Prevalence of Seropositive Blood Donors for Hepatitis B, C and HIV Viruses at Federal Medical Centre, Ido-Ekiti, Nigeria

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ABSTRACT

A high burden of Hepatitis B and C (HBV and HCV) and Human Immunodeficiency Virus (HIV) infections exists in developing countries including Nigeria with wide variability in the prevalence of co-infection and clinical syndromes in various regions. The aim of this study is to determine the prevalence rate of these infections and co-infections among the blood donors at the Federal Medical Centre, Ido-Ekiti and to determine the more vulnerable age-group in this region.

From July 2007 to July 2009, 662 donors were studied. Blood samples taken from the donors were screened for HIV and HCV antibodies by double ELISA technique, and for HbsAg by ELISA technique. Data entry and processing were done using EPI-INFO version 6 and SPSS version 15. Data were compared using 2-tailed chi-square test and Yates correction or Fisher exact test when applicable. Probability value less than 0.05 was considered significant.

Overall, 7.9% of the donors were sero-positive for HbsAg, 7.3% for HCV antibody and 5% for HIV antibody. Co-infection rate of HIV/HCV was 1.1%, HIV/HBV was 1.2%, HBV/HCV was 2.1% and HIV/HBV/HCV was 0.6%. The age-group 20-30 years had the highest prevalence for HCV (17.9%), HBV/HCV co-infection (2.4%) and HIV/HBV/HCV infection (1.2%). Up to 57.6% of HIV infected blood donors have co-infection with either HBV or HCV or both.

This study detected a high prevalence rate of HBV, HCV and HIV infections among blood donors in Ido Ekiti. All co-infections were detected at lower rates compared to single infections. The age-group 20-30 years were the most vulnerable group to these infections. A high percentage of HIV sero-positive donors had other co-infections. Adequate screening of blood donors and widespread awareness programmes on these infections especially among the youth as well as immunization against HBV are important in curtailing these infections. Follow-up incidence study in this field is recommended.

Keywords: Prevalence, Blood donors, Hepatitis B virus, Human immune-deficiency virus.

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Introduction

Viral hepatitis caused by Hepatitis B and C viruses is of major public health concern worldwide while Human Immunodeficiency Virus infection/Acquired Immunodeficiency Syndrome (HIV/AIDS) pandemic poses a major threat to public health and development with immense socioeconomic burden worldwide.[1,2] Hepatitis viruses (B and C) and HIV share common routes of transmission usually parenterally through blood transfusion, injury with contaminated sharps or by sexual contacts.[1,3]. Viral hepatitis and HIV/AIDS are endemic in tropical Africa including Nigeria.[4-6]

Hepatitis B Virus (HBV) represents the most common aetiological agent of serious liver infection globally with an estimated two billion people being infected and over 350 million people having chronic infection.[7] More than 70% of Nigerian population is reportedly likely to have been exposed to HBV at one time or the other in their life.[8]

Hepatitis C Virus (HCV) is reported to have infected more than 170 million people worldwide representing a viral pandemic seven times more widespread than infection with HIV (estimated 39.5 million people infected worldwide in 2006).[9] It has a high chronic infection rate. The global prevalence rate of chronic HCV infection is estimated to approach 3% at the end of 2nd millennium with prevalence rates among blood donors ranging from 0.1% in the UK and Scandinavia.[10] to 28% in Egypt.[11] It is estimated that 20% of people with chronic HCV will develop cirrhosis over 20-50 years interval.[12]

The Joint United Nation Programme of AIDS (UNAIDS) estimated that at the end of 2003, there were a total of 40 million people living with HIV with about 5 million individuals newly infected and cumulative death for the year 2003 from the disease put at three million .[13] The greatest burden of this infection is in the sub-saharan Africa with almost 9% of its adult population living with the virus.[14] The incidence of the disease has continued to rise at an alarming rate in Nigeria with adult population prevalence rate rising from 1.8% in 1991, 4.5% in 1996 to 5.8% in 2001 and 5.0% in 2003[13], but with a decrease to 3.1% in 2007.[15] The prevalence rate of these viral infections/ co-infections (Hepatitis B, C and HIV) varies from region to region and various reports have shown that co-infection of the hepatitis viruses with HIV is of great public health importance. Co-infection of HCV with HIV has been documented to accelerate the progression of hepatitis to cirrhosis[16] while co-infection of HIV with HBV is associated with three-fold increase in the development of persistent hepatitis B surface antigenemia.[17], However, only few studies in Nigeria have examined the co-infection rate of HBV and HCV with HIV among blood donors who serve as the major route of transmission of these viruses to patients.

