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Dengue in co-infection with Hepatitis B virus in Enugu, Eastern Nigeria: Seroprevalence, impacts and risk of increasing transmission

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Abstract

This study was designed to investigate the seroprevalence and impact of Haematological and biochemical markers of dengue virus infection among subjects co-infected with hepatitis B virus infection in Enugu State, Nigeria. The study involved a cross-sectional study consisting of 150 subjects (120 discordant and concordant partners of hepatitis B, and 30 controls). Dengue Virus IgM and IgG were analyzed using ELISA rapid kit while HBsAg was screened using a rapid ELISA diagnostic strip. Both Dengue and HBsAg were re-screened later to reaffirm the result using Ichroma Fluorescence Immunoassay (FIA). Haematological parameters were analyzed using Mindray autoanalyser while ALT/AST was analyzed using COBASS 111. Statistical analysis was performed using Graph Pad Prism. The results showed a prevalence of 44.7% dengue virus seropositivity among the study population, 43.3% in dengue/hepatitis B co-infected subjects. The dengue virus seropositive participants had significantly greater IgG (70.1%) levels compared to IgM (29.9%), more in females (68.6%) compared to males (31.4%), and predominantly in the age group 31 to 40 years. A significant higher ($p<0.005$) mean haemoglobin was seen in males compared to females, and there is no significant difference in both WBC and platelets. A greater mean of ALT ($p=0.005$), AST ($p=0.018$) is gotten in Dengue/HBV co-infection when compared to non- Dengue/HBV co-infected subjects. This study revealed a high seroprevalence of dengue virus infection and the possibility of hepatic complications. This calls for urgent medical attention and more studies to confirm the circulating strains of the dengue virus as well as its involvement in hepatic complications.

Keywords: Seropositivity; Dengue Virus; Hepatitis B; Discordant Partners; Co-infection

1. Introduction

Several tropical vector-borne infectious diseases continue to cause a rising incidence of morbidity and mortality in the tropical zone especially in resource-restricted nations like Nigeria. One of these leading infections is dengue viral infection. Dengue viral infection (DENV) is a febrile sickness caused by four closely related dengue virus serotypes (designated DENV-1, DENV-2, DENV-3 and DENV-4) of the genus flavivirus [1,2,3]. The four serotypes share a common transmission cycle with mosquitoes; *Aedes aegypti* and *Aedes albopictus* being the main vector, *Aedes polynesiensis* and *Aedes scutellaris* have also been implicated, most of which are widely distributed in tropical and subtropical areas of the world [4]. Dengue virus is an enveloped positive-stranded RNA virus of about 50nm and the family Flaviviridae, closely related to Japanese encephalitis virus (JEV), and West Nile virus (WNV). The clinical burden and severity of the disease

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which according to the World Health Organization (WHO) falls into a wide spectrum of four grades ranging from uncomplicated dengue fever (DF) to Dengue Hemorrhagic Fever (DHF), or a devastating Dengue Shock Syndrome (DSS) [4].

Dengue virus has increased dramatically within the last 20 years, becoming one of the worst mosquito-borne human pathogens. The most common clinical manifestation of DENV infection is Dengue fever (DF) - a benign illness characterized by fever, headache, malaise, anorexia, maculopapular rash and lymphadenopathy. Although clinically, dengue has been recognized in Nigeria for many years, all identified cases among Nigerians manifested as DF, and no cases of DHF have been seen until recently [5]. DHF is a severe form of dengue occurring in tropical countries where DENV is endemic. It is estimated that between 2.5 and 3.6 billion cases of DF occur annually, out of which about 2 million cases progress to DHF, accompanied by about 20,000 deaths largely as a result of shock [6]. In Nigeria, DENV was first isolated between 1964 and 1968 in Ibadan [7], and dengue virus fever is not a reportable disease in this country with most cases often undiagnosed, misdiagnosed as malaria or referred to as pyrexia of unknown origin [8,9]. Dengue can cause multi-organ dysfunction and can cause myocarditis, encephalitis, renal failure, and most importantly hepatitis [10]. Liver involvement in dengue can cause painful hepatomegaly, transaminitis and jaundice in varying levels [11]. Also, dengue in pregnancy carries the risk of haemorrhage for both the mother and the newborn and in addition, there is also a risk of premature birth and fetal death and vertical transmission causing neonatal thrombocytopenia that necessitates platelet transfusion [12,13]. Infection in early pregnancy or within the first trimester often leads to miscarriage.

