



RESEARCH ARTICLE

Epidemiologic Survey of HBV, HCV and HIV Infections in a Pregnant Women Population in Central Nigeria: A Cross-Sectional Study

Victor B Oti^{1*}, Isa H Mohammed¹, Yahaya Ibrahim¹, Chindo Ibrahim², Iboro Orok³, Yakubu Y Saje⁴, Attah A Ambrose⁵ and Muriana Olotu⁶

¹Department of Microbiology, Nasarawa State University Keffi, Nigeria

²Department of Biology, Federal College of Education Okene, Nigeria

³Department of Pharmaceutical Science, Anglia Ruskin University, United Kingdom

⁴Centre for Integrated Health Programs, Abuja, Nigeria

⁵Department of Medical Microbiology, Ahmadu Bello University Teaching Hospital Zaria, Nigeria

⁶Department of Health and Nutrition, INTERSOS INGO, Abuja, Nigeria

*Corresponding authors: Victor B Oti, Department of Microbiology, Nasarawa State University Keffi, Nigeria



Abstract

Parallel and overlapping of HBV, HCV and HIV infections in pregnant women is a major public health problem. In this cross-sectional study, we evaluated the parallel and overlapping infections of HBV, HCV and HIV among pregnant women population in Keffi, Central Nigeria between June through August 2019. Four hundred (400) women blood specimens were collected from major Hospitals in Keffi for the study after informed consent and ethical approval were retrieved and a structured questionnaire was administered to each women before sample collection. Specimens were analyzed for HBsAg, anti-HCV and anti-HIV antibodies using rapid test kits according to the manufacturer's instructions. Information obtained were statistically analysed using SSP version 2.80 and any P values less than 0.05 were reflected statistically significant. Out of the 400 women screened, there was overlapping infections of 11 (2.8%), 6 (1.5%) and 3 (0.8%) for HBV/HCV, HBV/HIV and HCV/HIV respectively. Parallel infections were 22 (5.5%), 12 (3.0%) and 14 (3.5%) for HBV, HCV and HIV. Only educational status was statistically related to HCV infection ($p < 0.05$). Those women that were below 20-years-old had the highest prevalence of HBV and HIV, meanwhile, women aged > 51 years recorded the highest prevalence for infection due to HCV. The parallel and overlapping HBV, HCV and HIV infections reported in this study is a stimulant for more proactive measures towards eliminating these viruses among pregnant women in Nigeria.

Keywords

HBV, HCV, HIV, Pregnant women, Keffi

Introduction

Hepatitis B Virus (HBV), Hepatitis C Virus (HCV) and Human Immunodeficiency Virus (HIV) are blood abided viruses which can be transmitted from mother to child and they constitute major health issues, with particularly high prevalence among African pregnant women [1-3]. The proportion of these viral infections among individuals is mostly hinged on particular predisposing reasons like socio-economic status and environmental conditions. Overall, the reduced rate of the infections has been found to exist in industrialized countries when relate to the developing countries [4,5].

Worldwide, there are approximately 260 million persons chronically infected with HBV and a carrier rate that differs from 9-20% in Sub Saharan Africa (SSA) [6-8] while 190 million HCV infections that are prolonged [9]. From the time when HIV epidemic started, above 70 million individuals have acquired this virus, leading to approximately 35 million deaths globally. As at 2019,

the global persons living with the virus was tagged at 38.0 million while 1.7 million of them became newly infected with the viral agent [9,10]. Due to the fact that these viruses have similar transmission entry, the epidemic of the viral agents' overlaps, with about 10% of the HIV infected persons reportedly have prolonged HBV infection and approximately one third of them have prolonged infection due to HCV [4].

The ranges of HBV are normally from a mild sickness to severe, which can last about a few weeks to a complex prolonged illness that can result to cirrhosis or hepatocarcinoma [11,12]. This viral infection is a crucial wellbeing risk in different nations, with approximately 10 percent prevalence [9]. Former researches carried out in Western regions have depicts that prolonged liver disease, particularly due to HBV was the 5th prominent reason of death in pregnant women infected with HIV [4,13]. In a related hospital-based research, the medical evaluation of patients with HBV infection reported that most of the participants (68%) are asymptomatic while a small number of the participants (32%) showed symptoms like; jaundice, nausea, abdominal pain, body ache among others [1,12].

