SEROLOGICAL EVIDENCE OF HBc IgM AMONG HIV-INFECTED INDIVIDUALS ATTENDING SELECTED HOSPITALS IN ANAMBRA STATE, NIGERIA

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Received: 03.11.2024 **Accepted: 20.11.2024** **Published: 21.11.2024**

Abstract:

The South-Eastern area of Nigeria does not currently have data on the serological evidence of anti-HBc-IgM antibodies. The study aimed to show the serological evidence of anti-HBc-IgM antibody biomarkers among HIV-infected individuals in selected hospitals in Anambra State, Nigeria. This study also investigated the prevalence of Hepatitis B core IgM (HBc IgM) among HIV-infected individuals in Anambra State, Nigeria, highlighting its sociodemographic correlates, CD4 counts, and viral load implications. Following the manufacturer's standard operating procedures, 372 participants were tested for anti-HBc IgM antibodies during a cross-sectional study. Of the 372 participants, 27.7% tested positive for HBc IgM. The overall prevalence of anti-HBc IgM antibodies recorded 27.7%. The serological evidence of anti-HBc- IgM antibody was higher among females (32.1%), older age groups (33.8%), other marital categories (41.7%), monogamous family type (29.7%), primary educational level (41.5%), unemployed (38.5%), Christian religion (30.8%), and having HIV-positive spouse (31.7%). Among the immunological markers, a higher prevalence of anti-HBc IgM antibodies occurred in participants with CD4 counts ≤200 cells/µl (52.5%). For the virological markers, a higher prevalence of anti-HBc IgM antibodies occurred among participants with a plasma viral load of ≥1000 copies/ml (61.3%). This study identifies a possible danger of HBV transmission from HIV-infected individuals to the general population. Anti-HBc-IgM antibodies are prevalent in Anambra State, Nigeria and this represents the first evaluation of anti-HBc IgM in the South-Eastern region of the nation. The findings underscore the need for integrated healthcare approaches, emphasising comprehensive screening and tailored interventions to manage co-infections effectively.

Keywords: Antibodies, anti-HBc IgM, CD4 count, Hepatitis B core IgM, HIV, co-infections, HIV-infected, Immunological markers, Serological Evidence, viral load, Virological markers, Nigeria

1. INTRODUCTION

CO-INFECTIONS among HIV-infected individuals pose significant health challenges, with the Hepatitis B Virus (HBV) being a critical concern due to its shared transmission routes and exacerbated health impacts on immunocompromised individuals [1]. HBc IgM is an important marker indicating recent or ongoing HBV infection and reactivation [2].

Hepatitis B virus (HBV) infection remains a significant global public health issue, with over 290 million people living with chronic HBV infection worldwide [3]. Among these, a considerable proportion are co-infected with human immunodeficiency virus (HIV). The dual burden of HBV and HIV poses unique challenges, particularly in resource-limited settings where access to comprehensive healthcare services may be constrained. In sub-Saharan Africa, where the prevalence of both infections is notably high, the interplay between these viruses exacerbates health outcomes and complicates treatment regimens [2].

Hepatitis B core IgM (HBc IgM) is a critical marker used to identify recent or acute HBV infections and reactivations. The presence of HBc IgM antibodies indicates active viral replication and potential liver inflammation, which can significantly impact the clinical management of HBV, particularly in HIV-infected individuals who are already immunocompromised [1]. Understanding the prevalence of HBc IgM in HIV-positive populations is crucial for developing effective screening, treatment, and prevention strategies.

HIV and HBV share similar transmission routes, including perinatal, sexual, and parenteral means. Consequently, co-infection rates are high in regions with endemic levels of both viruses. The immunosuppressive nature of HIV accelerates the progression of HBV-related liver disease, increasing the risk of cirrhosis, hepatocellular carcinoma, and liver-related mortality [4, 5]. Moreover, HIV complicates the serological profile of HBV, often leading to atypical antibody responses and

challenges in accurately diagnosing and monitoring HBV infection.

Co-infections in HIV-infected individuals present complex clinical challenges that require multifaceted healthcare approaches. Hepatitis B Virus (HBV) co-infection is particularly significant due to its shared transmission routes with HIV, including sexual contact, intravenous drug use, and perinatal transmission [1]. Hepatitis B core IgM (HBc IgM) is an important serological marker used to detect recent or acute HBV infections and reactivations, especially in immunocompromised populations such as those with HIV [2].

