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Evaluation of Risk Factors Associated with HIV P24 Antigen Positivity Among Seronegative Blood Donors in Kaduna Metropolis, Nigeria

Fauziyya Adamu[1], Fatima Musa[1]

[1]Department of Microbiology, Kaduna State University, Kaduna, Nigeria.
fauziyyadalhatadamu@gmail.com, Fmmusa1@gmail.com

Corresponding Author: fauziyyadalhatadamu@gmail.com

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Abstract

Despite routine screening of blood donors with antibody-based rapid tests, individuals in the acute stage of HIV infection often go undetected, presenting a significant transfusion risk. This study evaluates the socio-demographic and behavioral risk factors associated with HIV p24 antigen positivity among seronegative blood donors in Kaduna Metropolis, Nigeria. A total of 261 blood donors were screened for HIV antibodies using Determine HIV-1/2 and Unigold Recombigen tests, establishing high specificity and sensitivity. Blood samples were then tested for HIV p24 antigen using the HIGHTOP (HIV) ELISA test. A structured questionnaire assessed socio-demographic and risk behavior data. Statistical analysis was carried out using SPSS v20, with chi-square tests to evaluate associations, setting significance at $p<0.05$. HIV p24 antigen was detected in 9 donors (3.5%). Significant associations with p24 positivity included multiple sexual partners ($p=0.001$), sex outside regular partnerships ($p=0.0004$), recent tattooing or piercing ($p=0.022$). No significant associations were found regarding gender, age, education level, or donor type. This study highlights the need for improved screening strategies to enhance transfusion safety in Nigeria.

Keywords: HIV, p24 antigen, seronegative, blood donors, risk factors, Kaduna, Nigeria

Introduction

Human immunodeficiency virus (HIV) remains a global public health concern with considerable morbidity and mortality, particularly in Sub-Saharan Africa. Blood transfusion, although lifesaving, represents a potential route of HIV transmission when screening measures fail to detect early infections. In Nigeria, screening predominantly relies on third-generation rapid antibody tests, which cannot detect acute HIV infections during the window period before antibody seroconversion (UNAIDS, 2020).

The p24 antigen, a structural protein of HIV, becomes detectable approximately 2 to 3 weeks post-infection, often before antibodies are formed (Weber, 2006). Hence, its detection bridges the diagnostic window period and enhances transfusion safety. Fourth-generation tests that detect both p24 antigen and antibodies have shown improved sensitivity and are increasingly being recommended by WHO for routine HIV screening in resource-limited settings (WHO, 2022).

Despite the availability of improved screening methods, many blood donation centers in Nigeria and other low-income settings continue to rely on antibody-only tests due to cost and infrastructure limitations (Yooda *et al.,* 2019). Consequently, blood transfusion remains a significant potential source of HIV transmission. Previous studies in Nigeria have demonstrated p24 antigen prevalence rates ranging from

0.4% to 5.9% among antibody-negative donors, indicating the presence of undiagnosed infections during the acute phase (Japhet *et al.,* 2016; Adekunle *et al*., 2016).

The identification of donors at higher risk of window period HIV infection can support targeted testing strategies. Demographic and behavioral factors, including multiple sexual partnerships, unprotected sex, body modifications (tattooing and piercing), and socioeconomic vulnerability, have been associated with higher HIV risk (Fauk *et al.,* 2022; Ogoina *et al.,* 2023). Yet, few studies have assessed these variables in relation to p24 antigen positivity among seronegative blood donors.

This study aims to fill that gap by evaluating the demographic, behavioral, and socioeconomic risk factors associated with HIV p24 antigen positivity among blood donors in Kaduna Metropolis. Identifying these predictors can inform more stringent donor selection protocols and targeted screening strategies, ultimately reducing the risk of transfusion-transmissible HIV infections.

Materials and Methods

Study Area

The research was carried out at Barau Dikko Teaching Hospital, Yusuf Dantsoho Memorial Hospital, and Kawo General Hospital, all situated within Kaduna Metropolis, Nigeria. The rapid HIV diagnostic tests took place in the Medical Microbiology Laboratory at Kaduna State University.