This study aims to determine the prevalence of HBV, HCV, HIV, and different co-infections of these viruses among healthy blood donors at Federal Medical Centre, (FMC) Ido-Ekiti, Nigeria to establish a baseline data for policy makers, and to determine the age-groups most vulnerable to these infections as an aid to the ongoing preventive strategies to curtail infection with the viruses.

MATERIALS AND METHODS

The study was conducted from July 2007 to July 2009 at the Federal Medical Centre, Ido-Ekiti, South-Western Nigeria. Six hundred and sixty-two consecutive male and female Nigerians of different age groups ranging from 16 to 55 years who presented at the blood bank of FMC, Ido-Ekiti to donate blood for their wards on hospital admission were recruited into the study. The study was carried out after obtaining approval from Ethics committee on medical research of the hospital while oral informed consent to participate in the study was taken from all participants proir to their recruit to the study.

Five to eight millilitres of blood were taken from each patient into a labelled tube, allowed to

clot, and then centrifuged. Two millilitres of serum obtained was stored at -20°C for further analysis to confirm any positive antibody test to HIV-1 and 2 and HCV. Detection of HBV infection was done by screening for Hepatitis B surface antigen (HBsAg) by Enzyme-Linked Immunosorbent Assay (ELISA) (Clinotech Diagnostics Inc), antibody to HCV was detected by ELISA (Abbott murex version 4.0) and antibody to HIV-I and 2 was detected by Unigold HIV test kit. All positive HCV and HIV-1 and 2 cases were confirmed with another ELISA test kit, (Clinotech Diagnostic Inc) for HCV and 'Determine' for HIV-1 and 2. No Molecular method was used in confirmation of positive cases due to limited resources. All positive cases were referred to the appropriate specialist Physician for proper management and follow up.

Data entry and processing were done using computer software EPI-INFO version 6 and SPSS version 15. Prevalence rates of HBV, HCV and HIV-1 and 2 and various co-infections were determined among the male and female donors of varying age groups and data were compared using two-tailed chi-square test with Yates correction or Fisher exact test when applicable. Probability value less than 0.05 was considered significant. Data was presented in percentages and cross-tabulations.

RESULTS

Of the Six hundred and sixty-two (662) blood donors recruited into the study, 52 (7.9%) were sero-positive for HBsAg, 48 (7.3%) were sero-positive for antibody to HCV, while 33 (5.0%) were sero-positive for antibody to HIV. (Table-1) Co-infection of HBV and HCV was detected in 14 (2.1%) of the donors, co-infection of HIV and HCV in 7 (1.1%), co-infection of HIV and HBV in 8 (1.2%), while co-infection of HIV, HCV and HBV was detected in 4 (0.6%) of the blood donors. (Table-2) Sero-prevalence of HBsAg and anti-HCV was higher in females than the males (9.7% versus 6.7% and 7.8% versus 6.9% respectively) and no significant difference was found between the two groups ($p>0.05$). Antibody to HIV was detected at a higher rate in males (5.2%) than in females(4.7%) (Table-1). Also, no significant difference existed between the two groups ($p>0.05$). Various co-infections were higher in females than the males and there was no significant difference between the two groups for all co-nfections.$p>0.05$). (Table 2) Sero-prevalence rate of 17.9% was detected among the age range 20-30 years for HCV (Table-3). The HBV/HCV and HIV/HBV/HCV co-infection rates of 2.4% and 1.2% respectively were detected among the age group 20-30 years while the age group <20 years had the highest HIV/HCV infection rate of 1.6% (Table-4).

