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Parallel and Overlapping Infection of Hepatitis B Virus (HBV) and *Plasmodium Falciparum* among Prison Inmates in Correctional Facilities in Keffi, Nigeria

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Abstract

Hepatitis B virus (HBV) and *Plasmodium Falciparum* are two worldwide public health infectious agents and they are endemic in Nigeria. There is scarcity of published reports on HBV/*P. falciparum* coinfection among incarcerated persons in Nigeria. This was a pilot study carried out to determine the parallel and overlapping infection of HBV and falciparum malaria among inmates in the 2 correctional facilities in Keffi, Nigeria. In this cross-sectional study, blood samples were obtained from 300 incarcerated persons and were analyzed for HbsAg and *P. falciparum* using standard laboratory techniques. Information obtained were analyzed using Smith's Statistical Package version 2.80. P value ≤ 0.05 were considered statistically significant. Out of the 300 inmates, 44(14.7%) tested positive for HBV and 174 (58.0%) for *P. falciparum* while 28 (9.3%) had HBV/*P. falciparum* coinfection. Overlapping infections of HBV and malaria were higher in females (13.3%) and among those aged less than 20 years old (12.0%). This study reported a statistically significant association between knowledge of transmission routes and malarial infection (p = 0.0221). Gender, age, duration in prison, history of blood transfusion and vaccination, and use of ITNs were not statistically associated with the infections (p> 0.05). The 9.3% HBV/falciparum malaria coinfection among incarcerated people in the area is alarming. Public health education and compulsory laboratory screening of the infectious agents in correctional centres should be advocated and implemented to curb the infections in Nigeria because ignorance of transmission routes was a risk factor among inmates in our study.

Keywords: HBV; *Plasmodium Falciparum*; Prison Inmate; Coinfection; Correctional Facility; Nigeria

Abbreviations: HBV: Hepatitis B Virus; SSA: Sub Saharan Africa; LFTS: Liver Function Tests.

Introduction

Hepatitis B virus (HBV) and *P. falciparum* infections are two public health problems globally [1-2]. HBV is a partially double-stranded with a circular DNA virus that replicates by reverse transcription [3]. There are more than 2 billion HBV infected persons living today worldwide with 260 million estimated to be chronically infected with the infection and having a carrier rate varying from 9–20% in Sub Saharan Africa (SSA) [4-6]. Annually, there are close to 900,000 HBV related deaths, mainly due to cirrhosis or hepatocellular carcinoma [6]. The malaria infection still remains the most extensively studied protozoan infection that causes morbidity and mortality worldwide [7]. Malaria cases and incidences is at an increasing rate globally especially in the SSA region [8]. Thus, malaria makes up a greater percentage in incarcerated people in Nigeria and other nations of the world where the disease is endemic [9].

HBV and Malaria coinfection pose a great, hazardous, and serious health issue in developing countries like Nigeria. These infections are prevalent in most tropical subtropical regions and are both major risks to preventive medicine. Co-infection between HBV and falciparum malaria can prevail

in areas and regions where infection is endemic as a result of their existence in the same geographical area [1-2]. Both infections have shown high activity in the hepatocytes and their role on the erythrocytes might lead to a compromised immunity in an individual, making them vulnerable to other related infections that will also results to high death rate and illness [10,11]. HBV and *P. falciparum* share a common intra-hepatic microenvironment, and each may independently cause abnormalities in liver function tests (LFTs). Immunologically, both pathogens may also overlap, as each is observed to induce a robust pro-inflammatory Type 1 immune response (Th1) [12,13].

Correctional facilities in Nigeria are known to be a high risk environment for blood borne and sexually transmitted infections and over the past years the centres have been in deplorable state with enhanced pathogenic disease among inmates [14]. The living situations in Nigerian correctional facilities are in dismay as poor environmental sanitation, overcrowding, lack of portable water, food and drugs, and denial of contact with families are common negative circumstances [15]. Most of the incarcerated people in the centres sleep paired to a bed and in most cases sleeps on the floor in filthy cells. Toilets facility are often blocked and overflowing or simply do not exist and in few events. Studies have shown that inmates exhibit poorer health status than the general public and as such are potential reservoirs to pathogenic infections to the uninfected entrants and the general non-incarcerated population after been freed [14-16].The coinfection of HBV and *P. falciparum* among inmates have been reported in Italy, Ghana and Rivers state, Nigeria [1,2,11]. However, there is paucity of published reports on HBV and *P. falciparum* coinfections among incarcerated persons in Nigeria. This is the first report on the coinfection of HBV and *P. falciparum* among prison inmates in Nasarawa State. We found that the prevalence of HBsAg and *P. falciparum* was high with a 9.3% coinfection and associated risk factors identified. The findings of this study will add significant insights to the understanding of the infections among prison inmates in Nigeria with implications for intervention initiatives.