As a result of under-reporting and misdiagnosis, DENV remains a dangerous health problem to the populace because of its widespread in Nigeria with high prevalence report in several locations [6, 9,14,15,16. Dengue virus is often mistaken for Malaria because they have similar symptoms and this usually led to mistreatment as a result of the wrong diagnosis in so many DENV conditions including in pregnancy and hepatitis. As a result of the paucity of data, wrong diagnosis of DENV in favour of malaria and because of the absence of DENV in the differential diagnosis of febrile illness in Nigeria, there is an urgent need to improve epidemiological surveillance, clinical and laboratory diagnosis and proper management to adequately control the dengue virus menace. Therefore, this study was designed to screen for seroprevalence of dengue virus infection among subjects co-infected with hepatitis B virus infection in Enugu state, Nigeria.

2. Material and methods

2.1. Study Area

This study was done at Enugu State University Teaching Hospital, (ESUTH) Parklane, Enugu, Nigeria.

2.2. Research Design

This research employed a cross-sectional study, using a simple random sampling technique in sample collection.

2.3. Specimen Collection

A total of 150 subjects were recruited for this study including 30 uninfected partners (controls), 90 discordant and 30 concordant partners of hepatitis B virus infection. Blood samples were collected from the subjects in EDTA bottles and plain tubes. The samples in plain tubes were allowed to clot before the separation of the serum through centrifugation at 3,000 rpm for 5 minutes, while the EDTA tubes were used immediately for preliminary Haematological tests.

2.4. Sample Analysis

2.4.1. Serological Screening

The samples were first screened for HBsAg using a rapid diagnostic strip (LabAcon, Biotest Biotech Co. Ltd, China). The test strip is a qualitative solid-phase, two-site sandwich immunoassay that detects HBsAg in serum or plasma. The tests were done according to the manufacturer's instruction and positive samples were further screened for hepatitis A, C, and Human immune Virus (HIV), and positive samples of HAV, HCV or HIV were excluded.

2.4.2. Dengue Virus Screening

Samples were screened for dengue virus infection using Dengue IgM/IgG ELISA rapid kit (Boditech Med Incorporated, Republic of Korea). The dengue IgG/IgM rapid test device is a qualitative membrane-based immunoassay for the detection of dengue antibodies in whole blood, serum or plasma. The test consist of two components: an IgG component

and an IgM component. In the test region, anti-human IgM and IgG are coated, and during testing, the serum specimen reacts with the dengue antigen-coated particles in the test strip. The mixture then migrates upward on the membrane chromatographically by capillary action and reacts with the anti-human IgM or IgG in the test line region. The positive test results identify whether the antibodies are from IgG or IgM while negative results imply that none of IgG or IgM was present. The test was followed strictly according to the manufacturer's protocol.

2.4.3. HBsAg and Dengue Assay

An additional test on HBsAg and Dengue was done to confirm the positive screened hepatitis B and dengue samples using Ichroma Fluorescence Immunoassay (FIA) technique. The test uses a sandwich immunodetection method and dried antibodies once diluted with the diluent, bind with antigens in the sample to form an antigen-antibody complex. The complex then migrates through the nitrocellulose matrix and are captured by another set of immobilized antibodies on the test line. The more the antigens HBsAg or Dengue antibodies in the sample serum, the more the antigen-antibody complexes the stronger the fluorescence signal. The signal is then interpreted by the reader and results are displayed on the screen. The procedure for the test was followed following the manufacturer's instruction and results were interpreted as follows:

HBsAg

≤0.9 Negative	>0.9, <1.0 Indeterminate	≥1.0 Positive	Linearity limitation is between 0 – 500 miu/ml.

Dengue

≤5 Negative	>5, <10 Indeterminate	≥10 Positive	Linearity limitation is between 0 – 500 miu/ml.

2.4.4. Hemoglobin (Hb), Total White Blood Cell (WBC) and Platelets

Haematological parameters (Hb, WBC and Platelets) were estimated using Mindray BC10 autoanalyser. Liver enzymes (Alanine Transferase (ALT) and Aspartate Transaminase (AST)) were estimated using COBAS 111.

2.5. Data Analysis

All continuous variables were expressed as mean ± standard deviation (SD) or range, and categorical variables were presented as frequencies or percentages. Differences in variables or comparison between groups were analyzed using analysis of variance and Student's -tests (for normally distributed data) or the Kruskal-Wallis and Mann-Whitney -tests (for non-normally distributed data). The level of statistical significance was set at $p<0.05$. Statistical analysis was performed using Graph Pad Prism version 6.0 software.