Nigeria, with its high HIV prevalence, also grapples with a significant burden of HBV, making the co-infection scenario an urgent public health concern [6]. Anambra State, in particular, has seen rising HIV rates, and understanding the prevalence and implications of HBV in this context is crucial for effective healthcare delivery [7]. The intersection of these infections can lead to accelerated liver disease progression, higher HIV viral loads, and increased mortality rates, underscoring the need for comprehensive co-infection management strategies [4, 5].

Recent studies have highlighted the importance of integrated screening and treatment programs for HIV and HBV to improve patient outcomes and reduce the burden on healthcare systems [3]. However, data specific to Nigeria, particularly in regions like Anambra State, remain sparse. This study aims to fill this gap by providing detailed insights into the prevalence of HBc IgM among HIV-infected individuals in Anambra State and exploring its associations with sociodemographic factors, CD4 counts, and viral loads.

Despite the recognized burden of HIV/HBV co-infection, there is limited data on the prevalence of HBc IgM among HIV-infected individuals in Anambra State, Nigeria. This region, like many others in sub-Saharan Africa, faces significant healthcare challenges, including limited access to diagnostic facilities and antiretroviral therapy (ART) coverage. The high prevalence of both HIV and HBV necessitates a focused investigation into the co-infection dynamics to inform public health interventions and optimize patient care [8].

This study aims to fill this knowledge gap by determining the prevalence of HBc IgM among HIV-infected individuals in Anambra State and exploring the sociodemographic and clinical correlates of HBc IgM positivity. Specifically, the study examines the association between HBc IgM and variables such as gender, age, marital status, educational level, occupation, and religion. Additionally, it investigates the relationship between HBc IgM prevalence and immunological markers, including CD4 counts and HIV viral loads.

By identifying the prevalence and correlates of HBc IgM among HIV-infected individuals, this study seeks to highlight the need for integrated healthcare approaches that incorporate routine HBV screening and management into HIV care protocols. The findings aim to inform public health policies and contribute to the development of targeted interventions that address the unique healthcare needs of co-infected individuals in resource-limited settings.

This study aims to determine the prevalence of HBc IgM among HIV-infected individuals in Anambra State, Nigeria, and analyze its association with sociodemographic factors, CD4 counts, and viral loads. Additionally, the study seeks to analyze the relationship between HBc IgM positivity and various sociodemographic factors (such as gender, age, marital status, education level, and occupation), as well as immunological markers (CD4 counts) and virological parameters (HIV viral load). Understanding these associations is crucial for developing targeted interventions to manage and mitigate the impact of HBV co-infections in this vulnerable population.

This research contributes to the growing body of literature on HIV-HBV co-infections by providing region-specific data that can inform local healthcare policies and practices. By identifying high-risk groups and correlating HBc IgM positivity with clinical and demographic factors, the study aims to support the development of more effective, personalized healthcare strategies for individuals living with HIV in Anambra State and similar settings.

2. MATERIALS AND METHODS

A cross-sectional study was conducted involving 372 HIV-infected individuals attending healthcare facilities in Anambra State, Nigeria. Ethical approval was obtained from the relevant institutional review board, and informed consent was obtained from all participants. Sociodemographic data were collected using structured questionnaires. Blood samples were taken to test for HBc IgM, CD4 counts, and HIV viral load using standard laboratory methods according to the manufacturer's specifications. Data were analyzed using SPSS version 26. Descriptive statistics were used to summarize the prevalence rates, while chi-square tests and logistic regression were employed to explore associations between HBc IgM positivity and sociodemographic variables, CD4 counts, and viral load.

3. RESULTS

3.1. Overall Prevalence of HBc IgM

Out of 372 participants, 103 (27.7%) tested positive for HBc IgM. The overall prevalence of anti-HBc IgM antibodies was 27.7% for HIV/HBc IgM and 72.3% for HIV only (Figure 1).

