

HIV Infection Among Pregnant Women in a Vietnamese Population: Prevalence and Associated Factors

Hang Thi Thu Ho^{1,2}, Thuan Hoa Nguyen³, Ha Hong Nguyen⁴, Sam Phan Hai Nguyen⁴, Kien Trung Nguyen⁴

¹Vinh Long Department of Health, Vinh Long City, Vietnam; ²Faculty of Medicine, Can Tho University of Medicine and Pharmacy, Can Tho City, Vietnam; ³Vinh Long General Hospital, Vinh Long City, Vietnam; ⁴Department of Physiology, Faculty of Medicine, Can Tho University of Medicine and Pharmacy, Can Tho City, Vietnam

Correspondence: Ha Hong Nguyen, Department of Physiology, Faculty of Medicine, Can Tho University of Medicine and Pharmacy, 179 Nguyen Van Cu Street, Tan An Ward, Can Tho City, Vietnam, Email nhha82@ctump.edu.vn

Background: In pregnant women, HIV infection warrants special attention due to the high risk of complications during pregnancy and the increased likelihood of fetal HIV exposure. Consequently, screening for HIV in pregnant women within the community and identifying associated risk factors are essential.

Objective: The study aims to investigate the prevalence of HIV infection and the associated risk factors in pregnant women.

Materials and Methods: This is a cross-sectional study that utilized convenience sampling and was conducted between 2018 and 2020 at 107 commune health stations, 8 district health centers, and the Obstetrics Department of Vinh Long Provincial General Hospital.

Results: A total of 18,034 pregnant women, with a median age of 28 years. Fifty-one cases (0.3%) tested positive for HIV. The risk factors associated with an increased likelihood of HIV infection included having multiple sexual partners, drug addiction, smoking, and engaging in unprotected sex. In the multivariate model, only multiple sexual partners, drug addiction and alcohol consumption were independent factors that significantly increased the risk of HIV infection among pregnant women.

Conclusion: The study among pregnant women indicated that the HIV exposure rate within the community is below 1.0%. Unsafe sexual behaviors with multiple partners were identified as the most significant risk factor for HIV exposure among pregnant women.

Keywords: HIV infection, pregnant women, risk factors

Introduction

HIV remains a global pandemic, with a rapidly increasing number of cases, a high mortality rate, alongside non-communicable chronic diseases.^{1,2} The incidence peaked in 1997, with 3.3 million new infections. Since 2005, the annual incident has remained relatively stable at approximately 2.6 million cases per year (ranging from 2.5 to 2.8 million), following a decline from 1997 to 2005. The number of people living with HIV/AIDS has steadily increased, reaching 38.8 million in 2015. Simultaneously, the mortality rate due to HIV/AIDS has steadily decreased, from a peak of 1.8 million deaths in 2005 to 1.2 million deaths in 2015.³ Vietnam, a developing country, has recorded a rapid increase in the number of new cases annually since the first HIV case was reported in 1990. In 1999, Vietnam reported 17,046 HIV infections, including 2947 AIDS cases and 1523 deaths. The cumulative incidence rate nationwide is 22.5 per 100,000 population. Intravenous drug users accounted for 89.0% of all reported at-risk individuals before 1997 and 88.0% during the period from 1997 to 1999. In 1999, the HIV prevalence rate among intravenous drug users ranged from 0.0% to 89.4% by province. The HIV prevalence rate among sex workers ranged from 0.0% to 13.2%. In 1999, the incidence rates among pregnant women, blood donors, and military recruits were 0.12%, 0.20%, and 0.61%, respectively.⁴ Pregnant women should be prioritized for HIV screening due to the numerous dangerous impacts during pregnancy. The