3. Results

3.1. Demographic and Baseline Characteristics of the Study Population

Table 1 shows the demographic and baseline characteristics of the study population. The mean age of the participants was 36.60 years (ranged from 24 to 62 years) with an SD of ± 7.06 years. The majority of the participants (control, 56.7%; discordant, 62.2%; concordant, 50%) were of the age group 31-40 years. Fifty per cent of the subjects were males and fifty per cent were females in all the study groups. Regarding their smoking habit, the majority are non-smokers in all the groups (control, 86.7%, discordant, 96.7% and concordant, 90%). A greater percentage of both discordant (51.1%) and concordant (60%) groups drink alcohol. The majority of the participants (control, 90%; discordant, 92.2%; concordant, 100%) had no history of HBV vaccination. Fifty per cent of the discordant group and 100% of the concordant group were infected with hepatitis B virus.

Table 1 Demographic and baseline characteristics of the study population in Mean ± SD or n (%)

Characteristics	All (n = 150)	Uninfected Control (n = 30)	Discordant Partners (n = 90)	Concordant Partners (n = 30)
Age (yrs)	36.30 ± 7.06	35.26 ± 7.69	36.31 ± 6.67	37.30 ± 7.62
20-30	30 (20%)	9 (30%)	16 (17.8%)	5 (16.7%)
31-40	88 (58.7%)	17 (56.7%)	56 (62.2%)	15 (50%)
>40	32 (21.3%)	4 (13.3%)	18 (20%)	10 (33.3%)
Sex				
Males	75 (50%)	15 (50%)	45 (50%)	15 (50%)
Females	75 (50%)	15 (50%)	45 (50%)	15 (50%)
Smoking Habit				
No	140 (93.3%)	26 (86.7%)	87 (96.7%)	27 (90%)
Yes	10 (6.7%)	4 (13.3%)	3 (3.3%)	3 (10%)
Drinking Habit				
No	75 (50%)	11 (36.7%)	46 (51.1%)	18 (60%)
Yes	75 (50%)	19 (63.3%)	44 (48.9%)	12 (40%)
Vaccination				
No	140 (93.3%)	27 (90%)	83 (92.2%)	30 (100%)
Yes	10 (6.7%)	3 (10%)	7 (7.8%)	0 (0%)
HBV Status				
Negative	75 (50%)	30 (100%)	45 (50%)	0 (0%)
Positive	75 (50%)	0 (0%)	45 (50%)	30 (100%)

3.2. Prevalence of Dengue Virus Infection/ Co-infections with Hepatitis B

The prevalence of dengue Virus seropositivity among the study population gave a prevalence of 44.7%, while 43.3% prevalence was gotten on Dengue/hepatitis B co-infected subjects. 50% of both the control and concordant groups indicated the presence of dengue viral infection, while the presence of dengue infection was 41.1% in the discordant group. Also, the prevalence of IgM antibodies from the dengue seropositive subjects (study group) indicating recent infection was 29.9% while IgG prevalence showing remote infection gave 70.1%, (Table 2).

Table 2 Distribution of Dengue Virus Infection in both Study Groups

Variables	**No of samples**	**+ve**	**%Prevalence**	**T_1**	**T_2**
Discordant	90	37	41.1	13	24
Concordant	30	15	50	2	10
Controls	30	15	50	5	13
Total	150	67	44.7	20 (29.9)	47 (70.1)
(Discordant/concordant)	120	52	43.3		

Key: T1 = IgM; T2 = IgG

The Haematological profile of Dengue/HBV virus co-infected individuals is shown in Table 3. The total mean and standard deviation for all subjects was 12.84±1.45 g/dl for Hb concentration, 5.68±1.99 x10^3 cells/mm3 for white blood cells and 264.31±70.36 cells/mm3 for platelets. There were significantly higher ($p < 0.001$) mean Hb concentrations in

males compared to the females and in contrast, no significant differences were observed in WBC and platelets between males and females. Table 4 shows the mean ALT and AST levels of Dengue/HBV co-infected and non-infected individuals. Results indicated that Dengue/HBV co-infected individuals had significantly greater mean ALT (p = 0.005) and AST (p = 0.018) compared with the non-Dengue/HBV co-infected individuals. The mean concentrations of ALT and AST of Dengue/HBV co-infection in males (n = 11) and females (n = 24) are shown in figure 1. There was no significant differences between males and females in mean ALT (p = 0.705) and AST (p = 0.726) concentrations. The mean concentrations of ALT and AST in different age groups are shown in figure 2, there were no significant differences between the three age groups, 20-30, 31-40, and >40 years, in mean ALT (p = 0.388) and AST (p = 0.943) concentrations.