Up to 57.6% of the HIV infected blood donors were co-infected with HBV or HCV or both. (Table-5) and 9.5% and 16.7% of HIV-infected male and female donors respectively were co-infected with both HBV and HCV. (Table 6)

Table 1: Sex prevalence of HBV, HCV and HIV among blood donors

Sex	Number	Age (years) (Mean + SE)	Prevalence n (%)		
			T-HBV	T-HCV	T-HIV
Male	405	36+4.5	27 (6.7)	28 (6.9)	21 (5.2)
Female	257	28+2.7	25 (9.7)	20 (7.8)	12 (4.7)
Total	662		52 (7.9)	48 (7.3)	33 (5.0)
P-value			0.19 (NS)	0.69 (NS)	0.77 (NS)
$\div^2$			1.73	0.15	0.08

NB:

SE = Standard error N= Number of positive cases T-HBV=Total HBV positive donors
T-HCV=Total HCV positive donors T-HIV=Total HIV positive donors
P-value=Probability value NS=Not Significant $\div^2$ =chi-square value

Table 2: Sex prevalence of HBV, HCV and HIV co-infection among blood donors

Sex	Number	Prevalence n (%)			
		HBV/HIV	HBV/HCV	HCV/HIV	HBV/HCV/HIV
Male	405	4 (1.0)	6 (1.5)	4 (1.0)	2 (0.5)
Female	257	4 (1.6)	8 (3.1)	3 (1.2)	2 (0.8)
Total	662	8 (1.2)	14 (2.1)	7 (1.1)	4 (0.6)
P-val		0.7 (NS)	0.16 (NS)	1.00 (NS)	0.64 (NS)
$\div^2$		0.08	1.93	0.03	0.21

NB:
N = Number of positive cases *p-val = probability value*
NS = Not significant $\div^2$ *=chi-square value*

Table 3: Age prevalence of HBV, HCV and HIV among blood donors.

Age group (years)	Number	Prevalence n (%)		
		HBV	HCV	HIV
<20	63	3 (4.8)	4 (6.3)	2 (3.2)
20-30	254	26 (10.2)	22 (8.7)	14 (5.5)
31-40	272	19 (7.0)	18 (6.6)	10 (3.7)
41-50	70	3 (4.3)	4 (5.7)	6 (8.6)
>50	3	1 (33.3)	0 (0)	1 (33.3)
Total	662	52 (7.9)	48 (7.3)	33 (5.0)

NB:
n= Number of positive cases

Table 4: Age prevalence of HBV, HCV and HIV co-infections among blood donors

A-G (years)	No	Prevalence n (%)			
		HBV/HCV	HIV/HBV	HIV/HCV	HIV/HBV/HCV
<20	63	1 (1.6)	0 (0)	1 (1.6)	0 (0)
20-30	254	6 (2.4)	3 (1.2)	2 (0.8)	3 (1.2)
31-40	272	6 (2.2)	3 (1.1)	3 (1.1)	1 (0.4)
41-50	70	1 (1.4)	1 (1.4)	1 (1.4)	0 (0)
> 50	3	0 (0)	1 (33.3)	0 (0)	0 (0)
Total	662	14(2.1)	8 (1.2)	7 (1.1)	4 (0.6)

NB:
A-G = Age group *No = Number of blood donors examined*
n = Number of positive cases.

Table 5: showing relationship between single infection and co-infection with HIV, HCV and HBV among blood donors at Ido-Ekiti

Sex	Male (%)	Female (%)	Total (%)
HBV+ only	15 (55.6)	11 (44)	26 (50)
HBV co-infection	12 (44.4)	14 (56)	26 (50)
Total HBV+	27 (51.9)	25 (48.1)	52 (100)
HCV+ only	16 (57.1)	7 (35.0)	23 (47.9)
HCV co-infection	12 (42.9)	13 (65.0)	25 (52.1)
Total HCV+	28 (58.3)	20 (41.7)	48 (100)
HIV+only	11 (52.4)	3 (25.0)	14 (42.4)
HIV co-infection	10 (47.6)	9 (75.0)	19 (57.6)
Total HIV+	21 (63.6)	12 (36.4)	33 (100)