consequences of immunodeficiency increase the risk of miscarriage, preterm birth, and negatively affect fetal health.^{5,6} Meta-analyses indicate that HIV-infected women have an eightfold higher risk of pregnancy-related mortality compared to non-HIV-infected women. The mortality rate due to HIV among pregnant and postpartum women is 994 per 100,000 pregnant women. Approximately 12.0% of deaths during pregnancy and within one year postpartum are attributed to HIV/AIDS in regions where the HIV prevalence among pregnant women is 2.0%. This figure increases to 50.0% in regions with an HIV prevalence of 15.0%.⁷ Therefore, screening for HIV prevalence and associated risk factors in pregnant women within the community is essential for effective management and prevention of exposure. According to Ronald H. Gray's survey in Rakai, Uganda, the HIV incidence rate was 2.3 per 100 person-years during pregnancy, 1.3 per 100 person-years during breastfeeding, and 1.1 per 100 person-years among non-pregnant and non-breastfeeding women. The adjusted incidence rate was 2.16 (95% CI=1.39–3.37) during pregnancy and 1.16 (95% CI=0.82–1.63) during breastfeeding.⁸ Factors such as intravenous drug use, having tattoos, a history of blood transfusions, and same-sex sexual relations were identified as major risk factors for HIV exposure among pregnant women in Europe. Meanwhile, poor economic conditions, unsafe sexual practices, multiple sexual partners, and a history of other sexually transmitted infections were the primary risk factors in African countries.⁹ In Vietnam, data on HIV among pregnant women in the community is still limited, particularly in the Mekong Delta region, which is a major agricultural economic area of the country with an increasingly improved healthcare system. Therefore, we conducted this study to investigate the prevalence of HIV infection and the associated risk factors among pregnant women in Vinh Long province, located in the Mekong Delta.

Materials and Methods

Study Design and Population

This is a cross-sectional descriptive study with a convenience sampling method, conducted from 2018 to 2020 at 107 commune health stations, 8 district health centers, and the Obstetrics Department of Vinh Long Provincial General Hospital, located in the Mekong Delta region of southern Vietnam. The study population consisted of all pregnant women aged 18 and above who visited the centers for prenatal check-ups and were invited to participate in the study and undergo HIV testing. Exclusion criteria included: (1) refusal to undergo HIV testing or failure to provide HIV test results; (2) pregnant women who had not been residing in Vinh Long province for at least 12 months; (3) pregnant women with mental illnesses, deaf-mute, or unable to respond to the interview; (4) pregnant women hospitalized for severe obstetric issues such as preeclampsia or eclampsia; (5) Cases with a prior diagnosis of HIV infection were excluded from the study. At the end of the follow-up process, a total of 18,034 pregnant women met the criteria and were invited to participate in the study.

Data Collection

The interviewers include midwives and doctors who have been trained by project staff. Pregnant women who meet the inclusion criteria and did not meet the exclusion criteria were interviewed in a private setting to ensure the confidentiality of their information. Data collected during the interviews included age, gestational age, occupation, educational level, economic status, and the total number of pregnancies to this point. Multiple partners were defined as having two or more sexual partners within the past 12 months.⁸ Individuals with a history of or current dependence on any type of drug were classified as drug addiction.¹⁰ Pregnant women who smoked or consumed alcohol at any time during pregnancy were defined as users.¹¹

Recruitment Procedure: All pregnant women residing in Vinh Long province who attended routine antenatal care visits at 107 commune health stations, 8 district health centers, and the Obstetrics Department of Vinh Long Provincial General Hospital were invited to participate in the study, with no daily enrollment limit. Screening and interviews were conducted by trained midwives and physicians, who were rotated monthly to ensure that they were unfamiliar with the participants, thereby maintaining confidentiality. In addition to clinical assessments of pregnancy status and anthropometric characteristics, structured interviews were conducted to assess HIV-related risk factors. The questionnaire included the following items: (1) Are you currently married or single?; (2) Apart from your husband or current partner,