Table 3 Haematological profile of Dengue/HBV co-infected individuals (n = 35)

Variables	All (n = 35)	Males (n = 11)	Females (n = 24)	P-Value
Hemoglobin (g/dl)	12.84±1.45	14.42±0.80	12.12±1.05	<0.001
White Blood Cells (x10^3 cells/mm^3)	5.68±1.99	5.80±2.31	5.62±1.87	0.799
Platelets (cells/mm^3)	264.31±70.36	282.0±66.19	256.20±72.08	0.321

Table 4 Mean ALT and AST levels of Dengue/HBV co-infected and non- Dengue/HBV co-infected individuals

Liver Enzyme	HBV-Den Co-infection Status	N	Mean ± SD	T – Statistics	P-Value
ALT	Yes	35	11.0 ± 6.15	2.82	0.005
	No	115	8.19 ± 4.82		
AST	Yes	35	12.94 ± 6.65	2.39	0.018
	No	115	10.22 ± 5.63		

Table 5 shows the incidence of abnormal ALT and AST in all Dengue/HBV co-infected populations following sex and age. Data indicated that out of the 35 Dengue/HBV co-infected individuals, 4 (11.4%) had abnormal ALT, while 2 (5.7%) had abnormal AST. Of the four patients with abnormal ALT, 25% (n = 1) were males while 75% (n = 3) were females; 25% (n = 1) were of the age groups 20-30 years and >40 years respectively, and 50% (n = 2) were of age 31-40 years. Two (100%) of the patients who had abnormal AST were all males. Fifty per cent (n = 1) was of the age, 20-30 years and 31-40 years respectively while none was of the age >40 years.

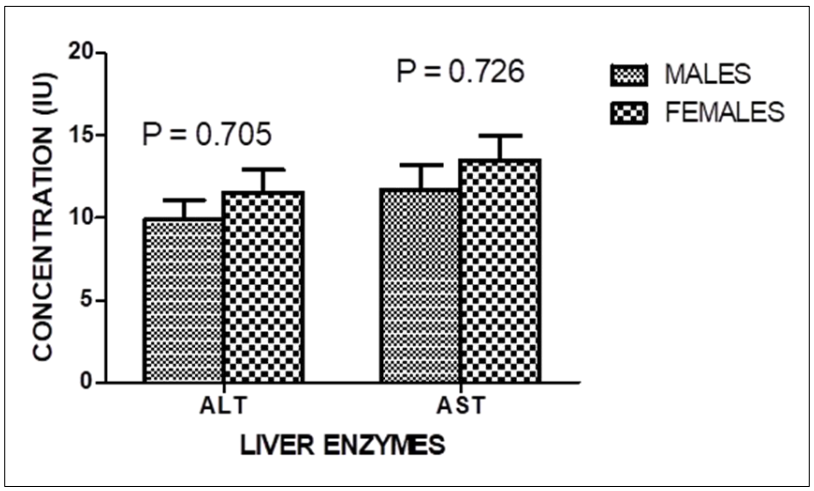

Figure 1 Evaluation of the liver function of Dengue/HBV co-infected individuals (n = 35)

Table 6 shows the distribution of Dengue/HBV co-infection according to sex and age in all subjects. Higher cases of Dengue/HBV co-infection in males were observed in the concordant (53.3%), while females indicated higher positivity in the discordant group (85%) and all the subject data (68.6%). The cases of Dengue/HBV co-infection indicated the highest occurrences in the discordant group (65%) than in the concordant group (46.7%), and in all subject data (57.1%).

