of HBV positive inmates	HBV Positive inmates (%)
Minna Old Prison	201	57	28.4
Medium Security prison, Kontagora	70	17	24.3
Nigeria Prison Service Bida	73	13	17.8
Total	344	87	25.3

($X^2 = 3.2$, *df* = 2, P= 0.201)

3.1.3. Prevalence of HBV infection based on age of inmates

Table 4 shows the prevalence of HBV infection based on the age of inmates. The age groups of 21-30 with total participants of 155 had the highest prevalence rate (29.7%) followed by 31-40 year having prevalence rate of 26.4%.

Table 4: Prevalence of HBV infection based on age of inmates

Age group (year)	Total	No of HBV positive inmates	HBV Positive inmates (%)
11 – 20	62	15	24.2
21 – 30	155	46	29.7
31 – 40	72	19	26.4
41 – 50	35	5	14.3
51 – 60	16	2	12.5
61 – 70	4	0	0
Total	344	87	25.3

($X^2 = 6.65$, *df*= 5, P= 0.248)

3.1.4 Prevalence of HBV infection based on gender of inmates

Table 5 shows the prevalence of HBV infection based on gender. The total number of male screened was 328, out of which 83 were positive. On the other hand, the female were 16, having 4 of them being positive. The male and female inmates had prevalence rates of 25.3% and 25% respectively.

Table 5: Prevalence of HBV infection based on gender of inmates

Gender	Total	No of HBV positive inmates	HBV Positive inmates (%)
Male (M)	328	83	25.3
Female (F)	16	4	25
Total	344	87	25.3

($X^2 = 0.007$, *df* = 1, P = 0.978)

3.1.5 Prevalence of HBV infection based on Educational level of inmates

Table 6 shows the result of the prevalence of HBV based on the level of educational of inmates. Highest prevalence was recorded among the inmates with secondary school (32.6%) education followed by those who had primary school (28.6%) education.

3.1.6 Prevalence of HBV infection based on duration of stay of inmates

Table 7 shows the prevalence rate of HBV infection among inmates based on the duration spent in the correctional facilities. The prevalence rate of those who had spent a year and below was 21%, while those who had spent between a year to two was 29.2%.

Table 6: Prevalence of HBV based on Educational level of inmates

Level	Total	No of HBV positive inmates	HBV positive inmates (%)
Primary	28	8	28.6
Secondary	86	28	32.6
Tertiary	65	15	23.1
No formal education	165	36	10.5
Total	344	87	25

($X^2 = 3.78$, *df* = 3, P= 0.286)

Table: 7: Prevalence of HBV infection based on duration of stay of inmates

Duration (years)	No screened	No of HBV positive inmates	HBV positive inmates (%)
0 – 1	214	45	21
1 to 2	48	14	29.2
2 to 3	24	9	37.5
3 to 4	13	8	61.5
4 to 5	9	6	66.7
> 5	36	5	13.9
Total	344	87	25.3

($X^2 = 24$ *df* = 5, P= 0.00022)

3.1.7 Prevalence of HBV infection based on marital status of inmates

Table 8 shows the prevalence based on marital status of inmates. The number of married inmates was higher as compared to the singles. No divorcee was in the facilities at the time of study and only one widow was present. The only widow screened tested negative. The prevalence rates in the singles and married inmates were 28.1% and 23.7% respectively.

Table 8: Prevalence of HBV infection based on marital status of inmates

Status	No screened	No of HBV positive inmates	HBV positive inmates (%)
Single	128	36	28.1
Married	215	51	23.7
Widow	1	0	0
Divorce	0	0	0
Total	344	87	25.3

($X^2 =$ 1.16, *df* = 3, P= 0.559)

3.1.8 Hepatitis B Serological Markers

The results of further tests done on the HBsAg positive samples using 5-panel test card are presented in Figure 3. In Minna, out of the 57 inmates that were HBsAg positive, Nine (9) of them had their HBsAb as positive, ten (10) had HBeAg as positive, HBeAb was positive in thirty (30) and HBcAb was positive in forty two (42). The results showed that some of the samples had only HBsAg as positive, while the remaining serological markers were negative. Some of the samples have about three serological markers positives. For instance, five samples had HBsAg, HBcAb and HBeAg detected as positive which implied that either acute or chronic active HBV infection with ongoing high level replication had set in. In Kontagora, Out of the 17 inmates that were HBsAg positive, HBsAb, HBeAg,, HBeAb, and HBcAb are detected in six (6), seven (7), nine (9) and fifteen (15)

samples respectively. While at Bida, Out of the 13 inmates that were HBsAg positive, HBsAb, HBeAg,, HBeAb, and HBcAb were detected positive in four (4), three (3), eight (8) and eleven (11) samples respectively.