NB:

HBV only	*=donors positive to HBV only*
HBV co-infection	*=donor positive to HBV plus other virus/viruses*
Total HBV	*=Total HBV positive donors*
HCV only	*=donors positive to HCV only*
HCV co-infection	*=donors positive to HCV plus other virus/viruses*
Total HCV	*=Total HCV positive donors*
HIV only	*=donors positive to HIV only*
HIV co-infection	*=donors to HIV plus other virus/viruses*
Total HIV	*=Total HIV positive donors*

Table 6: Sex distribution of various HIV co-infections among blood donors in Ido-Ekiti

Sex	HIV+ only (%)	HIV/HBV/HCV (%)	HIV/HBV (%)	HIV/HBV (%)	Total (%)
Mal	11 (52,4)	2 (9.5)	4 (19.0)	4 (19.0)	21 (63.6)
Fem	3 (25/0)	2 (16.7)	4 (33.3)	3 (25.0)	12 (36.7)
Total	14 (42.9)	4 (12.1)	8 (24.2)	7 (21.2)	33 (100)

NB:

Mal =Male *Fem =Female*
HIV/HBV/HCV = HIV/HBV/HCV co-infection *HIV/HBV= HIV/HBV co-infection*
HIV/HCV =HIV/HCV co-infection

DISCUSSION

The results of this study suggest that a high burden of infection with HBV, HCV and HIV exists in Ido-Ekiti, South western Nigeria. Based on this study, infection with HBV can be described as endemic in this area with prevalence rate of 7.9%, since high endemicity of HBV has been put at prevalence rate of >7%.[18] This is comparable to reports of similar studies in Sagamu (6.8%),[19] Ife (7.3%)[20], Benin (10.4%),[21] Zaria (11.4%),[22] all in Nigeria and Rawalpindi, Pakistan (5.86%)[10] but higher than the mean prevalence rate of 1.57% (range 0.53%-2.05%) reported in Port-Harcourt, Nigeria[23] and 3.7% in Enugu, Nigeria.[24] However, a prevalence rate as high as 14.3% has been reported in Jos, Nigeria[25] and 14.9% in Mali.[26]

The overall prevalence rate of HIV in this study (5%) is similar to those of previous studies.[18,26-28] It is higher than the global prevalence rate (0.8%) quoted by WHO for the year 2000. United Nations Programme on AIDS quoted a prevalence rate of 3.1% for Nigeria in 2007[15] similar to WHO documented 5% prevalence rate for Sub-saharan Africa for the year 2007.[29] However, this result contradicted previous reports by National Agency for Control of AIDS (NACA) and USAIDS on HIV infection prevalence rate in this part of the country which was put at 1.6% in 2005,[30,31] though it might not be unrelated to the fact that there has been little prevalence studies in Ekiti in the past, and only few pregnant women deliver in hospitals with very few of them giving consent to HIV testing and counselling, therefore, hindering the generation of accurate data for the region in that regard.

The prevalence rate of HCV in this study (7.3%) is comparable to 6.21% of Rawalpindi, Pakistan,[10] but higher than 2.2% reported from Thailand, [28] 0.5% from Port-Harcourt, Nigeria, [23] and 3% from Benin-City, Nigeria,[21] although, it is within the quoted range for its global prevalence rate of 0.1% - 28%.[10,32] Moreover, earlier studies have reported similar prevalence rates among blood donors.[19,23,25]

In agreement with similar studies, various co-infections were detected at lower prevalence rates compared to single infections with the highest co-infection rate being ascribed to HBV/HCV (2.1%).[19,26,33]

For unclear reasons, the prevalence rates of HBV and HCV infections among female blood donors in this study are higher than that of their male counterparts although there was no significant difference between the two groups for both viral infections. This may be related to the lower socioeconomic status of women compared to men which renders them more prone to acquisition of the blood-borne viral infections. However, the prevalence rate of HIV in this study is higher among the male donors compared to female counterparts (5.5% vs 4.7%) although there was no significant difference between the two groups.

