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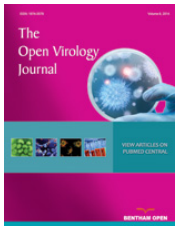

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RESEARCH ARTICLE

# Hepatitis B, C and Delta Viruses' Infections and Correlate Factors Among Female Sex Workers in Burkina Faso, West-Africa

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**Abstract:**

***Background:***

Female Sex Workers (FSW) have increased vulnerability to viral hepatitis B, C and D transmission. Our study aimed to assess the seroprevalence of hepatitis B, C and D viruses and their associated factors among FSW in Ouagadougou, Burkina Faso.

***Methods:***

This is a cross-sectional study among FSW at least 18 years old in Ouagadougou, Burkina Faso. Data were collected from February 2013 to May 2013 using Respondent-Driven Sampling (RDS). Hepatitis B, C, and D tests were performed on FSW storage serums using fourth generation ELISA kits. Survey-weighted bivariate and multivariate logistic regression analyses were performed using Stata version 14 to identify factors associated with viral hepatitis infections.

***Results:***

Population-weighted prevalence of viral hepatitis infections in FSW was respectively 18.2% (95%CI: 14.4-22.9) for Hepatitis B Virus (HBV), 10.6% (95%CI: 07.5-14.8) for Hepatitis C Virus (HCV) and 1.5% (95Cl: 0.2-10.3) for Hepatitis D Virus (HDV). Factors independently associated with HCV include positive HIV status, inconsistent condom use during the last 12 months, condom reuse with clients, sex with clients in the street, bars or public gardens. No sociodemographic or behavioral factors were independently associated with HBV infection.

***Conclusion:***

The prevalence of HBV and HCV was high among FSW and the prevalence of HDV was relatively low in this group in Burkina Faso. These findings suggest urgent and comprehensive prevention of these viruses through education for safer sex and behaviors, and immunization against HBV for FSW.

**Keywords:** HBV, HCV, HDV, Female sex workers, Burkina faso, Respondent-driven sampling.

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|---|---|---|---|

## 1. BACKGROUND

Viral hepatitis is a major global health problem despite the existence of preventive measures. According to WHO, more than 257 million people are infected by Hepatitis B Virus (HBV) worldwide. HBV mortality c ounts in 2015 totaled approximately 887,000 due to liver cancer and cirrhosis [1]. Hepatitis D Virus (HDV) is unique because it requires HBV to survive in the human body [2]. It is estimated that globally, more than 5% of the people infected by the HBV are also infected by the HDV [3]. Hepatitis C Virus (HCV), affects 71 million people and causes 399,000 deaths every year from hepatocellular carcinoma and cirrhosis [1]. HBV, HCV, and HDV viruses are endemic in Sub-Saharan Africa [1, 4]. In a systematic review, the authors estimated the seroprevalence of

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HBV virus in Sub-Saharan Africa to be 8.83% (95%CI:8.82 -8.83) compared to 3.61% (95%CI: 3.61-3.61) globally [5]. Hepatitis D virus prevalence in the West African population was estimated to be 7.33% (95% CI 3·55-12·20) [6]. In another systematic review on HCV epidemiology in 33 Sub-Saharan African countries, the overall seroprevalence of the infection was estimated to be 2.98% (95% CI 2.86-3.10), and specifically to be 4.34% (95%CI:3.99-4.70%) in West Africa [7].

HBV and HDV are transmitted among adults through blood and sexual intercourse. Although HCV transmission is mainly transmitted through blood, the literature reports indicate increasing sexual transmission, notably through traumatic sexual intercourse [8 - 10]. FSW are a known group of high-risk for sexually transmitted infections [11], including HBV, HCV, and HDV [12]. Failure to use condoms, having multiple sexual partners, sexual violence, and co-infections with other sexually transmitted infections increase the risk of acquisition and transmission of hepatitis B, D, and C viruses [12 - 15]. Research on HBV and HCV, especially related to risky sexual behavior including sex work remains poorly studied in West Africa. In order to better understand the epidemiology of HBV, HCV, and HDV among FSW, the prevalence and associated risk factors related to HBV, HCV, and HDV infections were evaluated in this group in Ouagadougou.

## 2. METHODS

### 2.1. Study Design and Participants

We conducted a cross-sectional study among FSW. Participants were recruited through Respondent Driven Sampling (RDS) [16, 17]. Inclusion criteria were: (1) age not less than 18 years, (2) assigned female sex at birth, (3) having at less 50% of annual income from sex work in the past 12 months, (4) having stayed in the city at least for the past three months, (5) having a valid study coupon and (6) being able to provide informed consent for participation in study activities and (7) providing additional consent for serum storage and use in other studies.

