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# Correlates of Hepatitis B Virus Infection among Antenatal Clinic Attendees of Volta Regional Hospital, Ho, Volta Region, Ghana

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## Abstract

Hepatitis B virus (HBV) infection remains a global health problem. With about 380 million chronic carriers of the HBV virus, there are over two million global deaths annually. Ghana is among the high endemic countries in Africa, with HBV prevalence ranging from 4.8% to 12.3% in the general population, 10.8% to 12.7% in blood donors and about 10.6% in antenatal clinic (ANC) attendees. The main objectives of this study were to test how socioeconomic factors, risky behaviors, knowledge and awareness of HBV infection correlate with actual HBV status among antenatal clinic attendees and to determine the predictors of HBV testing among ANC attendees. The study employed random sampling technique to sample 500 pregnant women, at mothers' clinic of Volta Regional Hospital, Ho, Ghana. A structured questionnaire was used to collect information on socio-demographic characteristics, Hepatitis B status, possible risk factors, awareness and knowledge levels of HBV infection. Cross tabulation and the *chi*-square ($\chi^2$) statistic were used to determine statistical independence or association of study variables. Kruskal-Wallis test was applied to test for the differences in HBV knowledge scores across HBV status and levels of HBV awareness; and the binomial regression model was used to determine the predictors of HBV testing among ANC attendees. It is evident that age, religion, ethnicity, educational level, blood transfusion, number of blood transfusions, gravidity, parity, awareness of HBV and monthly income were associated with HBV status. Results of the Binomial Logistic Regression model indicate that Age ($p = 0.03$), Education level ($p = 0.04$), Religion ($p = 0.04$), Ethnicity ($p = 0.00$) and Blood transfusion ($p = 0.04$) were significant ($p < 0.05$) predictors of HBV testing. Knowledge of HBV status enables patients to seek early treatment, facilitates referral for social support and counseling. We recommend that the Ministry of Health should carry effective education on HBV and its prevention for women of child-bearing age.

**Keywords**

Binomial Logistic Regression, Hepatitis B Virus Infection, Antenatal Clinic Attendees

## 1. Introduction

With about three hundred and eighty million chronic carriers of Hepatitis B virus (HBV) globally and over two million global deaths annually, HBV infection remains a global health problem [1]. HBV is among a group of viruses known as hepatotropic virus, belonging to the family hepadnavirus [2]. The natural host is only humans. The blood transports HBV to the liver, where replication of the virus only occurs [3]. Among hepatitis A, B, C, D and E, HBV is the most important hepatitis virus during pregnancy [4]. Hepatitis B virus-related liver diseases include chronic hepatitis, liver cirrhosis and hepatocellular carcinoma [5].

Hepatitis B virus infection is a major global health problem associated with high prevalence, significant morbidity and mortality [5]. An estimate of about 2 billion people are infected with the HBV worldwide, of which about a quarter would develop chronic infection with increasing risk of progressing to liver disease and hepatocellular carcinoma (HCC). Chronic carriers of the HBV are over 380,000,000 worldwide with HBV related diseases contributing to over 2,000,000 deaths annually [4].

The likelihood that infection with the virus becomes chronic depends upon the age at which a person becomes infected. Children less than 6 years of age who become infected with the hepatitis B virus are the most likely to develop chronic infections. 80% - 90% of infants infected during the first year of life develop chronic infections and 30% - 50% of children infected before the age of 6 years develop chronic infections. Less than 5% of otherwise healthy persons who are infected as adults would develop chronic infection, with 20% - 30% of adults who are chronically infected developing cirrhosis and/or liver cancer [6].

Ghana is among the high endemic countries in Africa, with HBV prevalence ranging from 4.8% to 12.3% in the general population, 10.8% to 12.7% in blood donors and about 10.6% in ANC attendees [7]. Although, perinatal transmission of HBV infections is common in endemic areas, the reduction of vertical transmission rate is achievable by increasing the awareness and knowledge level in the general public including pregnant women.

Various studies conducted in Ghana indicate that HBV is endemic in Ghana with sero-prevalence rates ranging from 6.7% to 10% in blood donors [8], 6.4% in pregnant women [9] and 15.6% in children [10] among the general population. With an overall sero-prevalence of 61.2% in a study, there were increasing rates from 48% to 80% in children aged between 6 - 18 years [10]. Further studies show the prevalence rate of Hepatitis B surface antigen (HBsAg) among pregnant women in Accra, Ghana, increased from 6.4% in1994 [9].