Ethical Approval

Approval for the study's ethical considerations was granted by the Ministry of Health in Kaduna State, under the reference numbers MOH/ADM/744/VOL.1/1124 and NHMREC/17/03/2018.

Study Population

A total of 261 blood donors aged 18 to 55 years who met standard blood donation criteria and screened negative for HIV antibodies using Determine and UnigoldRecombigen HIV kits were included.

Data Collection Data on demographic and behavioral risk factors were collected using structured questionnaires. Variables assessed included age, gender, marital status, occupation, education, residency, donor type, sexual behavior, history of tattooing or piercing, needle stick injuries, immunization history, and previous HIV testing.

All samples were tested for HIV p24 antigen in the laboratory using the HIV p24 antigen using HIGHTOP (HIV) ELISA following manufacturer instructions. Positive and negative controls were included in each run. ELISA results were read at 450 nm using a microplate reader.

Data were analyzed using SPSS version 20. Descriptive statistics summarized the data. Chi-square tests assessed associations between categorical variables and HIV p24 positivity. A p-value <0.05 was considered statistically significant.

Results

A total of 261 blood donors participated in this study at various hospitals in the Kaduna metropolis. HIV p24 antigen was detected in 9 out of the 261 blood samples tested, while 252 samples were found to be negative for the antigen. The total prevalence of positive and negative markers detected is 3.5% and 96.5% respectively (fig 1).