There is a reported association of extra-hepatic indications with HCV like glomerulonephritis which most times lead to end-stage renal disease [14]. Most women are active in conceiving in their 20s through 40 years; this is as well the time the risk of acquiring HCV infection is high.

While HIV is a global epidemic, no continent has been more impacted than Africa. With 24.5 million individuals has the virus, this statistic signifies a small under two-thirds of the global persons with the virus [15,16]. The virus has severe impact on females especially in SSA, and reproductive aged women constitute about 57% of adults infected with HIV in this region [3,15]. In 2019, women and girls accounted for 59% of all new infection due to HIV in SSA [10]. Infection due to this viral agent in pregnancy is often linked to harsh fetal and maternal results, for example; severe loss of blood, vertical spread and infectious morbidity [11,16].

Parallel and overlapping infection of HIV with both HBV and HCV is linked to faster progress to liver cirrhosis and consequently result to a heightened death rate. There is no clear evidence on how HCV affects the progression of HIV infection to AIDS [17-19]. More so, persons infected with both HBV and HCV has a high chance of resulting to hepatotoxicity that is often linked to antiretroviral treatment usage [18].

Overlapping of these viruses is a growing health challenge [17]. However, there is need for more seroprevalence studies on HBV, HCV and HIV among pregnant women in Nigeria. We found that the 2.8%, 1.5% and 0.8% overlapping infections of HBV/HCV, HBV/HIV and HCV/HIV respectively were relatively high when com-

pared to the WHO standard, and linked predictors identified. The outcomes of this study will play a significant role in the understanding of the overlapping infections of these viruses among women in Nigeria with a serious need for antenatal-intervention strategies. The aim of this study was to determine the parallel and overlapping infections of HBV, HCV and HIV among pregnant women population in Keffi, Central Nigeria.

Methods

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 the Federal Medical Centre, Keffi, Nigeria. Official permission and administrative clearance was also received from the General Hospital, Keffi prior to sample collection.

Study area

This project was done in Keffi, Nigeria. Keffi is approximately 68 Km from Abuja, the Federal Capital Territory and 128 Km from Lafia, Capital of Nasarawa State. The area lies in latitude eight 5'N of the equator and longitude seven 8'E, it is situated on altitude of 850 M up sea level [20]. The mean yearly rainfall is \pm 2,000 millimeters (79 in), and is always heavier during the rainy months with its highest downpour around July through September [21]. The inhabitants mostly engage in trading, farming, schooling and petty jobs.

Study population and sample size determination

Four hundred (400) pregnant women who access the Federal Medical Centre Keffi and General Hospital Keffi, Nasarawa State for antenatal care were recruited to be part of this hospital based, cross-sectional study between June through August 2019. After informed consent was obtained from each woman who were between 16 and 36-years-old and eligibility for the study was identified during the study period. The participants were recruited consecutively when they come for antenatal care (ANC) services at the study facilities.

A descriptive size of the population was obtained after having approximately the necessary minimum sample size using the method proposed by Naing [22] at a 95% confidence interval. Permission was sought from the management of the hospitals. Data concerning the participants socio-demographic and risk factors were retrieved by a self-structured questionnaire.

Sample collection

About 5 ml of blood specimen was drawn from each participant in the study facilities by venipuncture into a plain tube and was labelled. Samples were left to clot at a minimal room atmosphere and spun at 3,000 rpm for 5 minutes. The subsequent sera were collected into well

marked cryovials and kept at -20 °C till set for analysis.

Inclusion and exclusion criteria

Pregnant women who had a history of HBV vaccination were excluded from the study. All pregnant women, irrespective of their ages, who indicated interest to be part of this study and signed a written/verbal informed consent, were included for the study.

Laboratory Investigation

HBsAg analysis

A quick *in vitro* which is a qualitative sandwich immunoassay rapid test kit was used for the initial check of subjects' sera for Hepatitis B surface antigen (HBsAg). The diagnostic kit (HBsAg one step test strips, ACON Laboratories Inc, USA) employs a mixture of monoclonal and polyclonal antibodies to identify HBsAg in serum and was confirmed using with Shantest™HBsAg ELISA (Shantha Biotechnics Ltd, India). The tests protocol and results readings were done based on the instructions of the manufacturer.