The modes of transmission of HBV include having sexual contacts with multiple sexual partners, being transfused with infected blood or other infected human blood products through the re-use of contaminated needles and syringes, and vertical transmission from mother to child during childbirth [11]. Without intervention, a mother who is positive for HBsAg confers a 20% risk of passing the infection to her offspring at the time of birth. This risk is as high as 90% if the mother is also positive for HBeAg. HBV can be transmitted horizontally between family members within households, and among children possibly by contact of non-intact skin or mucous membrane with secretions containing HBV. However, at least 30% of reported HBV infection among adults cannot be associated with an identifiable risk factor. Other risk factors for contracting HBV infection include working in a healthcare setting, blood transfusions, dialysis, acupuncture, tattooing, body piercing, scarification, using contaminated razors or toothbrushes. However, hepatitis B viruses cannot be spread by holding hands, sharing eating utensils or drinking glasses, kissing, hugging, coughing, sneezing, or breastfeeding [12].

The most common mode of HBV transmission worldwide is perinatal transmission [5]. Perinatal period however, is from the 28th week of gestation to the 28th day after delivery [13]. There is 70% - 90% chance of perinatal transmission of Hepatitis B for a baby born to a mother who is positive for both HBsAg and Hepatitis B envelope antigen HBeAg [5], while those born to seropositive mother with HBsAg but negative to HBeAg have 25% chance of acquiring perinatal HBV [14]. This notwithstanding, a seropositive mother with low titres of both HBsAg and HBeAg still has the chance of infecting the unborn child perinatally [5].

Babies are one of the vulnerable groups for HBV infection. This is because of the risk of transmitting the HBV infection from mothers who are infected to their babies [4]. Transplacental viral infection is uncommon, and Towers *et al.* [15] reported that viral DNA is rarely found in amniotic fluid or cord blood. However, HBV DNA has been found in ovaries of HBV-positive pregnant women, and the highest levels were found in women who transmitted HBV to their fetuses [16] [17] [18]. A prospective cohort study between 2011 and 2013 with the aim of determining the effects of hepatitis B during pregnancy on birth outcomes in Ghana, and consisting of 512 pregnant women who attended antenatal clinic at the Cape Coast Teaching Hospital, indicated that there is a higher risk of transmission from mothers with positive HBsAg to their babies with adverse neonatal consequences [19]. In a related study, babies of women with acute HBV infection are likely to be premature [20].

One in 8 pregnant women is infected with HBV because the risk of transmitting HBV contaminated blood remains high [21]. Pregnant women with Acute

Hepatitis B infection are likely to have premature labour while chronic HBV infection in pregnancy results to intra-partum and post-partum haemorrhage, because vitamin K dependent clotting factors are not produced [20].

Hepatitis B infection is a serious public health threat in Ghana and considering the fact that pregnant women are a high-risk group [22], there is the need to research into the correlates of HBV infections among pregnant women. Knowledge of HBV status provides opportunities for patients to seek early treatment, facilitates referral for social support and counseling. The main objectives of this study are to test how socioeconomic factors, risky behaviors, knowledge and awareness of HBV infection correlate with actual HBV status among antenatal clinic attendees and to determine the predictors of HBV testing among antenatal clinic attendees.

## 2. Materials and Methods

### 2.1. Data

The study is a cross sectional study. Structured questionnaires were used to find knowledge level of the study population. On the knowledge of HBV infection, questions including the transmission of the infection, risk factors, management, prevention and immunization against the infection were asked. Information on the status; presence or absence of hepatitis B surface antigen, and socio-demographic information (*Age*, *Marital status*, *Residence*, *Number of children*, *Religion*, *Level of education*, *Occupation*), *Parity* (number of children), history of *blood transfusion* and *sexual history* (number of life-time sexual partners) were collected using the structured questionnaire and/or from the antenatal record books of the study subjects.

The data (available as **Additional Material**) was obtained through face-to-face interview and interpretation of the question was either carried in English, Ewe and Twi; and in the participants' dialect. The population includes pregnant women reporting for routine antenatal check-up between 1st February, 2017 and 27th April, 2017.