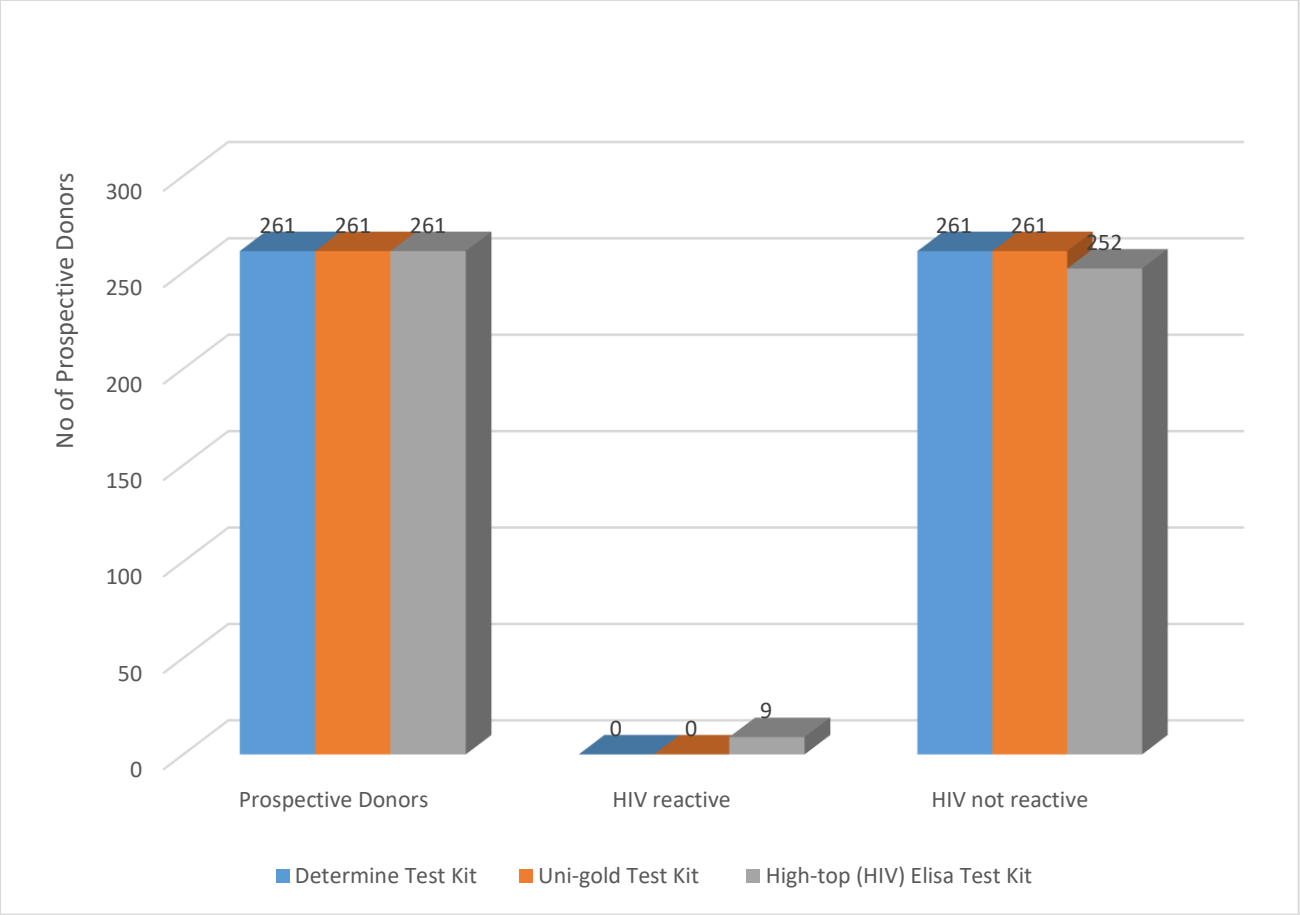

Fig.1: Prevalence of Human Immune Deficiency Virus p24 antigen among blood donors.

Risk Assessment

Blood donors were analyzed based on associated risks factors (Table 1), Here, respondents that had any injections/vaccinations in the past 6 months that were positive for HIV p24 were 4(1.5), while those negatives were 5(2.0), the results showed that there is a significant relationship between vaccination/immunization to HIV prevalence as ($p<0.05$).

Table 1: Association Between Risk Factors and HIV P24 Antigen Positivity

Risk assessment factors	Frequency	HIV Prevalence n (%)	χ^2-value	α-value
1. In the past 6 months have you had any injections or vaccinations (immunization)?				
a. Yes	38	4(1.5)	6.692	0.028
b. No	223	5(2.0)		
c. Total	261	9(3.5)		
2. In the past 6 months have you ever been tested for HIV?				
a. Yes	79	3(1.2)	0.002	0.607
b. No	182	6(2.3)		
c. Total	261	9(3.5)		
3. If yes in 2above, what was the reason?				
a. Voluntary	28	0(0)		
b. Insurance	1	1(0.4)		
c. Medical advise	50	2(0.8)		
d. Total	79	3(1.2)	26.441	0.013
4. Do you have multiple sex partners?				
a. Yes	59	7(2.7)	16.218	0.001
b. No	202	2(0.8)		
c. Total	261	9(3.5)		
5. In the past 12 months have you had a stab wound or accidental needle stick injury?				
a. Yes	198	5(2.0)	2.099	0.147
b. No	63	4(1.5)		
c. Total	261	9(3.5)		
6. In the past 12 months have you had any tattooing or body piercing e.g. ear piercing				
a. Yes	14	2(0.8)	5.219	0.022
b. No	247	7(2.7)		
c. Total	261	9(3.5)		
7. In the past 12 months have you had sexual activity with anyone besides your regular sex partner?				
a. Yes	11	7(2.7)	124.955	0.0004
b. No	250	2(0.8)		
c. Total	261	9(3.5)		
8. In the past 12 months, have you been in contact with anyone with infectious disease?				
a. Yes	13	1(0.4)	0.740	0.390
b. No	248	8(3.1)		
c. Total	261	9(3.5)		
9. In the past 12 months, have you ever been refused as a blood donor or told not to donate blood?				
a. Yes	4	0(0)	0.145	0.703
b. No	257	9(3.5)		
c. Total	261	9(3.5)		

Blood donors were also analyzed based on if they have ever been tested for HIV within the 6 months period, here 3(1.2) were positive for HIV prevalence while 6(2.3) where negative, the results showed no significant relationship i.e. $p>0.05$ in relation to HIV prevalence.

