

Original Research Article

Prevalence of Hepatitis B virus infection in correctional facilities in Sokoto metropolis, Sokoto state Nigeria.

This study was designed to determine the prevalence of HBV infection in correctional facilities in Sokoto metropolis, Sokoto State, Nigeria. A questionnaire survey was used to determine the associated risk factors of the disease and serological method using [Enzyme link immunosorbent Assay (ELISA)] to determine hepatitis B surface antigen (HB_sAg) among inmates. Of the 180 participants from the two correctional facilities in Sokoto state (Sokoto central prison and Remand home) overall prevalence rate of (42.2%) was obtained. The distribution of HBV infection, according to age was statistically significant, and the age groups of 21-25 and 36-40 years had the highest prevalence rates (61.3%). However the highest prevalence was recorded among males (42.6%) than females (36.4%). Analysis of spatial distribution of the prevalence of HBV infection showed that Remand home (juvenile detention center) had the highest prevalence rate of (75%). It was concluded that hepatitis B virus infection was found to be prevalent in correctional facilities in Sokoto State in which duration of stay and multiple sexual partners were the main risk factors. Furthermore, there is a need for the Nigerian government to establish a policy that would make general screening of all the inmates in correctional facilities for HBV infection and vaccinate them against the disease.

Key words: Enzyme linked immunosorbent Assay; Remand homes; Central prison

INTRODUCTION

Hepatitis B virus infection is a potentially life-threatening liver infection caused by the hepatitis B virus. It can cause chronic infection and puts people at high risk of death from cirrhosis and liver cancer (Lozano *et al.*, 2012). In some people, the hepatitis B virus can also cause a chronic liver infection that can later develop into cirrhosis of the liver or liver cancer. Therefore the complications from hepatitis B include progression to hepatocellular carcinoma (HCC) and, rarely, cirrhosis (Lozano *et al.*, 2012).

The development of chronic infection is very common in infants infected from their mothers or before the age of 5 years. Infection in adulthood leads to chronic hepatitis in less than 5% of cases.

A small subset of persons with acute hepatitis can develop acute liver failure, which can lead to death (Lozano *et al.*, 2012).

Hepatitis B virus (HBV) is an envelope, double-stranded DNA virus belonging to Hepadnaviridae family and genus Orthohepadnavirus. It is among group VII viruses and possesses double-stranded DNA genomes and replicate using reverse transcriptase according to Baltimore classification of viruses (Baltimore, 2008).

Hepatitis B surface antigen or HB_sAg, previously described as Australia antigen, is the most important protein of the envelope of Hepatitis B Virus. However, some people have acute illness with symptoms that last several weeks, including yellowing of the skin and eyes (jaundice), dark urine, extreme fatigue, nausea, vomiting and abdominal pain (Lozano *et al.*, 2012).

Hepatitis B prevalence is highest in sub-Saharan Africa and East Asia, where between 5–10% of the adult population are chronically infected (Nelson *et al.*, 2011). High rates of chronic infections are also found in the Amazon and the southern parts of eastern and central Europe (Kassaian *et al.*, 2012).

A vaccine against hepatitis B has been available since 1982. The vaccine is 95% effective in preventing infection and the development of chronic disease and liver cancer due to hepatitis B (Lozano *et al.*, 2012).

A correctional facility, detention centre, penitentiary, prison, or remand centre is a facility in which inmates are forcibly confined and denied a variety of freedoms under the authority of the state as a form of punishment. Prisons for juveniles are known by a variety of names, including "youth detention facilities", "juvenile detention centres", "Remand centres" and "reformatories" (Ross, 2012). Like adult facilities, youth detention centres in some cases are experiencing overcrowding due to large increases in incarceration rates of young offenders, which can create extremely dangerous environments in correctional facilities. Overcrowding may also lead to the decrease in availability to provide the youth with much needed and promised programs and services, therefore the facilities can become unstable and create instability in simple logistics (Walsh, 2013).

Correctional facilities is therefore a place where people of unknown health status, could spread infectious diseases.