A systematic random sampling was adopted to give all potential respondents an equal chance of being selected for the study. With an average daily attendance at the booking clinic of about 50, an average of five questionnaires was administered per day giving a sampling interval of 10. Using the booking records books at the antenatal clinic the first respondent was selected from the first 10 attendants randomly by balloting. The next respondent was therefore the 10th attendant after the first attendant sampled and then it followed. If an attendant declined to participate, the third attendant after her was selected. Predetermined criteria were the bases for this sampling method. Sample size was determined as expressed in Equation (1):

$$n = \frac{(z)^2 (p)(1-p)}{E^2} \tag{1}$$

where; $n$ is the estimated sample size; $E$ is the desired margin of error (0.05), $z$ is the statistic for the level of confidence (95%) = 1.96; $p$ is the (10.6%) prevalence of HBV infection among pregnant women in the Eastern Region of Ghana in a previous study in 2012 [23]. From Equation (1), the minimum sample size is 137. Adding 20% gives a sample size of 164 which catered for unforeseen circumstances such as uncompleted questionnaires. However, the final study size was 500 participants.

## 2.2. Analysis

The data for the study was analyzed with the R statistical software (R Core team [24]; version 3.4.4; Released 15 March, 2018). The study employed a cross tabulation which is a joint frequency distribution of cases based on two or more categorical variables which is known as contingency table analysis. The joint frequency distribution was analyzed with the *chi*-square ($\chi^2$) statistic to determine whether the variables are statistically independent or if they were associated. In the analysis, other indicator of association, such as *Phi*-value ($\phi$) was used describe the degree which the values of one variable predict or vary with those of the other variable if a dependency or association between variables does exist.

Scores of respondents on knowledge of HBV infection was converted to 100% and the Kruskal-Wallis test was applied to the data to test for the differences in HBV knowledge scores across HBV status and levels of HBV awareness. In this study, HBV knowledge scores, measured on a continuous scale from 0 - 100, was used as the dependent variable for the Kruskal-Wallis test and for independent variables, HBV status and levels of HBV awareness were used. The Kruskal-Wallis test was used because the response variable (HBV knowledge scores) violated the normality test. Pairwise Wilcoxon rank sum test was used to calculate pairwise comparisons between group levels. Box and Whiskers was also used to visualize the variation or differences in HBV knowledge scores, HBV status, and levels of HBV awareness.

HBV status had four independent groups: respondents with "positive status", "negative status", "do not know status" and "have not tested status". Also, HBV awareness had three independent groups: respondents with "very aware", "somehow aware" and "not aware".

The study also formulated a Binomial regression model to determine the predictors of HBV testing among antenatal clinic attendees. In formulating the binomial regression model, HBV testing was used as binary (Bernoulli) response variable and was denoted by

$$p = P\left(\text{HBV}_{\text{test}} = 1\right). \tag{2}$$

The binomial regression model specification is given as:

$$\log_e\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 Age + \beta_2 Rel + \beta_3 Eth + \beta_4 Edu + \beta_5 BT + \beta_6 Par + \beta_7 MI \tag{3}$$

where $p = P\left(\text{HBV}_{\text{test}} = 1\right)$; $Age$ = Age of attendees; $Eth$ = Ethnicity; $Edu$ = Educational levels; $BT$ = blood transfusion; $Par$ = parity; and $MI$ = monthly income of attendees.

In this study, the chosen significance level ($\alpha$) was 5% (less than 1 in 20 chance of being wrong) and all estimated probability ($p$-value) less than $\alpha$ was considered significant. The choice of the $\alpha$-value was arbitrary.

# 3. Results

## 3.1. *Chi*-Square ($\chi^2$) Test and Cross Tabulation

Table 1 captures the summary of cross tabulation, the $\chi^2$ tests and it corresponding significance and $\phi$ values of variables of interest. The first column represents the variables of interest. The second column represents the Pearson $\chi^2$ values of the various cross tabulation models. The third column represents statistical significance $p$-values. The fourth column represents degrees of freedom and the last column represents $\phi$ values. Ten variables or factors were associated with HBV status. These factors were age, religion, ethnicity, educational level, blood transfusion, number of blood transfusion, gravidity, parity, awareness of HBV infection and monthly income.

