

The Burden and Determinants of Dual Infections of Syphilis and HIV among Blood Donors in a Blood Donation Centre in Ibadan, Oyo State, Nigeria

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Abstract

This study investigated the burden and determinants of dual infections of Syphilis and Human Immunodeficiency Virus (HIV) among blood donors at the Central Medical Diagnostic Centre (CMDC), Total Garden, Ibadan, Oyo State, Nigeria. This was a cross-sectional study in 104 consenting blood donors aged 18-60 years (mean age $\approx$ 34 years). Donor information, including sex, age, education, occupation, donor type, sexual behavior, condom use, alcohol intake, and previous history of sexually transmitted infections, were obtained through structured questionnaires. Blood samples were screened for syphilis, and HIV antigen using Rapid Diagnostic Test (RDT) kits for preliminary detection and confirmed by Enzyme-Linked Immunosorbent Assay (ELISA) according to the National Blood Transfusion Service protocol. Data were analyzed using SPSS version 27 with descriptive and inferential statistics; associations were tested at a 95% confidence interval ($p < 0.05$). Out of 104 donors screened, 78 (75.0%) were males and 26 (25.0%) females. The overall seroprevalence was 1.9% for HIV, 1.9% for Syphilis, and 0.96% for dual HIV-Syphilis co-infection. Although infection rates were low, they were higher among males and replacement donors compared to voluntary donors. Inconsistent condom use showed a statistically significant association with HIV infection ($p = 0.028$). The study concludes that despite low prevalence, the presence of dual infections indicates persistent transfusion-transmissible infection risks. Strengthening routine dual screening using ELISA confirmation, intensifying donor health education, and encouraging voluntary non-remunerated blood donations are essential for ensuring safer transfusion practices in Nigeria.

Keywords: HIV; Syphilis; Blood Donors; Co-Infection; Transfusion-Transmissible Infections; Ibadan; Nigeria

Introduction

In circumstances like severe anemia, trauma, surgery, and obstetric emergency, blood transfusions continue to be a vital component of contemporary medicine [1,2]. However, the ongoing risk of transfusion-transmissible infections (TTIs), particularly syphilis and HIV, jeopardise its therapeutic effectiveness. Both illnesses continue to place a heavy strain on public health systems, especially in low- and middle-income nations like Nigeria, and have comparable modes of transmission, mostly through blood and sexual contact [3]. Two prominent sexually transmitted infections (STIs) that provide serious global public health challenges are syphilis and HIV. *Treponema*

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pallidum, the bacterium that causes syphilis, can manifest in a number of clinical stages, from latent and tertiary stages, which can cause major complications if left untreated, to primary and secondary stages, which are extremely contagious. HIV is a virus that targets the immune system, causing gradual immunological suppression and heightened vulnerability to opportunistic infections including tuberculosis and several types of cancer [4]. The relationship between syphilis and HIV is especially worrisome because syphilis can make it easier to contract and spread HIV since vaginal ulcers give the virus a place of entry [5]. On the other hand, HIV infection can change how syphilis progresses, resulting in unusual symptoms and a quicker progression to more severe forms like neurosyphilis [6].

HIV and syphilis are serious health problems in Nigeria and the country has the second-largest HIV epidemic in the world [1,7]. The incidence of these illnesses is still high despite coordinated efforts to lower transmission rates, especially in critical populations including injecting drug users (PWID), female sex workers (FSW), and men who have sex with men (MSM) who are generally in asymptomatic and may also be potential voluntary blood donors. Blood transfusions are still essential medical procedures, but if donor blood is not properly screened, there is a chance that blood-borne pathogens such as *Treponema pallidum* and HIV could continue to spread [8].

Syphilis and HIV co-infection among blood donors is a public health issue that affects both public and individual health. Co-infection can worsen the course of the illness and make treatment plans more difficult [14]. Additionally, the combined burden of HIV and syphilis makes clinical management more difficult, necessitating integrated care strategies that treat both infections at the same time [16]. By examining the prevalence of syphilis and HIV co-infection among blood donors at the CMDC in Ibadan, Oyo State, this study seeks to close the current information gap.

