Hepatitis B in Pregnancy: Knowledge, Access to Screening and Vaccination in a Low-Resource Setting, Cameroon

Armelle Maffo Mengouo[1], Gregory Edie Halle-Ekane[1*], Marcellin Nimpa Mengouo[2,3], Théophile Nana Njamen[1], Haman Makebe Nwain[1] and Henry LumaNamme[4]

[1]Department of Obstetrics and Gynecology, University of Buea, Cameroon.
[2]Ministry of Public Health, Yaounde, Cameroon.
[3]World Health Organization (WHO), Antananarivo, Madagascar .
[4]Department of Medicine, Faculty of Medicine and Biomedical Sciences, University of Yaoundé, Cameroon.

Original Research Article

ABSTRACT

Background: Hepatitis B virus (HBV) infection is a global public health problem with a high burden in Sub-Saharan Africa. This burden is more felt in the paediatric population, mother to child transmission (MTCT) being a major mode of infection. This study sought to assess the knowledge of pregnant women on HBV and their access to screening and vaccination.
Methods: A cross-sectional study was carried out in the South West Region, Cameroon from 15th January to the 15th April, 2018 involving third trimester pregnant women attending antenatal care (ANC) and those in the post-partum period admitted at the maternity wards of some hospitals. Data was collected using a structured questionnaire and analysed using SPSS version 23. Knowledge was evaluated using a series of twelve questions. Vaccination status was determined from vaccination cards and ANC registers.
Results: Of the 349 women studied, 31.8% were knowledgeable with scores of ≥ 6/12. High educational level (P= 0.002) and occupation as a health worker (P < .001) were associated with good knowledge. Ninety (90.0%) had been screened for hepatitis B surface antigen (HBsAg) during pregnancy while 14.6% had been vaccinated. Determinants of vaccination were monthly income >60.000FCFA (OR: 5.7 CI: 1.6-19.9), urban residence (OR: 4.0 CI: 1.1-15.0) and regional level of ANC health facility (OR: 12.4 CI: 2.0-76.4).
Conclusion: Only about three in ten women were knowledgeable on HBV infection. Ninety percent were screened during pregnancy but only ten percent were vaccinated. These results show that despite the high rate of HBV screening in this setting, most women have a poor level of knowledge about this infection and its prevention. We recommend that health education on HBV should be provided to pregnant women especially during antenatal visits and that preventive measures be re-enforced in South West Region.

**Corresponding author: E-mail: halle-ekane.edie@ubuea.cm, hallegregory@yahoo.fr;*

Keywords: Hepatitis B, pregnancy, prevalence, determinants, access, screening, vaccination, Cameroon.

ABBREVIATIONS

ANC : Antenatal care;
CI : Confidence interval;
HBsAg : Hepatitis B surface antigen;
HBV : Hepatitis B virus;
MTCT : Mother to Child Transmission;
WHO : World Health Organization

1. INTRODUCTION

Infection with Hepatitis B virus (HBV) is a major public health problem worldwide. Burdens of the disease are mainly in WHO Western Pacific Region and WHO African Region where 6.2% and 6.1% of the adult population is infected respectively [1]. Approximately 2 billion persons are infected worldwide of which 240 million are chronic carriers of hepatitis B virus (HBV) virus [2]. It is an important cause of morbidity and mortality with approx 800.000 infected persons dying yearly of complications of chronic hepatitis mainly liver cirrhosis and hepatocellular carcinoma (HCC) [2]. Sub-Saharan Africa is described as an area of high endemicity with an average prevalence above 8% [1,3]. Few studies in Cameroon have reported the prevalence of HBV in different sub-populations as11.9%, 19.9% and 7.7% in the general population, among children, and among pregnant women respectively [4–6]. A more recent study in Buea health district showed a prevalence of 9.7% in pregnant women [7]. These results place Cameroon at a high endemicity for HBV infection (> 8% prevalence) and reveal that the disease burden in Cameroon is in the pediatric population [1,5,8].