### 2.2. Study Setting

This study was carried out in Ouagadougou, the capital of Burkina Faso in West Africa. Ouagadougou is the largest city in Burkina Faso, located in the center of the country with a population estimated at more than 2.8 million inhabitants. From the respondent-driven sampling, the number of FSW in this city was estimated at 4988 (95% CI: 2856-7120) in 2013 [18].

### 2.3. Participant Recruitment

Study participants were recruited *via* Respondent-Driven Sampling (RDS), a peer-driven sampling method designed to reach hidden populations [19, 20]. RDS begins with recruitment "seeds" that are used to create chains of individuals and can be adjusted for in regression models. Five seeds were selected purposively and recruited based on diverse socio-demographic selection criteria, including popularity, sociability, age, location, type of sex work and nationality, with the assumption that each individual represented a different social network within the FSW population as a whole in each Ouagadougou. After giving informed consent the recruitment seeds completed a demographic and behavioural questionnaire and blood sampling for HIV and syphilis testing. These seeds were each provided with three coded coupons which were valid for four weeks, to recruit peer FSW from their social network. This process continued until the target sample size was reached.

To avoid multiple inclusions, a single survey office was used. At the study site, there was a manager (screener), two data collectors, an HIV test counselor, a lab technician and all of them were trained. Full detail of the study methodology has been previously described [21].

### 2.4. Sample Size Calculation

Sample size calculations were based on the assumption that populations that always use condoms have a 75% lower prevalence than populations who do not, and the effectiveness of condoms is roughly 80%, with 73% a conservative estimate [22]. Overall, HIV prevalence was estimated at 15% with a 19% prevalence among those who did not consistently use condoms [23, 24], A design effect of 1.5 associated with RDS, and a significance level of 0.05 and a power of 80% were employed. The necessary sample size to achieve the significance level and power was 345 FSW.

### 2.5. Data Collection and HIV and Syphilis Testing

Data were collected from February to May 2013 in Ouagadougou. After informed consent, each participant completed private behavioral interviewer-administered questionnaires conducted in French or the local language. Topics included demographic and socio-economic characteristics, sexual partnerships and behavior, knowledge, attitudes and practices towards sexual transmitted infections and HIV, condom use during the last 12 months. Venous blood specimens were collected from each consenting participant for testing. Pre-and post-test HIV and syphilis counseling, was conducted for all participants after completion of the behavioral questionnaire. Male condoms, condom compatible lubricants, HIV and STIs prevention and educational material, and information regarding existing health and behavioral services were provided to all study participants.

### 2.6. Laboratory Methods

HIV and syphilis tests were performed in the study office using the rapid screening procedure for both tests (HIV and syphilis). After these testing *in situ*, anonymized serums were storage with participant additional consent for further infections testing like HBV, HDV, and HCV. Storage serum samples were tested by Enzyme Linked Immunoassay (ELISA) methods for determination of Hepatitis B surface antigen "ELISA HBsAg ULTRA-Dia.Pro 4$^{th}$ generation (Diagnostic BioProbes Srl, Italy)". HBsAg reactive samples were subsequently tested for the antibodies anti-hepatitis D virus using competitive ELISA HDV Ab - Dia.Pro (Diagnostic BioProbes Srl, Italy). For antibody anti-hepatitis C virus, the Fourth generation ELISA "HCV Ab-Dia.Pro (Diagnostics BioProbes Srl, Italy) was used. All tests were performed according to the

manufacturer's procedures and equivocal samples were retested and the result of the second test was accepted.

### 2.7. Data Processing and Analysis

Data were entered using double data entry into EpiData 3.1 (EpiData Association, Odense, Denmark), and analyzed with Stata 14 (StataCorp, College Station, TX). Descriptive statistics were used to describe FSW characteristics, sexual behaviors, condom use, HBV, HDV and HCV prevalence. We adjusted all proportions to account for the RDS method [25]. This adjustment takes into consideration the probability of each participant to be included in the study. This probability was measured through weighting based on the size of each participant's network. This probability was measured through weighting based on the size of each participant's network. Network size was determined using the survey question: "How many different people do you know personally who are female sex workers or sell sex? i.e., you know them and they know you, and you could contact them if you needed to?" The mean network size was 69 FSW (95%CI: 54-84). We presented population estimates and 95% Confidence Intervals (CI) adjusted for RDS design using the RDS Analysis Tools (RDSAT) version 6.0.1 (RDS, Inc., Ithaca, NY). Weighted bivariate and multivariate logistic regression analyses were performed using Stata to identify factors associated with HBV and HCV infections at the $p<0.05$ level of significance along with a 95% Confidence Interval (CI). The outcome variable was HBV or HCV status (positive or negative) as determined by blood tests. Bivariate analysis was not done for hepatitis D due to a limited number of positive cases. Predictor variables included sociodemographic variables such as age, education level, marital status, employment, and migration to Burkina Faso. Other selected predictor variables included: years of sex work experience, number of clients, and condom use, venues for sex work (sex with clients in street or public gardens), drug abuse, and alcohol abuse. Sociodemographic and selected behavioral variables associated with hepatitis virus B or C infection at the significance level of $p<0.2$ [26 - 28]. in weighted bivariate analyses were included in a backward elimination model selection procedure. Variables independently associated with infection were retained in the weighted multivariate model to produce the final results.