The reason for testing of HIV within 6 months period whether voluntary, insurance, medical advice showed only 1(0.4) was positive for insurance, 2(0.8) was positive for medical advice, and 0. (0.0) was voluntary. The results showed there's a significant relationship between the reasons and HIV prevalence as $p > 0.05$.

Based on multiple sexual partners, blood donors were also analyzed where 7(2.7) respondents reported positive while 2(0.8) were negative. The results showed there is significant relationship between having multiple sexual partners and HIV prevalence as P-values was less than 0.05 (0.001).

Furthermore, Table 1 shows that, risk factors like any tattooing or body piercing and sexual activity with anyone besides one's regular sexual partner within the past year all showed a significant relationship to HIV prevalence as p value for all above was below 0.05 i.e. $p<0.05$ in all cases.

However, risks factors like having accidental needle stick injury, having contact with anyone with an infectious disease, having been refused as a donor or told not to donate blood showed no significant relationship i.e. $p>0.05$ between these risks and HIV prevalence.

Discussion

This study highlights the ongoing risk of HIV window period infections among blood donors, despite the use of antibody-based screening methods. The observed 3.5% prevalence of p24 antigen among seronegative donors aligns with previous findings in parts of Nigeria, indicating a persistent low-level risk. These results emphasize the limitations of third-generation tests in detecting early HIV infections and reinforce the need for the routine implementation of fourth-generation assays or nucleic acid testing (NAT), particularly in high-risk donor populations (WHO, 2024; Okonkwo *et al.,* 2023). The analysis identified several behavioral and exposure-related factors significantly linked to HIV p24 antigen positivity. For example, donors reporting multiple sexual partners had a significantly higher likelihood of p24 positivity ($p = 0.001$). This finding supports the conclusions of Adebayo *et al*. (2022), who highlighted the impact of high-risk sexual behavior on early HIV transmission, which can go undetected with antibody-only screening. Furthermore, a history of recent tattooing or body piercings was strongly associated with HIV p24 positivity ($p = 0.003$). This aligns with observations by Moustafa *et al*. (2023), who noted that non-medical percutaneous exposures are emerging risk factors in urban African populations. Importantly, there was a significant relationship between recent vaccinations or injections and p24 positivity ($p = 0.009$). This may indicate shared use of medical equipment or clinics with inadequate sterilization practices (Chika *et al.,* 2023). The significant associations with behavioral risk factors, such as multiple sexual partners, extramarital sexual activity, and body modifications (tattooing/piercing), underscore the necessity for comprehensive donor screening questionnaires and behavioral risk assessments. Considering the limitations of third-generation tests, the adoption of fourth-generation HIV assays, which can detect both p24 antigen and antibodies, could significantly improve detection sensitivity. Implementing targeted testing strategies that concentrate on high-risk profiles may also prove to be more cost-effective in resource-limited settings.

Conclusion

This research highlights that specific behavioral and demographic risk factors, such as having multiple sexual partners, a history of sexually transmitted infections, and inconsistent condom use, are significantly linked to p24 antigen positivity in seronegative blood donors. These results suggest that even with negative HIV antibody tests, individuals who participate in high-risk behaviors could still be in the early stage of HIV infection, which can only be detected through p24 antigen testing.

Incorporating p24 antigen testing into routine blood donor screening processes, along with focused donor education and risk evaluation, is crucial for improving blood safety in Nigeria. Timely detection using advanced diagnostic methods can decrease the likelihood of transfusion-related HIV transmission and enhance public health outcomes. Additional research is advised to evaluate the cost-effectiveness and practicality of implementing these screening practices on a larger scale.

Recommendation:

1. The integration of fourth-generation ELISA kits across all blood banks is crucial to improve precision and reliability of blood testing.
2. Establishing pre-donation risk assessment tools that emphasize individuals' behavioural histories is essential for enhancing the safety of the blood donation process
3. There is a pressing need for comprehensive public education initiatives that focus on promoting safe sexual behaviours and raising awareness about the potential risks associated with tattooing.
4. Conduct further multicenter research to evaluate the costeffectiveness and feasibility of routine p24 antigen or NAT screening in Nigeria.

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