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# Seroprevalence of Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and Human Immunodeficiency Virus (HIV) 1 and 2 Co-infection among Female Sex Workers and Female Non-sex Workers and its Associated Risk Factors in Osun State, Nigeria

**Sajanat Olubusola Salinsile [a,b], Olalekan Olumide Akomolafe [c], Oyebola Idayat Badmus [b] and Oluyinka Oladele Opaleye [a*]**

*[a] Department of Medical Microbiology, Ladoke Akintola University of Technology, Ogbomosho – 210214, Nigeria.*
*[b] Department of Public Health, Adeleke University, Ede – 232104, Nigeria.*
*[c] Department of Public Health, University of East London - E162RD, United Kingdom.*

***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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**Corresponding author: Email: ooopaleye@lautech.edu.ng;*

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## ABSTRACT

This study examines the seroprevalence and co-infection rates of hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) among female female sex workers (FSWs) and the general female population in Osun State, Nigeria. Using a cross-sectional design, 182 female participants—91 FSWs and 91 non-FSWs—were randomly selected and tested for HBV, HCV, and HIV markers. Results indicated a significantly higher prevalence of HIV among FSWs (15.4%) compared to non-FSWs (4.4%), while HBV prevalence was similar in both groups (8.8% for FSWs and 7.7% for non-FSWs). No cases of HCV were identified, possibly reflecting low prevalence in this region. Notably, higher awareness and preventive behaviors among both FSWs and non-FSWs regarding STIs, with over 80% reporting knowledge of STIs, previous testing, and awareness of blood transmission. However, HBV vaccination rates are lower, particularly among FSWs (55%). The study emphasizes the need for focused public health initiatives, such as regular screening, education on HIV and HBV prevention, and easily accessible healthcare resources, to reduce the risk of infection among high-risk populations, such as FSWs, as well as more general public awareness campaigns.

*Keywords: Hepatitis B virus; Hepatitis C virus; HIV; female sex workers (FSWs); seroprevalence; co-infection.*

## 1. INTRODUCTION

A major global health concern is sexually transmitted diseases (STIs), particularly for high-risk groups like female sex workers (FSWs). These infections—which include the human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV)—have a significant negative influence on health because they can result in long-term conditions that impair immunity, cause liver disease, and, in extreme situations, raise mortality (Shiferaw et al., 2024). According to Van Gerwen et al. (2020), these infections are particularly prevalent in sub-Saharan Africa, where a lack of resources for healthcare and public health infrastructures exacerbates the impact and spread of STIs. Concentrated efforts are urgently needed to control and lower the risks of transmission, as evidenced by the high prevalence rates of these infections in Nigeria, one of the most affected countries in the region (Aguh et al., 2024).

Many sexual relationships, inconsistent condom use, and restricted access to medical facilities are among the professional and social factors that increase the risk of STIs for female FSWs in Nigeria. Although some preventive measures are available, these environments create an environment that is favourable for the spread of diseases like HIV, HBV, and HCV. Stigma, ignorance about STIs, and poor access to care compound these threats (Dongurum, 2021). This study found that, despite HIV awareness being relatively high, awareness of HBV and HCV remains low, particularly among high-risk populations such as FSWs, further facilitating long-term transmission rates and increased risk of co-infection (Martyn et al., 2023).

Even though these risks are known, a dire research gap exists in understanding the precise prevalence, co-infection and risk factors for HBV, HCV, and HIV among female FSWs in Nigeria (especially Osun State). The vast majority of data available on these infections addresses the population at large, which leaves FSWs with unique vulnerability and challenges. The lack of targeted research on female sex workers (FSWs) poses a significant challenge in developing healthcare policies and interventions that address their unique risks. These populations are disproportionately affected by infections such as HIV, HBV, and HCV (Martyn et al., 2023; Cyrus et al., 2023).

Adopting robust, data-driven public health strategies is crucial to reduce the transmission, controlling infections, and improving healthcare access among vulnerable groups like FSWs (Adeiza et al., 2021). Research focused on the prevalence of HBV, HCV, and HIV among FSWs in Nigeria could provide critical insights to shape regional health policies and allocate resources effectively. By bridging this research gap, it becomes possible to design evidence-based and targeted interventions that significantly reduce the burden of these infections on vulnerable populations (Cyrus et al., 2023; Adeiza et al., 2021). This study aims to address these needs by comparing the seroprevalence and co-infection rates of HIV, HBV, and HCV among

FSWs and a control group of women in Osun State, Nigeria. It examines the serological indicators of these infections, assesses the extent of co-infections, and identifies key risk factors contributing to the transmission. Furthermore, the study evaluates participants' awareness of these diseases to provide a comprehensive picture of the infection landscape.

