Hepatitis B and C Virus, Human Immunodeficiency Virus Co-infection among Pregnant Women in Semi-rural Health District, Cameroon

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Abstract

Background In Cameroon, Human Immunodeficiency Virus (HIV), Hepatitis B (HBV) and C virus (HCV) are highly endemic to the pregnant woman. These viruses pose a high risk of vertical transmission and have been reported as the most important causes of maternal mortality. The aim objective of this study was to determine the hepatitis B, C and HIV virus co-infection among pregnant women in the Bafia health district.

Methods A cross-sectional study was conducted from may to july 2018 in 145 pregnant women attending the health district of Bafia. HIV was diagnosed and confirmed using the Determine and Oraquick HIV1/2, HBV by NOVA test (HBV Multi Panel One Step) and HCV by ACCURATE test. Statistical analysis was performed using the Epi info software version 7.2.1.0. Furthermore, statistical association was performed using Odds Ratio (OR) and Fisher Exact test where appropriate, with corresponding 95% confidence interval (CI). The probability was considered statistical significant for all values $p < 0.05$.

Results The average age was 25 ± 5.96 years and the seroprevalence of HIV, HBV and HCV was 6.90% (10/145), 10.34% (15/145) and 33.79% (49/145), respectively. Those aged 24-32 years had peaks of infection, with 9.84% (6/61) and 45.90% (28/61) of HIV, Odds Ratio (OR): 2.18 [95%CI: 0.58-8.09], $p = 0.39$ and HCV, OR: 2.54 [95%CI: 1.25-5.15], $p = 0.008$ respectively. However, the peak of HBV (HBsAg) infection (35.29% [6/17]) was in the age group 33-41 years, $p = 0.001$ and carriage rate of HBeAg was only observed in those aged 15-23 years (5.97% [4/67], $p = 0.30$). No cases of co-infection were observed between HBsAg carrier rates ($p = 0.56$), HBeAg ($p = 0.65$) and HIV. Meanwhile, 10.20% (5/49) of pregnant women were co-infected with HCV/HIV, OR: 2.06 [95%CI: 0.56-7.51], $p = 0.26$ and this co-infection was observed among those aged 24-32 years (8.20% [5/61], $p = 0.02$).

Conclusion Seroprevalence of HIV, HBV and HCV in pregnant women remain high in the Bafia health district, reflecting a significant risk of vertical transmission, especially HIV/HCV co-infection. The prevention strategies of these three viruses would primarily target pregnant women aged over 24 years in health care areas with a typology similar to that of Bafia.

Background

Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV) are major public health problems in the worldwide. The severity of these infections is related to the risk of transition to chronicity and exposing patients to cirrhosis and liver cancer [1]. The World Health Organization (WHO) estimates that about 2 billion people are infected with HBV, ~248 million people are chronically infected with the HBV, and more than 686 000 die from complications (cirrhosis and hepatocellular carcinoma) related to Hepatitis B each year [1]. About 110 million people are infected with HCV (ie antibody anti-HCV) and ~80 million people have chronic infection. Of the 36.7 million people infected with HIV (including 2.6 million children) around the world, ~70% live in sub-Saharan Africa, with constant risks of Mother-To-Child Transmission (MTCT) [2]. Due to the common modes of transmission (blood,

sexual, blood transfusion and mother-to-child transmission) [3, 4], these morbid infections could sustain a vicious cycle of reinforcement mutual. Mother-To-Child Transmission (MTCT) of HBV is an essential link in the maintenance of infection, especially in highly endemic countries. This risk is estimated at 10-40% if the mother carries HBsAg and 70-90% if the HBe antigen (HBeAg) is detected in the maternal serum. However, even in the absence of HBeAg (pre-core mutant) the risk of HBV transmission exists and the interpretation must take into account the viremia (threshold to be defined: $> 7 \log \text{ IU/ml}$) [5]. Viral hepatitis in pregnancy is associated with a high risk of maternal and child complications leading to spontaneous abortion, premature delivery, intrauterine growth restrictions and low birth weight [6]. Co-infection of HBV and HCV has become a factor of co-morbidity and mortality among people living with HIV (PLHIV) [7]. HIV infection increases the transition to the chronicity of acute hepatitis B and hepatitis C by increasing viral replication. It also increases the frequency of HBV reactivation in inactive HBV carriers, and accelerates the rate of progression of fibrosis, the development of cirrhosis and hepatocellular carcinoma (HCC) [8].