Intravenous drug users (IDUs), and those sharing of nail cutter, clipper and or those engaged in homosexual activities, are at high risk for infection with several blood-borne pathogens such as HBV, hepatitis C virus (HCV), and human immunodeficiency virus (HIV) (Kassaian *et al.*, 2012).

HBV infection and other blood-borne diseases among prison inmates are higher than the general population and maybe it is because of the over representation of IDUs and high-risk addiction-related behaviours, having multiple sexual partners and homosexuality, prison life style and limited educational opportunities of this Population group (Kassaian *et al.*, 2012).

Currently, there is no periodic national survey for HBV in either the Nigerian population or in correctional facilities; however, prisoners worldwide are at high risk of contracting HBV, especially those who engage in high-risk behaviours and therefore could serve as potential reservoirs of infection to the uninfected incarcerated people or non-incarcerated population upon regaining freedom. In this study a cross-sectional survey was carried out in selected correctional facilities in Sokoto metropolis, Sokoto state Nigeria, to determine the prevalence of hepatitis B surface antigen and associated risk factors with this silent and deadly infection.

MATERIALS AND METHODS

Study Design

The study was descriptive cross sectional study in correctional facility in Sokoto Metropolis, Sokoto state, Nigeria.

Study Area

The study was conducted in Sokoto central prison in Sokoto metropolis, Sokoto state Nigeria. Sokoto is the capital city of Sokoto State, The metropolitan city of Sokoto lies between latitude 13° 3' 49N, longitude 5° 14' 890E and at an altitude of 272 m the sea level above (Udo and Mamman, 1993).

Study Population and Sample Size Determination

One hundred and eighty (180) subjects were involved aged (≥ 15) comprising 169 males and 11 females in correctional facilities in Sokoto State. The sample size was calculated using the formula for Sample Size, $n = z^2 pq / d^2$ (Thrushfield, 2005).

Inclusion criteria

Inclusion criteria include adults' inmates, and willingness to give an informed consent to partake in the study.

Ethical Clearance

The study was approved by the State Ministry of Health (SMH/1580/V.IV) and the Ministry of interior/prison authority (PHS48/Vol.II557).

Samples collection and transportation

Five milliliters (5 ml) of Venous blood samples were collected from each subject using a sterile 5ml Syringe and needle. The collected blood samples were transferred into clean plain sample bottles and transported to the Medical Microbiology Laboratory of Usmanu Dandodiyo University, Sokoto (UDUS) where the serum was harvested and stored at -20°C. The samples were later transported to Usmanu Danfodio University Central research laboratory, city campus complex, where ELISA test was conducted. During sample collection, a total of 180 structured questionnaires on the general awareness of HBV infection were administered to the inmates study area. The questionnaire was initially tested for validity and reliability before the final copy was printed and used for the study.

Assay of Serum samples

The serum samples were analysed for the presence of HBsAg using the sandwich Enzyme Linked Immunosorbent Assay (ELISA) AccuDiag™ HBsAg ELISA and the procedure of the sandwich ELISA was carried out according to manufacturer's instruction.

- The reagents and samples were allowed to reach room temperature (18-30°C) for 30 minutes.
- Wells were numbered including one Blank (e.g. A1), three for the Negative control (e.g. B1, C1, D1), and two for the Positive control (e.g. E1, F1).
- 50µl of Positive control, Negative control, and test sera were added into their respective wells.
- 50µl HRP-Conjugate (Horseradish peroxidase-conjugated anti-HBs) to each well except the Blank was added, and mixed by tapping the plate gently.
- The plate was covered with plate cover and incubated for 60 minutes at 37°C.
- Plate cover was removed and discarded.
- The plate was emptied by aspiration and washed each well 5 times with diluted Wash buffer.
- After the final washing cycle, the plate was dried by turning them upside down onto blotting paper.
- 50µl of Chromogen A (Urea peroxide solution) and 50µl Chromogen B (tetramethyl benzidine solution) was dispensed into each well including the Blank, and mixed by tapping the plate gently.
- The plate was incubated at 37°C for 15 minutes avoiding light.
- Multichannel pipette was used to stop the reaction by adding 50µl Stop Solution (diluted sulfuric acid solution 0.5M H₂SO₄) into each well and was mixed gently.
- The cut-off value was calculated using, cut-off value (C.O.) = $N_c \times 2.1$. The A (absorbance) value of the blank must be < 0.080, the A (absorbance) value of the positive control must be > 0.800, the A (absorbance) value of the negative control must be < 0.100 and the result was interpreted as: Negative results (A/ C.O. < 1), Positive results (A/ C.O. > 1) and Borderline (A/ C.O. = 0.9-1.1).