Mother-to-child-transmission (MTCT) is a major mode of HBV transmission worldwide, which is problematic since around 90% of infected infants progress to chronic hepatitis B. This risk is much higher than from horizontal transmission where the rate of chronicity is 30–50% when infected before 6 years of age and <5% when infected in adulthood [1,9,10]. Perinatal transmission being one of the commonest route of transmission, prevention of MTCT is, therefore, an essential step in reducing the burden of disease [11,12]. For this reason, routine screening of all pregnant women for hepatitis B surface antigen in each pregnancy, introduction of hepatitis B vaccine into the expanded program on immunization (adopted in 2005 in Cameroon) as well as neonatal HBV immunoprophylaxis at birth and vaccination of pregnant women at high risk of HBV is recommended [13–16]. Despite all these measures put in place, the prevalence of hepatitis B in Cameroon as a whole, and in Cameroonian pregnant women remains high with a prevalence of 7.7% in 2013 similar to 7.85% in a study done on samples collected ten years earlier [4,17].

Hepatitis B vaccine is the most effective measure for preventing HBV infection. After receiving all three doses, it provides a greater than 90% protection when received before being exposed[1,18-20]. This vaccine is not contraindicated in pregnancy and is safe both for the mother and fetus when administered at any of the three trimesters of gestation [21,22]. A meta-analytic study in Iranian pregnant women, 2017 estimated the HBV vaccination coverage at 9.8% [23]. In China coverage was estimated at 33% in pregnant women [24].In Cameroon, vaccination coverage of 2.7% was reported by Fomulu *et al* in 2012.

Several studies have assessed the prevalence of hepatitis B in pregnancy as well as the risk factors in Cameroon [4,7,25–27]. Hepatitis B vaccination in pregnancy is not one of the recommended vaccines during antenatal care (ANC) in Cameroon. However, it is fast becoming a standard of care in some health institutions because of its proven efficacy in the prevention of MTCT of hepatitis B. Despite this proven safety and protective effect of the vaccine, there is a paucity of data about the vaccination coverage in pregnant women in Cameroon. This study sought to assess the knowledge of pregnant women on HBV and their access to screening and vaccination.

2. MATERIALS AND METHODS

2.1 Study Design, Study Setting and Enrollment of Participants

This cross-sectional study was conducted at the antenatal clinics of three facilities in the south-west region (Buea, Limbe, Kumba) from 15th January to the 15th April, 2018. Two centres were selected from the secondary and one in the primary level of health care based on their high antenatal care client turnout. The study sites were the District Hospital Kumba (primary); the Buea and Limbe Regional Hospitals (secondary).

The study population included pregnant women in the third trimester attending antenatal clinics and women in the postpartum period admitted at the maternity ward in each of the selected centres. These women were informed about the study and requested to sign a written consent if they understood goals, procedures and accepted to participate in the study. Women in the first and second trimester and those who had never attended antenatal care for the ongoing pregnancy were excluded.

2.2 Sample Size Calculation and Sampling

The minimum sample size was calculated using the LORENZ formula [28]. The HBV prevalence used was 20.4% reported by Ducancelle *et al*, 2013 [26]. A minimum sample size of 271 was obtained with a 95% confidence and 5% accuracy and considering a 10% non-respondent rate. This sample size was then divided into the three hospitals according to their antenatal care turnout (BRH= 50 ANC clients/month giving a sample of 76 women; LRH= 60 ANC clients/month giving a sample of 90 women; DHK= 70 ANC clients/month giving a sample of 105 women). The study participants were chosen by convenience sampling.