The $\chi^2$ test is based on a null hypothesis and an alternative hypothesis. In the context of age against HBV status, the hypotheses were:

**$H_0$: *Age* is not related (associated) to HBV status among antenatal attendees.**

**$H_1$: *Age* is related (associated) to HBV status among antenatal attendees.**

Table 1. Summary of cross tabulation and the *chi*-square results.

| | Variables of Interest | $\chi^2$ Value | $p$-Value | DoF | $\phi$-Value |
|---|---|---|---|---|---|
| 1 | *Age* **against** Hepatitis B Status | 33.243 | 0.04** | 15 | 0.258 |
| 2 | *Employment* **against** Hepatitis B Status | 5.99 | 0.424 | 6 | 0.109 |
| 3 | *Religion* **against** Hepatitis B Status | 24.168 | 0.00** | 6 | 0.22 |
| 4 | *Ethnicity* **against** Hepatitis B Status | 54.241 | 0.00** | 12 | 0.329 |
| 5 | *Marital status* **against** Hepatitis B Status | 12.519 | 0.186 | 9 | 0.158 |
| 6 | *Education* **against** Hepatitis B Status | 73.822 | 0.00** | 15 | 0.384 |
| 7 | *HIV status* **against** Hepatitis B Status | 1.892 | 0.929 | 6 | 0.062 |
| 8 | *Blood trans* **against** Hepatitis B Status | 15.533 | 0.001** | 3 | 0.176 |
| 9 | *No. of blood trans* **against** Hepatitis B Status | 22.092 | 0.037** | 12 | 0.21 |
| 10 | *No. sex partners* **against** Hepatitis B Status | 11.073 | 0.271 | 9 | 0.149 |
| 11 | *Gravidity* **against** Hepatitis B Status | 54.158 | 0.004** | 30 | 0.329 |
| 12 | *Parity* **against** Hepatitis B Status | 83.28 | 0.00** | 15 | 0.408 |
| 13 | *No. of preterm babies* **against** Hepatitis B Status | 2.795 | 0.972 | 9 | 0.075 |
| 14 | *Heard of HBV* **against** Hepatitis B Status | 50.483 | 0.00** | 9 | 0.318 |
| 15 | *Monthly Income* **against** Hepatitis B Status | 23.944 | 0.021** | 12 | 0.219 |

$\chi^2$ = *Chi*-square value, $\phi$ = *Phi*-value, **Figures in italics are significant ($p < 0.05$).

From the first row of Table 1, $\chi^2 = 33.243$ and $p = 0.04$; is a very small probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p < 0.05$. This test result suggests that there is relationship or association between *age* and HBV status of antenatal attendees. Also the $\phi$ value of 0.258 indicates that the magnitude of association is approximately 26% which is a weak positive relationship between *age* and HBV status of antenatal attendees.

The association between *religion* and HBV status: with $\chi^2 = 24.168$ and $p = 0.00$, there is a zero probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p < 0.05$. These test results indicate that there is a relationship or association between religion and HBV status of antenatal attendees. The $\phi$ value of 0.109 indicates that the magnitude of association is approximately 11% which is weak positive relationship between *religion* and HBV status of antenatal attendees.

*Ethnicity*: $\chi^2 = 54.241$ and $p = 0.00$; is a zero probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p < 0.05$. This test result implies that there is a relationship or an association between *ethnicity* and HBV status of antenatal attendees. The $\phi$ value of 0.329 indicates that the magnitude of association is approximately 33% which is weak positive relationship between *ethnicity* and HBV status of antenatal attendees.

*Education*: $\chi^2 = 73.822$ and $p = 0.00$ for *education* vs. HBV status, has a zero probability of the observed data under the null hypothesis of no relationship. The null hypothesis is rejected, since $p < 0.05$. This test result implies that there is a relationship or association between *education* and HBV status of antenatal attendees. The $\phi$ value of 0.384 indicates that the magnitude of association is approximately 38% which is weak positive relationship or association between *education* and HBV status of antenatal attendees.

Clearly the $\phi$-values (Table 1) indicate that, all the significant variables had weak positive associations with HBV status of antenatal attendees. The approximate magnitude or size of association of these factors with HBV status ranged from 18% to 41% and with degrees of freedom (DoF) also ranging from 3 to 30.

## 3.2. Analyses of Variance

### HBV Status and HBV Awareness Levels with HBV Knowledge Scores as

Table 2 captures the distribution of HBV knowledge cores, HBV status and HBV awareness levels in terms of median, minimum and maximum scores. The number of positive HBV attendees who are *very aware of HBV* were 14, the number of negative HBV attendees who are *very aware of HBV* were 339 and so on.