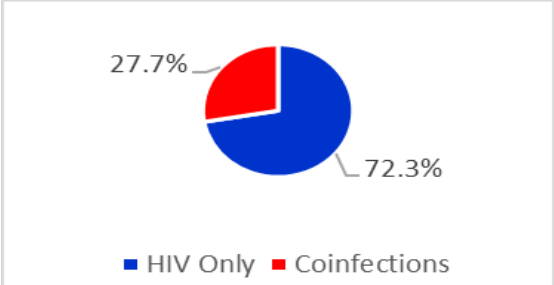

Figure 1: HIV mono-infection and HBc IgM Coinfections

3.2. HIV and HBc IgM Coinfections with Sociodemographic Characteristics

The serological evidence of anti-HBc- IgM antibody was higher among females (32.1%) than males (Figure 4.4). It was higher among older age groups (33.8%) than other age groups as indicated in Table 1.

Married individuals showed a higher prevalence (32.6%). There is a higher prevalence among those with primary education (41.5%) as indicated in Table 1.

The serological evidence of anti-HBc- IgM antibody was higher among other marital categories (41.7%) than the married and singles (Table 1).

The serological evidence of anti-HBc- IgM antibody was higher among the monogamous family type (29.7%) than the polygamous family type (Table 1).

The serological evidence of anti-HBc- IgM antibody was higher among primary educational levels (41.5%) than those with tertiary and secondary education. It is also higher among the unemployed (38.5%) than other occupation categories (Table 1).

The serological evidence of anti-HBc- IgM antibody was higher among Christians (30.8%) than among other religious groups. It was higher among those having HIV-positive spouses (31.7%) than those with seronegative spouses (Table 1).

3.3. Socio-Demographic Characteristics with Statistical Correlation with HBc IgM

None of the sociodemographic variables evaluated for HBc IgM antibodies was statistically associated except for occupational status ($p = 0.00008119$, $df = 3$, $X^2 = 21.543$) and religion ($p = 0.01225$, $df = 2$, $X^2 = 8.80418$) as in Table 1.

3.4. HBc IgM with Immunological and Virological Markers

Higher prevalence of HBc IgM in individuals with CD4 counts <200 cells/µl (34.5%). Higher prevalence in individuals with viral loads >1000 copies/ml (36.8%) as indicated in Table 2.

3.5. Immunological and Virological Markers and Correlation with Viral Co-Infections

Among the immunological markers, a higher prevalence of anti-HBc IgM antibodies occurred in participants with CD4 counts ≤200 cells/µl (52.5%). This difference is statistically associated ($p = 0.00005607$, $df = 3$, $X^2 = 19.5778$) with HBc IgM co-infections.

For the virological markers, a higher prevalence of anti-HBc IgM antibodies occurred among participants with a plasma viral load of ≥1000 copies/ml (61.3%). High viral loads (>1000 copies/ml) were associated ($p = 0.000$, $df = 3$, $X^2 = 94.1789$) with increased prevalence of HBc IgM as indicated in Table 2.

TABLE 1
HIV AND HBc IgM COINFECTIONS WITH SOCIODEMOGRAPHIC CHARACTERISTICS

Variables	No. Tested (%)	No. Positives (%)	P-Value	X^2_i
Sex				
Males	138(37.1)	28(30.7)	0.6216	0.243661
Females	234(62.9)	75(32.1)		
Age (years)				
≤30	55(14.8)	9(16.3)	0.1657	5.08521
31-40	114(30.6)	31(27.2)		
41-50	126(33.9)	37(29.4)		
≥51	77(20.7)	26(33.8)		
Marital Status				
Singles	94(25.3)	10(26.3)	0.1353	4.00004
Married	224(60.2)	73(32.6)		
Others	54(14.5)	20(41.7)		
Marriage Type				
Monogamous	219(58.9)	65(29.7)	0.3042	1.05549
Polygamous	153(41.1)	38(24.8)		
Educational Status				
Primary	65(17.5)	27(41.5)	0.102	4.56616
Secondary	181(48.7)	59(32.6)		
Tertiary	70(18.8)	17(24.3)		
Occupational Status				
Student	51(13.7)	1(2.0)	0.00008119*	21.543
Unemployed	26(7.0)	10(38.5)		
Self- Employed	225(60.5)	74(32.9)		
Employed	70(18.8)	18(25.7)		
Religion				
Christianity	325(87.4)	100(30.8)	0.01225*	8.80418
Islam	26(7.0)	1(3.8)		
Traditional	21(5.6)	2(9.5)		
HIV Status of Spouse				
Positive	126(33.9)	40(31.7)	0.2106	1.567
Negative	246(66.1)	63(25.6)		
Total	**372(100.0)**	**103(27.7)**		