2.3 Data Collection

A structured interviewer-administered questionnaire was used to collect data for both literate and illiterate women in the language they best understood. The questionnaire contained questions about socio-demographic characteristics. Questions to evaluate the level of knowledge of pregnant women about Hepatitis B virus infection, their access to screening and vaccination were equally asked. Prior to the use of the questionnaire in study participants, the questionnaire was pretested in 30 pregnant women in the Limbe Regional Hospital, Limbe with the aim of revising poorly structured questions, estimate the average time required to fill the questionnaire and thus validate the use of the questionnaire in our context. Information retrieved from pre-test group was not included in the final analysis. After data collection, the data were entered into CS Pro and then exported to SPSS version 23 for analysis.

2.4 Data Analysis

Knowledge was assessed by computing the number of correct responses to 12 general knowledge questions on Hepatitis B and scored. For each correct answer, a score of one (1) was allocated, while the score of zero (0) was allocated for no answer and for incorrect answers. Scores were stratified into four levels based on Essi and Njoya's 2013 guide on assessment of knowledge in KAP studies (Poor knowledge was considered for respondents with a total score of <3 marks(less than 25% right answers); insufficient knowledge for scores ranging from 3 to5 (25 to 49% of right answers), average knowledge for scores ranging from 6 and 8(50 to % of 74 right answers) and adequate knowledge for scores >8 (>74% of right answers) [29]. The vaccination status was based on the vaccination card and ANC registers, in the absence of which the participant's recall was used. All women who had a documentation of administration of at least a dose of hepatitis B Vaccine were considered "vaccinated"; those who had received at least three doses of the vaccine were considered "completely vaccinated" while those who had not completed their vaccination schedule were considered "incompletely vaccinated". Participants who had never received a dose of Hepatitis B vaccine were considered "not vaccinated". The screening status was based on the documentation of HBsAg testing during the previous ANC sessions for the ongoing pregnancy.

Data was analyzed with the Statistical Package for Social Sciences (SPSS) software version 23; frequency tables were created for proportions, Chi-square test for associations between categorical variables and one-way analysis of variance (ANOVA) for comparison of means between groups. Significant variables from cross tabulation between knowledge, screening vaccination status and socio-demographic variables were inserted into a binary logistic regression model. A p-value of <0.05 was considered statistically significant.

3. RESULTS

Out of a total of 353 potential participants who were approached for the study, 349 women were recruited. Of these, 93 (26.6%) and 114 (32.7%) were enrolled at the Buea and Limbe Regional Hospitals respectively (secondary centres); while 142 (40.7%) were enrolled at the District Hospital Kumba (Primary centre). Four potential participants did not consent for personal reasons, giving a response rate of 98.9%. The ages of the participants ranged from 16 to 43 years with a mean age of 27.35 ± 5.18 years in the general population. The majority were married or cohabiting 234 (67%) while 115 (33%) were

single. More than half 55(58.5%) had < 60000FCFA as monthly income because the majority of the participants refused to disclose their income. The study included 191 (54.7%) pregnant women and 158 (45.3%) women in the post-partum period. All pregnant participants were in the third trimester with gestational ages (weeks) ranging from 28 to 41weeks and a mean of 32.2 ± 4.1weeks. Significant differences between participants in the different health facilities were found in age, residence and

Table 1. Socio-demographic characteristics of participants in the various centres