Comparing the median HBV knowledge scores of the attendees that are "*Very aware*" to attendees that are "*Somehow aware*" and "*Not aware*", it is clear from Table 2 that higher HBV knowledge scores are obtained by attendees that were

**Table 2.** Distribution of HBV knowledge scores, HBV status and HBV awareness levels.

| | HBV Status | HBV Awareness Levels | Number of Attendees | Median HBV Scores (%) | Minimum HBV Scores (%) | Max. HBV Scores (%) |
|---|---|---|---|---|---|---|
| 1 | Positive | Very Aware | 14 | 36 | 3.6 | 79.2 |
| 2 | Negative | Very Aware | 339 | 50.4 | 3.6 | 93.6 |
| 3 | Do Not Know | Very Aware | 12 | 48.6 | 3.6 | 75.6 |
| 4 | Haven't Tested | Very Aware | 11 | 64.8 | 3.6 | 93.6 |
| 5 | Negative | Somehow Aware | 35 | 3.6 | 3.6 | 61.2 |
| 6 | Do Not Know | Somehow Aware | 14 | 3.6 | 3.6 | 3.6 |
| 7 | Positive | Not Aware | 4 | 21.6 | 3.6 | 54.0 |
| 8 | Negative | Not Aware | 60 | 7.2 | 3.6 | 68.4 |
| 9 | Do Not Know | Not Aware | 9 | 3.6 | 3.6 | 57.6 |
| 10 | Haven't Tested | Not Aware | 2 | 3.6 | 3.6 | 3.6 |

"*Very aware of HBV*". Also attendees with negative HBV status had higher HBV knowledge scores compared with attendees with positive HBV status.

The information in the forgoing paragraphs is well captured by the box and whiskers plot in **Figure 1**, the lines in the middle of the boxes are the median HBV knowledge scores for each group. The vertical sizes of the boxes are the interquartile range which measures the spread of the HBV knowledge scores in the form of standard deviation. The whiskers or the flattened arrows extending out of the box represent the reasonable extremes (minimum and maximum) of HBV knowledge scores. The points beyond the whiskers are outliers, HBV knowledge scores that are too huge compared with the rest of the data.

Results from **Table 3** indicate that there is a significant difference in HBV knowledge scores between HBV status *i.e.* Positive, Negative, Do not know and Have not tested (*p*-value = 0.00). In the context of pairwise comparison, there is also a significant difference in HBV knowledge scores across HBV status. Specifically, *Negative* against *Do not know* (*p*-value = 0.00) and Do not know against Have not been tested (*p*-value = 0.03).

Also, there is a significant difference in HBV knowledge scores between HBV awareness levels (*p*-value = 0.00). In the context of pairwise comparison, there is also a significant difference in HBV knowledge scores across HBV awareness levels. Specifically, *Very aware* against *Somehow aware* (*p*-value = 0.00); *Very aware* against *Not aware at all* (*p*-value = 0.00); and *Somehow aware* against *Not aware at all* (*p*-value = 0.03).

### 3.3. Binomial Logistic Regression for HBV Testing

The Binomial Logistic Regression model was built to determine the predictors of HBV testing (**Table 4**). The result indicate that, *Age* (*p*-value = 0.03), *Education level* (*p*-value = 0.04), *Religion* (*p*-value = 0.04), *Ethnicity* (*p*-value = 0.00) and *Blood transfusion* (*p*-value = 0.04) were significant predictors of HBV testing.