Anti-HCV analysis

Anti-HCV antibodies were identified using the anti-HCV-EIA-avicenna based on the instructions of the manufacturer. Anti-HCV-EIA-avicenna is a qualitative enzyme immunoassay for the identification of anti-HCV antibodies.

Anti-HIV analysis

The Genscreen™ ULTRA HIV Ag-Ab test kit by BIO RAD which is a qualitative enzyme immunoassay kit for the detection of antibodies to HIV-1 was used for the screening based on the instructions of the manufacturer.

Statistical analysis

The information realized from this study was subjected to descriptive statistical investigation using Smith's Statistical Package (version 2.80, Claremont, California-USA). Chi-square statistical test was used to decide associations and coinfections. Values obtained were reflected statistically significant at $p \leq 0.05$.

Results

Out of the 400 pregnant women that were recruited for this study, parallel infections of 22 (5.5%), 12 (3.0%) and 14 (3.5%) were reported for HBV, HCV and HIV respectively. Overlapping infections were 11 (2.8%), 6 (1.5%), and 3 (0.8%) for HBV/HCV, HBV/HIV and HCV/HIV. Those women below 20-years-old had the highest prevalence for HBV and HIV, while those above > 51 years had the highest prevalence due to HCV infection. Only educational status was associated with HCV infection in this study ($p < 0.05$). However, arithmetic differences were observed within risk factors studied.

Concerning marital status, we recorded higher prevalence of HBV (11.7%) and HIV (8.3%) infections among

divorced women, while HCV infection was higher among married (4.2%) than among singles (2.0%) and divorced (1.7%) women. In relation to educational status, HBV infection was highest among pregnant women with non-formal education (9.4%). However, both HCV (9.4%) and HIV (4.7%) infections were highest among those with primary school education. Only educational status was statistically related to HCV infection ($p < 0.05$). We also recorded higher seroprevalence of HBV (6.9%) and HCV (4.8%) among pregnant women who were from urban settings, while those from rural localities were more infected with HIV (3.5%). Similarly, in this study, students were more infected with HBV (9.3%), civil servants with HCV (5.2%) while farmers were more infected with HIV (6.3%).

In this current study, infection with HBV, HCV and HIV was not significantly associated with blood transfusion, tribal marks, type of family, parity, practice of self-manicure and pedicure ($p > 0.05$). However, higher prevalence of HBV infection recorded among pregnant women with history of blood transfusion (7.5%), without tribal marks (6.9%), from polygamous family (5.6%), at their 3rd trimester (10.0%) and who practice both self-manicure (6.7%) and pedicure (7.8%).

HCV infection was also higher among subjects with a history of blood transfusion (6.3%), without tribal marks (3.5%), from polygamous family (3.2%), at their 3rd trimester (5.0%), who did not practice self-manicure (3.2%) and who practice self-pedicure (3.9%). Similarly, pregnant women with a history of blood transfusion (6.3%), tribal marks (4.3%), from monogamous family (4.7%), at 1st trimester (4.7%), who practice self-manicure (5.0%) and who did not practice self-pedicure (4.5%) were found to have a higher HIV prevalence in our study (Table 1, Table 2 and Table 3).

Discussion

Infections with HBV, HCV and HIV among pregnant women are serious health concerns since their unborn children are also at risk [1]. In this current study, out of the 400 pregnant women screened, 22 (5.5%), 12 (3.0) and 14 (3.5%) were positive for HBV, HCV and HIV, respectively. Overlapping infections were 11 (2.8%), 6 (1.5%) and 3 (0.8%) for HBV/HCV, HBV/HIV and HCV/HIV.

The 5.5% prevalence of HBV infection recorded in this study is lower than what was obtained from similar studies done with similar subjects in North Central, Nigeria. For instance, it was 8.0% among pregnant women accessing antenatal care in a tertiary health care facility in Nigeria [2], 11.0% among pregnant women attending antenatal in a rural clinic in Northern Nigeria [23] and 19.8% among pregnant women attending antenatal care in Central Nigeria [24]. Different prevalence rates of the infection have been reported from researchers in other parts of Nigeria [25], Africa and the World. It

Table 1: Seroprevalence of Hepatitis B virus infection among pregnant women in Keffi with respect to risk factors studied.