Variables	BRH		LRH		DHK		TOTAL		p-value
	n	%	n	%	n	%	n	%	
Age									
<20	7	7.5	4	3.5	7	4.9	18	5.2	
20 < 25	28	28.6	27	23.7	36	25.4	91	26.1	
25 < 30	35	37.6	39	34.2	48	33.8	122	35.0	
30 < 35	21	22.6	37	32.4	38	26.7	96	27.5	**0.004**
>35	2	2.2	7	6.1	13	9.2	22	6.3	
Total	93	100	114	100	142	100	349	100	
Residence									
Urban	62	66.7	78	68.4	61	43.0	201	57.6	
Rural	31	33.3	36	31.6	81	57.0	148	42.4	**0.000**
Total	93	100	114	100	142	100	349	100	
Marital status									
Single	35	37.6	29	25.4	51	35.9	115	33.0	
Married	58	62.4	85	74.6	91	64.1	234	67.0	0.111
Total	93	100	114	100	142	100	349	100	
Income level									
<60.000fcfa	11	45.8	21	44.7	7	30.4	39	41.5	
>60.000fca	13	54.2	26	55.3	16	69.6	55	58.5	0.463
Total	24	100	47	100	23	100	94	100	
Gravidity									
1	47	50.5	38	33.3	39	27.5	124	35.5	
2-4	42	45.2	62	54.3	88	62.0	192	55.0	
≥5	4	4.3	14	12.2	15	10.6	33	9.5	**0.004**
Total	93	100	114	100	142	100	349	100	

gravidity. Table 1summaries the socio-demographic and obstetric characteristics of the respondents.

On the assessment of knowledge, 195 (55.9%) of participants had a poor knowledge about HBV infection, MTCT of HBV and HBV vaccination with knowledge scores < 3. Only 74 (21.2%) of participants had good knowledge (knowledge score ≥ 8). Table 2 summarizes the knowledge of study participants on Hepatitis B.

Knowledge about HBV was obtained from various sources; among all respondents, common sources included counselling sessions (79.5%), discussions with relatives and friends (27.3%) and the media (16.9%).

As shown in Table 2, 314 (90.0%) respondents had previously been screened for HBV infection during the ongoing pregnancy, and 51 (14.6%) had received at least one dose of hepatitis B vaccine. Only 9 (2.6%) were completely vaccinated. Thirty-eight (10.9%) were incompletely vaccinated but were following their normal vaccination schedule while 4 (1.1%) were incompletely vaccinated and had missed their subsequent doses by more than two years. An evaluation of associations between knowledge, previous screening and vaccination with socio-demographic variables was done using cross tabulation and significant variables were entered into a binary logistic regression model (Tables 3 to 6).

Following a univariate analysis, health workers (OR: 0.9 CI: 0.9-1.0), respondents attending ANC in a regional hospital (OR: 3.4 CI: 3.0- 5.4) and respondents with more than primary level of education (OR: 0.1 CI: 0.0- 0.4) were more likely to have good knowledge p-values = 0.002, 0.000 and 0.000 respectively (Table 3). However, on

Table 2. Knowledge, screening and vaccination status of the participants

Variables	Frequency (n= 349)	Percentage (%)
Knowledge		
Good (score ≥8)	74	21.2
Average (score 6-7)	37	10.6
Insufficient (score 3-5)	43	12.3
Poor (score <3)	195	55.9
Previously screened		
Yes	314	**90.0**
No	35	10.0
Previously Vaccinated*		
Yes	51	14.6
Completed (3 doses)	9	**2.6**
Incomplete respecting schedule	38	**10.9**
Incomplete not respecting schedule	4	1.1
No	**298**	**85.4**

**Vaccination status was based on participant's recall (3.9%) and vaccination cards (96.1%).*

Table 3. Factors associated with good knowledge on Hepatitis B

Variables	Knowledge level		Odds ratio	Confidence interval	p-value
	Good	Not good			
Age					
<35	67 (20.5%)	260 (79.5%)	0.6	0.2-1.4	0.277
>35	7 (31.8%)	15 (68.2%)			
Occupation					
Health worker	4 (100%)	0 (0.0%)	0.9	0.9-1.0	**0.002**
Not health worker	70 (20.3%)	275(79.7%)			
Level of Education					
≤ Primary	2 (3.6%)	54 (96.4%)	0.1	0.0-0.4	**0.000**
>Primary	72 (24.6%)	221 (75.4%)			
ANC hospital					
Secondary	47 (33.3%)	94 (66.6%)	3.4	2.0- 5.7	**0.000**
Primary	27 (13.0%)	181 (87.0%)			