In Cameroon, the prevalence of HBV varies from 6 to 12% in pregnant women [6,9] and to our knowledge, there are very few national data available on the seroprevalence of HCV in pregnant women but also the co-infection of HBV and HCV infections in pregnant women living with HIV. In addition, the high prevalence of HIV infection during pregnancy in Africa (7.8% in Cameroon) suggests significant rates of vertical HIV infection, in the context of ongoing risks of mother-to-child transmission [10]. The prevalence of HIV-1 in infants born from mother-to-child transmission is 11.5% (434/3789) in Cameroon [11], suggesting possible T-cell immunity impaired and lower response to vaccination in these potentially vulnerable populations [12]. The risk of HCV transmission from mother to child is 4-8% in the perinatal period and 10-25% in children born to mothers co-infected with HIV [13]. Although UNAIDS has developed a program to prevent mother-to-child transmission of HIV, no program currently exists for viral hepatitis B and C [14]. A study conducted by Kaba and collaborator in three health areas in the West (Bafoussam, Bangangté and Bangoua) showed that in a population of 143 pregnant women received antenatal care (ANC) during the period from October to December 2015, 18 women (12.6%) were screened positive for HIV versus 14 (9.79%) positive for HBV-HBsAg and 14 (9.79%) for hepatitis C virus [15].

Study objectives

The objectives of this study was: (i) to determine the seroprevalence of HIV, HCV and HBV, (ii) to distribute serological markers of HIV, HBV, HCV based on socio-demographic characteristics, (iii) to show the co-infection between serologic markers of HIV, HBV and HCV in pregnant women in Bafia Health District.

Methods

Study design and population

A cross-sectional study was carried out from May to July 2018 in pregnant women attending the health district of Bafia. Bafia is a city of Cameroon located in the Center region, Mbam and Inoubou department, 120 km north of Yaoundé. It is the third largest city in the Central Region after Yaoundé and Mbalmayo. The health district of Bafia includes: a health center within it, the district hospital of Bafia, main health structure of the city which is endowed with the main specialties (general medicine, pediatrics, gynecology, odonto-stomatology, surgery, etc.) and several integrated health centers in certain neighborhoods and villages.

Sample and strategy of enrollment The minimum sample size was calculated using the following standard formula: $N = z^2 p (1-p) / d^2$. With "z"= the standard deviation of 1.96 (95% confidence interval), "p"= the prevalence of HIV among pregnant women in Cameroon (7.8%) found by Bilong et al. [10] and "d"= degree of precision (0.05) for a minimum sample size $N = 110.46$. One hundred and forty five (145) pregnant women were enrolled in our study. The type of sampling was accidental non-probabilistic and the enrollment technique for the participants was the interview via a well-formulated anonymized questionnaire containing sociodemographic data (age, marital status, level of education, profession, parity and age of pregnancy). The criteria for selecting pregnant women were as follows: pregnant woman who came for prenatal consultation and who informed consent or parental informed consent has been obtained. **Biological analyzes of samples** A total of 145 samples taken at the bend of the elbow were collected in the dry tubes and a tube under anticoagulant including Ethylene Diamine Tetra Acetate (EDTA) previously labelled with the participant's code. After centrifugation of the whole blood in the dry tubes, the serum was collected in eppendorf tubes, previously labeled with the code and then stored in a -20c freezer until analysis. **HIV1/2 test and confirmation**

The determine HIV-1/2 test kit Abbott was used for the qualitative detection of anti-HIV-1/2 antibodies. For this, a quantity of 50 microliters of serum was deposited on the absorbent part of the Abbott HIV-1/2 strip previously labeled with the identification code of each participant. The positive reactivity was marked by the appearance of a red line at the test area of the patient and a red line at the control zone. Each positive result was confirmed by the "OraQuick ADVANCE® HIV-1/2" test (manufactured by OraSure Technologies, PA 18015 USA, Item 3001-1203 rev.03/16).