Risk factor	Number Tested	Number Positive (%)	Chi square	P value
Age (Years)				
< 20	76	5 (6.6)	3.0599	0.5478
21-30	162	12 (7.4)		
31-40	101	3 (3.0)		
41-50	43	1 (2.3)		
< 51	18	1 (5.6)		
Marital status				
Single	150	8 (5.3)	4.8208	0.0897
Married	190	7 (3.7)		
Divorced	60	7 (11.7)		
Educational status				
Primary	64	5 (7.8)	4.9617	0.1745
Secondary	154	5 (3.2)		
Tertiary	86	3 (3.5)		
Non-formal	96	9 (9.4)		
Locality				
Urban	145	10 (6.9)	0.7603	0.3832
Rural	255	12 (4.7)		
Occupations				
Students	43	4 (9.3)	2.7163	0.7436
Civil servants	58	2 (3.4)		
Traders	67	4 (6.0)		
Artisans	81	3 (3.7)		
Farmers	63	5 (7.9)		
Unemployed	88	4 (4.5)		
History of Blood Transfusion				
Yes	80	6 (7.5)	0.6798	0.4096
No	320	16 (5.0)		
Tribal Marks				
Yes	140	4 (2.9)	2.6239	0.1052
No	260	18 (6.9)		
Types of Family				
Monogamous	150	8 (5.3)	0.0115	0.9146
Polygamous	250	14 (5.6)		
Parity				
1 st Trimester	170	10 (5.9)	4.8529	0.0882
2 nd Trimester	150	4 (2.7)		
3 rd Trimester	80	8 (10.0)		
Self-Manicure				
Yes	180	12 (6.7)	0.7662	0.3813
No	220	10 (4.5)		
Self-Pedicure				
Yes	180	14 (7.8)	2.9160	0.0876
No	220	8 (3.6)		
Total	400	22 (5.5)		

was 6.7% among antenatal attendees in Bauchi, Nigeria [26], 3.3% among pregnant women in Ghana [27], 0.85% in North Indian population [28] and 0.5% in a cohort of pregnant women from Southern Italy [29]. The observed differences might be due to varied socio-economic

status, screening protocols, study subjects and the size of the population.

Surprisingly, none of the socio-demographics and risk factors were significantly associated with HBV infection statistically, although, there were arithmetic

Table 2: Seroprevalence of Hepatitis C virus infection among pregnant women in Keffi with respect to risk factors studied.

Risk factor	Number Tested	Number Positive (%)	Chi square	P value
Age (Years)				
< 20	76	2 (2.6)	0.4726	0.9761
21-30	162	5 (3.1)		
31-40	101	3 (3.0)		
41-50	43	1 (2.3)		
< 51	18	1 (5.6)		
Marital status				
Single	150	3 (2.0)	1.7305	0.4209
Married	190	8 (4.2)		
Divorced	60	1 (1.7)		
Educational status				
Primary	64	6 (9.4)	9.7844	0.0203
Secondary	154	2 (1.3)		
Tertiary	86	2 (2.3)		
Non-formal	96	2 (2.1)		
Locality				
Urban	145	7 (4.8)	2.4403	0.1182
Rural	255	5 (2.0)		
Occupations				
Students	43	2 (4.7)	3.7019	0.5930
Civil servants	58	3 (5.2)		
Traders	67	2 (3.0)		
Artisans	81	1 (1.2)		
Farmers	63	3 (4.8)		
Unemployed	88	1 (1.1)		
History of Blood Transfusion				
Yes	80	5 (6.3)	3.3401	0.0675
No	320	7 (2.2)		
Tribal Marks				
Yes	140	3 (2.1)	0.5141	0.4733
No	260	9 (3.5)		
Types of Family				
Monogamous	150	4 (2.7)	0.0864	0.7688
Polygamous	250	8 (3.2)		
Parity				
1 st Trimester	170	4 (2.4)	1.3018	0.5215
2 nd Trimester	150	4 (2.7)		
3 rd Trimester	80	4 (5.0)		
Self-Manicure				
Yes	180	5 (2.8)	0.0523	0.8190
No	220	7 (3.2)		
Self-Pedicure				
Yes	180	7 (3.9)	0.8356	0.3606
No	220	5 (2.3)		
Total	400	12 (3.0)		