Table 4. Predictors of good level of knowledge on Hepatitis B

Variables	Good knowledge	AOR(Confidence Interval)	A p-value
Age			
<35	67 (20.5%)	0.3 (0.6-1.4)	0.254
>35	7 (31.8%)		
Occupation			
Health worker	4 (100%)	0.3 (0.0-2.1)	0.999
Not health worker	70 (20.3%)		
Level of education			
≤ Primary	2 (3.6%)	0.3 (0.03-2.2)	0.218
>primary	72 (24.6%)		
ANC hospital			
Regional	47 (33.3%)	2.5 (0.8-8.0)	0.113
Peripheral	27 (13.0%)		

Table 5. Predictors of Screening for Hepatitis B

Variables	Previous screening (yes)	AOR (Confidence Interval)	A p-value
Age			
<35	279 (90.3%)	0.5 (0.06- 5.0)	0.577

**Corresponding author: E-mail: halle-ekane.edie@ubuea.cm, hallegregory@yahoo.fr;*

>35	20 (90.9)	1	
Occupation (Monthly Income)			
≤60.000FCFA	247 (89.8%)	1	
>60.000FCFA	70 (94.6%)	1.0 (0.2-5.7)	0.961
Level of education			
≤ Primary	48 (85.7%)	0.5 (0.1- 2.4)	0.376
>primary	269 (91.8%)	1	
ANC hospital			
Regional	136 (96.5%)	5.6 (1.1-28.4)	**0.036**
Primary	181 (87.0%)	1	

Table 6. Predictors of HBV vaccination

Variable	N (%)	AOR(95% CI)	p- value
Knowledge			
Good knowledge	25 (32.5)	2.6 (0.8- 9.1)	0.124
Poor knowledge	52 (67.5)	1	
ANC health facility			
Regional hosp.	48 (62.3)	12.4 (2.0- 76.4)	**0.007**
Primary.	29 (37.7)	1	
State of client			
Pregnant	49 (63.6)	2.4 (0.5- 11.5)	0.261
Post-partum	28 (36.4)	1	
Residence			
Urban	45 (58.4)	4.0 (1.1- 15.0)	**0.037**
Rural	32 (41.6)	1	
Monthly income			
>60000 CFA	34 (44.2)	5.7 (1.6- 19.9)	**0.007**
<60000 CFA	43 (55.8)	1	

multivariate analysis, none of the factors was found to be predictors of good knowledge (Table 4). The Tables 3 to 6 show predictors of good knowledge, screening and vaccination in the respondents.

Pregnant women attending ANC at the regional hospitals were more likely to have been screened during the ongoing pregnancy (OR: 5.6, CI: 1.1-28.4, p= 0.036) and vaccinated than their counterparts (AOR 12.4(2.0- 76.4) p= 0.007). Furthermore, those living in urban areas (p= 0.037) and those with a monthly income of greater than 60.000FCFA (p= 0.007) were more likely to have been vaccinated. However, a good knowledge on HBV infection was not significantly associated with HBV vaccination (Table 6).

4. DISCUSSION

Limiting Mother to child transmission of HBV infection has been identified as the main axis of care in order to envisage eradication of HBV infection worldwide. Screening asymptomatic people is an important instrument of disease detection, diagnosis and intervention but also a means of detecting candidates eligible for vaccination. Given that infected pregnant women stand the chance of transmitting the HBV infection to their newborn babies, we decided to conduct a cross-sectional study to determine what proportion of pregnant women attending ANC in Buea are knowledgeable, screened and/ or vaccinated during pregnancy to limit MTCT of HBV in the southwest region. The information gathered from this piece of work will be used by the health care providers in the region to scale up their current practices as concerns PMTCT of HBV infection.

In the current study, the predominant age group of the respondents was 25<30 years. This is similar to the results of Adeyemi *et al*, Nigeria 2013 who described a predominant age group of 26-35 years which is within the reproductive age bracket and this emphasises the need for preventive measures in all women of childbearing age [30].