Serological markers of HBV and HCV Serological markers of HBV by immunochromatography using "NOVA TEST ©" one step HBV rapid diagnostic test Multi Panel (Lot: 20170503; Expiration: 05/2019) and the HCV (anti-HCV antibody) marker using ACCURATE one step dipstick HCV test (Lot: 20170525; Expiration: 20200524), ISO 9001 certified, Made in USA.

HBsAg test.

The HBsAg marker was used to qualitatively detect any pregnant woman infected with HBV, using lateral flow chromatographic immunoassay HBsAg Gold Rapid Screen (colloidal gold), with 100µl of serum. The test utilizes a pair of anti-HBsAg antibodies to detect HBeAg in the test serum or plasma. Validated results were reported as HBsAg reactive (HBsAg -positive) or non-reactive (HBsAg-negative).

HBeAg test

The HBeAg marker was used to qualitatively detect any pregnant woman with HBV replication. The test utilizes a pair of anti-HBeAg antibodies to detect HBeAg with 100µl of serum or plasma. A burgundy colored T band indicates an HBeAg positive test result and absence of the T band suggests a negative result.

Statistical analysis

The data compiled on the data sheets were entered in a Microsoft Excel version 2007 then transported to the analysis software Epi info version 7.2.1.0. For the descriptive analysis, we used the absolute frequency (effective), the relative frequency (percentage), the average and the standard deviation (SD). Seroprevalence (Percentage) of HIV, HBV and HCV was calculated by the formula $P = n/N$, where “n” is the total number of pregnant women tested positive or negative for HIV, HBV, HCV, and N (N= 145) the total number of samples tested. The statistical test used to compare frequencies was Fisher's exact test. The probability was significant for all values of $p < 0.05$. The study of associations was done by univariate analyzes and associations between the variables were sought with the Odds Ratio (OR), expressed with its 95% confidence interval (CI).

Results

Socio-demographic characteristics of the study population A total of 145 pregnant women attending the antenatal Bafia Health District were enrolled in our study. The average age of the participants was 25 ± 5.96 years (min-max: 15-41 years, [IQR: 20-29 years]). According to socio-demographic characteristics, the majority of participants were: 15-23 years old with 46.21% (67 cases), a life in couple with 68.96% (100 cases), a secondary level with 77.24% (112 cases), housewives occupations with 54.49% (79 cases), multiparous with 46.21% (67 cases) and the first trimester of pregnancy with 49.66% (72 cases).

Seroprevalence of HIV, HCV and HBV in the study population Of the 145 pregnant woman enrolled, 6.90% (95%CI: 3.36%-12.32%; 10/145) were HIV-positive and 33.79% (95%CI: 26.15%-42.11%; 49/145) were anti-HCV antibodies positive (anti-HCVAb). For HBV markers, HBsAg was present in 10.34% (95%CI: 5.91%-16.49%; 15/145) and HBeAg was detected in 2.76% (95%CI: 0.76%-6.91%; 4/145). **Figure 1** **Figure 1: Seroprevalence of HIV, HCV and HBV in the study population** **Carrier rate of HIV antibodies according to socio-demographic characteristics** On the 145 pregnant women tested for HIV, 6.90% (10/145) were carriers of HIV antibody and among them, 9.84% (6/61) were aged 24-32 years,

8.00% (8/100) were living in couples or married, 8.04% (9/112) were secondary school, 6.33% (5/79) were housewives, 8.96% (6/67) for multiparous and 13.33% (4/30) in the third trimester, OR: 2.79 (95%CI: 0.73 – 10.62), p=0.24. **Table 1: Carrier rate of HIV antibodies according to socio-demographic characteristics**