differences ($p > 0.05$). However, the highest prevalence observed among women aged 21-30 years-old (7.4%) could be as a result of the enhanced sexual activity of this group hence, signifying the role of sex in the viral dissemination [2]. Higher prevalence was also recorded

among pregnant women with a history of blood transfusion (7.5%). This may be due to the transmission of blood that was not properly screened, since not all Nigerian hospitals screen for all the HBV serologic markers. Abah and Aminu, [25] also reported higher preva-

Table 3: Seroprevalence of Human immunodeficiency virus infection among pregnant women in Keffi with respect to risk factors studied.

Risk factor	Number Tested	Number Positive (%)	Chi square	P value
Age (Years)				
< 20	76	4 (5.3)	2.0990	0.7175
21-30	162	6 (3.7)		
31-40	101	2 (2.0)		
41-50	43	2 (4.7)		
< 51	18	0 (0.0)		
Marital status				
Single	150	4 (2.7)	4.3855	0.1115
Married	190	5 (2.6)		
Divorced	60	5 (8.3)		
Educational status				
Primary	64	3 (4.7)	0.7128	0.8702
Secondary	154	4 (2.6)		
Tertiary	86	3 (3.5)		
Non-formal	96	4 (4.2)		
Locality				
Urban	145	5 (3.4)	0.0017	0.9673
Rural	255	9 (3.5)		
Occupations				
Students	43	2 (4.7)	2.8287	0.7263
Civil servants	58	1 (1.7)		
Traders	67	3 (4.5)		
Artisans	81	2 (2.5)		
Farmers	63	4 (6.3)		
Unemployed	88	2 (2.3)		
History of Blood Transfusion				
Yes	80	5 (6.3)	2.0472	0.1524
No	320	9 (2.8)		
Tribal Marks				
Yes	140	6 (4.3)	0.3658	0.5453
No	260	8 (3.1)		
Types of Family				
Monogamous	150	7 (4.7)	0.8978	0.3433
Polygamous	250	7 (2.8)		
Parity				
1 st Trimester	170	8 (4.7)	1.1874	0.5522
2 nd Trimester	150	4 (2.7)		
3 rd Trimester	80	2 (2.5)		
Self-Manicure				
Yes	180	9 (5.0)	2.0278	0.1544
No	220	5 (2.3)		
Self-Pedicure				
Yes	180	4 (2.2)	1.4786	0.2239
No	220	10 (4.5)		
Total	400	14 (3.5)		

lence among pregnant Nigerian women that had been transfused.

There is a paucity of published data on HCV infection among pregnant women in the area. The seroprevalence

of anti-HCV antibodies among the women was 3.0% which is lower than previously published report by Oti, et al. [2]. He found a 6.0% HCV infection among pregnant women in Keffi [2]. Reports from other part of

the country showed varied prevalences. For instance, it was 3.6% amongst pregnant women in parts of North Central Nigeria [30]. Pennap, et al. [23] reported 3.0% seroprevalence of HCV antibodies in a rural clinic in Northern Nigeria. It was 8.0% among students of University of Ilorin [31], 11.5% among students of Federal Polytechnic, Mubi, Adamawa State [32] and 16.6% among patients attending a tertiary hospital in Jalingo [33]. The differences in prevalence observed across the studies may be due to differences in demographics, socio-economic status, risk behavior and methods of testing employed.

Among all the socio-demographics and possible risk factors for HCV infection studied, only educational status of the subjects was associated with the infection ($p < 0.05$). However, highest prevalence was observed among those with primary education (9.4%) than those with tertiary (2.3%), non-formal (2.1%) and secondary education (1.3%) education. This corresponds to the report of Gacche and Al-Mohani [34] but, they however, recorded higher prevalence among illiterates than those with other educational qualifications. The higher prevalence among those with primary education in this study may be as a result of their low level of awareness about HCV infection, including its preventive measures.