All co-infections were detected at higher rates among the female blood donors although no association between various co-infections and the sex of blood donors was detected. It was noted that a high percentage (57.6%) of HIV infected blood donor (47.6% male and 75% female) were co-infected with either HBV, HCV or both. Up to 9.5% and 16.7% of HIV-infected male and female donors respectively were co-infected with both HBV and HCV, 19% and 33.3% of HIV infected male and female donors respectively were co-infected with only HBV, while 19% and 25% of HIV infected male and female donors respectively were co-infected with only HCV. These findings like those of similar studies supports the assertion that HIV-infected individuals are at higher risk of co-infection with the blood-borne hepatotropic viruses such as HBV and HCV which share the same routes of infection with HIV.[34]

The highest prevalence rate for HBV and HCV in this study was found among the age-group 20-30 years and this, similar to an earlier study[35] may be related to the well known fact that this age-group are more predisposed to all risk factors associated with acquisition of blood-borne viral infections such as sexual promiscuity, drug addiction/intravenous drug abuse, and alcoholism. One of the three donors in the age-group >50 years was positive for both HbsAg and HIV, but this number is rather small for statistical consideration. However, the occurrence of infection with HIV and hepatitis virus among older age-group may suggest chronicity of hepatitis virus although we cannot prove this since this study is a prevalence study as opposed to an incidence study. It is well documented that a chronic hepatitis infection is more likely in a HBV or HCV infected individual who is co-infected with HIV since it is postulated that HIV hampers the immune system with the consequent inability to eliminate the hepatitis virus.[36] Also, co-infection of the hepatitis virus with HIV has been associated with a more severe liver pathology and rapid progression of liver

damage[37] while the clinical progression of HIV infection to AIDS was rapid in co-infected patients.[38]

There has been little documentation especially in Nigeria on prevalence rate of HCV/HBV co-infection, but in this study, it was found to be less common than single infection with either of the two viruses but relatively more common than HIV/HBV, HIV/HCV or HIV/HBV/HCV co-infections. The two viruses share a common route of transmission especially through blood transfusion and injuries from contaminated sharps. The role of sexual and perinatal transmission is less pronounced for HCV as compared to HBV.[39] The outcome of co-infection with the two viruses varies; the rate of progression of liver damage may increase when the two viruses behave synergistically or one of the two viruses may inhibit the other's replication such that one is practically dormant especially in the case of HCV inhibiting the replication of HBV, or the two viruses may be indifferent to one another .[40] The pattern in a particular individual can only be ascertained by a quantitation of the viral load in the serum. This is particularly important in determining the best intervention for a particular co-infected individual.

The overall prevalence rate (0.6%) of triple co-infection with HIV/HBV/HCV, like previous studies is low[34], however, a prevalence rate as high as 2.4% was found among the age-group 20-30 years. In a similar trend, the highest prevalence rate for HBV/HCV co-infection was found among this age group, bringing to light the role played by this vulnerable age-group as a potential focus in transmission of these blood-borne infections.

In conclusion, HIV, HBV and HCV infections are high among blood donors in this part of the country. The youth within the age-range 20-30 years constitute the most important focus in relation to these infections while older age-groups have relatively higher rate of co-infections with these viruses. Adequate screening and referral of positive blood donors is mandatory in reducing transmission of these infections while public awareness programmes to educate the general public and especially the youths on the risk factors associated with acquisition of these infections will go a long way to curtail the upward trend of the prevalence of these infections. The public should be aware of the need to be fully immunised against hepatitis B virus . Multi-centre prevalence study to determine the prevalence rate of these infections in Ekiti State is imperative while an incidence study in this environment as a follow-up of this work in near future is highly desirable to examine the role of HIV co-infections with HBV and HCV in the chronicity of viral hepatitis and progression of liver pathology. These studies may also be helpful in highlighting any relationships between the various age-groups and different co-infection types.