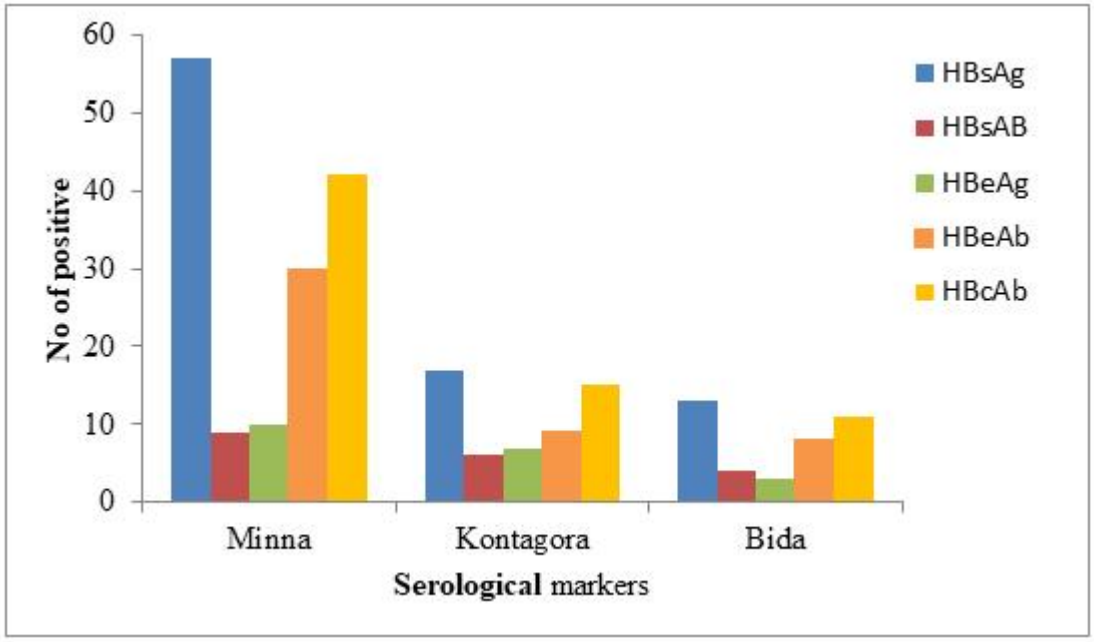

Figure 3: Hepatitis B Serological Markers in Inmates from Correctional Facilities

The result of the biomarkers of the total inmates in the study area is presented in Table 9. Of the total inmates, the prevalence of hepatitis B infection (HBsAg) was 87 (25.3%) representing the level of hepatitis B endemicity in inmates in Niger state correctional facilities.

Table 9: Overall percentage positive of Hepatitis B biomarkers among Inmates (N= 344)

Biomarkers	No of HBV positive inmates	No of HBV positive inmates (%)
HBsAg	87	25.3
HBsAb	19	5.52
HBeAg	20	5.81
HBeAb	47	13.66
HBcAb	68	19.77

3.1.9 Infection with HBV among inmates and some associated risk factors

Table 10 shows the HBV infection among inmates and some associated risk factors. Five associated risk factors were considered based on literature and the willingness of the inmates to respond to those factors. While 75 inmates have awareness about the HBV infection, 269 claimed ignorance of the disease. Out of 344 inmates, only 45 had knowledge on mode of transmission of the virus. Out of the 45, 13 were positive, while 74 of the remaining 299 that lack knowledge of its mode of transmission were also positive.

Table 10: Infection with HBV among inmates and some associated risk factors

Risk factor	Sample population	No of HBV positive inmates	No of HBV positive inmates (%)	P-value
Awareness	on HBV			
Yes	75	21	28	0.184
No	269	66	24.5	
Knowledge on	transmission mode			
Yes	45	13	28.9	0.145
No	299	74	24.7	
Intravenous	drug use			
Yes	225	70	31.1	0.2121
No	119	17	14.3	
Sharing of	Objects			
Yes	267	72	26.9	0.028
No	77	15	19.5	
Multiple sex	Partner			
Yes	105	54	51.4	0.482
No	149	33	22.15	

P<0.01

3.2 Discussion

From the results of the prevalence rate in the correctional facilities, it was noted that the ELISA method detected more positive samples. The additional positive samples detected by ELISA were not unexpected as earlier researcher had asserted that though, ICT could be used for rapid decision, ELISA was more sensitive [31].