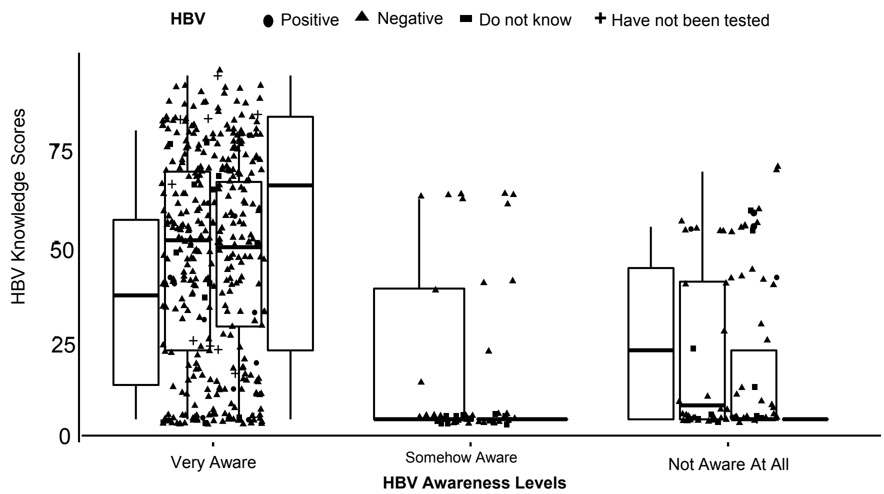


**Figure 1.** Box and whisker plot of HBV knowledge scores, HBV awareness levels and HBV status.

**Table 3.** Kruskal-Wallis test for differences in HBV knowledge scores and pairwise Wilcoxon rank sum test for HBV status and HBV awareness levels.

| Kruskal-Wallis Test | $\chi^2$-Value | DoF | *p*-Values | Pairwise Wilcoxon Rank Sum Test | *p*-Values |
|---|---|---|---|---|---|
| **HBV knowledge scores by HBV status** | 19.03 | 3 | 0.00** | Negative by Positive | 0.33 |
| | | | | Negative by Don't Know | 0.00** |
| | | | | Negative by Haven't Tested | 0.59 |
| | | | | Positive by Don't Know | 0.11 |
| | | | | Positive by Haven't Tested | 0.46 |
| | | | | Don't Know by Haven't Tested | 0.03** |
| **HBV knowledge scores by HBV awareness levels** | 99.77 | 2 | 0.00** | Very Aware by Somehow Aware | 0.00** |
| | | | | Very Aware by Not Aware at All | 0.00** |
| | | | | Somehow Aware by Not Aware at All | 0.03** |

$\chi^2$ = *Chi*-square value; **Figures in italics are significant ($p < 0.05$).

**Table 4.** Results of binomial regression for HBV testing.

| | HBV Testing Predictor | Exponential Estimate | Standard Errors | *p* Values |
|---|---|---|---|---|
| 1 | Intercept | $4623 \times 10^{15}$ | 39,864.46 | 0.99 |
| 2 | *Age* | | | 0.03** |
| 3 | 15 - 20 | Reference variable | Reference variable | Reference variable |
| 4 | 21 - 25 | 0.779 | 1.204 | 0.84 |
| 5 | 26 - 30 | 12.799 | 1.090 | 0.02** |
| 6 | 31 - 35 | 4.243 | 0.939 | 0.12 |
| 7 | 36 - 40 | 9.716 | 0.979 | 0.02** |

Continued

| | | | | |
|---|---|---|---|---|
| 8 | 41 and above | 4.244 | 0.970 | 0.14 |
| 9 | ***Education*** | | | 0.04** |
| 10 | No Education* | Reference variable | Reference variable | Reference variable |
| 11 | Primary | 0.106 | 1.370 | 0.102 |
| 12 | JHS | 0.051 | 0.981 | 0.00** |
| 13 | Middle School Form 4 | 0.155 | 0.720 | 0.01** |
| 14 | SHS | 8,185,888,344.519 | 40,192.970 | 1.00 |
| 15 | Tertiary | 0.126 | 0.720 | 0.10 |
| 16 | ***Religion*** | | | 0.04** |
| 17 | Christianity* | Reference variable | Reference variable | Reference variable |
| 18 | Moslem | 0.294 | 1.740 | 0.481 |
| 19 | Traditional | 7.748 | 1.875 | 0.275 |
| 20 | ***Ethnicity*** | | | 0.00** |
| 21 | Ewe* | Reference variable | Reference variable | Reference variable |
| 22 | Akan | 67.390 | 1.296 | 0.001 |
| 23 | Ga | 14.677 | 1.314 | 0.041 |
| 24 | Adangbe | 7,955,572,048.021 | 20,837.814 | 0.999 |
| 25 | Others† | 1.548 | 1.250 | 0.726 |
| 26 | ***Blood Transfusion*** | | | |
| 27 | Yes* | Reference variable | Reference variable | Reference variable |
| 28 | No | 0.341 | 0.52 | 0.04** |

Nagelkerke $R^2 = 0.444$; *p*-values with ** indicate significance ($p < 0.05$); JHS = Junior High School, SHS = Senior High School. Others† represents ethnic groups from northern Ghana.