Statistical analysis

Data obtained from the study were analyzed using Statistical Package for Social Sciences (SPSS) software version 22. Chi-square and Fisher's exact test were used to perform categorical comparison and level of significance at 99% confidence interval. Regression analysis was also used to investigate the relationship between variables (risk factor and HBV infection) P-value less than or equal to 0.01 was considered statistically significant.

RESULT AND DISCUSSION

Of the 160 participants from the correctional facility in Sokoto state (Sokoto central prison), showed an overall prevalence rate of (38.1%), which was regarded as high prevalence rate. World Health Organisation (WHO) defines low prevalence to be <2%, moderate prevalence as 2-8% and high prevalence as > 8% HBsAg positivity (WHO, 2010). This result is higher than the prevalence rate of 23% found among prison inmates in Nasarawa state (Adoga *et al.*, 2009), 6.7% among inmates in Lagos (Dada *et al.*, 2006), 25.5% among Ghanaian prisons (Adjei *et al.*, 2008) and (19.9%) obtained among blood donors in Osogbo, Osun state Nigeria (Opaleye *et al.*, 2013). The reasons for these variations may be related to the fact that infection tend to vary from one locality to another and from one country, depending on the level of associated risk factors (Isah *et al.*, 2015), also the higher prevalence obtained in this study could be due to the fact that study population was among the most high risk group. The 38.1% prevalence observed in this study is also higher than the 20.0% observed in Greece prisons (Vassiliki *et al.*, 2006), 0.9% reported for prison inmates in USA (Hennessy *et al.*, 2009). The possible reasons for this difference may be due to difference in geographical locations and institutionalized infection control measures taking by some countries against HBV infections. Nigeria a tropical country, has been documented as highly endemic for HBV infection and about 75% of its population are likely to have been exposed to the virus at one time or the other in their lives (Ojo and Anibijuwon, 2009). The prevalence rate in Nigeria is high and 19 million Nigerians are considered to be infected with HBV (Okafor, 2011) and have reached hyper-endemic levels with the prevalence of HBsAg estimated to range from 10-40% (Bello *et al.*, 2011).

Table 1: Gender Distribution of HBV infection among study populations (correctional facilities) in Sokoto state (using fisher's exact test).

	Gender	No. Of samples tested	No. of positive Samples (%)	No. of Negative samples (%)
Male	169	72(42.6)	97(57.4)	
Female	11	4(36.4)	7(63.6)	
Total	180	76 (42.2)	104(57.8)	
P-value =0.7622		p> 0.01		

There was no observed statistical association in sex distribution of HBV infection in correctional facilities. However, higher prevalence was recorded among males (38.3%) than females (36.4%) this could be attributed to the number of males to females in the study and males engaged themselves in practicing of illegal behaviours. This finding agrees with that of Pennap *et al.*, (2011) and Isah *et al.*, (2015) which showed higher prevalence of HBV infection among males than females. The result, however contrast the report of Mustapha and Jibrin (2004) in which prevalence of HBV infection was higher in female than male.

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170 **Table 2: Age Distribution of HBV infection among study populations (correctional facilities) in Sokoto state**
 171 **(using chi square test).**

	Age (Years)	No. of samples tested	No. of positive samples (%)	No. of negative samples (%)
172	15-20	40	16(40.0)	24(60)
173	21-25	31	19(61.3)	12(38.7)
174	26-30	29	9(31.0)	20(69.9)
175	31-35	23	8(34.8)	15(65.2)
176	36-40	21	11(52.4)	10(47.6)
177	41-45	19	9(47.4)	10(52.6)
178	> 46	17	4(23.5)	13(76.5)
179	Total	180	76(42.2)	104(57.8)