References

1. Seeger C, Mason WS. Hepatitis B virus Biology. Micro Mol Biol Rev 2000: 64 (1): 51-68.
2. Levinson W, Jawetz E. In "Medical Microbiology & Immunology Examination & board review" 6th ed ,chapter 45 271-8. Appleton & Lange, 1998.
3. Kamal GI. Pathogenic features of chronic hepatitis. Am J Clin Pathol 2000:113: 40-55.
4. Ghendon Y. Perinatal transmission of hepatitis B virus in high incidence countries. J. Virol. Methods 1987; 17:69-79
5. Francis TI. Epidemiology of viral hepatitis in the tropics. Bull NY Acad-med '11977;51:501-507.
6. Prince AM. Prevalence of serum hepatitis-related antigen in different geographical regions. Amer J Trop Med Hyg 1970;19:872.
7. Drosten C, Nippraschk T, Manegold C, Meisel H, Brixner V, Roth WK et al. Prevalence of hepatitis B virus DNA in anti-HBC-positive/HBsAg-negative sera

correlates with HCV but not HIV serostatus. J Clin Virol 2004:29: 59-68.
8. Sirisena ND, Njoku MO, Idoko JA, Isamade E, Barau C, Jelpe D et al. Carriage rate of hepatitis-B surface antigen (HbsAG) in an urban community in Jos, Plateau State, Nigeria. Nig Postgrad Med 2002:J 9: 7-10.
9. WHO. Global surveillance and control of hepatitis C. Report of a WHO consultanion organized in collaboration with the viral hepatitis prevention board.
10. Mumtaz S, Rehman M, Muzaffar M, Hassan M, Iqbal W. Frequency of seropositive blood donors for hepatitis B, C and HIV viruses in railway hospital Rawalpindi. Pakistan J. Med. Research .2002:41: 2
11. Armstrong G, Alter M, McQuillang, et al. The past incidence of hepatitis C virus infection; implication for the future burden of chronic liver disease in United States. Hematol 2000; 31; 777-82.
12. Lauer GM, Walker BD. Hepatitis C virus infection. N Engl J Med 2001;345:41-52.
13. Federal Ministry of Health Technical Report. National HIV seroprevalence Sentinel survey. 2004;13-14.
14. WHO. Global Health-sector Strategy for HIV/AIDS 2003-2007, Geneva, 32 pp
15. UNAIDS. Report on the global AIDS epidemic. 2008.
16. Bonacini M, Puoti M. Hepatitis C in patients with human immunodeficiency virus infection: Diagnosis, natural history, meta-analysis of sexual and vertical transmission and therapeutic issues. Arch Intern Med 2000;160:3365-73.
17. Fauci AS, Lane HC. Human immunodeficiency virus (HIV) disease: AIDS and related disorders. In AS Fauci, E Braunwald, KJ Isselbacher (eds), Harrison's Principles of Internal Medicine, 1998:. 1, 14th ed., Mc-Graw-Hill, New York, p. 718-724.
18. Hodges M, Sanders E, Aitken C. Seroprevalence of hepatitis markers: HAV, HBV, HCV, and HBV amongst primary school children in Freetown Sierra Leone. W Afr J Med 1998:17: 3-7.
19. Ola SO, Jaiyesimi AEA, Olusanya OO. Co-infection of HIV and HBV among Nigerian patients and blood donors at Sagamu. Nig Med J 2005:46 (3): 64-67
20. Durosinmi MA, Ndububa DA, Alabi OA, Soyinka OO. Prevalence of HIV-1 and HbsAg in Normal Blood Donors in Ile-Ife, Nigeria. Nig. Med. Journ. 1991, 1(5) 138-140.
21. Olubuyide IO, Aliyu B, Olaleye OA, Ola SO, Olawuyi F. et al. Hepatitis B and C virus and hepatocellular carcinoma. Trans. Roy. Soc. Trop. Med. Hyg. 1997;91: 38-41.
22. Esan OA, Akanmu AS, Akinsete I. HIV seroprevalence in emergency department patients, Lagos University Teaching Hospital, Lagos. Nig. Postgrad. Med. J. 2003 10 (2) 71-5.
23. Ejele OA, Ojule AC. The prevalence of hepatitis B surface antigen (HBsAg) among prospective blood donors and patients in Port-Harcourt, Nigeria. Nig. J. Med. 2004:13 (4) 336-338.
24. Udeozo IOK, Ele E. The prevalence of Australian antigenaemia in Enugu, Nigeria. Nig. Med. J. 1974; 4: 127-132.
25. Uneke CJ, Ogbu O, InyamaPU, Anyanwu GI, Njoku MO, Idoko JH. Prevalence of hepatitis-B surface antigen among blood donors and human immunodeficiency virus-infected patients in Jos, Nigeria. Mem Inst Oswaldo Cruz, Rio de Janeiro 2005; 100(1): 13-16.
26. Tounkara A, Sarro YS, Kristensen S, Dao S, Diallo H, Diarra B et al. Seroprevalence of HIV/HBV Coinfection in Malian Blood Donors. J. Intern Assoc Phys in AIDS Care. 2009;10: 1177.