Keys: * = Significant

4. DISCUSSION

HBV infection is a significant global public health issue [9, 10]. Globally, it is estimated that 5%–10% of people living with HIV are co-infected with hepatitis B virus (HBV), while HIV/HBV frequency in sub-Saharan Africa varied from 0.0% to 28.4% [11-16]. According to various studies, Port Harcourt had a prevalence rate of 2.0%, 4.3%, 12.4%, 2.0%, 3.1%, 10.9%, 14.0%, 3.0%, and 8.0% [9, 10, 17-23]; Uyo had a prevalence rate of 6.3% [25]. The study reveals a substantial prevalence of HBc IgM among HIV-infected individuals in Anambra State, Nigeria, with 27.7% of the participants testing positive. This high prevalence indicates that a significant

TABLE 2:
HIV AND HBc IgM COINFECTIONS WITH IMMUNOLOGICAL AND VIROLOGICAL MARKERS

Variables	No. Tested (%)	No. Positives (%)	P-Value	X^2_i
CD4 (Cells/µl)				
≤200	40(10.8)	21(52.5)	0.000056 07*	19.5778
201-349	83(22.3)	29(34.9)		
≥350	249(67.0)	53(21.3)		
Viral Load (Copies/ml)				
TND	177(47.6)	12(6.8)	0.00*	94.1789
≤40	55(14.8)	14(25.5)		
41-999	65(17.5)	31(47.7)		
≥1000	75(20.1)	46(61.3)		
Total	**372(100.0)**	**103(27.7)**		

Keys: * = Significant at P ≤0.05

portion of the HIV-infected population is either experiencing a recent or ongoing HBV infection, highlighting a critical public health issue. This 27.7% is lower than the 35.9% reported in Port Harcourt [24]. The findings align with previous studies that have reported high rates of HBV co-infection among HIV-positive individuals in Sub-Saharan Africa [8].

The study reveals a 27.7% prevalence of HBc IgM among HIV-infected individuals in Anambra State, indicating a significant burden of recent or ongoing HBV infections within this population. This prevalence is higher than that reported in some other regions, underscoring the unique epidemiological dynamics in Nigeria [8]. This observed result is much higher than the 14.0% reported from Rivers State, Nigeria [17], 6.6% [18] and 2.6% [16] from other studies in Rivers State, Nigeria. The 27.7% is higher than the 17.7% reported from Awka, Anambra State, Nigeria [26] and lower than the 40.9% in Onitsha, Anambra State, Nigeria [27].

It is not uncommon for an anti-HBc serological pattern to serve as the sole marker [24, 28]. This 27.7% reported in this study is lower than the 35.9% value reported by Okonko and Chindah [24] in Port Harcourt, Nigeria and the 30.6% value reported by Ojo et al. [29] in Abeokuta, Nigeria.

The 27.7% prevalence of HBc IgM among HIV-infected individuals indicates a significant burden of recent or ongoing HBV infections. The higher prevalence among males, certain age groups, and lower CD4 counts suggests that these subpopulations are particularly vulnerable [8].

The higher prevalence of HBc IgM among females (32.1%) compared to males (30.7%) may be attributed to behavioural factors such as higher rates of intravenous drug use and less engagement in healthcare services among men. The higher prevalence of anti-HBc IgM among females (32.1%) is consistent with other studies in resource-limited settings [24]. Awanye et al. [30] reported the presence of HBV only in females in Port Harcourt, Nigeria. Research suggests that women, especially those of reproductive age, are at greater risk due to factors such as pregnancy-related immunosuppression and increased healthcare interactions during antenatal care, which may increase exposure. In regions where HBV and HIV co-infection are prevalent, women may also be more susceptible due to gender-related barriers to healthcare access and education. When compared to Mohammed et al. [31], who discovered a considerable difference in the prevalence of hepatitis B infection between the two sex groups, with male patients having 72.7% and female patients recording 27.3%, this finding was found to be practically the opposite.

The higher prevalence among females (32.1%) compared to males (30.7%) aligns with existing literature suggesting higher HBV infection rates among males due to behavioural and biological factors [2], which corresponds with other previous studies in Nigeria [9, 10, 13, 16-18, 26, 32-35] where a higher prevalence was reported among females than males. However, this observation also contradicted the work by Bhattarai et al. [36] and Ugwu et al. [27], where the co-infection was higher in males.