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180 **P-value = 0.003 $\chi^2 = 19.75$ $p < 0.01$**
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182 The distribution of HBV infection, according to age was statistically significant, and the age groups of 21-25 and
 183 36-40 years had the highest prevalence rates 48.8% and 52.4%, respectively, this could be due to the fact that
 184 they are within the reproductive age group and their over representation among the age groups in the study.
 185 And this agreed with the earlier reports among the general population in Nigeria, Brazil and Ghana which
 186 spans the generally accepted sexually active age group of 15-45 years (Adjei *et al.*, 2008). This finding is
 187 contrary to report by Isah *et al.* (2015) and Okonko *et al.* (2012) which showed higher prevalence rate in
 188 those above 40 years. Apart from HIV, many people are not aware with other sexually transmitted diseases
 189 and continue to have unprotected sex with other HIV negative partners who might be chronic carriers of HBV
 190 (Isah *et al.*, 2015).

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Table 3: Distribution of HBV infection among study populations (correctional facilities) in Sokoto state based on Ethnicity of the subjects (using chi square test).

Ethnicity	No. Tested	No. positive	No. Negative
Hausa	102	49 (48.0)	53 (52.0)
Fulani	38	18 (47.4)	20 (52.6)
Igbo	4	0 (0)	4 (100)
Yoruba	4	2 (50)	2 (50)
Others*	32	7 (21.87)	25 (78.9)
Total	180	76(42.2)	104(57.8)
*Dakarawa, Gobirawa, P-value = 0.0346 p>0.01			

And Zabarmawa.

There was no significant difference in the prevalence of HBV infection in correctional facilities based on their ethnicity, however, higher prevalence rate was observed among Hausa's (42.2%) followed in decreasing order by Igbo, Yoruba, Fulani and [others (Gobirawa, Dakarkari and Zabarmawa)]. The high prevalence among Hausa's could be due to their large number among the ethnic groups. In addition, no significance difference was observed in the prevalence of HBV infection in correctional facilities based on their Nationality. High prevalence was observed among Nigerians (37.8 %) this could be due to their over representation in the study.

Table 4: Distribution of HBV infection among study populations (correctional facilities) in Sokoto state based on Educational background of subjects (using chi square test).

Level	No. of samples tested	No. of positive samples (%)	No. of Negative samples (%)
Primary	30	22(73.3)	8(26.7)
Secondary	74	22(29.7)	52(70.3)
Tertiary	26	8(30.8)	18(69.2)
Others*	50	24(48)	26(52)
Total	180	76(42.2)	104(57.8)
P-value =0.0001 $\chi^2=25.07$ p< 0.01			

*non formal education

The prevalence of HBV infection in correctional facilities based on their educational background was significant. The highest prevalence was observed among those with primary education followed by those that attended non formal education followed by those with secondary education and the least prevalence was observed among those with tertiary education. The high prevalence among these groups could be due to their low level of education and lack of knowledge of HBV infection (unawareness), while the lower prevalence among those in tertiary institutions is because they are careful enough and usually take necessary precautions when negotiating new sexual partners.

Table 5: Distribution of HBV infection among study population (correctional facilities) in Sokoto state based on Marital status of subjects (using fisher's exact test).

Status	No. of samples tested	No. of positive Samples	No. of Negative samples (%)
Single	114	37(32.5)	77(67.5)
Married	31	22(70.9)	9(29.0)
Separated	12	6(50)	6(50.0)
Widow/Widower	6	0(0)	6(100)
Divorcee	17	11(64.7)	6(35.3)
Total	180	76(42.2)	104(57.8)
P-value =0.0001		p< 0.01	

The prevalence of HBV infection based on marital status was statistically significant. Higher prevalence rate was observed among those that were married followed by those that were divorcees, separated and singles, while none was found to be positive among widows. The high prevalence among married ones could be attributed to their indiscriminate sexual activities.

Table 6. Distribution of the prevalence of HBV infection among prison inmates based on their Duration of stay.