have you had sexual relations with another partner?; (3) Have you ever engaged in same-sex sexual activity, either currently or in the past?; (4) Do you regularly use contraception during sexual intercourse, and if so, what method do you use?; (5) Are there any individuals in your family, among your friends, or in your living or working environment who are known to be HIV positive?; (6) How would you describe your current economic status?; (7) Did you regularly attend antenatal check-ups during your previous or current pregnancy?; (8) Have you ever used any illicit substances, such as drugs or marijuana, either currently or in the past?; (9) Have you ever received a blood transfusion?; (10) Have you ever smoked cigarettes or consumed alcohol, either currently or in the past?. Trained nursing staff performed blood collection for HIV testing from pregnant women, following standardized protocols. The blood samples were transferred to the Laboratory Department of Vinh Long Provincial General Hospital for rapid HIV testing. According to WHO standards for diagnosing HIV infection,¹² a pregnant woman is considered HIV-positive if both ELISA tests, including Genscreen HIV 1/2 (Bio-Rad, US) and Murex HIV 1/2 (Murex Biotech, UK), yield positive results. If the rapid test indicates a positive result, the sample is further sent to the Vinh Long Provincial HIV/AIDS Prevention Center for confirmation. If the confirmatory result again indicates HIV infection, the pregnant woman will be counseled by an infectious disease specialist and subsequently registered for management and treatment in accordance with the guidelines issued by the Ministry of Health of Vietnam.

Statistical Analysis

The data were analyzed using SPSS 20.0 software. Qualitative variables are presented as frequencies (percentages), quantitative variables with a normal distribution are presented as means ($\pm$ standard deviation, SD), and those with a non-normal distribution are presented as medians (interquartile range, IQR). The normality of the distribution of variables was assessed using the Kolmogorov–Smirnov test, and variables were considered normally distributed when the significance level (Sig) was greater than 0.05. Differences between qualitative variables were assessed using the Chi-square test. Differences between quantitative variables were assessed using the *T*-test. Finally, both univariate and multivariate logistic regression were used to assess the impact of risk factors on HIV infection status in pregnant women.

Ethical Approval

Ethical clearance for the study was obtained from the People's Committee of Vinh Long province (reference number 1746/QD-UBND) and the Science and Technology Advisory Council of Vinh Long province (reference number TI.020718154312). All patients were informed about the objectives and methods of the study and provided written informed consent before participating. They were also allowed to withdraw from the study at any stage of the study. All collected data were used exclusively for research purposes and would not be disclosed without the patient's consent. The study was complied with the ethical principles outlined in the Helsinki Declaration.

Results

The general characteristics of the study population revealed that the total number of pregnant women was 18,034, with a median age of 28 (24–33) years. The age group of 25–35 years accounted for the highest proportion at 62.0%, and 80.7% of participants had a gestational age of over 36 weeks at the time of the study. There were 51 HIV-positive cases, accounting for 0.3%. Sociodemographic factors associated with HIV positivity included a gestational age between 28 and 36 weeks, occupations as housewives and farmers, poor economic status, having only one antenatal care (ANC) visit, and receiving care at a general clinic (Table 1).

Considering the risk factors for HIV infection (Table 2), we identified that factors such as multiple sexual partners (OR=9.97; 95% CI=2.21–15.72; $p<0.05$); drug addiction (OR=4.22; 95% CI=1.11–7.89; $p<0.05$); smoking (OR=4.10; 95% CI=1.52–8.73; $p<0.05$); and unprotected sexual intercourse (OR=2.80; 95% CI=0.92–4.47; $p<0.05$) significantly increase the risk of HIV infection in pregnant women.

In the univariate logistic regression model, factors including multiple sexual partners, drug addiction, smoking, alcohol consumption, and low educational level were associated with HIV infection in pregnant women. However, in the multivariate model, only multiple sexual partners (OR=9.63; 95% CI=3.36–21.74; $p<0.05$), drug addiction (OR=3.81;