### 2.8. Ethical Issues and Protection of the Participants

The study received ethical approval from the Ethics Committee for Health Research (CERS) of Burkina Faso and The Johns Hopkins Bloomberg School of Public Health Institutional Review Board. Research ethics training and sensitivity training were provided to all staff the study. Confidentiality was maintained by using a unique study identifier rather than real names on questionnaires. Participant unique and anonymized codes were used to link study questionnaires with blood sample tubes. All participants who tested positive for HIV during HIV behavior and seroprevalence survey were referred to a healthcare center for appropriate care. Those who tested positive for syphilis received syphilis treatment in situ. In addition to the consent for participation to the HIV behavioral survey, individual consent was required for serum samples storage for further research related to sexually transmitted diseases.

## 3. RESULTS

### 3.1. Socio-Demographic Characteristics of FSW

The mean age of the FSW was 24.9 ± 6.4 years. Table **1** shows the socio-demographic and socio-professional characteristics of the FSW. The education level of study participants was low; about 23.8% had no education, and one-third of them had a primary level of education (38.0%). More than 63% (219/348) of the FSW in the sample were single. The vast majority (about 70%) had at least one biological child. Half of the FSW (50.4%) declared to have no other income generating activity (except for sex work).

**Table 1. Characteristics of female sex workers.**

| Variables | n | Unadjusted % | RDS-adjusted | |
|---|---|---|---|---|
| | | | % | (95% CI) |
| **Current age (years)** | | | | |
| < = 24 | 202 | 58.0 | 56.8 | 51.4 - 62.1 |
| 25 - 29 | 83 | 23.9 | 23.3 | 19.1 - 28.1 |
| > = 30 | 63 | 18.1 | 19.8 | 15.7 - 24.7 |
| **Education** | | | | |
| None | 82 | 23.8 | 24.6 | 22.0 - 29.7 |
| Primary | 131 | 38.1 | 37.8 | 32.7 - 43.2 |
| Secondary and above | 131 | 38.1 | 37.6 | 32.5 - 42.9 |
| **Marital status** | | | | |
| Single | 219 | 62.9 | 61.2 | 55.8 - 66.4 |
| Married/cohabitating | 33 | 9.5 | 09.8 | 07.0 - 13.6 |
| Divorced/separed/widow | 96 | 27.6 | 29.0 | 24.3 - 34.2 |
| **Occupation** | | | | |
| Student/pupil | 20 | 5.8 | 05.4 | 03.5 - 08.3 |
| Employees (public or private) | 151 | 43.6 | 43.5 | 38.2 - 48.9 |