Duration	No. of samples	No. of positive	No. of Negative
(Years)	tested	samples (%)	samples (%)

242	0-1	82	27(32.9)	55(67.1)
243	2-3	64	28(43.8)	36(56.3)
244	>3	14	6(42.9)	8(57.1)
	Total	160	61(38.1)	99(61.9)
	P-value =0.0031		$\chi^2=1.545$	P< 0.01

245 Significant association in prevalence of HBV infection in correctional facilities was also observed based on their
 246 duration of stay in correctional facilities, inmates that spends 2-3years had the highest prevalence followed by
 247 those with >3years and the least 0-1years. This shows that, high chance increases with long period of
 248 incarceration.

249 **Table 7: Distribution of HBV infection among study populations (correctional facilities) in Sokoto state based**
 250 **on Occupation of subjects.**

	Occupation	No. of samples tested	No. of positive samples (%)	No. of Negative samples (%)
251	Civil service	30	9(30)	21(70)
252	Public service	5	3(60)	2(40)
253	Farming	10	6 (60)	4(40)
254	Business	55	28(50)	27(49)
	Others	80	30 3(7.5)	50(62.5)
	Total	180	76 (42.2)	104 (57.8)
255	P-value =0.1769		p> 0.01	

256 There was no statistical significant association in the prevalence of HBV infection in correctional facilities based
 257 on their occupation. Those in public service and farming were more infected (60%), followed in decreasing
 258 order of prevalence by Businessmen, Students and those in civil service.

259 **Table 8: Distribution of HBV infection among study population by Locations of correctional facilities in**
 260 **Sokoto state.**

Location	No. of samples tested	No. of positive samples (%)	No. of Negative samples (%)
Central prison	160	61(38.1)	99(61.9)
Remand Home	20	15(75)	5(25)
Total	180	76 (42.2)	104 (57.8)

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Significant association in prevalence of HBV infection in correctional facilities was also observed based on their

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locations. Remand home (juvenile detention centre) had the highest prevalence rate of (75%), while Sokoto

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central prison had prevalence of (38.1%). The high prevalence among those in remand home might be

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associated to their dirty habit because they are still young and their untidy environment as compared to that

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of Sokoto central prison.

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Table 9. Prevalence of HBV infection among prison inmates in Sokoto state in relation to some associated

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risk factors

Risk Factor	No Samples tested	of No. of samples	positive	Percentage positive (%)	X ²	P-value
knowledge on HBV						
Yes	12	6		50	0.07	0.7932
No	168	70		41.7		
Knowledge on mode of transmission						
Yes	22	10		45.5	0.01	0.9225
No	158	66		41.8		
Sharing of sharp object						
Yes	163	65		39.8	2.94	0.0865
No	17	11		64.7		
Blood Transfusion						
Yes	4	2		50		0.1344
No	176	74		42.0		
Intravenous drug use						
Yes	35	20		57.1	2.74	0.0981
No	145	56		38.2		
Homosexuality						
Yes	10	5		50	0.03	0.8548
No	170	71		41.8		
Multiple sexual partners						

Yes	85	17	20	30.9	0.0001
No	95	59	62.1		

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272 Table 10. Regression analysis of HBV infection with some associated risk factors.

Risk factor	Standardized Coefficients (Regression)	Sig.
Knowledge of HBV	-0.01	0.992
Knowledge on mode of transmission	-0.133	0.069
Sharp objects	-0.15	0.836
Blood transfusion	-0.144	0.040
IDU	-0.125	0.074
Homosexuality	-0.035	0.623
Multiple sexual partners	0.260	0.000
Duration of stay	-0.267	0.000
Constant sig=0.000		

273 Among the associated risk factors result showed that, multiple sexual partners are associated with a higher
 274 prevalence rate of HBV infection in correctional. This could be because of indiscriminate sexual activities and
 275 lack of taking measures / unprotected sex, which will increase the chance of infection.