Materials and Methods

Study Area

This study was carried out in Keffi. Keffi is 68 Km from Abuja, the Federal Capital Territory and 128 Km from Lafia, Nasarawa State. It lies in latitude eight 5'N of the equator and longitude seven 8'E, it also situates on altitude of 850 M above sea level [17]. The average annual rainfall in Keffi is ±2,000 millimeters (79 in), and is often heavier during the rainy months having its peak around July through September [7]. Most of the people living here are dominantly traders, farmers, civil servants, and students.

Study Population

A total of 300 prison inmates from the 2 correctional facilities in Keffi, Nasarawa State participated in this pilot cross sectional study between April through June 2018 after an informed consent was obtained from each participant. A representative sample size was determined after having estimated the required minimum sample size using the formula propounded by Naing, [18] at a 95% confidence interval. Permission was sought from the management of the correctional facilities and each inmate. Their socio-demographic information was obtained by a self-structured questionnaire.

Sample Collection

Five (5) ml of blood specimen was collected from each inmate in the studied facilities by venipuncture into a labeled plain tube. The samples were transported in ice packs to the Microbiology Laboratory of the Nasarawa State University, Keffi for processing and examinations. Samples were allowed to clot at room temperature and spun for 5 minutes at 3,000 rpm. The resultant sera were harvested into well labeled cryovials and stored at -20oC until ready for use.

Inclusion and Exclusion Criteria

Participants who were less than or exactly 2 months old in the facility were excluded from the study. All inmates who subscribed to this study and gave written/verbal informed consent were included to be part of the study.

Laboratory Investigation

Screening for Hepatitis B Surface Antigen (HBsAg): A rapid in vitro which is a qualitative sandwich immunoassay diagnostic kit was used for screening the sera for HBsAg. The test kit (HBsAg one step test strips, ACON Laboratories Inc, USA) utilizes a combination of monoclonal and polyclonal antibodies to detect HBsAg in serum and was confirmed using Shantest TMHBsAg ELISA (Shantha Biotechnics Ltd, India). The tests procedure and results interpretations were carried out according to the manufacturer's instructions.

Screening for *Plasmodium Falciparum*: All the subjects were screened for malarial parasite using the Care Start TM malaria HRP2 (Pf) rapid test for *Plasmodium Falciparum* malaria ML no: 338 (Orchid Biomedical System, India) following the manufacturer's specifications prior to microscopy.

Microscopic Investigation: Thin and thick smears were prepared to determine the malaria parasite in the inmates' samples. The both smears were stained using 3% Giemsa technique as described by Cheesbrough [19]. This is

considered as the gold standard and it was used to confirm the initial screening with the rapid kit.

Ethical Approval: In line with the Helsinki Declaration which specifies the code of ethics for biomedical research involving human subjects, clearance for this study was obtained from the Health Research Ethics Committee of Nasarawa State's Ministry of Health, Nigeria. Official permission and administrative clearance was received from the Asst. Controller of Prisons in the State.

Statistical Analysis: The information obtained was subjected to descriptive statistical analysis using Smith's Statistical Package (version 2.80, Claremont, California-USA). Chi-square statistical test was used to determine associations and coinfections. Values obtained were considered statistically significant at $p \leq 0.05$.

Results

Out of the 300 incarcerated persons that were recruited for this study, 44(14.7%) tested positive for HBV and 174 (58.0%) for *P. falciparum* while 28 (9.3%) had HBV/falciparum malaria coinfection. Overlapping infections of HBV and malaria were higher in females (13.3%) than males (8.3%) and highest in those aged less than 20 years old (12.0%). This study reported a statistically significant association between knowledge of transmission routes and malarial infection ($p = 0.0221$). It was higher in those with informed knowledge of transmission routes (81.1%) than those ignorant of the transmission routes (50.4%). HBV infection was more among the males (15.0%), 51-60 years old (50.0%), those without history of blood transfusion (17.3%) and HBV vaccination (14.8%), those less than 6 months in detention (16.7%) and those ignorant of HBV transmission routes (15.9%). Male participants (62.5%), 41-50 years old (77.8%), those with knowledge of transmission routes (81.1%), those < b months in detention (80.0%) and those that do not use ITNs (63.6%) were more likely to be infected with falciparum malaria. Gender, age, duration in prison, history of blood transfusion and vaccination, and use of ITNs were not statistically associated with the prevalence of HBV and malarial infections ($p > 0.05$).