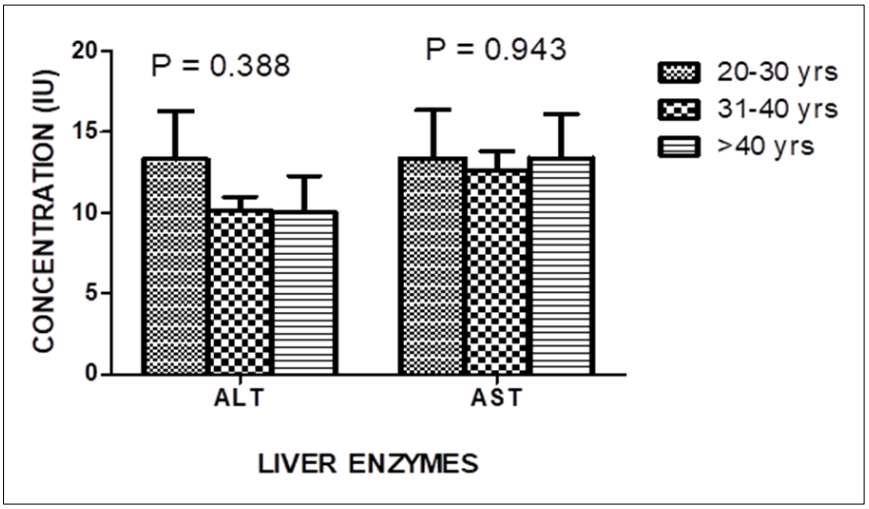

Figure 2 Evaluation of the liver function of HBV-Dengue co-infected individuals (n = 35) according to their age

Table 5 The incidence of abnormal ALT and AST in all Dengue/HBV co-infected populations (n = 35) and according to sex and age

Characteristics	Abnormal ALT	Abnormal AST
All	4 (11.4)	2 (5.7)
Gender		
Males	1 (25.0)	0 (0)
Females	3 (75.0)	2 (100)
Age Groups (years)		
20-30	1 (25.0)	1 (50.0)
31-40	2 (50.0)	1 (50.0)
>40	1 (25.0)	0 (0)

Table 6 Distribution of Dengue/HBV co-infection of the study groups according to sex and age

Characteristics	All (n = 35) N (%)	Discordant (n = 20) N (%)	Concordant (n = 15) N (%)
Sex			
Males	11 (31.4%)	3 (15%)	8 (53.3%)
Females	24 (68.6%)	17 (85%)	7 (46.7%)
Age (yrs)			
20 – 30	10 (28.6%)	7 (35%)	3 (20%)
31 – 40	20 (57.1%)	13 (65%)	7 (46.7%)
>40	5 (14.3%)	0 (0%)	5 (33.3%)

Also, Table 7 shows the logistic regression analyses of risk factors for HBV-Dengue co-infectivity among study participants. The univariate logistic regression showed that no significant associations were observed between HBV/Den seropositivity and sex, age, drinking, smoking and history of previous vaccination. This indicated that none of the risk factors was predictive of HBV-Dengue co-infection.

Table 7 Logistic regression analyses of risk factors for HBV-Dengue co-infectivity among study participants (n = 120)

Risk Factors	N	HBV-Dengue Co-infectivity N (%)	Binomial Logistic Regression		
			Wald	OR (95% CI)	P – Value
Sex					
Males	60	11 (18.3)	1.54	0.51 (0.18-1.46)	0.214
Females	60	24 (40.0)		1 (reference)	
Age (yrs)					
20-30	21	10 (47.6)	1.68	2.73 (0.59-12.46)	0.195
31-40	71	20 (28.2)	0.15	1.27 (0.38-4.16)	0.692
>40	28	5 (17.9)		1 (reference)	
Drinking					
No	64	22 (34.4)	0.21	0.80 (0.30-2.08)	0.648
Yes	56	13 (23.2)		1 (reference)	
Smoking					
No	114	34 (29.8)	0.008	1.11 (0.10-11.54)	0.927
Yes	6	1 (16.7)		1 (reference)	
History of Vaccination					
No	113	35(31.0)	0	1 (reference)	
Yes	7	0(0)		0(0)	0.999

4. Discussion

Dengue virus fever remains an important emerging disease of the tropical and sub-tropical regions today. It is clear that since the last decade, dengue viral fever has been occurring regularly with periodic surges in several cases (WHO, 2013) [17]. The incidence of dengue has grown dramatically around the world in recent decades with over 2.5 billion people - over 40% of the world's population now at risk of dengue infection (WHO, 2013) [17]. Current estimates indicate that as many as 390 million infections occur each year of which around 96 million manifest clinically [2], and many dengue infections are increasingly understood to be asymptomatic or subclinical. Dengue is spreading fast across the globe as it is now endemic in more than 100 countries in Africa, the Americas, the Eastern Mediterranean, South-east Asia and the Western Pacific contrary to what it used to be in the 1970s when it was found only in nine countries of the world (WHO, 2013) [17]. Although the literature survey showed a few articles on dengue virus infection generally in Nigeria, there is none on patient's co-infected with hepatitis B virus infection. The current study is the first to enumerate the seroprevalence of dengue virus infection in the general population, as well as in patients with hepatitis B infection and to compare thereof with normal individuals (non-hepatitis B subjects) infected with dengue in other to evaluate dengue impact on liver enzymes.