The goal of this study is to give useful information that will help design focused strategies to lessen the spread of these illnesses and enhance the general safety and effectiveness of blood transfusion services in Ibadan. Syphilis and HIV can spread through sexual contact, blood transfusions, and vertical transmission, therefore, co-infection is both physiologically and epidemiologically possible [2]. The two illnesses interact in a synergistic way. Syphilis inflammatory sores make it easier for HIV to enter and spread, and immunosuppressive effects hasten the disease progression and unusual presentation [20]. If donated blood is not properly screened, this mutual enhancement raises the chance of transmission, exacerbates the severity of the disease, and complicates clinical management.

This study determined:

1. The prevalence of syphilis and HIV separate infections among blood donors at the CMDC in Ibadan.
2. Prevalence of dual infections of the pathogens among blood donors at the CMDC in Ibadan.
3. The socio-demographic characteristics (e.g. age, gender, marital status, occupation, level of education, marital status, drug use, sexual practices, history of sexually transmitted infections) of blood donors with syphilis, HIV, or both infections at the CMDC in Ibadan. This study will help larger public health initiatives targeted at reducing STIs and improving the standard of care provided in Ibadan. The results will have an impact on future research directions, clinical practice, and policy formation, especially when it comes to integrated STI/HIV prevention and treatment programs.

Methodology

Study design

This is a cross-sectional study among blood donors attending the Central Medical Diagnostic Centre, Total Garden, Ibadan, Oyo State, Nigeria. The blood donors are distinguished by their readiness to support the medical system by giving blood for transfusions, which are essential for the treatment of numerous illnesses. This population is a crucial component of the healthcare system, and the prevalence of syphilis and HIV, especially multiple infections, may have serious consequences for public health and blood.

Study site

The Central Medical Diagnostic Centre (CMDC), Total Garden Ibadan, Oyo State, Nigeria, was the site of the study. Because of its critical role in supplying safe blood and blood products to medical facilities around Ibadan, the CMDC was selected. The CMDC in Ibadan provides a distinctive and thorough environment for researching the prevalence of syphilis and HIV among blood donors because it is a major hub for blood donation and transfusion services.

Modern facilities for blood collection, testing, and storage are part of the CMDC infrastructure, guaranteeing high standards of quality and safety. In order to acquire representative data on the burden of multiple infections, the strategic location in Ibadan, a large urban area, offers access to a broad donor population.

Selection of study participants

To guarantee the relevance and accuracy of the results regarding the burden of dual infections of syphilis and HIV among blood donors at the Central Medical Diagnostic Centre (CMDC), Total Garden Ibadan, Oyo State, the study participants will be carefully chosen based on specific inclusion and exclusion criteria.

Inclusion criteria:

1. **Voluntary blood donors aged 18 years and above:** People who are qualified to donate blood and who are legally adults; this ensures that the study population is representative of the adult donor pool as a whole.
2. **First-time and repeat blood donors:** To determine the frequency of syphilis and HIV infections among various donor categories, both first-time and repeat blood donors were included.
3. **Agreement to take part in the research:** Individuals who give their informed consent, stating that they are willing to participate in the study and gathering of medical, behavioral, and demographic data, as well as blood samples for testing.

Exclusion criteria:

1. People under the age of eighteen.
2. Potential blood donors who are ill or physically frail.
3. Refusal to participate in the research.
4. Inadequate health records or refusal to take part.

Sample size calculation

Using Cochran formula; $N = Z^2 P(1-p)/d^2$

Where N= Sample size, Z= Standard normal deviate (1.96 at 95% confidence limit) P= Prevalence of syphilis and HIV co-infections, d= error margin (0.073), P= 7.3% [8].

A total of 104 potential blood donors were enrolled into the study after obtaining their informed consent.

Data collection

Pretested and structured questionnaires were used to socio-demographic and clinical data such as (age and gender), medical history, and other pertinent behavioural information (e.g. sexual practices and prior history of STDs) that may affect infection risk from the participants.

Blood sample collection

About 2 mL of venous blood sample was collected from voluntary blood donors into EDTA blood specimen bottle at the CMDC in Ibadan. Strict aseptic procedures were followed during sample collection to reduce the possibility of contamination and guarantee the samples; integrity and dependability.

Laboratory procedures:

1. Laboratory screening and confirmation of HIV was performed as described by Lewin, S.J and Russell, A respectively.
2. Laboratory screening (RPR) and confirmation of Syphilis (ELISA) was performed as described by Drews, S.F and O'Brien respectively.

Interpretation of results

Samples are deemed reactive (positive) if screening and confirmatory tests are both positive while they were declared negative if the screening test was positive but confirmatory test was negative. Positive and negative controls samples were run along with the test samples.