276 No association was observed between blood transfusion and prevalence of HBV infection in correctional
 277 facilities. This tally with the reports of Adoga *et al.*, (2009) and Adekanle *et al.* (2010) who reported insignificant
 278 association of HBV with blood transfusion. The result of the present study, however, contradicts the report of
 279 Agbede *et al.* (2007) who observed significant association between the HBV and blood transfusion. In addition,
 280 intravenous drug use (IDU) was not significantly associated with the prevalence of HBV infection in
 281 correctional facilities in Sokoto State. This agreed with the report of Abdul *et al.* (2010). This could be because
 282 of banning of the IDU practice among the prison inmate in the study area. In addition, the result of this study
 283 did not reveal a significant association between the sharing of sharp objects with prevalence of HBV infection
 284 in correctional facilities in Sokoto State. It may be due to the restriction on the use of the sharp objects
 285 imposed on the inmates. This is in contrast with the reports of Samuel *et al.* (2009), Ray and Hunter (2010),
 286 who reported a significant association between the sharp objects and infection with the HBV. Similarly, the
 287 result of this study did not reveal a significant association between knowledge of the HBV infection and its
 288 modes of transmission in the study areas. This agreed with the study of Butler *et al.* (1997) who reported that
 289 in Australia there was poor knowledge of hepatitis risk factors among their study subjects. Regression analysis
 290 revealed that multiple sexual partners and duration of stay were significantly associated with HBV infection
 291 ($p < 0.01$). Therefore, multiple sexual partners and duration of stay were the only significant risk factors in the
 292 study area.

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 294 Other HBV infection serological markers such as anti-HBs, anti-HBc, HBeAg, and anti-HBe should be detected in
 295 future studies, this will help in knowing people that are susceptible, immune due to natural infection, immune
 296 due to vaccination, acutely infected and chronically infected.

297 Our findings in this study stress the need for further research on molecular detection and molecular
 298 characterization to help understand the specific pattern of distribution of the virus in the society.
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There is a need for the federal government to establish a policy that would make general screening of all the inmates in correctional facilities for HBV infection, and those prior to incarceration, and vaccinate them against the disease. In addition, the affected ones should undergo proper treatment.

Conclusion

Prevalence of Prevalence of 42.2% of HBV infection was obtained and shown that HBV infection is prevalent with males and age group of (21-25years). Duration of stay and multiple sexual partners were the main risk factors in the transmission of HBV infection among prison inmates in Sokoto metropolis, Sokoto state Nigeria.

References

- Abdul M. K., Sharaf A. S., Cathy A. J., Bryan E. S., and Sten H. V. (2010). Risk factors and prevalence of Tuberculosis, Human Immunodeficiency virus, Syphilis, Hepatitis B and C virus. Among Prisoners in Pakistan. *International journals for infectious diseases*, 14 (3): 60-66.
- Adekanle O, Ndububa D. A., Ayodeji O. O., Paul-Odo B., Folorunso T. A., (2010). Sexual transmission of the hepatitis B Virus among blood donors in a tertiary hospital in Nigeria. *Singapore J Med*. 51(12): 944-947.
- Anaemia. *Nig J Paed* 13 :95.
- Asabe S, Wieland S. F, Chattopadhyay P. K, Roederer M, Engle R. E, Purcell R. H, (2009); The size of the viral inoculum contributes to the outcome of hepatitis B virus infection. *J Virol*. 83: 9652–62.
- Baltimore classification of viruses (2008) :(Website.) *molecular biology web book*.
- Bello R. H., Olabode H. O. K. (2011). Sero-prevalence and risk factors associated with hepatitis B surface antigen (HBsAg) amongst patients Biu, Borno State, Nigeria *journal of public Health and Epidemiology*, 3(10): 448-453.
- Blumberg B. S. (1977). Australia antigen and the biology of hepatitis B. virus, *journal of medical sciences*, (197): 17-227.
- Chisari FV *et al.*, (2010) Pathogenesis of hepatitis B virus infection. *Pathological Biology*; 58: 4, 258-266.
- Coffin C. S. Mulrooney P. M., van Marle G., Roberts J. P., Michalak T. I. and Terrault N. A. (2011). Hepatitis B virus (HBV) quasispecies in hepatic and extrahepatic viral reservoirs in liver transplant recipients on prophylactic therapy. *Journal of Liver Transplantation*, 17(8): 955-62.
- Colin W. S., Simard E. P., Lyn F., Anthorony E. F. and Beth P. B. (2006). Hepatitis B Virus Infection: Epidemiology and Vaccination. *Oxford Journal Medicine Epidemiologic Reviews*, 28(1): 112-125.
- Dada M. O., A A. S., E O. A. (2006). Seroprevalence of HIV and HBV among male prisoners in Lagos state, Nigeria. *Nigerian postgraduate Medical journal* 13: 6-9.
- Horvat RT (2011) Diagnostic and clinical relevance of HBV mutations. *Lab Medicine*; 42: 8.
- Howard CR (1986). "The biology of hepadnaviruses". *J. Gen. Virol*. 67 (7): 1215-1235.
- Isa I. Aminu M. Abdullahi, S. A. Sani, M. A. Esona M.D (2015). "Seroprevalence of hepatitis B virus in a tertiary institution in North Western Nigeria" *African journal of Microbiology Research* 9 (3): 171-179.
- Ito K., Kim K. H., Lok A S. and Tong S. (2009). Characterization of genotype-specific carboxyl terminal cleavage sites of hepatitis B virus e antigen precursor and identification of furin as the candidate enzyme. *Journal for Virology*, (83): 3507-3517.
- Kaine W. N., Okafor G. O (1983); Hepatitis B Surface Antigen in Nigerian Children with Sick Cell Anaemia. *J Trop Paed* 29: 55 - 7.
- Krugman S. (1976). Viral hepatitis, type B. Studies on natural history and prevention re-examined. *Yale journal of Biology and Medicine*. 49(3): 199-203.
- Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, Abraham J. (2012);Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study. 380:2095-2128.