Variables	Total N=145 (%)	Anti-HIV antibody		OR (95%CI)	p-value
		Positive (%) 10 (6.90)	Negative(%) 135 (93.10)		
Age (years)					
15-23	67 (46.21)	2 (2.99)	65 (97.01)	0.26 (0.05 – 1.31)	0.16
24-32	61 (42.07)	6 (9.84)	55 (90.16)	2.18 (0.58 – 8.09)	0.39
33-41	17 (11.72)	2 (11.76)	15 (88.24)	2.00 (0.38 – 10.30)	0.73
Marital status					
Life in couple	100 (68.96)	8 (8.00)	92 (92.00)	1.86 (0.38 – 9.17)	0.66
Single	45 (31.34)	2 (4.45)	43 (95.55)		
Level of education					
Primary	28 (19.31)	0 (0.00)	28 (100.0)	NA	0.23
Secondary	112 (77.24)	9 (8.04)	103 (91.96)	2.79 (0.34 – 22.91)	0.54
University	05 (3.45)	1 (20.00)	04 (80.00)	3.63 (0.36 – 36.04)	0.78
Profession					
Pupils	27 (18.62)	0 (0.00)	27 (100.0)	NA	0.25
Student	03 (2.07)	0 (0.00)	03 (100.0)	NA	1.00
housewives	79 (54.48)	5 (6.33)	74 (93.67)	0.82 (0.22 – 2.98)	0.76
Dressing	04 (2.76)	0 (0.00)	04 (100.0)	NA	1.00
Heamstresses	23 (15.86)	2 (8.69)	21 (91.30)	1.35 (0.26 – 6.84)	1.00
Nurses	02 (1.38)	1 (50.00)	01 (50.00)	14.88 (0.85-258.15)	0.30
Teachers	07 (4.83)	2 (28.57)	05 (71.43)	6.5 (1.08 – 38.87)	0.11
Parity					
Primiparous	28 (19.31)	1 (3.57)	27 (96.43)	0.44 (0.05 – 3.66)	0.72
Pauciparous	50 (34.48)	3 (6.00)	47 (94.00)	0.80 (0.19 – 3.24)	1.00
Multiparous	67 (46.21)	6 (8.96)	61 (91.04)	1.81 (0.49 – 6.74)	0.56
Age of pregnancy					
1 st trimester	72 (49.65)	4 (5.56)	68 (94.44)	0.65 (0.17 – 2.43)	0.76
2 nd trimester	43 (29.65)	2 (4.65)	41 (95.35)	0.57 (0.11 – 2.81)	0.73
3 rd trimester	30 (20.70)	4 (13.33)	26 (86.67)	2.79 (0.73 – 10.62)	0.24

N: total number; %: percentage; OR: Odds Ratio; NA: Not Applicable; CI: Confidence Interval

Carrier rate of anti-HCV antibodies according to socio-demographic characteristics

Table 2 shows that 33.79% (49/145) pregnant women were positive for antibodies to HCV and this carriage rate was higher in: pregnant women aged of 24-32 years with 45.90% (28/61; OR: 2.54 [95%CI: 1.25 - 5.15], p= 0.008), pregnant women living in couples or married with 36.00% (36/100), secondary school (31.25% [35/112]), housewives (36.71% [29/79]), multiparous (34.33% [23/67]) and those in the third trimester of pregnancy

(40.00% [12/30]). **Table 2** Table 2: Carrier rate of anti-HCV antibodies according to socio-demographic characteristics