Data entry

All of the data was methodically recorded into a safe electronic database following the conclusion of the data collection process. For this reason, Microsoft Excel 2016 was used because it is widely available and can handle large datasets. Standardized methods were used to guide the data entry process in order to reduce the likelihood of errors. Each data set was carefully added to the database, including test results and participant clinical data.

Questionnaires, the data collection tool, were meticulously designed and verified to guarantee correctness and completeness, which decreased the possibility of missing data.

Data analysis

IBM SPSS version 27, a potent statistical program ideal for managing sizable datasets and carrying out intricate analyses, was used to analyze the data. Descriptive statistics are used in the first stage of data analysis to provide an overview of the research population characteristics as well as the prevalence of HIV and syphilis. To characterize the central tendencies and variability of the data, this involves computing frequencies, means, and standard deviations.

Ethical considerations: Health Research Ethics Committee Approval: The study was approved by Oyo State Ministry of Health Research Ethics Committee with approval number NHREC/OYOSHRIEC/10/11/22.

Informed consent of all participants was obtained prior to questionnaire administration and blood sample collection. Confidentiality and privacy of research data were ensured by using unique identifiers and using pass worded electronic system to prevent access by unauthorized persons.

Results

This study reported ages of the potential blood donors were between the ages of 18 and 60, with a mean age of 34 years. The highest frequency was between the ages 25 - 34 and constituted 26.9% of the participants, while those between the ages of 35 and 44 constituted 26.0%. while participants over 55-year-old were 13.5% (Table 1). There was no significant difference between age groups and infection with HIV and or Syphilis (p value 0.567; Table 4) and between sex and Infection with HIV and or Syphilis (p-value 0.439, Table 4).

Male's participants were 75.0%, while females made up 25.0% (Figure 1) 57.7% of the participants were single and 37.5% were married. while 4.8%. were widowed or divorced (Table 1; figure 2). In terms of education, 40.4% of the participants had finished secondary school, 54.8% had tertiary education, and only 4.8% had received primary or no formal education (Table 1, figure 3 and 4). In terms of donor type, 37.5% were repeat donors and 62.5% were first-time donors (figure 5), indicating that many donors usually go for blood donation once a year. In terms of behavioral traits, 34.6% of respondents acknowledged alcohol consumption, while 65.4% denied doing so (Table 1, 2 and 5). However, there was no significant difference between alcohol use by the participants and HIV and or Syphilis infections (p-value 0.612; Table 5). On the other hand, there was significant difference between condom use and HIV and or Syphilis infection (p-value was 0.028, Table 5).

Additionally, a significant percentage reported using condoms inconsistently and having several sexual partners (Table 2 and 5). Students constituted highest frequency of donors (32%) followed by traders (24%); civil servants (18%) while health care practitioners were the least of potential donors (3.5%) (Figure 3). The prevalence of syphilis and HIV separate infections among blood donors were 1.9% and 1.9% respectively while the prevalence of dual infections of the pathogens among blood donors were 0.96% (Table 3). There was no significant difference between the sex of participants and infection with HIV and or syphilis (p value 0.439 (Table 4) and between age group of participants and infection with HIV and or syphilis (p value 0.567).

Variable	Category	Frequency (n)	Percentage (%)
Sex	Male	78	75.0
	Female	26	25.0
Age group (years)	18 - 24	17	16.3
	25 - 34	28	26.9
	35 - 44	27	26.0
	45 - 54	18	17.3
	≥ 55	14	13.5
Marital status	Single	60	57.7
	Married	39	37.5
	Divorced/Widowed	5	4.8
Educational level	None/Primary	5	4.8
	Secondary	42	40.4
	Tertiary	57	54.8
Donor type	First-time donor	65	62.5
	Repeat donor	39	37.5
Alcohol use	Yes	36	34.6
	No	68	65.4

Table 1: Sociodemographic and behavioral characteristics of respondents (N = 104).