The prevalence rate recorded in this study can be classified as high based on the submission of WHO [39] that > 8% HBSAg positivity in a population is high. Analysis of this study (which is a study at a state level) when compared to the inmates in other states within Nigeria showed Niger state ranked high in prevalence rate of the virus. It is higher when compared to the prevalence rate (18%) of inmates in Bali correctional facility Taraba, Lagos correctional facilities (6.7%) and inmates in Nasarawa state correctional facility (23%), it is however less than 42.2% rate recorded in Sokoto correctional facility [18] [20] [40] [41]. When the results are compared to the prevalence of hepatitis B in inmates in Nigeria (23%), Africa (13.14%) and the world (5.17%) population, the rate was higher in Niger state [32]. The high prevalence rate in the correctional facilities in this area of study as compared to the correctional facilities in Africa and the world; shows there is need for immediate measures to control the rate.

Though, the prevalence rate is almost the same with that of Ghanian correctional facilities (25.5%), a little higher than that of America correctional facilities (21.20 %), it is far higher than 4.5% found among inmates in Brazil, 3.4% found in Iranian correctional facilities and 6.5% in Greek inmates [33] [34]. It is however important to note that the rate of prevalence in this study is still within the hyper-endemic levels (10-40%) estimated for Nigeria [36]. The result of the statistical analysis showed that there is a significant difference between ICT and ELISA (df = 1, P= 0.0049).

Considering the results of prevalence of HBV infection based on locations of correctional facilities, it could be inferred that the prevalence rate does not necessarily depend on population. The rate could be associated with differences in infection rate as regards to locality and the level of associated risk factors [36]. None of the three correctional facilities seems to have an institutionalized infection control measures against HBV infections as done in some countries. The percentage difference (10.6%) between the highest prevalence of Hepatitis B observed in Minna and the lowest prevalence observed in Bida was higher than prevalence reported elsewhere. Though, no literature is available that compare the percentage difference in prevalence rate between correctional facilities in Nigeria, [33] reported percentage difference of 3.8% in a study conducted in correctional facilities in Iran. However, the result of the statistical analysis showed there is no statistical difference between sample locations ($X^2 = 3.2$, $df = 2$, P= 0.201).

Based on the results of prevalence of HBV infection with respect to age of inmates, the highest prevalence rate observed in the age group 21-30 could be as a result of their high representation among the age groups in the correctional facilities and also due to the fact that they are within the reproductive age group as opined by [20]. This age group noted in this research for the highest prevalence is in contrary to the earlier report which claimed higher prevalence rate exists in those above 40 years [37] [38]. This could be as a result of the difference in the targeted population while [36] examined the virus in the tertiary institution

in North Western Nigeria, [37] studied the virus in apparently healthy blood donors. However, the findings of this research is in agreement with findings of [20] and [40] who reported that age group of between 20-29 had the highest prevalence rate in correctional facilities. The reason for high prevalence rate could be due to youthful exuberance. From the age of 21, the proportion of persons susceptible to the virus infection decreased with increasing age. This linear trend was also noted in the findings of [42]. The distribution of HBV infection according to age was not statistically significant (X^2 = 6.65, *df*= 5, P= 0.248).

From the results of the prevalence rate based on gender, the higher prevalence rate noted in males could be attributed to the comparative higher number of male inmate which created crowdedness and probable transmission via a means such as body sweat. This result is in contrast with the report of [43] which showed that prevalence of HBV infection was higher in female than male. It however, agrees with the findings of [20] and [40] which showed higher prevalence of HBV infection among male inmates. [44] has earlier asserted that high levels of infection, contracted at a young age, affect mostly males and are associated with an increased risk of death or developing hepatocellular carcinoma [44]. There was no observed statistical difference in sex distribution of HBV infection among the inmates (X^2 = 0.007, *df* = 1, P = 0.978).

Based on the results of prevalence of HBV infection with respect to level of education of inmates, the higher prevalence rate in secondary as compare to the primary could be as a result of relatively high number of inmates (86) with secondary as compare to the inmates (28) with primary. Youthful exuberance could also be responsible for the high prevalence rate among those with secondary education. The high prevalence in both could be attributed to their low level of education and lack of unawareness on HBV infection. Those that attended non formal education had the least rate of prevalence (10.5%). The least in this group could be associated with their mode of life and their religious ideology. More so, those with no formal education probably accept any type of job for living while those with formal education (particularly secondary) will want to insist on white collar jobs which are not available; this could lead to frustration and various vices.