Risk Factor	No. Examined	No. Positive					
		HBV (%)	p value	*P. falciparum* (%)	p value	HBV/*P. falciparum* (%)	p value
Gender							
Male	240	36 (15.0)	**0.7773**	150 (62.5)	**0.0879**	20(8.3)	
Female	60	8 (13.3)		24 (40.0)		8(13.3)	0.2845
Age (Years)							
<20	50	8 (16.0)		36 (72.0)		6 (4.5)	
21-30	144	16 (11.1)		66 (45.8)		12 (0.0)	
31-40	76	12 (15.8)		56(73.7)		8 (2.4)	
41-50	18	4 (22.2)	**0.2261**	14 (77.8)		2 (0.0)	**0.8809**
51-60	8	4 (50.0)		4 (50.0)	**0.3026**	0 (0.0)	
>61	4	0 (0.0)		2 (50.0)		0 (1.9)	
History of Blood Transfusion							
Yes	80	6 (7.5)	**0.0622**				
No	220	38 (17.3)					
Knowledge of transmission routes							
Yes	74	8 (10.8)	**0.3457**	60 (81.1)	**0.0221**		
No	226	36 (15.9)		114 (50.4)			
History of HBV Vaccine							
Yes	30	4 (13.3)	**0.8503**				
No	270	40 (14.8)					
Duration in Prison							

< 6 months	60	10 (16.7)	**0.6747**	48 (80.0)	**0.0576**		
>6 months	240	34 (14.2)		126 (52.5)			
Use of ITNs							
Yes	80			34 (42.5)			
No	220			140(63.6)	**0.0801**		
Total	300	44 (14.7)		174 (58.0)		28 (9.3)	

Table 1: Parallel and Overlapping infections of HBV and *P. falciparum* among Inmates in the Correctional facilities in Keffi, Nigeria with respect to risk factors studied.

Discussion

This study investigated the parallel and overlapping infection of HBV and falciparum malaria among prison inmates in Correctional centers in Keffi, Nigeria. Such studies have been reported in a good number of nations, yet there is still paucity of reports of the coinfection among incarcerated people in Nigeria. The overall prevalence of HBV, *Plasmodium Falciparum* and HBV/*P. falciparum* infections in the current study was 14.7%, 58.0% and 9.3% respectively. Few researchers around the world have reported the coinfection of HBV/*P. falciparum* in their studies. It was 36.6% among African immigrants in Italy [1], 1.9% among pregnant women in Ghana [2], 4.33% among outpatients in Rivers state, Nigeria [11]. These differences might be as a result of different study population, diagnostic methods, sample size, and weather and climate conditions in the study areas.

The 14.0% HBV infection reported among prison inmates in this study is lower than the 23.0% reported among prison inmates by Adoga MP, et al. [15] in Nasarawa State and6.0% reported among outpatients by Abah AE, et al. [11] in Rivers state, Nigeria. Several studies on the prevalence of HBsAg among inmates in different countries of the world have also shown different rates. For example, it was 12.5% in among prison inmates in West Africa [20], 27.2% and 3.06% among inmates in Iran [16,21], 13.7% among prison inmates in Brazil [22], 24.5%, 25.2% and 0.7% among adolescent and young incarcerated adults in Taiwan, Bulgaria and USA respectively [23]. The observation in this study might not be unconnected with the fact that there is a high prevalence of HBV previously reported circulating in the area. The prevalence of HBV in this study was low when compared to previous reports in the same area. This outcome signifies positive intervention initiatives by Government to curb the infection in correctional centres in the state.

The prevalence of malarial infection among the study population in the present study was 58.0%. Similar studies have reported high prevalences. Abah AE, et al. [9] reported 55.2% of malaria among prisoners in Rivers State. Mamman AS, et al. [14] found a prevalence of 53.67% in Jos prison, Plateau. It was 81.06%, 77.67% and 73.33 among prisoners in Abakaliki, Enugu and Onitsha respectively [8]. Shanks GD [24] reported 54% malaria prevalence in Australia and British prisoners of war. This disparity in the prevalence of malaria reported in the different study area and country might be attributed to variations in climatic and weather conditions. The study was also done during the rainy reason which favors the breeding of mosquitoes.