In the present study, the prevalence rate of Dengue Virus seropositivity (dengue virus antibodies exposure) across the different participants or groups (discordant, concordant and control) was found to be 44.7% and 43.3% in dengue/hepatitis B co-infected subjects in the Enugu metropolis. Further analysis revealed that IgM antibodies denoting primary or active infection were 29.9%, while IgG antibodies of secondary or remote infection were 70.1%. Enugu being a typical urban area, in addition to this finding, totally aligned with previous literature that dengue virus infection is a tropical arboviral infection mostly found in urban cities. A combination of increased and unplanned urbanization, changing lifestyles and lack of effective mosquito control has made most tropical cities highly permissive for efficient

dengue transmission by *A. aegypti*. The result of this current study is in line with earlier and a similar study in Western Nigeria where Fagbami and Fabiyi [6], got a seroprevalence of 45% in the asymptomatic adult population. Narkwa *et al*. [18] in Ghana showed a dengue virus seroprevalence of 43.6% among blood donors, while Kajeguka *et al*. [19] in Tanzania showed a high dengue virus seroprevalence of 50.6%, and elsewhere in febrile children in Cameroon was 26.8% [6,18,19,20]. This finding was in sharp contrast to the study carried out in Nnewi, Eastern Nigeria, where Chukwuma *et al*. [9], investigated the serological presence of dengue virus infection among febrile children and reported a prevalence rate of 77.1%, while Adeleke *et al*. [21], also working on febrile patients got 67.7% in Osogbo. Also, Adesina and Adeniji [22] in Ile Ife, western Nigeria on their work on Dengue viral infection in febrile episode got a 25.7% prevalence in Ile Ife, a value lower than our finding. Ahmed *et al*., in Chittagong, found 63% anti-dengue IgM positive and 68% anti-dengue IgG positive cases, Aniakwaa- Bonsu in Ghana got IgG 12.6% and anti-dengue IgM 2.2%, while Nagi *et al*., in Pakistan, showed 73% anti-dengue IgM positive patients [23,24,25]. However, the prevalence of 44.7% in this work combines with the above previous works still corroborates the endemicity of dengue in subtropical or tropical regions to which Enugu belongs. This relative high endemicity of dengue viral infection could lead to the development of any of the complications of severe dengue infections like dengue hemorrhagic fever or dengue shock syndrome.

Further analysis in this study indicates that the dengue infection burden is more pronounced in the age group of (31-40) years. This can be explained in respect to mosquito vector of the virus that is a day time biting *Aedes egypti*, like the age group in question is within a critical and busy period of the workforce, and therefore more exposed outdoors than any other age group. In terms of gender, this report showed that females (68.6%) were more exposed to dengue virus infection than their male (31.4%) counterparts. This is in line with the study of Aniakwaa-Bonsu *et al.* in Ghana, and Teixeira *et al*., that reported a higher prevalence rate of dengue virus infection in female than in male, but contrary to Feneye et al., that reported more males than females [24,26,27].

Also, the seroprevalence of 43.3% of dengue virus antibodies in co-infection with hepatitis B virus infection affirmed the endemicity of dengue in Nigeria. Evaluation of the liver enzyme (ALT and AST) of the Dengue-HBV co-infection shows a significantly greater mean of both ALT and AST in Dengue-HBV co-infected when to compare to non-Dengue/HBV infected, but there is no significance in the mean value of ALT and AST in gender and age groups of both Dengue-HBV co-infected and non-Dengue/HBV co-infected. The slight elevation of ALT and AST in Dengue/HBV co-infection indicates the possibility of dengue implication which rhymes with the work of Lee *et al*. [28] who noted that liver enzymes (ALT/AST) were higher in the febrile and the severer phases of dengue vis-à-vis the convalescent phase. Also, Manohar *et al.* [29] reported a significant association between abnormality of liver function tests and severity of dengue fever but concluded that it is not enough to confirm the association as larger control studies are desirable.