Variables	Total N= 145 (%)	Anti-HCV antibody		OR (95%CI)	p-value
		Positive (%) 49 (33.79)	Negative (%) 96 (66.21)		
Age (years)					
15-23	67 (46.21)	15 (22.39)	52 (77.61)	0.37 (0.18 – 0.77)	0.007
24-32	61 (42.07)	28 (45.90)	33 (54.10)	2.54 (1.25 – 5.15)	0.008
33-41	17 (11.72)	06 (35.29)	11 (64.71)	1.07 (0.37 – 3.11)	0.88
Marital status					
Life in couple	100 (68.96)	36 (36.00)	64 (64.00)	0.22 (0.10 – 0.49)	0.40
Single	45 (31.34)	13 (28.89)	32 (71.11)		
Level of education					
Primary	28 (19.31)	14 (50.00)	14 (50.00)	2.34 (1.01 – 5.42)	0.04
Secondary	112 (77.24)	35 (31.25)	77 (68.75)	0.61 (0.27 – 1.36)	0.23
University	05 (3.45)	0(0.00)	05(100.0)	NA	0.25
Profession					
Pupils	27 (18.62)	8 (29.63)	19 (70.37)	0.79 (0.31 – 1.96)	0.61
Student	03 (2.07)	0 (0.00)	03 (100.0)	NA	0.52
Housewives	79 (54.48)	29 (36.71)	50 (63.29)	1.33 (0.66 – 2.67)	0.41
Dressing	04 (2.76)	01 (25.00)	03 (75.00)	0.64 (0.06 – 6.37)	0.70
Heamstresses	23 (15.86)	09 (39.13)	14 (60.87)	1.31 (0.52 – 3.30)	0.55
Nurses	02 (1.38)	01 (50.00)	01 (50.00)	1.97 (0.12 -32.33)	1.00
Teachers	07 (4.83)	01 (14.28)	06 (85.72)	0.31 (0.03 – 2.67)	0.47
Parity					
Primiparous	28 (19.31)	8 (28.57)	20 (71.43)	0.74 (0.30 – 1.83)	0.51
Pauciparous	50 (34.48)	18 (36.00)	32 (64.00)	1.16 (0.56 – 2.38)	0.68
Multiparous	67 (46.21)	23 (34.33)	44 (65.67)	1.04 (0.52 – 2.08)	0.89
Age of pregnancy					
1 st trimester	72 (49.65)	23 (31.94)	49 (68.06)	0.84 (0.42 – 1.69)	0.64
2 nd trimester	43 (29.65)	14 (32.56)	29 (67.44)	0.92 (0.43 – 1.97)	0.83
3 rd trimester	30 (20.70)	12 (40.00)	18 (60.00)	1.40 (0.61 – 3.21)	0.41

N: total number; %: percentage; OR: Odds Ratio; NA: Not Applicable; CI: Confidence Interval

HBV markers according to socio-demographic characteristics The HBsAg was more represented in pregnant women aged 33-41 years with 35.29% (6/17), $p= 0.001$. However, HBeAg was only represented in those aged 15-23 years with 2.76 (4/67), $p= 0.30$ (**Table 3**). For marital status, HBsAg and HBeAg were more represented in couples or married with 10.00% (10/100), $p= 0.92$ and 3.00% (3/100), $p= 0.77$ respectively (**Table 3**). According to the level of education, we found HBsAg and HBeAg in 10.71% (12/112), $p= 0.96$ and 3.57% (4/112), $p= 0.56$ respectively in pregnant women with a level secondary. For the age of pregnancy, it appears that 8.33% (6/72) and 16.67% (5/30) of pregnant women respectively in the first and third trimesters of pregnancy were carriers of HBsAg ($p= 0.65$). However, the carriage rate of HBeAg was more represented in pregnant women in

the first trimester. **Table 3** Table 3: HBV markers according to socio-demographic characteristics

Variables	Total N=145(%)	HBsAg		HBeAg	
		Positive (%)	Negative (%)	Positive (%)	Negative (%)
		15 (10.34)	130 (89.66)	04 (2.76)	141 (97.24)
Age (years)					
15-23	67 (46.21)	05(7.46)	62 (92.54)	4(5.97)	63 (94.03)
24-32	61 (42.07)	4(6.56)	57 (93.44)	0(0.00)	61 (100.0)
33-41	17 (11.72)	6(35.29)	11 (64.71)	0(0.00)	17 (100.0)
p-value		0.001		0.30	
Marital status					
Life in couple	100 (68.96)	10(10.00)	90 (90.00)	3(3.00)	97 (97.00)
Single	45 (31.34)	05(11.11)	40 (88.89)	1(2.22)	44 (97.78)
p-value		0.92		0.77	
Level of education					
Primary	28 (19.31)	03(10.71)	25 (89.29)	0(0.00)	28 (100.0)
Secondary	112 (77.24)	12(10.71)	100 (89.29)	04(3.57)	108 (96.43)
University	05 (3.45)	0(0.00)	05 (100.0)	0(0.00)	05 (100.0)
p-value		0.96		0.56	
Profession					
Pupils	27 (18.62)	2(7.41)	25 (92.59)	1(3.70)	26 (96.30)
Student	03 (2.07)	0(0.00)	03 (100.0)	0(0.00)	03 (100.0)
Housewives	79 (54.48)	09(11.39)	70 (88.61)	2 (2.53)	77 (97.47)
Dressing	04 (2.76)	0(0.00)	04 (100.0)	0(0.00)	04 (100.0)
Heamstresses	23 (15.86)	03(13.04)	20 (86.96)	1(4.35)	22 (95.65)
Nurses	02 (1.38)	0(0.00)	02 (100.0)	0(0.00)	02 (100.0)
Teachers	07 (4.83)	01(14.29)	06 (85.71)	0(0.00)	07 (100.0)
p-value		0.99		0.24	
Parity					
Primiparous	28 (19.31)	4(14.29)	24 (85.71)	2(7.14)	26 (92.86)
Pauciparous	50 (34.48)	5(10.00)	45 (90.00)	2(4.00)	48 (96.00)
Multiparous	67 (46.21)	6(8.96)	61 (91.04)	0(0.00)	67 (100.0)
p-value		0.73		0.4	
Age of pregnancy					
1 st trimester	72 (49.65)	6 (8.33)	66 (91.67)	2 (2.78)	70 (97.22)
2 nd trimester	43 (29.65)	4 (9.30)	39 (90.70)	1 (2.33)	42 (97.67)
3 rd trimester	30 (20.70)	5 (16.67)	25 (83.33)	1 (3.33)	29 (96.67)
p-value		0.65		0.84	