*(Table 1) contd.....*

| Variables | n | Unadjusted % | RDS-adjusted | |
|---|---|---|---|---|
| | | | % | (95% CI) |
| Unemployee | 175 | 50.6 | 51.1 | 45.7 - 56.4 |
| **Number of children** | | | | |
| 00 | 106 | 30.5 | 29.3 | 24.8 - 34.4 |
| 01 | 157 | 45.1 | 44.9 | 39.6 – 50.3 |
| ≥ 02 | 85 | 24.4 | 25.8 | 21.3 – 30.9 |
| **Migrant** | | | | |
| No | 231 | 67.0 | 66.3 | 61.0 - 71.2 |
| Yes | 114 | 33.0 | 33.7 | 28.8 - 39.0 |
| **Hepatitis B immunization** | | | | |
| No | 329 | 94.8 | 94.5 | 91.3 - 96.5 |
| Yes | 14 | 4.0 | 04.4 | 02.6 - 07.5 |
| Unknown | 4 | 1.2 | 01.1 | 00.4 - 02.9 |
| **Injectable drug user** | | | | |
| No | 342 | 98.3 | 98.4 | 96.4 - 99.3 |
| Yes | 342 | 1.7 | 01.6 | 00.7 - 03.6 |
| **Alcohol user** | | | | |
| No | 99. | 28.4 | 27.9 | 23.4 - 32.9 |
| Yes | 249 | 71.6 | 72.1 | 67.1 - 76.6 |
| **HIV serological status** | | | | |
| Negative | 321 | 92.2 | 86.9 | 81.7 – 90.8 |
| Positive | 27 | 7.8 | 13.1 | 09.2 - 18.3 |
| **Syphilis serological status** | | | | |
| Negative | 333 | 95.7 | 95.3 | 92.2 - 97.2 |
| Positive | 15 | 4.3 | 04.7 | 02.8 – 07.8 |
| **Age at start of selling sex (years)** | | | | |
| < 20 | 225 | 64.8 | 64.1 | 58.7 - 69.1 |
| 20 to 24 | 81 | 23.3 | 23.7 | 19.4 - 28.6 |
| ≥ 25 | 41 | 11.8 | 12.2 | 09.0 - 16.3 |
| **Experience in sex work (years)** | | | | |
| < 1 | 59 | 17.1 | 17.0 | 13.3 - 21.4 |
| 1 to 5 | 203 | 58.8 | 58.9 | 53.5 - 64.1 |
| ≥ 6 | 83 | 24.1 | 24.2 | 19.8 - 29.1 |
| **Mean number of clients per weeks** | | | | |
| 1 to 14 | 214 | 61.7 | 63.0 | 57.8 - 68.0 |
| 15 to 29 | 91 | 26.2 | 25.6 | 21.2 – 30.5 |
| ≥ 30 | 42 | 12.1 | 11.4 | 08.5 - 15.1 |
| **Mean income per week (1 USD = 500 XOF)** | | | | |
| < 30 USD | 29 | 8.3 | 08.3 | 05.8 - 11.8 |
| 30 – 69 USD | 147 | 42.2 | 43.4 | 38.2 - 48.9 |
| 70 – 200 USD | 126 | 36.2 | 35.2 | 303 – 40.4 |
| ≥ 200 USD | 46 | 13.2 | 13.1 | 09.9 - 17.1 |

## 3.2. HBV, HCV and HDV Prevalence Among FSW

In total, 348 FSW were tested for viral hepatitis. Sixty-one (61) were HBV positive, with RDS adjusted prevalence of 18.2% (95%CI: 14.4-22.9). Hepatitis D prevalence among HBV antigen positive FSW was 1.64% (1/61). HCV antibody virus tests were conducted on 325 available serums and 32 were reactive (9.8%). The adjusted prevalence of the HCV in the FSW was estimated to 10.6% (95%CI: 07.5-14.8). Table **2** shows the prevalence of HBV and HCV antigen positivity and the results of the bivariate and multivariate analyses.

### 3.3. Factors Associated with FSW' HBV and HCV Infection

In bivariate analysis, factors associated with HBV antigen positivity were previous pregnancy, the consistent condom use, the lower weekly wage and being HIV positive. None of these factors was independently associated with the HBV infection among FSW in multivariate analysis. The details are shown in (Table **2**).

For HCV, only the being HIV positive (aOR = 5.59, p = 0.005), the consistent condom use (aOR = 0.32, p = 0.019), sex with clients in street, public gardens or bars (aOR = 3.27, p = 0.027), and the reuse of condom (aOR = 6.91, p = 0.007) were independently associated with HCV antigen positivity in FSW.