Among the groups with formal education, least prevalence was noted in those with tertiary education. This could be because they are careful enough and usually take necessary precautions when negotiating new sexual partners as opined by [20]. The least prevalence recorded in those with "no formal education" in this study and lesser prevalence in secondary as compare to those with primary agrees 2with the findings of [42]. Prevalence of HBV infection in correctional facilities based on their educational background was not significant (X^2 = 3.78, *df* = 3, P= 0.286).

The results of the Prevalence of HBV infection based on duration of stay of inmates showed an increasing trend from a year up to five (5) years. This shows that there is high chance of contracting the virus as the period of incarceration increases. However, those with duration of stay above five (5) years, even with their high numbers (36), had the least prevalence rate (13.9%). The reason could be the type of seniority displayed in the correctional facility which allows them allocate some space to themselves. The increase in prevalence rate with year of incarceration has been reported in earlier studies [20], [2]. There is a significant difference (X^2 = 24 *df* = 5, P= 0.00022) in prevalence of HBV infection in correctional facilities based on their duration of stay in correctional facilities.

This result of the prevalence of HBV infection based on marital status of inmates suggests that the rate was higher in in the single as compared to the married. This could be as a result of indiscriminate sexual activities. This finding is in disagreement with results of [20] who claimed high prevalence rate was among the married ones but affirm the claim of [42] that there was higher proportion of susceptible persons among single participants as compared to the married. The prevalence of HBV infection based on marital status was not statistically significant (X^2 = 1.16, *df* = 3, P= 0.559).

From the results of the Hepatitis B Serological Markers, the obtained value for the HBsAb showed that; of the total carriers, 5.52% are having the presence of the protective antibodies in their serum, meaning they were developing immunity to the virus. This immunity is likely to be from the carrier's immune response as none of the inmate claimed to have received vaccine and vaccines are not administered to a known carrier. The overall HBeAg detected showed that the highly infectious individuals were 5.81%. The HBeAb indicated that 13.66% of the inmates were actively producing antibodies to suppress the HBV replication. The HBcAb results showed that 19.77% were experiencing onset of the acute hepatitis B which will persist for life; it may also imply ongoing HBV infection in those inmates.

From the results of the HBV infection among inmates and some associated risk factors, large majority of the inmates were not aware of the hepatitis B virus. However, the results of the screening showed that 28% of those who have awareness were positive while 24.5% of those who were not aware were also positive. There was no significant association between

awareness and prevalence rate of HBV. There was also no significant association between knowledge of modes of transmission and HBV infection in the study areas. This is in agreement with the findings of [20] and there was poor knowledge of hepatitis risk factors among their study subjects. The association of intravenous drug use (IDU) with the prevalence of HBV infection was not significant. This could be as a result of restriction on IDU practice among the inmates in the study area.

Out of the associated risk factors considered, result showed that "sharing of objects" was associated with high prevalence rate of HBV infection in correctional facilities. This may be as a result of sharing of dress and sharp objects by the inmates. The result of this finding is in agreement with the reports of [45] and [46] who reported significant association between the sharing of objects and infection with the HBV. The results of this study are in line with the findings of [47].

4. Conclusion

This study examined the prevalence of Hepatitis B virus infection in inmates of correctional facilities in Niger State. The overall prevalence rate of the HBV in the three correctional facilities was 25%. The infection was highest in the age bracket 21-30 years (29.7%).Through the serological markers, it was noted that 87 of the inmates were infected, 19 had immunity against the virus, 20 had active viral replication, 47 with no viral replication and 68 with onset of acute infection. The rapid chromatographic immunoassay test (ICT) method was cost effective and required lesser laboratory expertise; it is not as sensitive as the enzyme linked immunosorbent assay (ELISA) as there is statistically significant difference between the two when carrying out surface antigen of Hepatitis B (HBsAg). Also, both the duration of stay in correctional facilities and sharing of objects had statistical significant association with seropositivity of HBV and can thus be considered an important risk factor. By implication, HBeAg prevalence is influence by the unavailability of the common amenities such as dress and sharp object (such as razor). As such, there is a need for constant screening and vaccination of the negative inmates to avoid increasing rate of prevalence and placing the larger society at risk. Also, there is a need to create more awareness about HBV prevention and transmission especially by sharing of objects.

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