N: Total number; %: percentage **Co-infection of HBV, HCV and HIV markers** No cases of co-infection were observed between HBsAg carrier rates ($p= 0.3$), HBeAg ($p= 0.74$) and HIV. Meanwhile, 10.20% (5/49) of pregnant women were co-infected with HCV/HIV, OR: 2.06 [95%CI: 0.56-7.51], $p= 0.21$. Moreover, this co-infection was observed among those aged 24-32 years with 8.20% (5/61), $p= 0.02$, among those living in couples or married (5.00% [5/100], $p= 0.12$), those in the third trimester of pregnancy (10.00% [3/30], $p= 0.09$). **Table 4** Tableau 4: Co-infection of HCV and HIV markers

Variables	Total N=145(%)	HIV/HCV co-infected		p-value
		Positive (%) 05 (3.45)	Negative (%) 140 (96.55)	
Age (years)				
15-23	67 (46.21)	0 (0.00)	67 (100.0)	0.09
24-32	61 (42.07)	05 (8.20)	56 (91.80)	0.02
33-41	17 (11.72)	0 (0.00)	17 (100.0)	0.90
Marital status				
Life in couple	100 (68.96)	05 (5.00)	95 (95.00)	0.12
Single	45 (31.34)	0 (0.00)	45 (100.00)	
Level of education				
Primary	28 (19.31)	0 (0.00)	28 (100.00)	0.59
Secondary	112 (77.24)	05 (4.46)	107 (95.54)	0.48
University	05 (3.45)	0 (0.00)	05 (100.00)	1.00
Profession				
Pupils	27 (18.62)	0 (0.00)	27 (100.00)	0.61
Student	03 (2.07)	0 (0.00)	03 (100.00)	1.00
Housewives	79 (54.48)	03 (4.84)	76 (96.20)	1.00
Dressing	04 (2.76)	0 (0.00)	04 (100.00)	1.00
Heamstresses	23 (15.86)	01 (4.35)	22 (95.65)	1.00
Nurses	02 (1.38)	01 (50.00)	01 (50.00)	0.09
Teachers	07 (4.83)	0 (0.00)	07 (100.00)	1.00
Parity				
Primiparous	28 (19.31)	0 (0.00)	28 (100.00)	0.59
Pauciparous	50 (34.48)	01 (2.00)	49 (98.00)	0.83
Multiparous	67 (46.21)	04 (5.97)	63 (94.03)	0.27
Age of pregnancy				
1 st trimester	72 (49.65)	01 (1.39)	71 (98.61)	0.37
2 nd trimester	43 (29.65)	01 (2.33)	42 (97.67)	1.00
3 rd trimester	30 (20.70)	03 (10.00)	27 (90.00)	0.09