The proportion of HBV/*P. falciparum* coinfection prevalence was found to be higher in females (13.3%) than males (8.3%). Higher rate of parallel infection of HBV and malaria was discovered among males in the setting. However, there was no statistically significant association among prison inmates with respect to gender ($p > 0.05$). No study reported a coinfection in females but most studies reported single infection of either HBV or malaria in males [9,14,21,22]. There is no obvious reason(s) for coinfection in females. The parallel infection of HBV and falciparum malaria reported in males can be ascribed to the risky behavior that predisposes them to the infectious agents and negligence in the hand of the prison management while the female counterparts are most times given more attention in detention.

The present study reported a highest coinfection of HBV and *P. falciparum* among prison inmates aged < 20 years with a prevalence of 4.5% and a highest prevalence of single infection of HBV and malaria among those aged 51-60 years (50.0%) and 41-50 years (77.8%) respectively. There were no statistically significant associations between the prevalence of the infections and age ($p > 0.05$). This observation is in consonance with findings from similar studies [11,14,15,21,22]. This depicts that being young is a possible risk factor for contracting the pathogens. These age bracket lacks understanding on the risky activities that enhance transmission of the infectious agents.

This study did not demonstrate any association between HBV infection and history of blood transfusion ($p > 0.05$). Incarcerated people with no history of blood transfusion had a higher prevalence than those with a history of blood transfusion. This reflects the effectiveness of the measures

taken by our blood banks. Adoga MP, et al. [15] and Stief ACF, et al. [22] reported history of blood transfusion as risk factor for HBV. There was a statistically significant association of malaria and knowledge of transmission routes ($p < 0.05$). The infection with HBV was higher among those ignorant of the transmission modes (15.9%) while malaria was higher among those with knowledge of transmission routes (81.1%). This agrees with a similar study in Nasarawa State [15]. This report is obvious because the awareness of these pathogenic agents reduces your risky behaviors and enhances your hygiene levels.

History of HBV vaccination was found not to be associated with the prevalence of Hepatitis B virus among prison inmates ($p > 0.05$). Those who have not been vaccinated had a higher prevalence of 14.8% than those with a history of HBV vaccination (13.3%).This report is similar with a finding in Brazil [22]. There is need to intensify HBV vaccination programme in correctional facilities in Nigeria. With reference to duration in detention, inmates that have stayed less than 6 months in detention had 16.7% and 80.0% for HBV and malarial infections respectively. No association between duration in prison and the infections was recorded ($p > 0.05$). This report correlates with Moradi G, et al. [21] and Adoga MP, et al. [15] reports in Iran and Nigeria respectively. There is no obvious reason(s) for this outcome. In a related development, use of ITNs was not a risk factor for malaria in this study. Obviously, infection was high among those that do not use ITNs to sleep (63.6%) than those that uses ITNs (42.5%). Mamman AS, et al. [14] reported a similar finding in their study. There is an urgent need for ITNs usage in correctional facilities in the area.

Conclusion

The 9.3%, 14.7% and 58.0% prevalence of HBV/*P. falciparum*, HBV and *P. falciparum* among inmates is a serious concern since the infected inmates pose a high risk of transmitting the infection to uninfected counterparts. Effective control measures and health awareness strategies should be targeted at incarcerated people in Correctional centres in Nigeria.

Limitations

Limited availability of funds prevented molecular analysis of positive samples of the subjects. Coverage of large sample size and other correctional facilities in the State hindered a generalized prevalence of the infections in the State.

References

1. Scotto G, Fazio V (2018) Hepatitis B and asymptomatic malaria coinfection in Sub-Saharan African immigrants: epidemiological and clinical features of HBV infection. Rev Soc Bras Med Trop 51(5): 578-583.

2. Anabire NG, Aryee PA, Abdul-Karim A, Abdulai IB, Quaye O, et al. (2019) Prevalence of malaria and Hepatitis B among pregnant women in Northern Ghana: comparing RDTs and PCR. Plos One 14(2): e0210365.

3. Oti BV, Pennap GR, Ngari HR (2018) HBsAg and Anti-HCV Prevalence among pregnant women accessing antenatal care in a tertiary healthcare facility in Central Nigeria. Hepatology and Pancreatic Science 2(1): 1-4.

4. Ajegena SA, Oti BV, Pennap RG, Richard M (2017) Prevalence of HBsAg and HBV serotypes using antigen detection and PCR methods among Human Immunodeficiency virus patients accessing healthcare in a Tertiary healthcare facility in Central Nigeria. Journal of Advances in Microbiology 3(3): 1-10.