**Table 2. HBV, HCV Seroprevalence and selected socio-demographic and sex work-related characteristics associated.**

| | Hepatitis B Virus Seroprevalence Among Female Sex Workers | | | | | | | | | Hepatitis C Virus Seroprevalence Among Female Sex Workers | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | HBV Prevalence | | RDS Unadjusted OR | | | RDS Adjusted OR | | | | HCV Prevalence | | RDS Unadjusted OR | | | RDS Adjusted OR | | |
| **Variables** | **n** | **Crude %** | **RDS adjusted %** | **OR** | **95% CI** | **p** | **aOR** | **95% CI** | **p** | **n** | **Crude %** | **RDS adjusted %** | **OR** | **95% CI** | **p** | **aOR** | **95% CI** | **p** |
| **Age (years)** | | | | | | | | | | | | | | | | | | |
| ≤24 | 202 | 17.8 | 18.3 | 1 | | | | | | 189 | 9.0 | 09.8 | | | | | | |
| 25-29 | 83 | 20.5 | 19.7 | 1.10 | 0.49 -2.44 | 0.819 | -- | -- | -- | 77 | 9.1 | 08.7 | 0.88 | 0.34-2.24 | 0.789 | -- | -- | -- |
| ≥30 | 63 | 12.7 | 16.3 | 1.17 | 0.49 - 2.75 | 0.718 | -- | -- | -- | 59 | 13.6 | 08.7 | 1.62 | 0.63-4.13 | 0.311 | -- | -- | -- |
| Total | 348 | 17.5 | 18.2 | | | | -- | -- | -- | 325 | 9.8 | 10.6 | | | | | | |
| **Education** | | | | | | | | | | | | | | | | | | |
| None | 82 | 14.6 | 16.0 | 1 | | | | | | 76 | 10.5 | 10.5 | | | | | | |
| Primary | 131 | 16.8 | 15.9 | 0.99 | 0.45-2.19 | 0.990 | -- | -- | -- | 119 | 9.2 | 11.2 | 1.08 | 0.40-2.93 | 0.877 | -- | -- | -- |
| Secondary/high school | 131 | 19.8 | 21.8 | 1.47 | 0.67-3.19 | 0.334 | -- | -- | -- | 126 | 10.3 | 10.4 | 0.99 | 0.38-2.57 | 0.980 | -- | -- | -- |
| **Marital status** | | | | | | | | | | | | | | | | | | |
| Single | 219 | 17.8 | 17.9 | 1 | | | | | | 203 | 9.4 | 09.8 | | | | | | |
| Living in couple | 33 | 6.1 | 07.7 | 0.38 | 0.08-1.77 | 0.219 | -- | -- | -- | 30 | 6.7 | 08.4 | 0.85 | 0.18-4.10 | 0.840 | -- | -- | -- |
| Divorced/separated/widow | 96 | 20.8 | 22.4 | 1.32 | 0.71 -2.45 | 0.384 | -- | -- | -- | 92 | 12.0 | 13.0 | 1.38 | 0.61-3.12 | 0.441 | -- | -- | -- |
| **Occupation** | | | | | | | | | | | | | | | | | | |
| Student/pupil | 20 | 20.0 | 20.0 | 1 | | | | | | 19 | 5.3 | 05.3 | | | | | | |
| Employees (public or private) | 151 | 21.2 | 21.5 | 1.09 | 0.34-3.54 | 0.876 | -- | -- | -- | 138 | 12.3 | 13.7 | 2.87 | 0.35-23.25 | 0.32 | -- | -- | -- |
| Unemployee | 175 | 14.3 | 15.4 | 0.73 | 0.22 -2.39 | 0.602 | -- | -- | -- | 166 | 8.4 | 08.7 | 1.71 | 0.21-14.01 | 0.61 | -- | -- | -- |
| **Number of children** | | | | | | | | | | | | | | | | | | |
| 0 | 106 | 20.8 | 21.0 | 1 | | | | | | 101 | 8.9 | 09.4 | | | | | | |
| 1 | 157 | 16.6 | 17.1 | 0.77 | 0.41-1.48 | 0.439 | -- | -- | -- | 143 | 10.5 | 10.9 | 1.18 | 0.48-2.90 | 0.713 | -- | -- | -- |
| ≥2 | 85 | 15.3 | 17.0 | 0.767 | 0.35-1.67 | 0.505 | -- | -- | -- | 81 | 9.9 | 11.4 | 1.23 | 0.44-3.50 | 0.689 | -- | -- | -- |