Table 1 The General Characteristics of the Study Population

Variable	Total (n=18,034)	HIV Positive (n=51)	HIV Negative (n=17,983)	OR (95% CI)	p
Age	28 (24–33)	23 (20–29)	29 (25–34)	–	0.012
Age Group					
≤24	4538 (25.1)	8 (15.7)	4530 (25.2)	I	
25–35	11,173 (62.0)	35 (68.6)	11,138 (61.9)	1.78 (0.82–3.84)	0.186
≥36	2323 (12.9)	8 (15.7)	2315 (12.9)	1.96 (0.73–5.22)	0.155
Gestational Age					
<28 weeks	2785 (15.4)	16 (31.4)	14,529 (80.8)	I	
28–36 weeks	704 (3.9)	32 (62.7)	2753 (15.3)	10.55 (5.78–19.26)	<0.001
>36 weeks	14,545 (80.7)	3 (5.9)	701 (3.9)	3.89 (1.13–13.37)	0.072
Occupation					
Civil servant	6322 (35.1)	6 (11.7)	6316 (35.1)	I	
Housewife	3230 (17.9)	18 (35.3)	3212 (17.9)	5.90 (2.34–14.87)	0.002
Farmer	2516 (13.9)	11 (21.6)	2505 (13.9)	4.62 (1.71–12.51)	0.004
Other	5966 (33.1)	16 (31.4)	5950 (33.1)	2.83 (1.11–7.24)	0.054
Education Level					
Primary	2585 (14.3)	3 (5.9)	2582 (14.4)	I	
Secondary-High school	14,096 (78.2)	46 (90.2)	14,050 (78.1)	2.82 (0.88–9.07)	0.168
College/University	1353 (7.5)	2 (3.9)	1351 (7.5)	1.27 (0.21–7.63)	0.304
Economic Status					
Average	17,175 (95.2)	41 (80.4)	17,134 (95.3)	I	
Poor	859 (4.8)	10 (19.6)	849 (4.7)	4.92 (2.46–9.86)	<0.001
Number of Pregnancies					
First pregnancy	8849 (49.1)	29 (56.9)	8820 (49.1)	I	
≥2 pregnancies	9185 (50.9)	22 (43.1)	9163 (50.9)	0.73 (0.32–4.47)	0.112
Number of ANC visits					
≥2 visits	17,493 (97.0)	35 (68.6)	17,458 (97.1)	I	
1 visits	541 (3.0)	16 (31.4)	525 (2.9)	15.20 (8.36–27.64)	<0.001
Place of antenatal Care					
District or provincial hospital	10,419 (57.8)	22 (43.1)	10,397 (57.8)	I	
Commune health station	1428 (7.9)	12 (23.5)	1416 (7.9)	4.01 (1.98–8.11)	0.930
General clinic	5359 (29.7)	16 (31.4)	5343 (29.7)	1.42 (0.74–2.69)	0.010
Other	828 (4.6)	1 (2.0)	827 (4.6)	0.57 (0.07–4.24)	0.826

95% CI=1.88–7.77; $p<0.05$), and alcohol consumption (OR=2.43; 95% CI=1.01–5.18; $p<0.05$) were identified as independent factors that increased the risk of HIV infection in pregnant women (Table 3).

Discussion

Principal Findings

Our study, conducted on pregnant women, revealed an HIV exposure rate in the community of 0.3% out of a total of over 18,000 cases surveyed. This offers valuable information for pregnancy management and exposure prevention during childbirth. The independent factors associated with an increased risk of HIV positivity during pregnancy were identified

Table 2 Risk Factors and Their Association with HIV Infection in Pregnant Women

Variable	Total (n=18,034)	HIV Positive (n=51)	HIV Negative (n=17,983)	OR (95% CI)	p
Multiple partners	2826 (15.7)	33 (64.7)	2793 (15.5)	9.97 (2.21–15.72)	<0.001
Drug addiction	1233 (6.8)	12 (23.5)	1221 (6.8)	4.22 (1.11–7.89)	0.012
Smoking	3899 (21.6)	27 (52.9)	3872 (21.5)	4.10 (1.52–8.73)	0.038
Alcohol consumption	2140 (11.9)	15 (29.4)	2125 (11.8)	3.11 (0.79–6.63)	0.132
History of blood transfusion	1325 (7.3)	10 (19.6)	1315 (7.3)	3.09 (1.03–12.32)	0.221
Unprotected sexual intercourse	7918 (43.9)	35 (68.6)	7883 (43.8)	2.80 (0.92–4.47)	0.042