N: total number; %: percentage

Discussion

The aim objective of this study was to determine the hepatitis B (HBV), C (HCV) and Human Immunodeficiency Virus (HIV) virus co-infection among pregnant women in the Bafia health district. On the 145 pregnant women enrolled, seroprevalence of 6.90% (10/145) for HIV was obtained. This result is similar to that observed by Lem et al., 2015[16](6.60%), Jodie et al., 2016[17] (6.00%) respectively in the North and South West regions of Cameroon. However, it is lower than the sentinel study conducted among pregnant women in the ten regions of the country by Bilong et al.[10] (7.8%). Despite the estimated HIV prevalence of 7.8% found by Bilong et al., 2015[10] among pregnant women in Cameroon, there is regional variability in HIV prevalence. The central region ranks first with an estimated prevalence of 11.9% [10]. In addition, HIV prevalence in antenatal care centers in Cameroon has gradually decreased from 10.5% in 2004 to 3.4% in 2014 [18].

Our result could also be explained by the implementation of the new WHO recommendations requiring the treatment of any person infected with HIV in order to reach the global target of 90-90-90 in 2020 [19]. In our study, we obtained a carriage rate of anti-HCVAb in pregnant women of 33.79% (49/145). This prevalence is higher in the work done by Fouelifack et al., 2018 [20] (1.7%), Njouom et al., 2003 [21] (1.8%), in neighboring Nigeria by Osazuwa et al., 2012 (1.7%) [22]. These very low prevalence may be explained by the fact that these studies used RNA amplification techniques to screen pregnant women for hepatitis C while our study used rapid diagnostic tests. The carriage rate of HBsAg was 10.34% (15/145). According to the World Health Organization (WHO), this prevalence of HBV in pregnant women is consistent with the fact that Cameroon, like other countries in sub-Saharan Africa, is located in an area of high endemicity (prevalence $\geq 8\%$) [23]. This result is similar of the work done by (Mansour et al., 2012 [24], Noubiap et al., 2014 [9], Taheu et al., 2017 [25]) who found 10.9%; 10.2% and 10.78% respectively. However, this result is significantly higher than those of Fomulu et al., 2013 [26] and Kfutwat et al., 2012 [27], with 7.7% and 7.85%, respectively, reported in two studies conducted in Yaoundé urban health centers. This shows that the prevalence of HBV varies in different regions and in different groups of the same population. This may be due to the variability of ethnic origin, socio-economic conditions and the high rate of emigration due to urbanization [28]. Our study found an overall prevalence of 2.7% (4/145) for HBeAg (marker of infectivity and active viral transmission). This prevalence of HBeAg is almost twice that observed by Noubiap et al., 2015 [9] (1.2%) suggesting that the probability of HBV transmission remains in our study. According to age group, the study population was majority young (46.20% [67/145], ages 15-23 years) with an average age of 25 ± 5.96 years. Seroprevalence of HIV was higher among pregnant women between 24-32 years with 9.84% (6/61). This prevalence is contrary to the work done by Bilong et al., 2015 [10] who found high prevalence (11.3%) among women aged 35-39 years and Lem et al., 2015 (17.4%) among pregnant women aged 31-40 years. However, our prevalence is similar to the study observed by the National Statistics Survey [29] among pregnant women aged 30-39 (9.1%). This result could be attributed to the fact that pregnant women in this age group are at the peak of their reproductive years and are exposed to multiple sexual activities which is the main risk factor for HIV [30]. With regard to the prevalence of HBV, HBsAg was high in age 33-41 years (35.29% [6/17]), $p = 0.001$. Our results disagree with the work of Lem et al., 2015 [31] in Cameroon and Sania et al., 2009 [32] of Pakistan who reported a prevalence of 11.5% and 2.6% respectively in women aged 20 and over years. This age group correlates with the highest age of sexual activity, suggesting the role of sexual intercourse in HBV transmission [31]. It should be noted that the HBsAg carrier rate increases with age from 7.46% (5/67) between 15-23 years to reach a peak of 35.29% (6/17) between 33-41 years. This could be explained by the introduction of HBV vaccine into national immunization programs in 1992 and implementation in Cameroon in 2005 [33]. For the HCV marker (anti-HCVAb), it was high in 45.90% (28/61) of pregnant women