| **Parents alive** | | | . | | | | | | | | | | | | | | | |
| One died | 170 | 14.7 | 15.6 | 1 | | | | | | 155 | 10.3 | 11.1 | | | | | | |
| Both | 173 | 20.2 | 20.8 | 1.42 | 0.79 -2.55 | 0.230 | -- | -- | -- | 166 | 8.4 | 09.2 | 0.81 | 0.37-1.79 | 0.617 | -- | -- | -- |
| **Migrant** | | | | | | | | | | | | | | | | | | |
| No | 231 | 16.9 | 17.4 | 1 | | | | | | 217 | 10.6 | | | | | | | |
| Yes | 114 | 19.3 | 20.4 | 1.21 | 0.67 -2.22 | 0.393 | -- | -- | -- | 105 | 8.6 | | 0.79 | 0.34-1.84 | 0.586 | -- | -- | -- |
| **Hepatitis B immunization** | | | | | | | | | | | | | | | | | | |
| No | 329 | 17.3 | 18.2 | 1 | | | | | | 305 | 10.5 | 11.3 | -- | -- | -- | -- | -- | -- |
| Yes | 14 | 21.4 | 18.3 | 1.01 | 0.27-3.80 | 0.991 | -- | -- | -- | 15 | 0.0 | 0.00 | -- | -- | | -- | -- | -- |
| Don't know | 4 | 25.0 | 25.0 | 1.50 | 0.15 -14.84 | 0.729 | -- | -- | -- | 4 | 0.0 | 10.6 | -- | -- | | -- | -- | -- |
| **Injectable drug user** | | | | | | | | | | | | | | | | | | |
| No | 342 | 17.5% | 0.183 | 1 | | | | | | 321 | 10.0% | | | | | | | |
| Yes | 6 | 16.7% | 0.167 | 0.89 | 0.10-7.89 | 0.921 | -- | -- | | 4 | 0.0% | -- | -- | -- | | | | |
| **Alcohol user** | | | | | | | | | | | | | | | | | | |
| No | 99 | 16.2% | 0.163 | 1 | | | | | | 97 | 8.2% | 07.9 | | | | | | |
| Yes | 249 | 18.1% | 0.190 | 1.20 | 0.63-2.27 | 0.573 | -- | -- | | 228 | 10.5% | 11.7 | 1.55 | 0.66-3.64 | 0.308 | | | |
| **Age at start of sex work (years)** | | | | | | | | | | | | | | | | | | |
| <20 | 225 | 19.1 | 19.2 | 1 | | | | | | 206 | | 08.0 | | | | | | |
| 20-24 | 81 | 17.3 | 18.8 | 0.97 | 0.48 -1.93 | 0.931 | -- | -- | -- | 78 | | 14.9 | 2.02 | 0.86-4.78 | 0.107* | 2.42 | 0.83-7.10 | 0.106 |
| >=25 | 41 | 9.8 | 12.4 | 0.59 | 0.19 -1.84 | 0.368 | -- | -- | -- | 40 | | 15.5 | 2.11 | 0.73-6.05 | 0.165* | 2.02 | 0.58-7.02 | 0.265 |
| **Experience in sex work** | | | | | | | | | | | | | | | | | | |
| Less than one year | 59 | 18.6 | 20.2 | 1 | | | | | | 57 | | 12.6 | | | | | | |
| 1 to 5 years | 203 | 16.3 | 16.4 | 0.77 | 0.35-1.68 | 0.516 | -- | -- | -- | 191 | | 12.4 | 0.98 | 0.36-2.65 | 0.971 | 0.95 | 0.31-2.89 | 0.932 |
| 6 years and more | 83 | 20.5 | 21.9 | 1.10 | 0.46-2.64 | 0.825 | -- | -- | -- | 75 | | 04.7 | 0.34 | 0.08-1.53 | 0.160* | 0.21 | 0.04-1.09 | 0.065 |
| **Number of clients per week** | | | | | - | | | | | | | | | | | | | |
| 1 to 14 | 214 | 18.2 | 18.8 | 1 | | | | | | 203 | | 11.2 | | | | | | |
| 15 to 29 | 91 | 18.7 | 19.7 | 1.06 | 0.55-2.03 | 0.862 | -- | -- | -- | 84 | | 10.2 | 0.90 | 0.39-2.11 | 0.816 | -- | -- | -- |
| ≥30 | 42 | 11.9 | 11.9 | 0.58 | 0.21-1.59 | 0.290 | -- | -- | -- | 38 | | 07.9 | 0.68 | 0.19-2.44 | 0.554 | -- | -- | -- |
| **Mean income per week** | | | | | | | | | | | | | | | | | | |
| <30 USD | 29 | 6.9 | 06.5 | 1 | | | | | | 27 | 7.4 | 07.0 | 1.89 | 0.40-8.93 | 0.416 | -- | -- | -- |