The age-specific analysis shows a higher prevalence of HBc IgM among individuals aged ≥51 years (33.8%), highlighting the need for targeted interventions for this age group, which may be more sexually active and at greater risk of acquiring HBV through horizontal transmission. The increased prevalence in older age groups (33.8%) reflects the cumulative risk of HBV infection over time. This finding is consistent with research showing that older individuals are more likely to have been exposed to HBV, either through horizontal transmission during childhood or over time through unsafe medical practices, transfusions, or sexual transmission. Additionally, the immune response in older individuals may result in delayed virus clearance, leading to a higher detection of anti-HBc IgM. This observation aligns with that of Okonko and Chindah [24] that people over 36 years have a higher prevalence of HBc IgM antibodies than people between the ages of 20 and 35. It also aligns with a study by Japhet et al. [37] showing that anti-HBc-IgM seropositivity was marginally greater in febrile individuals older than 35 compared to younger patients. According to the Japhet et al. [37] study, participants under 35 may have a lower risk of having HBV infection or being a concealed HBV carrier [38]. This observation supports that of Bhattarai et al. [36], Akindigh et al. [39], Cyrille et al. [12], Gedefie et al. [34], Okonko and Shaibu [35], Elenwo et al. [16] and Okonko et al. [17, 18], who also reported a higher prevalence within the age group 41and above. However, the observation in this study deviated from that of another previous study in Nigeria and overseas [9-10, 13, 15, 26-27, 40-41], where a higher prevalence occurred among the age group <41 years. This observation of this present study also differed from Aniche et al. [42] observation,

which indicated a higher prevalence in the 10–19 age range in Enugu, Nigeria, compared to other age groups. The elevated prevalence in the >51 age group also suggests that individuals are at greater risk, emphasizing the need for targeted education and prevention programs for this demographic [2].

Individuals with other marital status (divorced/separated/widowed) showed a higher prevalence (41.7%), potentially due to the higher likelihood of stable sexual partnerships where one partner might unknowingly transmit the virus to the other. The findings of this study on marital status-specific co-infection correspond with other previous reports in Nigeria and overseas [9, 15, 18, 27, 36]. However, this observation contradicted previous studies in Nigeria and abroad [10, 13, 15, 17, 26, 35] which reported the highest prevalence in the married participants and some among the separated/divorced or widowed. Married individuals also exhibited a higher prevalence (32.6%) of HBc IgM, suggesting the possible role of spousal transmission and underscoring the importance of partner testing and vaccination [1].

The higher prevalence among individuals in "other marital categories" (41.7%) may be linked to socio-behavioural factors. Studies suggest that marital instability can influence sexual behaviours, with those in non-traditional marital arrangements potentially being more exposed to risky sexual practices and HBV transmission. In contrast to Mohammed et al. [31], who found a higher incidence among the married population than the unmarried class, this is discovered to be the case. It also deviated from that of Okonko and Chindah [24] who reported a higher prevalence among singles in their study. The reason for this can be a horizontal transmission.

The higher prevalence among those from monogamous families (29.7%) may also be linked to socio-behavioural factors. Studies also suggest that family structure can influence sexual behaviours, with those in non-traditional family structures potentially being more exposed to risky sexual practices and HBV transmission.

Education level also played a significant role, with those having primary education showing the highest prevalence (41.5%). This could reflect limited access to health information and services among less educated individuals, pointing to the necessity for public health initiatives that cater to this group [1]. The study also found that lower educational levels were associated with higher HBc IgM prevalence, with primary education level individuals showing the highest prevalence (41.5%). This finding suggests that educational interventions aimed at improving awareness and prevention of HBV could be beneficial in reducing the burden of infection among less educated populations. This finding contradicted that of other similar studies [13, 15, 16, 17, 26-27, 35] reported in Nigeria.

The significantly higher prevalence among those with primary education (41.5%) suggests that lower educational levels may be a key factor in HBV transmission. Individuals with less education are often less informed about HBV transmission and prevention. Other studies have similarly found that lower education levels are associated with higher rates of HBV infection due to reduced access to health services and preventive care. However, the observation of this study deviated from that of Okonko and Chindah [24] who reported a higher prevalence among those with tertiary education in their study. This observation also did not align with the findings of Fasola et al. [38], who discovered that participants' anti-HBc status was not significantly influenced by their educational level.