aged 24-32 years. This result is similar to that observed by Mati et al. (52.0%) of anti-HCVAb between the 26-32 age group [34]. This high rate of anti-HCVAb in this age group may be explained by the fact that these women are at the peak of their reproductive years and are exposed to multiple sexual activities [30]. No co-infection (0%) was observed between HBsAg carrier rates ($p = 0.56$), HBeAg ($p = 0.65$), and HIV. Our results are contrary to the studies of (Noubiap et al., 2015 [9] (1.5%), 1.3% in Ethiopia (Zenebe et al., 2014) [35]. This difference could be explained by the small size of our sample and the diagnostic technique used. On the other hand, 10.20% (5/49) of the pregnant women were co-infected with the hepatitis C virus and HIV (OR: 2.06 [95%CI: 0.56 - 7.51], $p = 0.26$). Although this result is not statistically significant ($p = 0.26$), the fact remains that pregnant women co-infected with these viruses (HIV and HCV) are twice as likely to infecting their baby. HCV transmission from mother-to-child is 4 to 8% of births when women are infected with HCV and 17 to 25% of births when women are co-infected with HIV and HCV [36]. This co-infection could increase the risk of vertical transmission of these two viruses[37]. This risk of mother-to-child transmission of the C virus would be greater in cases of high viral load and HIV/HCV co-infection of up to 15 to 20% [37].

Study limitations

The investigation of HCV RNA not performed in pregnant women with anti-HCV antibodies (33.79%; 49/145) is the main limitation of our study. Of note, confirming HCV infection by a direct testing approach (HCV RNA or Ag) will help in detecting those with on going from those with past infection/exposure. Also lack of HBV-DNA PCR assay did not allow us in determining the contribution of OBI on the epidemiological burden of HBV during pregnancy in this semi-urban setting.

Conclusions

Seroprevalences of HIV, HBV (HBsAg) and HCV in pregnant women receiving antenatal care at the health district of Bafia were respectively 6.90% (10/145), 10.34% (15/145) and 33.79% (49/145) reflecting a significant risk of vertical transmission, especially HIV/HCV co-infection. The prevention strategies of these three viruses would primarily target pregnant women aged over 24, married or in a couple in health care areas with a typology similar to that of Bafia.

Abbreviations

(Ab): antibody; (AIDS): Acquired Immunodeficiency Syndrom; (Ag): Antigen; (ANC): Antenatal Care; (CI): Confidence Interval; (DNA): Dexoyribonucleic Acid; (EDTA): Ethylene Diamine Tetra Acetic; (HBV): Hepatitis B Virus; (HCV): Hepatitis C Virus; (HCC): Hepatocellular Carcinoma; (HBeAg): Hepatitis B envelop antigen; (HBsAg): Hepatitis B surface antigen; (HIV): Human Immunodeficiency Virus; (MTCT): Mother-To-Child

Transmission; NA: Not Applicable; (OR): Odds Ratio; (PCR): Polymerase Chain Reaction; (PLHIV): People Living with Human Immunodeficiency Virus; (SD): Standard Deviation; (RNA): Ribonucleic Acid; (WHO): World Health Organization.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained (N°2018/07/1059/CNERSH/SP) from the National Ethics Committee of Research on Human Health of Cameroon and the administrative authorization from the Bafia Health District Chief. A written and verbal information note, informed consent from adult, parental consent or guardian for children were obtained. Confidentiality was secured by the use of unique identification codes attributed to each of the study participants.

Consent for publication

Not applicable.

Availability of data and material

The datasets used during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors have declared that no competing interests.

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Authors' contributions

MCOA, CNT, PSN, JF: Research design

CNT, ECE, LGE, PSN: Contributed reagents/materials/analysis tools

CNT, ECE, LGE, PSN, ADPB, JF: Sample collection and laboratory work

CNT, PSN, JF: Analyzed the data

CNT, PSN, JF: Preparation and wrote the manuscript

All the authors read, revised and approved the final version of the manuscript

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Authors' information

Not applicable.

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Figures

Figure 1

Seroprevalence of HIV, HCV and HBV in the study population