Table 3 Logistic Regression of Factors Associated with HIV Infection in Pregnant Women

Variable	Univariate			Multivariate		
	OR	95% CI	p	OR	95% CI	p
Gestational age	0.72	0.33–2.12	0.341	–	–	–
Multiple sexual partners	8.88	3.01–15.38	<0.001	9.63	3.36–21.74	<0.001
Drug addiction	3.72	1.11–6.53	0.021	3.81	1.88–7.77	0.010
Smoking	2.12	1.07–5.55	0.033	2.27	1.35–6.12	0.184
Alcohol consumption	2.28	0.83–4.21	0.006	2.43	1.01–5.18	0.032
History of blood transfusion	1.32	0.85–3.09	0.225	–	–	–
Unprotected sexual intercourse	1.75	1.01–4.43	0.098	–	–	–
Low educational level	2.22	1.45–3.33	0.040	2.37	1.87–4.01	0.107
Poor economic status	1.64	0.82–4.01	0.115	–	–	–

as having multiple sexual partners, drug addiction, and alcohol consumption, with risk levels ranging from 2.43 to 9.63 times higher. Among these, having multiple sexual partners, either currently or in the past, was identified as the most significant risk factor for HIV infection in pregnant women.

Strengths and Weaknesses of the Study

Our study involved a well-defined sample collection process with clear inclusion and exclusion criteria. All study participants were volunteers, and the large, multi-center sample size within Vinh Long province enhances the strength of statistical analysis and extrapolation value. The research methodology is clearly described and reproducible. The HIV infection rate among pregnant women in the community was determined to be 0.3%. The risk factors for HIV exposure during pregnancy were clearly identified as having multiple sexual partners, drug addiction, and alcohol consumption. These factors facilitate the identification of high-risk individuals for HIV screening in future ongoing studies.

However, the study also has certain limitations. It was conducted exclusively in Vinh Long province, which may lead to biases in some general and clinical characteristics. The main risk factors investigated were the socioeconomic and educational conditions, and sexual habits of pregnant women, while other sexually transmitted infections and the risk characteristics of husbands/partners were not investigated, leading to limitations in the analysis of risk factors. Therefore, a study with a similar or larger sample size across multiple centers in different regions, including a broader range of risk factors, is necessary to accurately reflect the characteristics of HIV exposure in pregnant women in the community.