*(Table 2) contd.....*

| | Hepatitis B Virus Seroprevalence Among Female Sex Workers | | | | | | | | | Hepatitis C Virus Seroprevalence Among Female Sex Workers | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | HBV Prevalence | | RDS Unadjusted OR | | | RDS Adjusted OR | | | | HCV Prevalence | | RDS Unadjusted OR | | | RDS Adjusted OR | | |
| **Variables** | **n** | **Crude %** | **RDS adjusted %** | **OR** | **95% CI** | **p** | **aOR** | **95% CI** | **p** | **n** | **Crude %** | **RDS adjusted %** | **OR** | **95% CI** | **p** | **aOR** | **95% CI** | **p** |
| 30 – 69 USD | 147 | 19.0 | 19.9 | 3.55 | 0.79 -16.04 | 0.099* | 3.23 | 0.67-15.62 | 0.143 | 140 | 11.4 | 12.5 | 1.53 | 0.31-7.49 | 0.597 | -- | -- | -- |
| 70 – 200 USD | 126 | 19.0 | 20.3 | 3.64 | 0.80-16.57 | 0.095* | 3.77 | 0.77-18.43 | 0.101 | 117 | 9.4 | 10.3 | 0.98 | 0.15-6.42 | 0.990 | -- | -- | -- |
| ≥200 USD | 46 | 15.2 | 14.5 | 2.41 | 0.46 -12.68 | 0.295 | 1.96 | 0.33-11.57 | 0.458 | 41 | 7.3 | 06.9 | | | | | | |
| **HIV status** | | | | | | | | | | | | | | | | | | |
| Negative | 321 | 16.5 | 16.5 | 1 | | | | | | 297 | 8.8 | 08.8 | | | | | | |
| Positive | 27 | 29.6 | 29.6 | 2.29 | 0.88 -5.14 | 0.093* | 1.85 | 0.74-4.66 | 0.189 | 28 | 21.4 | 21.4 | 2.84 | 1.05-7.67 | 0.039** | 5.59 | 1.71-18.28 | 0.005** |
| **Syphilis markers** | | | | | | | | | | | | | | | | | | |
| Negative | 333 | 18.0 | 18.8 | 3.80 | 0.48-29.97 | 0.204 | | | | 310 | 9.7 | 08.9 | 0.59 | 0.05-4.37 | 0.503 | -- | -- | -- |
| Positive | 15 | 6.7 | 05.8 | | | | | | | 15 | 13.3 | 10.6 | | | | | | |
| **STIs symptom over the last 12 months** | | | | | | | | | | | | | | | | | | |
| No | 174 | 17.8 | 18.2 | 1 | | | | | | 163 | | 08.9 | | | | | | |
| Yes | 172 | 16.9 | 17.9 | 0.98 | 0.55-1.74 | 0.95 | -- | -- | -- | 160 | | 12.4 | 1.45 | 0.67 -3.15 | 0.337 | -- | -- | -- |
| Don't know | 1 | 0.0 | 0 | -- | -- | | | | | 1 | | 0.00 | -- | 1 | | | | |
| **Ever got pregnant** | | | | | | | | | | | | | | | | | | |
| No | 73 | 17.8 | 17.8 | 1 | | | | | | 70 | | 09.9 | | | | | | |
| Yes | 274 | 17.2 | 18.1 | 1.017 | 0.51-2.02 | 0.961 | -- | -- | -- | 254 | | 10.8 | 1.43 | 0.59-3.45 | 0.420 | -- | -- | -- |
| **Abortion** | | | | | | | | | | | | | | | | | | |
| **No** | 220 | 15.0 | 15.1 | 1 | | | | | | 204 | | 10.4 | | | | | | |
| **Yes** | 128 | 21.9 | 23.4 | 1.72 | 0.96 -3.06 | 0.064* | 1.47 | 0.81-2.67 | 0.202 | 121 | | 10.8 | 1.04 | 0.47-2.28 | 0.921 | -- | -- | -- |
| **Ease of requesting client to wear a condom** | | | | | | | | | | | | | | | | | | |
| Easy | 237 | 15.6 | 16.3 | 1 | | | | | | 222 | | 09.4 | | | | | | |
| Difficult | 110 | 20.9 | 21.8 | 1.43 | 0.79-2.61 | 0.232 | -- | -- | -- | 102 | | 13.3 | 1.47 | 0.67-3.24 | 0.334 | -- | -- | -- |
| **Systematic use of condom with clients during the last 12 months** | | | | | | | | | | | | | | | | | | |
| No | 129 | 14.7 | 14.7 | 1 | | | | | | 121 | | 14.5 | | | | | | |
| Yes | 212 | 19.8 | 21.0 | 1.54 | 0.84 -2.83 | 0.161* | 1.49 | 0.76-2.92 | 0.245 | 197 | | 07.7 | 0.49 | 0.23-1.08 | 0.078* | 0.32 | 0.13-0.83 | 0.019** |
| **Condom use during the last intercourse with new client** | | | | | | | | | | | | | | | | | | |
| No | 36 | 5.6 | 05.6 | 1 | | | | | | 32 | | 15.6 | | | | | | |
| Yes | 300 | 18.7 | 19.2 | 4.05 | 0.94 - 17.52 | 0.061* | 3.29 | 0.74-14.64 | 0.116 | 281 | | 10.2 | 0.61 | 0.21-1.74 | 0.359 | -- | -- | -- |
| **Condom breakage over the last 12 months** | | | | | | | | | | | | | | | | | | |
| No | 127 | 16.5 | 17.6 | 1 | | | | | | 119 | | 07.0 | | | | | | |
| Yes | 221 | 18.1 | 18.6 | 1.06 | 0.58 -1.94 | 0.838 | -- | -- | -- | 206 | | 12.6 | 1.91 | 0.81-4.53 | 0.141* | 1.71 | 0.65-4.53 | 0.276 |
| **Already re-use condom** | | | | | | | | | | | | | | | | | | |
| No | 332 | 18.4 | 19.2 | 1 | | | -- | -- | -- | 310 | 9.4 | 10.2 | | | | | | |
| Yes | 10 | 0.0 | 0.0 | -- | -- | -- | -- | -- | -- | 09 | 33.3 | 33.3 | 4.38 | 1.03-18.67 | 0.046** | 6.91 | 1.70-28.0 | 0.007** |
| **Sex with clients in the street or public gardens** | | | | | | | | | | | | | | | | | | |
| No | 308 | 18.8 | 19.7 | 1 | | | | | | 288 | 8.7 | 09.2 | | | | | | |
| Yes | 39 | 7.7 | 07.1 | 0.31 | 0.09-1.05 | 0.061* | | | | 36 | 19.4 | 21.5 | 2.70 | 1.03-7.06 | 0.043** | 3.27 | 1.14-9.37 | 0.027** |