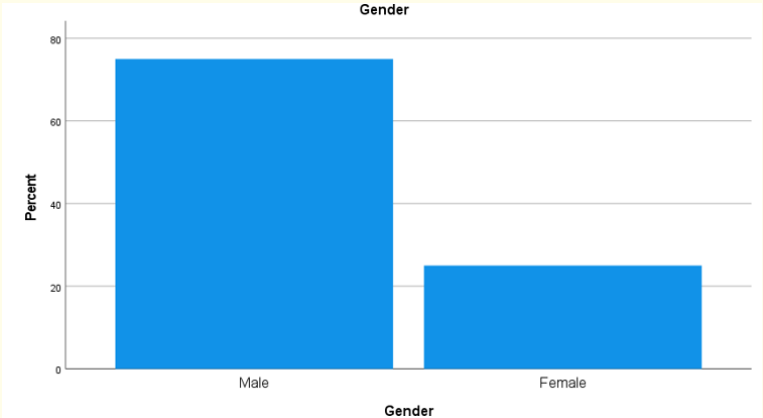


Figure 1: Bar chart showing the participant gender by percentage.

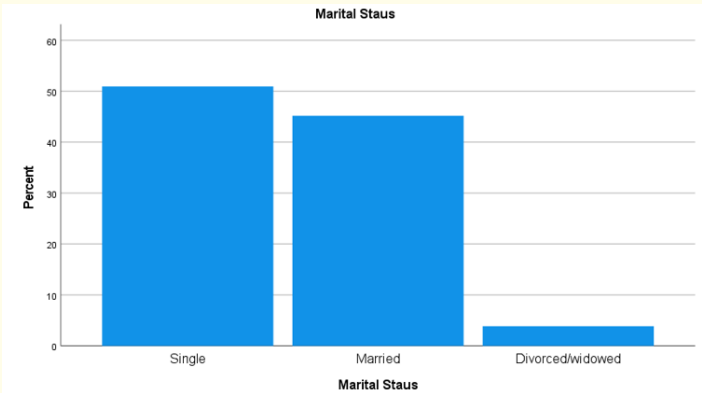


Figure 2: Bar chart showing the participants' marital status by percentage.

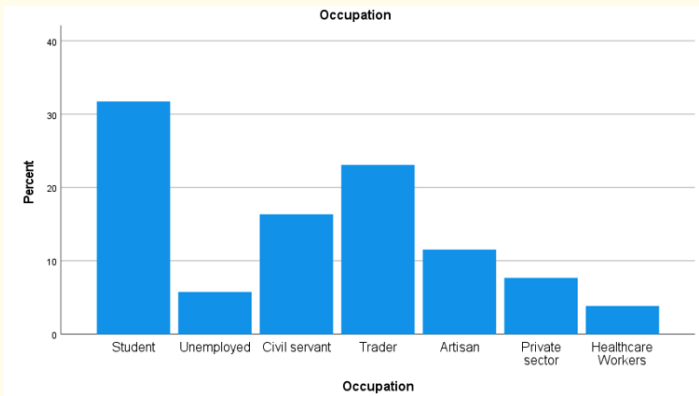


Figure 3: Bar chart showing the participant occupation by percentage.

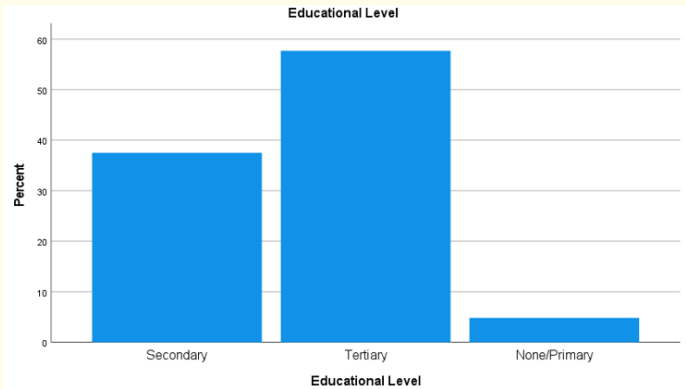


Figure 4: Bar chart showing the participants' educational level by percentage.

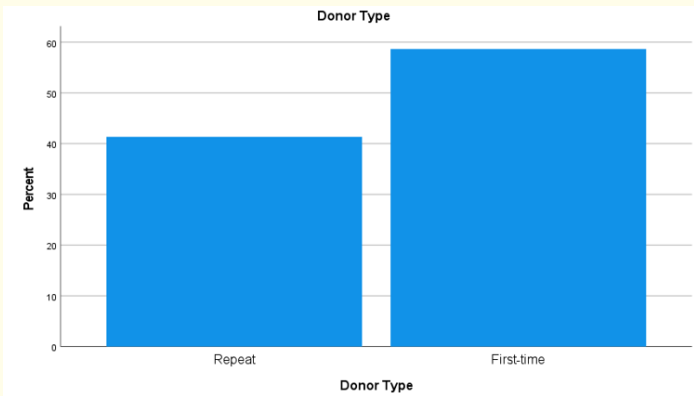


Figure 5: Bar chart showing the participant gender by percentage.