Although, measures have been put in place by both Governmental and Non-Governmental organizations (NGOs) for the control and prevention of HIV infection in Nigeria, in fact, special consideration is giving to children and pregnant women and these include but not limited to routine free HIV screening, provision of free antiretroviral drugs and awareness campaigns [35]. However, the 3.5% prevalence of HIV infection among pregnant women in this study is still high than the Nigerian national prevalence of 1.4% [36]. The prevalence of the infection from other previous studies done in Nigeria among pregnant women has also been quite high and range from 4.0% in Damaturu [3], to 8.3% in Jos [37] and 26.4% in Ibadan [38]. This therefore calls for more intervention programs for the control and prevention of this viral infection particularly among pregnant women due to its devastating medical implications not only to them but also to their unborn child.

Similarly, all socio-demographics and risk factors for HIV infection were not associated with the viral infection ($p > 0.05$). This outcome is in consonance with previous reported studies [3,15,18,37], Although, the prevalence of the infection was higher among young adults, those with history of blood transfusion and those who share or use unsterilized sharp objects.

In this study, 2.8% of the pregnant women were found to have overlapping infections with HBV and HCV. This is higher than the 1.0% prevalence reported by Pennap, et al. [23] in the same study area. It is also higher than the 1.3% and 0.5% reported in Benin and Edo-Ekiti [39,40]. The high prevalence of dual infection

of HBV and HCV in this study compared to other studies should not be neglected. This is because co-infection with these viral pathogens is known to occur with attendant complications especially in pregnant women who may likely spread the infection to their unborn children [23].

Co-infection with HBV and HIV is commonly observed because both viruses have similar mode of transmission like multiple sexual partners, use of unsterilized sharp objects, blood transmission and vertical transmission from mother to fetus among others [41]. The 1.5% prevalence of HBV/HIV overlapping infection in this study is lower than the 2.0% reported in Rivers State [1], 2.7% in Benue State [42] and 2.7% in Nasarawa State [43]. However, lower prevalence of 0.3%, 0.5% and 1.1% were reported in Yenagoa, Ebonyi and Ibadan respectively [44-46]. The lower prevalence reported by these authors reflects the low HBV and HIV prevalence in their study area which also reflects the regional distribution of HIV infection reported by FMOH [47] with Ebonyi and Oyo States having HIV prevalence of 3.3% and 3.0%, respectively.

The 0.8% prevalence of HCV/HIV overlapping infections reported in this area is low just like most other Nigerian studies done among pregnant women. For instance, it was 0.4% in Calabar [48], 1.5% in Lagos [11] and 1.6% in Ibadan [49]. In fact, HCV/HIV co-infection was not recorded in recent studies conducted by Ajugwo, et al. [1] and Oshun and Odeghe [16] in Rivers and Lagos States respectively. However, higher prevalence of 4.9% in Texas, USA [13] and 12.3% in Europe [4] were reported and these higher prevalence rates were attributed to intravenous drugs usage in those study populations. However, at present, intravenous drugs use is not a major challenge in our society particularly among pregnant women and thus may account for the lower prevalence in this current study.

Conclusion

This study reported overlapping infections of 11 (2.8%), 6 (1.5%) and 3 (0.8%) for HBV/HCV, HBV/HIV and HCV/HIV and parallel infections were 22 (5.5%), 12 (3.0%) and 14 (3.5%) for HBV, HCV and HIV respectively among the women which is a serious public health concern. Only educational status was statistically related to HCV infection ($p < 0.05$).

Effective control measures and health awareness strategies should be targeted at pregnant women in Nigeria especially at the community level.

Limitations

Limited availability of funds prevented genomic studies and viral loads of positive samples of the women. Coverage of larger sample size and other antenatal clinics in the state hindered a generalized prevalence of the infections.

Author's Contributions

VBO conceived the study. VBO, IHM, YI, and CI collected samples and performed the experiments. IO, YYS, CI, MO and AAA did literature search. VBO did the statistical analysis and wrote the first draft of the manuscript. All authors read and approved the manuscript for publication.

Declaration of Competing Interest

None exist.

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