Possible Explanations and Comparison with Other Studies

Pregnant women should be prioritized for HIV screening due to the numerous adverse effects that can occur during the pre-pregnancy, pregnancy, and postpartum periods. Immunodeficiency resulting from HIV can lead to outbreaks of various infectious diseases, increasing the risks of miscarriage, preterm birth, and negative impacts on fetal health. Additionally, the risk of mother-to-child transmission of HIV is significantly high, as HIV-1 can cause placental inflammation and expose the fetus to the virus even during the intrauterine stage.¹³ Therefore, it is critically important for pregnant women to screen for HIV in the community to ensure proper management and the initiation of antiretroviral therapy. Among the total of 18,034 pregnant women participating in our study and undergoing HIV screening, the median age was 28 years (24–33 years). The age group of 25–35 years accounted for the highest proportion at 62.0%, and 80.7% of participants had a gestational age of over 36 weeks at the time of the study. There were 51 HIV-positive cases, accounting for 0.3%. According to a study by Ronald H. Gray conducted in Rakai, Uganda, the HIV incidence rate was 2.3 per 100 person-years during pregnancy, 1.3 per 100 person-years during breastfeeding, and 1.1 per 100 person-years among women who were neither pregnant nor breastfeeding. The adjusted incidence rate was 2.16 (95% CI=1.39–3.37) during pregnancy and 1.16 (95% CI=0.82–1.63) during breastfeeding.⁸ In North Trinidad, GA Hutchinson conducted a survey involving 541 women attending antenatal clinics in the St. George West district and clinics at the Port-of-Spain General Hospital. The study identified a total of 37 HIV-positive women, yielding a prevalence rate of 6.84%. Among these, 14 out of 37 women (37.8%) were aware of their HIV status prior to pregnancy.¹⁴ In Nigeria, according to EA Etukumana, the prevalence of HIV among pregnant women was 11.1%, with 38 HIV-positive cases recorded among 350 pregnant women tested in Zawan, a rural settlement located approximately 20 km from Jos, Nigeria.¹⁵ According to the study by John G. Ayisi et al, the prevalence of HIV among asymptomatic pregnant women attending antenatal clinics in western Kenya was found to reach 26.1%.¹⁶ Data from these studies indicate that the prevalence of HIV exposure among pregnant women ranges from 6.0% to 26.0%,^{14–16} significantly higher than the findings of our report. Differences in socioeconomic conditions and sexual behavior may account for this discrepancy (Table 4). In addition to the relatively high HIV prevalence rates reported in the aforementioned countries, a survey conducted between 2017 and 2021 in Mogadishu, Somalia, documented that a total of 7874 pregnant women were tested for hepatitis B, hepatitis C, and HIV over a five-year period. The results showed a hepatitis B infection rate of 2.8%, hepatitis C at 0.4%, while the HIV positivity rate among pregnant women was notably low at only 0.2%.¹⁷ Also in Somalia, a study by Sabri Kurtay et al conducted at the Mogadishu Somalia Turkish Hospital (MSTH) from January 2015 to September 2021, reported that 17 out of 7959 pregnant women (0.2%) tested positive for HIV.¹⁸ These two studies reported a relatively low HIV positivity rate among pregnant women, which is consistent with our findings. This similarity may be attributed to the fact that Mogadishu is a major city in Somalia with relatively favorable socioeconomic conditions. Such factors have been shown to play a significant role in influencing HIV prevalence within communities.^{19–21}

Similar to men, risky sexual behaviors, socio-economic conditions, and inadequate awareness are significant risk factors contributing to the increased HIV infection rate during pregnancy. HIV can be transmitted through sexual intercourse, blood

Table 4 Studies on HIV Infection Prevalence in Pregnant Women

Author	Number of Pregnant Women	Exposure Prevalence
Ronald H Gray (2005) ⁸	2625	Rakai, Uganda: 2.3/100 person/year
GA Hutchinson (2006) ¹⁴	541	North Trinidad: 6.84%
EA Etukumana (2010) ¹⁵	350	Nigeria: 11.1%
John G Ayisi (2000) ¹⁶	2844	Kenya: 26.1%
Chiphangwi J (1990) ¹⁷	1483	Urban Malawi: 21.6%
Susan Allen (1991) ¹⁸	1458	Kigali, Rwanda: 32.0%
Nathaniel H Smith (1996) ⁹	793	Barcelona, Spain 1.6%;
	15308	Geneva, Switzerland 2.5%
	51561	Edinburgh, Scotland 0.27%