Variable	Category	Frequency (n)	Percentage (%)
Sexual activity	Yes	85	81.7
	No	19	18.3
Number of sexual partners (past year)	One	61	58.7
	Multiple	43	41.3
Condom use	Always	50	48.1
	Occasionally	35	33.7
	Never	19	18.3
Alcohol use	Yes	36	34.6
	No	68	65.4
Drug use (non-medical)	Yes	13	12.5
	No	91	87.5

Table 2: Behavioural and risk-related characteristics of respondents (N = 104).

Infection Type	Number Positive (n)	Prevalence (%)	95% Confidence Interval
HIV (ELISA confirmed)	2	1.9	0.53 - 6.74
Syphilis (ELISA)	2	1.9	0.53 - 6.74
HIV-Syphilis Co-infection	1	0.96	0.17 - 5.25

Table 3: Prevalence of HIV and syphilis among blood donors (N = 104).

Variable	Category	HIV Positive (n)	Syphilis Positive (n)	p-value
Sex	Male	1	1	0.439
	Female	1	1	
Age group (years)	18 - 24	0	0	0.567
	25 - 34	1	1	
	35 - 44	1	1	
	≥ 45	0	0	

Table 4: Association between sociodemographic characteristics and infection status.

Key: * $p < 0.05$.

Behavioral Variable	Category	HIV Positive (n)	Syphilis Positive (n)	p-value
Alcohol use	Yes	1	1	0.612
	No	1	1	0.612
Condom use	Always	0	0	
	Occasionally	1	1	0.028*
	Never	1	1	0.028*
Multiple sexual partners	Yes	1	1	0.545
	No	1	1	0.545

Table 5: Association between behavioral characteristics and infection status.

Key: * $p < 0.05$.

Discussion

The study showed a mean age of 34 years, the majority of blood donors in Ibadan are young, male, and educated. This trend is consistent with the sociodemographic profile frequently found in comparable research carried out in Nigeria and throughout sub-Saharan Africa. For example, Okonko, *et al.* (2023) and Oharume, *et al.* (2020) found that males between the ages of 20 and 40 made up more than 70% of blood donors in Lagos and Ilorin, respectively. Both biological and societal reasons could account for the over representation of men. Men are more commonly targeted for donation campaigns at companies, universities, and community drives, whereas women are typically postponed because of low hemoglobin levels, pregnancy, or menstruation.

A promising sign of awareness and health literacy is the high level of education among donors (more than 50% have post-secondary education). It implies that most contributors are probably aware of the value of voluntary giving and the dangers of risky behavior. The significant percentage of donors who report drinking alcohol, having several sexual partners, and using condoms inconsistently, however, shows that this does not completely eradicate dangerous behaviors. The paradox of having a high level of education but continuing to

engage in harmful activity illustrates the intricate interactions between practice, attitude, and knowledge that frequently define public health behavior in developing nations.

Important information about possible exposure pathways is provided by the behavioral results. Only 48.1% of sexually active donors regularly used condoms, while 41.3% reported having several partners. This is consistent with findings from Port Harcourt and Benin, where it was shown that many medically screened donors frequently conceal sexual risk concerns out of fear of being deferred. As the first line of protection before laboratory screening, the low percentage of condom compliance among this study population highlights the necessity of ongoing behavioral counselling and risk-based pre-donation consultations.

In this study, the prevalence of single infections with HIV or syphilis was 1.9% and 0.96% for both, respectively. Despite being modest, these numbers show that TTIs continue to pose a concern to blood safety. The observed result in this study is marginally greater than the national HIV prevalence (1.4% according to NAIHS, 2018), potentially because of the donor pool concentration and regional epidemiological variations. The 1.9% prevalence of syphilis is consistent with earlier study conducted in Nigeria, where rates among screened donors typically range from 1.5% to 3%.

Low prevalence does not mean that there is no risk. The World Health Organization has stressed, if a single infected unit of blood is transfused, the consequences could be disastrous.