- 350 N. Kassaian, P. Adibi, A. Kafashaian, M. Yaran, Z. Nokhodian, and P. Shoaie, (2012). "Hepatitis C virus and
351 associated risk factors among prison inmates with history of drug injection in Isfahan," International
352 Journal of Preventive Medicine, no. 3, supplements 1, pp. 156–161.
- 353 Nelson, P.K., Mathers, B.M., Cowie, B., Hagan, H., Des Jarlais, D., Horyniak, D. and Degenhardt, L., 2011.
354 Global epidemiology of hepatitis B and hepatitis C in people who inject drugs: results of systematic
355 reviews. *The Lancet*, 378(9791), pp.571-583.
- 356 Ola S. O. (2010). Hepatitis B virus infection in the Nigerian health care setting. Faculty lecture series faculty of
357 clinical sciences college of medicine university of Ibadan Nigeria.
- 358 Pennap G. R, Nwachukwu O, Ishakeku D, Ombugadu R. J. (2011): Hepatitis B virus carriage among student of a
359 Nigerian tertiary institution: A cohort of eligible blood donor, Research J. Med. Sci. 5(2): 90-93.
- 360 Ray M. M. and Hunter B. D. (2010): seroprevalence of markers for hepatitis B viral infection. International
361 journal of infectious Diseases, 15: 78-121.
- 362 Ross, Jeffrey Ian (2012). "The Invention of the American Supermax Prison". In Jeffrey Ian Ross. The
363 Globalization of Supermax Prisons. Rutgers University Press.
- 364 Udo RK, Mamman AB (1993). Nigeria: Giant in the tropics. State surveys, pp. 435-446.
- 365 Walsh, John P. (2013). "Conditions of Confinement: The Social Reality of the Jail Inmate". The Culture of Urban
366 Control: Jail Overcrowding in the Crime Control Era. Lexington Books. pp. 51.
- 367 Wieland S, Thimme R, Purcell RH, Chisari FV (2004); Genomic analysis of the host response to hepatitis B virus
368 infection. Proc Natl Acad Sci U S A. 101:6669–6674.
- 369 World Health Organisation (2010). Prevalence of hepatitis B virus infection in the world by country.
370 <http://www.who.int/csr/disease/hepatitis/en/>.
- 371 World Health Organization (2015). Guidelines for the prevention, care and treatment of persons with chronic
372 hepatitis B infection.
- 373 Zuckerman A. J., Banatva J. E., Schoub B. D., Griffiths P. D and Mortimer P. (2009), Principles of Clinical
374 Virology, Sixth Edition. Published 2009 John Wiley and Sons Ltd. Pp 283-306.