The findings are expected to inform tailored medical interventions and close information gaps that hinder effective management and prevention of sexually transmitted infections (STIs) in Nigeria. These results will provide valuable data for healthcare policymakers and practitioners striving to reduce the STI burden. By highlighting prevalence trends and gaps in knowledge, this research can support community-based prevention initiatives, routine screening programs, and educational campaigns. These efforts not only benefit FSWs but also help limit the spread of infections within the general population, emphasizing the importance of targeted public health interventions.

## 2. METHOD AND MATERIALS

This health study compared infection rates of hepatitis B, hepatitis C, and HIV between women in sex work and women in other professions. The research took place in three metropolitan cities in Osun State - Osogbo, Ikirun, and Iwo. These locations were carefully chosen because they represent different social and economic backgrounds, helping to capture a more complete picture of the community's health situation. A total of 182 females participated in the study, comprising 91 FSWs and 91 women from the general population (non-FSWs). Participants were recruited using a simple random sampling technique to eliminate selection bias and ensure a representative sample for both groups. Inclusion criteria required that all participants were aged 18 years or older, had lived in Osun State for at least one year, and were willing to participate. Stratifying participants into FSWs and non-FSWs allowed for meaningful comparisons of infection rates and associated risk factors between the groups.

Data collection involved both quantitative and biological methods. An interview-based questionnaire was administered to capture demographic details, sexual health practices, and levels of knowledge regarding STIs among participants. This questionnaire was designed to assess awareness and preventive behaviors related to HBV, HCV, and HIV. The instrument used for the questionnaire was self-designed based on existing literature and validated through a pilot study. Sample items included: "What are the common symptoms of HIV?" and "Have you been vaccinated against HBV?" These questions aimed to provide context for the serological findings and assess the participants' knowledge and awareness comprehensively.

Additionally, 2 mL blood samples were aseptically collected from each participant using standard phlebotomy procedures. These samples were then screened for HBV, HCV, and HIV markers using validated serological assay kits: HBV panel (Lumi Quick Diagnostic Inc. USA) for the qualitative assessment of the five markers of HBV, rapid immunochromatography assay for the qualitative detection of hepatitis B virus markers, a strip-based immunoassay from Micropoint Diagnostics (USA) for HCV, and the Genscreen ULTRA HIV Ag-Ab (Bio-Rad Laboratories, Singapore Pte. Ltd.), a qualitative enzyme immunoassay kit to detect HIV p24 antigen and antibodies to HIV-1 and HIV-2 in human serum or plasma. These standardized kits ensured accurate estimates of infection and co-infection rates.

Data analysis was performed using SPSS (version 26.0). Statistical tests included chi-square tests for categorical variables and t-tests to compare means between groups. Regression analysis was used to identify potential risk factors associated with infection. These methods were chosen for their appropriateness in evaluating associations and differences between the two participant groups.

## 3. RESULTS

The results of the study demonstrate significant disparities in HBV, HCV, and HIV infection rates between female FSWs and Osun State's general female population (non-FSWs). The data collected from serological assays were organized into tables for clearer comparison and interpretation.

Table 1 presents demographic and behavioral characteristics of study participants, highlighting key differences between FSWs and non-FSWs. FSWs showed a higher prevalence of multiple sexual partners (78%) compared to non-FSW (36.3%), and lower consistent condom use (45.1% vs. 28.6%). Additionally, both groups had

low awareness of HBV, with 22% of FSWs and 17.6% of non-FSWs reporting knowledge. These findings suggest increased exposure risks among FSWs and underscore the need for targeted STI education and prevention efforts.

Table 2 shows the prevalence of HBV, HCV, and HIV among the two groups. HBV prevalence was slightly higher among FSWs (8.8%) than non-FSWs (7.7%), while HIV prevalence was notably higher among FSWs at 15.4%, compared to 4.4% in the general population. No cases of HCV were detected in either group. Co-infection of HBV and HIV was observed in 1.1% of FSW and 2.2% of NFSW.