exposure, or mother-to-child transmission during pregnancy, childbirth, and breastfeeding. In individuals with multiple sexual partners, same-sex relationships, non-condom use, and drug injection, direct exposure to blood, semen, and vaginal fluids facilitates the rapid spread of the virus.^{22,23} The HIV exposure prevalence reported in Urban Malawi reached 21.6%, with identified risk factors including a history of genital warts (OR=3.07), husband's education level (OR=2.30), history of pelvic inflammatory disease (PID) (OR=1.93), husband having multiple partners (OR=1.88), history of syphilis (OR=1.84), non-husband partners (OR=1.72), and being a first-time mother (OR=1.48).²⁴ Similarly, in Kigali, Rwanda, also in Africa, the prevalence of pregnant women with positive HIV serology reached 32.0%. Risk factors included having multiple sexual partners (OR=1.88), bleeding during sexual intercourse (OR=1.86), history of blood transfusion (OR=1.81), partner drinking alcohol (OR=1.76), and illegal marriage (OR=1.66).¹⁸ In contrast, in Europe, the HIV infection prevalence in pregnant women is lower, with 1.6% in Barcelona, Spain; 2.5% in Geneva, Switzerland; and 0.27% in Edinburgh, Scotland.⁹ The factors including drug injection, having tattoos, history of blood transfusion, and same-sex sexual relationships are the primary risk factors for HIV exposure among pregnant women in these European countries.⁹ Similar to the studies mentioned above, our research also identified sexual behavior as a primary risk factor for HIV exposure in pregnant women. Specifically, multiple sexual partners (OR=9.97; 95% CI=2.21–15.72; $p<0.05$), unprotected sexual intercourse (OR=2.80; 95% CI=0.92–4.47; $p<0.05$) were significant risk factors. Additionally, other factors such as drug addiction (OR=4.22; 95% CI=1.11–7.89; $p<0.05$) and smoking (OR=4.10; 95% CI=1.52–8.73; $p<0.05$). However, in the multivariate model, only having multiple sexual partners, drug addiction, and alcohol consumption were identified as independent factors that increase the risk of HIV infection in pregnant women.

Conclusion

The study conducted on pregnant women revealed an HIV exposure rate in the community of less than 1.0%. Risk factors, including having multiple sexual partners, drug addiction, and alcohol consumption, were identified as independent factors that increase the risk of HIV transmission in pregnant women.

Data Sharing Statement

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Ethics Approval

Ethical clearance for the study was obtained from the People's Committee of Vinh Long province (reference number 1746/QD-UBND) and the Science and Technology Advisory Council of Vinh Long province (reference number TI.020718154312).

Consent to Participate

All participants provided informed consent before their inclusion in the study. The study was conducted in accordance with ethical guidelines and approved by the appropriate institutional review board.

Consent for Publication

All authors have reviewed and approved the manuscript for submission and publication.

Acknowledgments

We would like to thank Can Tho University of Medicine and Pharmacy for creating favorable conditions for this study to be carried out.