Furthermore, the independent sample t-test indicated significantly higher ($p < 0.001$) mean haemoglobin concentration in males compared with the females, and in contrast, no significant differences were observed in WBC and platelets between males and females. While this report showed no significant difference in the WBC, the work of Chukwuma *et al*. [9], showed a considerable increase in white blood cells of dengue infected groups, while Raju *et al*. [30], in their study, noticed significant leukopenia and thrombocytopenia. Studies by Christopher J Gregory *et al* [31] on the utility of WBC count as a marker to differentiate dengue fever from other febrile illnesses, the authors showed leukopenia could be taken up as one of the indicators to separate dengue from other febrile illnesses. The elevated haemoglobin that is seen more in males than in females may not have any effect as males physiologically have higher haemoglobin than the female, while the insignificant values obtained in both WBC and platelets in this study may be as a result of predominantly IgG antibodies status of most of the subjects indicating non-recent infections.

5. Conclusion

Our report has revealed a high seroprevalence of dengue viral infection which portend a potential risk of endemic proportion in Enugu state and which seem to be the first time of reporting issues of dengue virus in Enugu. This situation calls for urgent attention for proper surveillance and control to avoid the risk of getting a severe form of dengue such as DHF or DSS. In addition, further study is needed to clarify the spectrum of hepatic involvement in dengue virus infection since this study recorded significant high values of ALT and AST in dengue/hepatitis B co-infection. As dengue virus infection is implicated in febrile conditions, it is necessary, therefore, that clinicians reconcile their clinic observations with laboratory diagnosis to effectively tackle this alarming prevalence of dengue infection.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declare that they have no competing interests.

Statement of ethical approval

Ethical approval was obtained from the ethical committee of ESUT Teaching Hospitals, Parklane, Enugu, and following the code of ethics for biomedical research involving human subjects.

Statement of informed consent

Informed consent was obtained from each participating individual and a questionnaire was administered to all the participating subjects.

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References

[1] Rodenhuis-Zybert IA, Wilschut J, Smit JM. Dengue virus life cycle: viral and host factors modulating infectivity. Cellular and Molecular Life Sciences. 2010; 67 (16): 2773– 86.

[2] Westaway EG, Blok J. Taxonomy and evolutionary relationships of flaviviruses. In: Gubler DJ, Kuno G, editors. Dengue and dengue hemorrhagic fever. Wallingford: CAB International. 1997; 147–73.

[3] Anderson CR, Downs WG, Hill AE. Isolation of dengue virus from a human being in Trinidad. Science. 1956; 124(3214): 224–5.

[4] WHO. Dengue: guidelines for diagnosis, treatment, prevention and control, Geneva. 2009.

[5] Carey DE, Causey OR, Reddy S, Cooke AR. Dengue viruses from febrile patients in Nigeria, Lancet. 1964; 1:105–6.

[6] Fagbami AH, Fabiyi A. Epidemiology of dengue virus infections in Nigeria: virus isolations and clinical observations. J Trop Med Hyg. 1976; 79: 226–31.

[7] Annual Report. University of Ibadan Arbovirus Research Project 1964–1971.

[8] Gubler DJ. The global emergence/resurgence of arboviral diseases as public health problems. Arch Med Res. 2002; 33: 330–42.

[9] Chukwuma GO, Audu JS, Chukwuma OM, Manafa PO, Ebugosi RS, Akulue JC, Aneke JC, Ahaneku GI, Nchinda GW, Esimone CO. Seroprevalence of dengue virus among children with febrile illness in Nnewi, Nigeria. The Journal of Medical Research. 2018; 4(1): 24-30.

[10] Kulkarni AV, Choudhury AK, Premkumar M, Jain P, Gupta E, Sarin SK. Spectrum, Clin manifestations and outcomes of dengue infection in individuals with and without liver disease. J Transl Hepatol. 2019; 7(2): 1–6.

[11] Martina BE, Koraka P, Osterhaus AD. Dengue virus pathogenesis: an integrated view. Clin Microbiol Rev. 2009; 22: 564–581.

[12] Carroll ID, Toovey S, Van Gompel A. Dengue fever and pregnancy - a review and comment. Travel Med Infect Dis. 2007; 5: 183-188.

[13] Maroun SL, Marliere RC, Barcellus RC, Barbosa CN, Ramos JR, Moreira ME. Case report: vertical dengue infection. J Pediatr (Rio J). 2008; 84: 556-559.