Table 3 indicates higher awareness and preventive behaviors among both FSWs and non-FSWs regarding STIs, with over 80% reporting knowledge of STIs, previous testing, and awareness of blood transmission. However, HBV vaccination rates are lower, particularly among FSWs (55%). Notably, FSWs show greater resistance (90%) to unprotected sex demands, reflecting a potentially higher emphasis on risk reduction in this group. The p-values in highlight statistically significant differences in certain behaviors and knowledge levels between FSWs and non-FSWs. For example, the resistance to unprotected sex shows a significant disparity ($p = 0.015$), with FSWs displaying greater resistance (90%) compared to non-FSWs (70%). Similarly, knowledge of STDs ($p = 0.045$) and prior testing for diseases ($p = 0.030$) also reveal significant differences, favoring non-FSWs. Other characteristics, such as HBV vaccination ($p = 0.072$) and knowledge of transmission through blood ($p = 0.058$), did not reach statistical significance, indicating these differences may be due to chance.

Table 4 summarizes behavioral risk factors contributing to infection vulnerability. FSWs reported higher rates of multiple sexual partnerships (80%) compared to the general population (50%), and higher rates of consistent condom use at 45% compared to 28% among non-FSWs. Notably, a higher proportion of non-FSWs (60%) indicated concern primarily with pregnancy prevention rather than STI prevention.

**Table 1. Demographic and Behavioral Characteristics of Study Participants (N=182)**

| Characteristic | SWs (n=91) | Percentage (%) | Non-SWs (n=91) | Percentage (%) |
|---|---|---|---|---|
| **Age Group** | | | | |
| 18–24 years | 35 | 38.5 | 40 | 44.0 |
| 25–34 years | 40 | 44.0 | 32 | 35.2 |
| 35+ years | 16 | 17.5 | 19 | 20.8 |
| **Marital Status** | | | | |
| Single | 78 | 85.7 | 66 | 72.5 |
| Married | 13 | 14.3 | 25 | 27.5 |
| **Education Level** | | | | |
| No formal education | 10 | 11.0 | 6 | 6.6 |
| Primary education | 25 | 27.5 | 22 | 24.2 |
| Secondary education | 35 | 38.5 | 39 | 42.9 |
| Higher education | 21 | 23.1 | 24 | 26.4 |
| **Knowledge of HBV** | | | | |
| Aware | 20 | 22.0 | 16 | 17.6 |
| Unaware | 71 | 78.0 | 75 | 82.4 |
| **Number of Sexual Partners** | | | | |
| One partner | 20 | 22.0 | 58 | 63.7 |
| Multiple partners | 71 | 78.0 | 33 | 36.3 |
| **Consistent Condom Use** | | | | |
| Yes | 41 | 45.1 | 26 | 28.6 |
| No | 50 | 54.9 | 65 | 71.4 |

**Table 2. Prevalence Rate of Serological Markers of HIV Infections among the respondents**

| Infection Marker | FSWs (%) | Non-FSWs (%) | p-value |
|---|---|---|---|
| HBV (HBsAg) | 8(8.8) | 7(7.7) | ≤0.05 |
| HCV (Anti-HCV) | 0.0 | 0.0 | - |
| HIV | 14(15.4%) | 4(4.4%) | ≤0.05 |
| HBV and HIV Co-infection | 1(1.1%) | 2(2.2%) | ≤0.05 |

**Table 3. Knowledge of transmission and protection against sexual transmission diseases**

| Characteristics | FSW-YES (%) | FSW-NO (%) | NFSW-YES (%) | NFSW-NO (%) | p-value |
|---|---|---|---|---|---|
| Knowledge of sexually transmitted disease | 80 | 20 | 90 | 10 | 0.045* |
| Previous test for the diseases | 85 | 15 | 95 | 5 | 0.030* |
| Knowledge of disease transmission by blood | 85 | 15 | 90 | 10 | 0.058 |
| HBV Vaccination | 55 | 45 | 65 | 35 | 0.072 |
| Resistance to unprotected sex demand from partners | 90 | 10 | 70 | 30 | 0.015* |

**Table 4. Behavioral and Risk Factors among Participants**

| Risk Factor | SWs (%) | Non-SWs (%) | p-value |
|---|---|---|---|
| Multiple Sexual Partners | 80 | 50 | ≤0.05 |
| Consistent Condom Use | 45 | 28 | ≤0.05 |
| Concerned with Pregnancy Prevention Only | 30 | 60 | ≤0.05 |

## 4. DISCUSSION

The study findings reveal a distinct prevalence of HIV among female FSWs compared to the general female population in Osun State, with rates of 15.4% and 4.4%, respectively. This significant difference aligns with global trends showing that FSWs are disproportionately vulnerable to HIV due to multiple occupational exposures and inadequate preventive resources (Rhaburn, 2022). The high prevalence among FSWs is concerning, as it suggests that this group faces challenges in accessing healthcare and resources necessary to prevent transmission. Poor or variable condom use and lack of STI screening contribute to this high HIV rate, and these populations deserve individualised interventions (De Wit et al., 2023).