The significantly higher prevalence among the unemployed (38.5%) also suggests that lower socioeconomic status may be a key factor in HBV transmission. This result might be in keeping with the past studies that indicated that the infection is related to occupation [38, 39]. This observation did not correspond to Okonko et al. [17] and Elenwo et al. [16] in a previous study in Port Harcourt, Nigeria where self-employed dominated. This observation, however, deviates from the findings of other similar and prior studies [10, 13, 15, 35], where higher coinfection rates were reported mostly in students, and civil servants in some cases, among others.

Unemployment may limit access to healthcare services, including vaccination and treatment. Other studies have similarly found that unemployment is associated with higher rates of HBV infection due to reduced access to health services and preventive care. This finding is not in line with the findings of Fasola et al. [38], who discovered that participants' anti-HBc status was not significantly influenced by their occupation. Also, the observation of this study deviated from that of Okonko and Chindah [24] who reported a higher prevalence among civil servants in their study. This study shows that the prevalence of hepatitis B infection fluctuates depending on the patient's socioeconomic status [24, 44, 45].

The prevalence of anti-HBc IgM antibodies was higher among Christians (30.8%) compared to other religious groups. This could be reflective of regional differences in religious affiliation, as Christianity is predominant in many areas of sub-Saharan Africa where HBV is endemic. However, religious affiliation itself may not be a direct risk factor; instead, it may reflect broader demographic and socioeconomic trends in the population.

The higher prevalence among individuals with HIV-positive spouses (31.7%) highlights the overlap of HBV and HIV transmission pathways, which include sexual transmission, shared needles, and mother-to-child transmission. HIV-infected individuals are more susceptible to acquiring and transmitting HBV due to their immunocompromised status, and the presence of

both viruses can complicate the clinical course of both infections.

The findings of this study highlight key socio-demographic factors associated with HBV transmission, which are consistent with global trends observed in regions with high HBV and HIV prevalence. Targeted interventions, including education, HBV vaccination, and healthcare access for high-risk populations such as women, older individuals, and the unemployed, are essential for reducing the burden of HBV infection in these populations.

The significant association between HBc IgM positivity and lower CD4 counts (<200 cells/µl) indicates that HIV-infected individuals with more advanced immunosuppression are at greater risk for recent or ongoing HBV infection. This relationship highlights the need for regular HBV screening and timely antiviral therapy to manage co-infections effectively and prevent liver-related complications [3]. Similar observations were made in previous studies in Nigeria and overseas [41]. However, other studies reported higher rates in patients with <200 cells/mm^3 [16, 22, 25, 26, 32, 35, 47, 48], 200-350 cells/µl [20] while Okonko et al. [18] reported higher coinfection rates among participants with CD4 counts 500 & above.

The higher prevalence of HBc IgM among individuals with viral loads >1000 copies/ml suggests that uncontrolled HIV replication may facilitate HBV infection or reactivation. Therefore, optimizing HIV treatment to achieve viral suppression could play a crucial role in reducing HBV co-infections [8]. This finding is not comparable to that of other studies [16, 18, 26]. However, this assertion is at variance with some studies in Nigeria [27, 33, 35, 22-25].

The study underscores the importance of integrated screening programs for HBV within HIV care settings. Routine testing for HBV markers, including HBc IgM, should be a standard component of HIV management protocols. This approach will facilitate early detection and timely intervention, reducing the risk of severe liver disease and improving overall patient outcomes [3].

These findings highlight the need for integrated screening programs for HBV in HIV care settings, particularly for high-risk groups. Effective management strategies, including timely antiviral therapy and regular monitoring, are crucial to prevent further complications [3].

The study's cross-sectional design limits causal inferences. Additionally, the reliance on self-reported sociodemographic data may introduce bias.

Longitudinal studies are needed to assess the progression and outcomes of HBV infection in HIV-infected individuals, particularly regarding antiretroviral therapy and HBV antiviral treatment. Further research should also explore the effectiveness of integrated healthcare interventions, such as co-located HIV and HBV care services, to improve the management of co-infected individuals [1].

5. CONCLUSION

The study reveals a substantial prevalence of HBc IgM among HIV-infected individuals in Anambra State, Nigeria, with significant sociodemographic and immunological correlates. The higher prevalence of HBc IgM among individuals with lower CD4 counts (<200 cells/µl) suggests that immunocompromised patients are more. These findings underscore the critical need for comprehensive and integrated healthcare approaches to manage HBV co-infections effectively.

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