The results thus highlight the significance of upholding strict screening and confirmatory testing procedures, particularly in areas where sexually transmitted illnesses are persistently endemic.

There was no discernible correlation between infection status and sociodemographic characteristics, including age, sex, or marital status. The low number of positive cases, which lowers inferential power, may be the cause of this lack of statistical connection. However, the pattern of infections concentrated in people between the ages of 25 and 44 is consistent with findings from around the world, indicating sexually active adults constitute the epidemiological core for both HIV and syphilis transmission.

It is interesting to note that there was a weak but statistically significant correlation between condom use and HIV infection ($p = 0.028$), indicating that inconsistent condom use may be a modifiable behavioral risk factor among donors. This link confirms earlier claims that hazardous sexual behaviors continue to be an unappreciated driver of donor infection rates, especially in areas that appear to have low incidence, even though causality cannot be demonstrated due to the cross-sectional methodology.

Additionally, the study found that while drug use (12.5%) and alcohol use (34.6%) were common among donors, they were not substantially correlated with infection status. However, because they might impede judgment and encourage risky sexual behavior, which indirectly increases the risk of infection, these behaviors are therapeutically relevant. In contrast to data in northern Nigeria, where injectable drug use has been more frequently linked to donor infection profiles, this study found a comparatively low percentage of drug users.

Overall, the results show that although the prevalence of infection among blood donors in Ibadan is low, behavioral risk factors are still present and could jeopardize attempts to provide a 100% safe blood supply. Low seroprevalence and moderate behavioral risk coexist, indicating that the present donor-screening methods are efficient but not infallible, underscoring the significance of ongoing public awareness campaigns, behavioral education, and regular laboratory validation.

The results of this study closely match trends found in other studies carried out in Nigeria and throughout sub-Saharan Africa. Results from studies like Afolabi, *et al.* (2013) [14] in Ibadan and Shiru, *et al.* (2023) in Ilorin, which showed HIV prevalence rates of 1.6% and 2.0%, respectively, are consistent with the low prevalence of HIV and syphilis among donors (1.9% each).

Similarly, a study found that the prevalence of syphilis among donors in Port Harcourt ranged from 1.5 to 2.3%. This consistency highlights a good trend in Nigeria blood transfusion services, indicating that over the past 10 years, transfusion-transmissible infections (TTIs) have decreased as a result of better screening procedures and more stringent donor selection standards.

The study observed rates are significantly lower than those seen in other African regions when compared globally. For example, research conducted in Ethiopia and Cameroon found that the prevalence of HIV was as high as 3 - 4% and that of syphilis was as high as 5%. Since Nigeria southwestern region has historically shown better access to healthcare facilities, education, and awareness campaigns than some northern and central regions, the lower rates in Ibadan may be the result of both regional epidemiology differences and changes in donor demographics.

In contrast, the prevalence of HIV and syphilis among blood donors is less than 0.1% in developed countries like the United States and the United Kingdom, mostly because to extensive voluntary donation programs, strict screening algorithms, and sophisticated nucleic acid testing (NAT). Therefore, systemic disparities in screening technology, donor recruitment, and behavioral risk reduction are highlighted by the persistence of even low infection rates in developing countries. In terms of demographics, this study conclusion that 75% of donors are men is consistent with findings from studies conducted in Nigeria. Biological limitations and cultural norms that deter women from engaging in physically demanding activities have been blamed for the persistent under representation of women in blood donation throughout Africa.

Findings from Amoo., *et al.* (2021) and Afolabi., *et al.* (2018) [14] are reflected in the behavioral results of this study, especially the high proportion of repeated sexual partnerships (41.3%) and inconsistent condom use, who pointed out that despite being medically vetted, a large number of donors participate in dangerous sexual conduct. This suggests that behavioral self-reporting might not necessarily correspond with biological risk, highlighting the necessity of more private and psychologically secure donor-interview protocols that promote honest disclosure.

The lowest prevalence rate of 3.5% of health care professionals in this study showed the need for attitudinal change among health care professionals towards blood donations as they are expected to be champions for blood donation activities and are expected to lead by examples.

Conclusion and Recommendations

This study reported ages of the potential blood donors were between the ages of 18 and 60, with a mean age of 34 years. The highest frequency was between the ages 25 - 34 and constituted 26.9% of the participants, while those between the ages of 35 and 44 constituted 26.0%. while participants over 55-year-old were 13.5%.

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