27. Shokunbi WA, Saliu I, Essien E. Incidence of dual presence of antibodies to HIV-1 and HIV-2 in seropositive cases seen in Ibadan, Nigeria. Afr J Med Sci. 1995. 24: 2249-253.
28. Sawanpanyalert P, Boonmar S, Maeda T, Matsuura Y, Miyamura T. Risk factors for hepatitis C virus infection among blood donors in an HIV-epidemic area in Thailand. Journ. Epid.Com. Heal. 1996; 50:174-177.
29. WHO. AIDS epidemic update. Joint United Nations Programme on HIV/AIDS (UNAIDS) and World Health Organization (WHO) 2007.
30. NACA (National Agency for Control of AIDS). National HIV/AIDS Prevention Plan 2007-2009.
31. USAIDS/Nigeria: Investing in people – HIV/AIDS/TB. 2009
32. Armstrong G, Alter M, McQuillang, et al. The past incidence of hepatitis C virus infection; implication for the future burden of chronic liver disease in United States. Hematol 2000: 31; 777-82.
33. Mc Nair A, Main J, Goldin R, Thomas AC. Liver and AIDS in textbook of AIDS Medicine Ed. Broder S, Merigan TC, Bolognesi D. Williams & Wilkin, Baltimore USA. 1994; 37: 581-595.
34. Polsky B, Kim AY, Chung RT. Human immunodeficiency virus and hepatitis B and C co-infection: Pathogenic interactions, natural history and therapy. AIDS Clin Rev 2000-2001;263-306.
35. Muktar HM, Alkali CN, Jones EM. Hepatitis B and C co-infections in HIV/AIDS patients attending ARV centre, ABUTH, Zaria, Nig. Highl. Med. Journ 2006; 4(1) 21-24.
36. Thio CL, Netski DM, Myong J, Seaberg EC, Thomas DL. Changes in hepatitis B virus DNA levels with acute HIV infection. Clin. Infect. Dis. 2004.;38(7): 1024-1029.
37. Horvath J, Raffanti SP. Clinical aspects of the interactions between Human Immunodeficiency Virus anf the hepatotropic viruses. Clin. Infec. Dis. 1994; 18:339-347.
38. Piroth L, Duong M, Quantin C, Abrahmowicz M et al. Does hepatitis C virus co-infection accelerate clinical and immunological evolution of HIV-infected patients. AIDS; 12:381-388.
39. Njouom R, Pasquier C, Ayouba A, Tejiokem MC, Vessiere A, Mfoupouendoun J et al, Low-Risk of Mother-to Child Transmission of Hepatitis C Virus in Yaounde, Cameroun: The Anrs 1262 study. Am, J, Trop. Med. Hyg. 2005;73(2):460-466.
40. Chi-Jen Chu, Shou-Dong Lee. Hepatitis B Virus/Hepatitis C Virus Coinfection: Epidemiology, Clinical Features, Viral Interactions and Treatment. J Gastroenterol Hepatol. 2008;23(4):512-520.