In our study, 31.8% of women had at least an average level of knowledge while up to 55.9% had poor knowledge on HBV infection. Good knowledge about HBV was found to be more likely in women who attended antenatal care at

the secondary level of healthcare, those with higher levels of education and in health workers. The two latter may be due to their relatively higher exposure to the health care services and information on HBV infection. Good level of knowledge was associated with attending ANC in a higher health care level on the other hand could be due to increase standards of care probably attributable to the greater number of specialists who have been shown (Paul *et al,* Cameroon, 2017) to have a relatively higher level of knowledge on HBV infection as opposed to other health care workers [31].
The results also reveal a high rate of HBsAg screening of pregnant women with a 90% screening rate. This result is similar to the findings of Walker *et al* in the USA; 2016 who had reported a screening rate of 98.5% [32]. It is, however, higher than the 8.5% reported by Adeyemi *et a*l 2013, Nigeria. [30] This may be due to the relatively higher proportion of health practitioners in Cameroon who have incorporated HBsAg screening into the routine ANC as compared to those in Nigeria.

The vaccination rate of 14.6% for at least a dose of HBV vaccine was the highest reported nationwide [4, 25, 33]. This may be due to adoption of maternal HBV vaccination of non-infected pregnant women in some of our study areas. The result is, however, lower than the 33% reported by Chan *et al* in China, 2009 probably due to socio-economic differences between the two settings [24].

Attending ANC at the secondary health care level was associated with higher rates of screening and vaccination probably due to the increased standard of care as compared to the primary level. Living in an urban residence and having a higher monthly income were significantly associated with a higher vaccination rate probably related to the relatively easier accessibility to health care and also to information on the disease and its prevention via the media as supported by their relatively higher knowledge on HBV earlier stated.

These findings may mean that vaccination is poor among pregnant women in our society and that more effort needs to be directed towards instituting guidelines and well-structured protocols for these services in adults.

5. CONCLUSION

Only about three in ten women were knowledgeable on HBV infection. Ninety percent were screened during pregnancy but only ten percent were vaccinated. High vaccination rates were associated with; antenatal care provided at the secondary health care level, good knowledge, screening, urban residence and high monthly income. These results show that despite the high rate of HBV screening in this setting, most women have a poor level of knowledge about this infection and its prevention. We recommend that health education on HBV should be provided to pregnant women especially during antenatal visits and that preventive measures be re-enforced in our setting.

6. LIMITATIONS OF STUDY

The assessment of level of knowledge of the participants on hepatitis was not exhaustive using twelve questions but these questions were selected in such a way that they suited the study objectives and a scoring system ensure objectivity, reproducibility and reliability. Information on the vaccination status was obtained from the participants so there was a risk of recall bias, however, this was reduced by the fact that most of them (96 %) had vaccination cards. By selecting high volume centers providing both first and second levels of health care in the region, it permitted generalisation of the findings which is a limitation of the study. Despite these limitations, this study addressed issues on Hepatitis B in pregnancy in a country where routine screening and vaccination have not been instituted as a national policy.

CONSENT

It is not applicable

ETHICS APPROVAL

Ethical clearance was obtained from the Faculty of Health Sciences Institutional Review Board of the University of Buea (N^{O}2018/ 128/ UB/ SG/IRB/ FHS) and administrative authorization from the Regional Delegation of Public Health for the South West Region of Cameroon. **Consent :** Written informed consent was obtained from all participants.

AVAILABILITY OF DATA AND MATERIALS

The data sets supporting the conclusion of this study are available from the corresponding author upon reasonable request.