Funding

There is no funding to report.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Sullivan PS, Jones JS, Baral SD. The global north: HIV epidemiology in high-income countries. *Curr Opin HIV AIDS*. 2014;9(2):199–205. doi:10.1097/COH.0000000000000039
2. Nguyen PM, Thach AN, Pham XD, et al. Prevalence and determinants of medication adherence among patients with HIV/AIDS in southern Vietnam. *Infectious Dis Reports*. 2021;13(1):126–135. doi:10.3390/idr13010014
3. Wang H, Wolock TM, Carter A, et al. Estimates of global, regional, and national incidence, prevalence, and mortality of HIV, 1980–2015: the global burden of disease study 2015. *Lancet HIV*. 2016;3(8):e361–e387. doi:10.1016/S2352-3018(16)30087-X
4. Quan VM, Chung A, Long HT, et al. HIV in Vietnam: the evolving epidemic and the prevention response, 1996 through 1999. *J Acquir Immune Defic Syndr*. 2000;25(4):360–369. doi:10.1097/00126334-200012010-00011
5. Kourtis AP, Lee FK, Abrams EJ, et al. Mother-to-child transmission of HIV-1: timing and implications for prevention. *Lancet Infect Dis*. 2006;6(11):726–732. doi:10.1016/S1473-3099(06)70629-6
6. Study EC. Mother-to-child transmission of HIV infection in the era of highly active antiretroviral therapy. *Clin Infect Dis*. 2005;40(3):458–465.
7. Calvert C, Ronsmans C. The contribution of HIV to pregnancy-related mortality: a systematic review and meta-analysis. *Aids*. 2013;27(10):1631–1639. doi:10.1097/QAD.0b013e32835fd940
8. Gray RH, Li X, Kigozi G, et al. Increased risk of incident HIV during pregnancy in Rakai, Uganda: a prospective study. *Lancet*. 2005;366(9492):1182–1188. doi:10.1016/S0140-6736(05)67481-8
9. Smith NH, Hwang L-Y. Risk factors for HIV in pregnant women. *Int J STD AIDS*. 1996;7(6):388–395. doi:10.1258/0956462961918338
10. Etemadi-Aleagha A, Akhgari M. Psychotropic drug abuse in pregnancy and its impact on child neurodevelopment: a review. *World J Clin Pediatr*. 2022;11(1):1. doi:10.5409/wjcp.v11.i1.1
11. Cogswell ME, Weisberg P, Spong C. Cigarette smoking, alcohol use and adverse pregnancy outcomes: implications for micronutrient supplementation. *J Nutr*. 2003;133(5):1722S–1731S. doi:10.1093/jn/133.5.1722S
12. World Health Organization. *Guidance on Provider-Initiated HIV Testing and Counselling in Health Facilities*; 2007.
13. Altfeld M, Bunders MJ. Impact of HIV-1 infection on the foeto-maternal crosstalk and consequences for pregnancy outcome and infant health. *Semin Immunopathol*. 2016;38(6):727–738. doi:10.1007/s00281-016-0578-9
14. Hutchinson G, Jameson E. Prevalence and risk factors for HIV infection in pregnant women in north Trinidad. *West Indian Med J*. 2006;55(5):346–350. doi:10.1590/S0043-31442006000500011
15. Etukumana E, Thacher T, Sagay A. HIV risk factors among pregnant women in a rural Nigerian hospital. *West Indian Med J*. 2010;59(4):424.
16. Ayisi JG, Van Eijk AM, Kuile FOT, et al. Risk factors for HIV infection among asymptomatic pregnant women attending an antenatal clinic in western Kenya. *Int J STD AIDS*. 2000;11(6):393–401. doi:10.1258/0956462001916119
17. Hassan-Kadle MA, Keles E, Nor MA, et al. Seroprevalence of Hepatitis B, Hepatitis C, and HIV in pregnant women attending a tertiary care hospital in Mogadishu, Somalia, 2017–2021. *Res Square*. 2023.
18. Kurtay S, Hussein AI. Prevalence of human immunodeficiency virus among pregnant women. *Int J Women's Health*. 2022;Volume 14:1803–1806. doi:10.2147/IJWH.S392442
19. Abdulle AA, Khalif IY, Hashi AH, et al. Level of awareness about HIV/AIDS among people living in Galmudug, Somalia: a cross-sectional study. *MedS Alliance J Med Med Sci*. 2022;2(4):31–36. doi:10.3126/mjmmms.v2i4.53555
20. Santelli JS, Chen I, Makumbi F, et al. Household wealth and HIV incidence over time, rural Uganda, 1994–2018. *Aids*. 2021;35(11):1835–1843. doi:10.1097/QAD.0000000000002989
21. Greenwood BN, Agarwal R. Matching platforms and HIV incidence: an empirical investigation of race, gender, and socioeconomic status. *Manage Sci*. 2016;62(8):2281–2303. doi:10.1287/mnsc.2015.2232
22. Shaw GM, Hunter E. HIV transmission. *Cold Spring Harbor Perspect Med*. 2012;2(11):a006965. doi:10.1101/cshperspect.a006965
23. Moir S, Chun T-W, Fauci AS. Pathogenic mechanisms of HIV disease. *Ann Rev Pathol*. 2011;6(1):223–248. doi:10.1146/annurev-pathol-011110-130254
24. Chipangwi J, Dallabetta GA, Saah AJ, Liomba GN, Miotti PG. Risk factors for HIV-1 infection in pregnant women in Malawi [abstract]. *Int Conf AIDS*. 1990;6(1):158.

HIV/AIDS - Research and Palliative Care

Publish your work in this journal

HIV/AIDS - Research and Palliative Care is an international, peer-reviewed open-access journal focusing on advances in research in HIV, its clinical progression and management options including antiviral treatment, palliative care and public healthcare policies to control viral spread. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <https://www.dovepress.com/hiv-aids-research-and-palliative-care-journal>

Dovepress
Taylor & Francis Group