## 4. Discussion

Screening asymptomatic people is an important instrument of disease detection, prompt diagnosis and intervention especially concerning a typically asymptomatic infection such as chronic HBV infection. Given that infected pregnant women stand the chance of transmitting the HBV infection to their newborn babies, a cross-sectional study was conducted to test how socioeconomic factors, risky behaviors, knowledge and awareness of HBV infection correlate with HBV status among antenatal clinic attendees of Volta Regional hospital and to determine the predictors of HBV testing among antenatal clinic attendees at the hospital.

Five hundred pregnant women were involved in the evaluation. Out of the participants who were positive, 94.4% (17 out of 18) are in the reproductive age grouped 15 - 35 years, which indicates that the majority of people infected with HBV are in their reproductive and productive age. This finding was affirmed by the *Chi*-square model of association (**Table 1**) that *age* correlates with HBV status of antenatal clinic attendees of the hospital. This finding is similar to a study, in which persons aged between 16 to 39 years had the highest prevalence rates of HBsAg recorded [21].

The *Chi*-square model of association (**Table 1**) affirms that *blood transfusion* correlates with HBV status of antenatal clinic attendees of the hospital. Details are that 5.9% (four out of 68) of the pregnant women who had blood transfusion were positive to HBV infection. Blankson *et al.* [25], documented a 6.7% to 10% sero-prevalence rate of HBV infection among blood donors and out of 842 blood specimen investigated at the National Public Health/Reference-Laboratory 175 tested positive for Hepatitis B (20%) using HBsAg test in 2012 [12]. This rate would be considered high (≥8%) according to the WHO classification. Due to undetected donors with early acute infection, resolving infection, silent infection or infection with atypical virus serology [26], transfusion with blood could account for the 5.9% respondents who had HBV infection. This is similar to many studies carried out elsewhere as most often at least one risk factor is identified. Blood transfusion was identified as the single risk factor for HBsAg positivity in Mexico [27].

A previous study [21] documented the association of history of blood transfusion or multiple blood transfusion with HBV infection. The *Chi*-square model of association (**Table 1**) affirms that the number of multiple blood transfusion correlates with HBV status of antenatal clinic attendees of Volta Regional hospital. Data from the antenatal clinic attendees of Volta Regional hospital showed that, 59% (296 out of 500) scoring less than 50.4% warrant the need for sustained and continuous education not only about HBV but other diseases of similar transmission and burden.

HBV test is one of the basic tests for all pregnant women that attend antenatal clinic at the Volta Regional hospital but the HBV test is not free, it comes with a fee. Consequently, some antenatal clinic attendees of the hospital do not undergo this test due to the cost. Findings from the binomial logistic regression model indicate that *Age* ($p$-value = 0.03), *Education level* ($p$-value = 0.04), *Religion* ($p$-value = 0.04), *Ethnicity* ($p$-value = 0.00) and *Blood transfusion* ($p$-value = 0.04; **Table 4**) were significant predictors of HBV testing.

## 5. Conclusions

The study employed a cross tabulation with *Chi*-square statistic to test how socioeconomic factors, risky behaviors, knowledge and awareness of HBV infection correlate with HBV status among antenatal clinic attendees. The study also used other measures of association, including the *Phi*-value to describe the degree with which the values of one variable predict or vary with those of the other variable if a dependency or association between variables does exist. Scores of respondents on knowledge of HBV infection were converted to 100% and the Kruskal-Wallis test was applied to the data to test for the differences in HBV knowledge scores across HBV status and levels of HBV awareness. Also, a Box and Whiskers plot was used to visualize the variation or differences in HBV knowledge scores, HBV status and levels of HBV awareness. The study also formulated a Binomial regression model to determine the predictors of HBV testing among antenatal clinic attendees.

The results indicate that age, religion, ethnicity, educational level, blood transfusion, number of blood transfusion, gravidity, parity, awareness of HBV and monthly income are associated with HBV status of antenatal clinic attendees of Volta Regional Hospital, Ho.

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## Declarations

### Authors' Contributions

The idea was developed by JO, PKD and EYB. The questionnaire was prepared and executed by JO, PKD and EYB. Data was collected and analysed by all authors. All authors contributed to manuscript writing. DAA is the corresponding author. All authors approved the final manuscript.

### Additional Information

The questionnaire and data files for this study are submitted as part of this manuscript.

### Funding

This was a self-funded study, with all authors contributing.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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