REFERENCES

1. World Health Organization. WHO hepatitis B. Geneva: WHO; 2017. Available from: http://www.who.int/mediacentre/factsheets/fs204/en/. Accessed; 16/08/2017
2. Lavanchy D, Kane M. *Global Epidemiology of Hepatitis B Virus Infection* [Internet]. 2016. pp. 187–203. Accessed ; 18/08/2017
3. Zampino R, Boemio A, Sagnelli C, Alessio L, Adinolfi LE, Sagnelli E, *et al*. Hepatitis B virus burden in developing countries. *World J Gastroenterology. 2015;* 21(42): pp 11941–53.
4. Fomulu NJ, Morfaw FL, Torimiro JN, Nana P, Koh MV, William T. Prevalence, correlates and pattern of Hepatitis B among antenatal clinic attenders in Yaounde-Cameroon: is perinatal transmission of HBV neglected in Cameroon? *BMC Pregnancy Childbirth*. 2013;13(1):158.
5. Chiaramonte M, Stroffolini T, Ngatchu T, Rapicetta M, Lantum D, Kaptue L, *et al.* Hepatitis B virus infection in Cameroon: a sero epidemiological survey in city school children. *J Medical Virology*. 1991; 33(2):95–9.
6. Infectious Diseases of Cameroon: GIDEON Informatics, Google Books [Internet]. Cameroon: 2017 edition. Available from: https://www.gideononline.com/ebooks/disease. Accessed; 06/08/2017
7. Frambo AAB, Atashili J, Fon PN, Ndumbe PM. Prevalence of HBsAg and knowledge about hepatitis B in pregnancy in the Buea Health District, Cameroon: a cross-sectional study. *BMC Res Notes*. 2014;7(1):394.
8. Ndumbe PM, Njie TK. Hepatitis A and B infections in Yaoundé, Cameroon. *Res Virol*. 1989; 140:253–61.
9. Gambarin-Gelwan M. Hepatitis B in Pregnancy. Clin Liver Dis. 2007;11(4):945–63.
10. Lai CL, Ratziu V, Yuen M-F, Poynard T. Viral hepatitis B. *The Lancet*. 2003; 362(9401):2089–94.
11. Navabakhsh B, Mehrabi N, Estakhri A, Mohamadnejad M, Poustchi H. Hepatitis B virus infection during pregnancy: transmission and prevention. *Middle East J Dig Dis*. 2011;3(2):92.
12. Han Z, Yin Y, Zhang Y, Ehrhardt S, Thio CL, Nelson KE, et al. Knowledge of and attitudes towards hepatitis B and its transmission from mother to child among pregnant women in Guangdong Province, China. *PLoS ONE* [. 2017;12(6).
13. Ayoub WS, Cohen E. Hepatitis B management in the pregnant patient: an update. *Journal Clinical Translational Hepatology. 2016;4(3):241.*
14. UNICEF. Cameroon: WHO and UNICEF estimates of immunization coverage: 2016 revision. UNICEF; 2016.
    Available from:https://data.unicef.org/wp-content/uploads/country_profiles/Cameroon/immunization_country_profiles/immunization_cmr. Accessed; 19/9/2017.
15. Expanded programme on immunization. Global Advisory Group--Part I. *Weekly Epidemiological Records*. 1992;67(3):11–5.
16. Kane MA. Global status of hepatitis B immunization. *Lancet London England*. 1996 14;348(9029):696.
17. Kfutwah AKW, Tejiokem MC, Njouom R.A low proportion of HBeAg among HBsAg-positive pregnant women with known HIV status could suggest low perinatal transmission of HBV in Cameroon | *Virology Journal*. 2012; 9 (62)
18. Nelson NP, Jamieson DJ, Murphy TV. Prevention of Perinatal Hepatitis B Virus Transmission. *Journal Pediatric Infectious Disease Soc.* 2014;3 Suppl 1: S7–12.
19. Knoema. Cameroun Taux de fertilité. Cameroon: 2017 Knoema..
    Available from: https://knoema.fr//atlas/Cameroun/topics/Données-démographiques/Fertilité/Taux-de-fertilité.
20. Centers for Disease Control and Prevention. HBV FAQs for Health Professionals [Internet]. USA: CDC; 2016. Available from: https://www.cdc.gov/hepatitis/hbv/hbvfaq.htm. Accessed; 18/08/2017
21. Centers for Disease Control and Prevention. Hepatitis B Vaccine Safety Vaccines [Internet]. USA: CDC; 2015. Available from https://www.cdc.gov/vaccinesafety/vaccines/hepatitis-b-vaccine.html. Accessed;18/08/2017