This similar prevalence of HBV among FSWs and non-FSWs (8.8% and 7.7%, respectively) means that HBV could not be spread through high-risk sexual behaviors alone but through other channels as well. This distribution can reflect non-sexual modes of transmission such as vertical maternal to infant transmission or exposure to contaminated blood in areas with low rates of vaccination and access to health care (De Wit et al., 2023). Because HBV rates are similar across both groups, community-based prevention interventions, such as vaccines and education programmes, might be effective in decreasing HBV rates among the general population rather than at high risk individuals.

The absence of HCV cases in either group were possibly because HCV rates are low or there are not any shared routes of transmission. In contrast to HIV and HBV, HCV is transmitted by blood-to-blood contact (for instance, by intravenous drug use) which may be less common or easy to access in Nigeria (Amos et al., 2024). These findings support previous research that HCV has less widespread presence in sub-Saharan Africa than in the Western world where intravenous drug use is a major route of transmission (Mokaya, 2020). This low incidence of HCV in Osun State could indicate other transmission patterns in the state, and further supports the importance of region-specific data to inform public health interventions correctly.

The findings reveal that both FSWs and non-FSWs in Osun State demonstrate substantial knowledge and practices regarding STI prevention, aligning with broader research indicating high levels of HIV awareness in sub-Saharan Africa, even among vulnerable populations (Ssewanyana et al., 2020; Okoye et

al., 2021). However, the low rates of HBV vaccination, particularly among FSWs (55%), highlight a critical gap in global STI prevention efforts, consistent with studies suggesting HBV is often under-recognized in Africa compared to HIV. The strong resistance of FSWs to unprotected sex aligns with global trends showing that FSWs, despite occupational risks, often adopt protective behaviors to reduce STI exposure (Hanscamp, 2023; Shiferaw et al., 2024). This finding underscores the need for targeted HBV vaccination campaigns and broader STI education initiatives. The study also found that FSWs, due to their work environment, face higher exposure to multiple sexual partners and inconsistent condom use compared to non-FSWs. This occupational risk factor aligns with evidence indicating FSWs are at heightened risk of HIV transmission due to limited access to resources for safe sexual practices (Momoh & Patel, 2024). Addressing barriers such as stigma and inadequate health education is essential to increasing condom use and reducing STI transmission in this population. Personalized health interventions can play a pivotal role in mitigating these behavioral risk factors.

Interestingly, many non-FSWs prioritized avoiding pregnancy over STI prevention, potentially reflecting gaps in public health education about non-HIV STI risks. Expanding public health messaging to integrate STI prevention with family planning programs could enhance awareness and protection for women in the general population. Incorporating STI education into reproductive health initiatives may help reduce infections like HBV and HCV across society.

## 5. CONCLUSION

This study highlights the significant burden of HIV and HBV among FSWs in Osun State, alongside gaps in awareness about these infections, particularly HBV, in both FSWs and the general female population. Targeted public health interventions are urgently needed to improve STI prevention, raise awareness of risk factors, and address the unique circumstances of high-risk groups such as FSWs. Community-based education, widespread screening, and increased access to care could significantly reduce infections and improve health outcomes in these populations. These focused efforts are not only vital for protecting vulnerable individuals but also for minimizing the broader public health impact of STIs in Nigeria.

## 6. LIMITATIONS AND FUTURE RESEARCH

This study has certain limitations. First, the cross-sectional design provides only a snapshot of infection prevalence, limiting the ability to establish causality. Second, the relatively small sample size may affect the generalizability of the findings. Third, reliance on self-reported data for the questionnaire introduces the possibility of reporting bias. Future research should consider employing a longitudinal design to monitor changes in seroprevalence and co-infection rates over time. Additionally, expanding the sample size and geographic scope can enhance the robustness of findings. Further studies could also explore socioeconomic and cultural factors influencing infection rates to develop more targeted interventions.

## ETHICAL APPROVAL AND CONSENT

The study was authorized by the appropriate institutional review boards and carried out in accordance with ethical guidelines for research involving human beings. Every participant gave informed consent after being made aware of the study's goals, methods, and consequences of withdrawing from the study at any time. Strict confidentiality procedures were followed throughout the study process, and all data and biological samples were anonymized to preserve participant anonymity.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology.

Details of the AI usage are given below:
1. Grammarly

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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