[14] Onoja AB, Adeniji JA, Olaleye OD. High rate of unrecognized dengue virus infection in parts of the rainforest region of Nigeria. Acta Trop. 2016; 160(1): 39–43.

[15] Oladipo EK, Amanetu C, Gbadero TA, Oloke JK. Detectable anti-dengue virus among healthy individuals in Ogbomoso, Oyo state, Nigeria. Am J Infect Dis. 2014; 10: 64–7.

[16] Idris AN, Baba MM, Thairu Y, Bamidele O. Seroprevalence of dengue type-3 virus Among patients with febrile illnesses attending a tertiary hospital in Maiduguri, Nigeria. Int J Med Sci. 2013; 5: 560–3.

[17] WHO. Dengue and severe dengue, WHO Media centre fact sheet No 117, 2013. Updated September 2013.

[18] Narkwa PW, Mutocheluh, M, Kwofie, TB, Owusu, M, Annan A, Ali, I, et al. Dengue Virus Exposure among Blood Donors in Ghana. Journal of Medical and Biomedical Sciences. 2016; 5: 30-35.

[19] Kajeguka DC, Kaaya RD, Mwakalinga S, et al. Prevalence of dengue and chikungunya virus infections in north-eastern Tanzania: a cross-sectional study among participants presenting with malaria-like symptoms. BMC Infect Dis. 2016; 16: 183.

[20] Nkenfou CN, Fainguem N, Dongmo-Nguefack F, Yatchou LG, Kameni JJK, Elong EL, et al. Enhanced passive surveillance dengue infection among febrile children: Prevalence, co-infections and associated factors in Cameroon. PLoS Negl Trop Dis. 2021; 15(4).

[21] Adeleke MA, Mafiana CF, Idowu AB, Sam-Wobo SO, Idowu OA. Population Dynamics of Indoor Sampled Mosquitoes and their Implication in Disease Transmission in Abeokuta, South- Western Nigeria. Journal of Vector Borne Disease. 2010; 47: 33-38.

[22] Adesina and Adeniji. Incidence of Dengue Virus Infections in Febrile Episodes Ile–ife, Nigeriaa. Afr., J. Infect. Dis. 2016; 10 (1): 21 – 24.

[23] Ahmed FU, Mahmood CB, Sharma JD, Hoque SM, Zaman R, Hasan MS. Dengue and dengue haemorrhagic fever in children during the 2000 outbreak in Chittagong, Bangladesh. Dengue Bulletin. 2001; 25: 33-35.

[24] Aniakwaa-Bonsu E, Amoako-Sakyi D, Dankwa K, Prah J. and Nuvor S. Seroprevalence of Dengue Viral Infection among Adults Attending the University of Cape Coast Hospital. Advances in Infectious Diseases. 2021; 11, 60-72.

[25] Nagi AG, Murad R, Baig M. Dengue fever outbreak among children in Karachi: Experience at a tertiary care children hospital. J. Bahria Univ. Med. Dental Coll. 2011; 1: 44-48.

[26] Teixeira MG, Morato V, Barreto FR, Mendes CMC. Risk factors for the incidence of dengue virus infection in preschool children. Trop Med Int Health. 2012; 17: 1391-1395.

[27] Faneye A, Idika N, Motayo BO, Adesanmi A, Afocha E. Serological evidence of recent dengue virus infection among febrile children in a semi-arid zone. American Journal of Infectious Diseases. 2013; 9: 7-10.

[28] Lee LK, Gan VC, Lee VJ, Tan AS, Leo YS, Lye DC. Clinical relevance and discriminatory value of elevated liver aminotransferase levels for dengue severity. PLoS Negl Trop Dis. 2012; 6: 1676.

[29] Manohar MN, Madhavi Latha B, Sasi Kumar K, Madhavi K, Sivaramadu S. Reddy D. Clinical profile and liver function in Dengue. New Indian Journal of Pediatrics. 2015; 4(1).

[30] Raju M, Blessy MT, Dahlia J, Asha P, Punnoose RAI. Effect of Dengue on Haematological Profile and Liver Function. J Evid Based Med Healthc. 2020; 7.

[31] Christopher JG, Lorenzi OD, Colon L et al. Utility of the tourniquet test and the white blood cell count to differentiate dengue among acute febrile illnesses in the emergency room. PLoS Negl Trop Dis. 2015; 12.