22. Ayoola EA, Johnson AOK. Hepatitis B vaccine in pregnancy: Immunogenicity, safety and transfer of antibodies to infants. *International Journal of Gynecology/ Obstetrics. 1987* Aug 1;25(4): pp 297–301.

23. Badfar G, Shohani M, Nasirkandy MP, Mansouri A, Abangah G, Rahmati S, et al. Epidemiology of hepatitis B in pregnant Iranian women: a systematic review and meta-analysis. *Archives of Virology.* 2017; PMID: 29063378

24. Chan OK, Suen SSH, Lao TT-H, Leung VKT, Yeung SW, Leung TY. Determinants of hepatitis B vaccine uptake among pregnant Chinese women in Hong Kong. *Int J Gynecol/ Obstet*. 106:232–5.

25. Noubiap JJN, Nansseu JRN, Ndoula ST, Bigna JJR, Jingi AM, Fokom-Domgue J. Prevalence, infectivity and correlates of hepatitis B virus infection.
https://www.hindawi.com/journals/jp/2018/8435910/. Accessed ; 17/9/2017

26. Ducancelle A, Abgueguen P, Birguel J, Mansour W, Pivert A, Le Guillou-Guillemette H, *et al*. High Endemicity and Low Molecular Diversity of Hepatitis B Virus Infections in Pregnant Women in a Rural District of North Cameroon. *PLOS ONE*. 2013;8 (11).

27. PL026.Burden of Hepatitis B virus and the risk of vertical Transmission at the Penka Michel Health District.Cameroon:PL026; Mar2017.
Availablefrom: http://www.masante-cam.org/273.
Accessed: 16/08/2016

28. Charan J, Biswas T. How to Calculate Sample Size for Different Study Designs in Medical Research? *Indian J Psychol Med*. 2013 ;35(2) :121–6.

29. Essi MJ, Njoya O. L'Enquête CAP (Connaissances, Attitudes, Pratiques) en Recherche Médicale. Laboratoire de Recherche sur les Hépatites Virales et Communication en Santé .*FMSB. Health Sci. Di*.2013; 14(2).

30. Adeyemi AB, Enabor OO, Ugwu IA, Bello FA, Olayemi OO. Knowledge of hepatitis B virus infection, access to screening and vaccination among pregnant women in Ibadan, Nigeria*. J Obstet Gynaecol*. 2013;33(2):155–9.

31. Paul T, Marie TP, Bechem E. Knowledge, attitude and practice of staff of 4 hospitals in Yaoundé on the prevention of vertical transmission of hepatitis B. *Pan Afr Med J*. 2017 25;28(174).

32. Walker TY, Smith EA, Fenlon N, Lazaroff JE, Dusek C, Fineis P, *et al*. Characteristics of Pregnant Women with Hepatitis B Virus Infection in 5 US Public Health Jurisdictions, 2008-2012. *Public Health Rep*. 2016;131(5):685–94.

33. Dionne-Odom J, Mbah R, Rembert NJ, Tancho S, Halle-Ekane GE, Enah C et al. Hepatitis B, HIV, and Syphilis Seroprevalence in Pregnant Women and Blood Donors in Cameroon: a cross-sectional study. Infectious Diseases in Obst and Gynecol Volume 2016.
DOI.org/10.1155/2016/4359401, Article ID 4359401.
Accessed; 17/09/2017