5. Pennap GR, Mohammed HI, Oti VB, Adoga MP (2019) Genotype Distribution of Hepatitis B virus in a subset of infected young people in Central Nigeria. Scientific African 5: e00122.

6. World Health Organization (2019) Hepatitis B, Fact sheets.

7. Yohanna J, Oti V, Amuta E, Philip A, Anizoba L (2019) *Plasmodium Falciparum* Infection among Febrile Patients Attending a Tertiary Healthcare Facility in Central Nigeria: Prevalence, Haematologic and Sociodemographic Factors. International Journal of Tropical Diseases 2(2): 1-6.

8. Otuu FC, Shu EN (2019) Prevalent Diseases among Inmates in Three Federal Prisons in South-East Geopolitical Zone of Nigeria: A Peep into the Environmental Factors. Journal of Environmental Science and Public Health 3(1): 010-024.

9. Abah AE, Nduka FO, Amadi Q, Aguocha OC, Nzeji P (2018) Malaria infection among prison inmates of the maximum security prison Borokiri, Port Harcourt, Rivers State, Nigeria. Nigerian Journal of Parasitology 39(2): 127-131.

10. Andrade BB, Santos CJN, Camargo LM, Souza-Neto SM, Reis-Filho A, et al. (2011) Hepatitis B Infection Is Associated with Asymptomatic Malaria in the Brazilian Amazon. Plos One 6(5): e19841.

11. Abah AE, Udoidang IN (2019) Co-Infection of Malaria and Hepatitis B Virus in Port Harcourt, Rivers State, Nigeria. International Journal of Infection 6(4): e97033.

12. Schofield L, Grau GE (2005) Immunological processes in malaria pathogenesis. Nat Rev Immunol 5(9): 722-735.

13. Anabire NG, Aryee PA, Abdul-Karim A, Quaye O, Awandare GA, et al. (2019) Impact of malaria and hepatitis B co-infection on clinical and cytokine profiles among pregnant women. Plos One 14(4): e0215550.

14. Mamman AS, Gyar SD, Reuben CR (2014) Malaria infection among inmates of Jos Prison, Plateau State, Nigeria. International Journal of Microbiology and Immunology Research 3(3): 42-45.

15. Adoga MP, Banwat EB, Forbi JC, Nimzing L, Pam CR, et al. (2009) Human immunonodeficiency virus, hepatitis B virus and hepatitis C virus: sero-prevalence, co-infection and risk factors among prison inmates in Nasarawa State, Nigeria. J Infect Dev Ctries 3 (7): 539-547.

16. Dana D, Zary N, Peyman A, Behrooz A (2013) Risk prison and Hepatitis B virus infection among inmates with history of drug injection in Isfahan, Iran. The Scientific World Journal 2013: 1-4.

17. Akwa VL, Binbol NL, Samaila KL, Marcus ND (2007) Geographical perspective of Nasarawa state. Onaivi printing and publishing company, Keffi. pp: 3.

18. Naing NN (2003) Determination of sample size. Malays J Med Sci 10: 84-86.

19. Cheesbrough M (2010) District Laboratory Practice in Tropical countries. Low price edition. Publisher Cambridge University Press. pp: 240-241.

20. Jaquet A, Wandeler G, Tine J, Dagnra CA, Attia A, et al. (2016) HIV infection, viral hepatitis and liver fibrosis among prison inmates in West Africa. BMC Infect Dis 16: 249.

21. Moradi G, Jafari S, Zarei B, Mahboobi M, Azimian Zavareh F, et al. (2019) Prevalence and Risk Factors for Hepatitis B and Hepatitis C Exposure in Iranian Prisoners: A National Study in 2016. Hepatitis Monthly 19(7): e91129.

22. Stief ACF, Martins RMB, Andrade SMO, Pompilio MA, Fernandes SM, et al. (2010) Seroprevalence of hepatitis B virus infection and associated factors among prison inmates in state of matogrosso do sul, Brazil. Revista da Sociedade Brasileira de Medicina Tropical 43(5): 512-515.

23. Kinner SA, Snow K, Wirtz AL, Altice FL, Beyrer C, et al. (2018) Age-specific global prevalence of Hepatitis B, Hepatitis C, HIV and Tuberculosis among incarcerated people: A systematic review. J Adolescent Health 62(3S): 18-26.

24. Shanks GD (2019) Malaria-associated mortality in Australian and British prisoners of war on the Thai-Burma railway 1943-1944. Am J Trop Med Hyg 100(4): 846-850.