## 4. DISCUSSION

To our knowledge, this study was the first to use the RDS method among FSW for HBV, HCV, and HDV seroprevalence and one of the few studies to report seroprevalence data of these viruses among FSW in West-Africa. The results show a high prevalence of HBV (18.2%) and hepatitis C (10.6%), and low seroprevalence of hepatitis D (1.5%) among FSW in Ouagadougou. HBV and HCV prevalence reported in our study are higher than those described in the general population in the country [29]. In fact, the national prevalence of HBV in Burkina Faso was estimated at 8.8% [29]. In a recent systematic review in the country, a slightly higher prevalence of HBV was reported among specific groups: pregnant women (11.1%), blood donors (11.7%) and people living with HIV (12.6%) [30]. Our results are comparable to those of Forbi *et al*. who reported 17.1% of HBV prevalence in FSW in Nigeria [31], while Musa *et al*. found (13.6% in general population in this country [32].

Similar results were reported by De Matos *et al*. who found an HBV prevalence of 17.1%, which was 1.5 times higher than

the prevalence in general population estimated at 11.6% in Brazil [14]. Due to risk factors, FSW are more vulnerable to HBV infection. Universal vaccination against HBV among infants was initiated in Burkina Faso only in 2006 [33]. As indicated by our study, most of FSW were not immunized against HBV (only 4% declared to be in contact at least once with the vaccine), and are at increased vulnerability to transmit HBV among the unvaccinated adult population through multiple sex partners.

Certain factors such as advanced age and seniority in sex work, previous history of STIs, previous history of a blood transfusion, and drug use were associated with HBV prevalence in some studies [14]. Our study did not identify an independent association of socio-demographic or behavioral factors with HBV infection in FSW. A study in Congo reported age as a factor associated with HBV in FSW [15]. Another study in Tanzania concluded that sexual acquisition of HBV in adults is less common [34]. Vertical transmission of HBV from mother to child or childhood HBV infection is the most common in Africa suggesting lower infection rates from sexual activity [35, 36]. Risky sexual behaviors among FSW may lead to HBV infection or they may have been infected during childhood. The cross sectional nature of this study did not allow us to determine if HBV among the study population was acquired during childhood or during sex work. Future longitudinal cohort studies are needed to elucidate the vulner-ability factors of FSW in Burkina Faso.

In our study, only one FSW among those who were HBV positive was tested positive for HDV antibodies (1.64%), and reported to the total sampling of the study, its prevalence is 0.3%. HDV is endemic in Africa and its prevalence varies from one country to another [6]. Our study shows a lower HDV prevalence in FSW compared to that of the West African population (7.33%) [6]. The prevalence of HDV in our study is however, higher than the one reported in the female population of HBsAg carriers in Burkina Faso (0.77%) [37]. HBV and HDV coinfection is a concern because it could accelerate the HBV evolution, and potentially lead to liver cirrhosis or cancer if proper treatment is not offered [2].

The prevalence of HCV among the study population was high, despite the low number of injection drug users. Those who reported a history of injection drug use did not test positive for HCV. Compared to developed countries where injection drug use is a contributing factor to HCV transmission, injection drug use is not common in Burkina Faso [38, 39]. HCV antibody prevalence was 10.6% among FSW which was three times higher compared to 3.5% among a population of reproductive age at the national level, and to 3.1% among women [29]. This implies that FSW are more vulnerable to contracting HCV sexually as opposed to through injection drug use [30].

Socio-demographic characteristics did not indicate significant differences of HCV prevalence among FSW. Sexual behavior factors relating to HIV infection including condom use, condom scarcity, and location of sexual activity were associated with HCV infection and are opportunities for public health intervention and sexual health education. Some authors suggested that risky sexual behaviors including multiple sex partners and intense sexual practices can lead to accumulated risk for HCV transmission [40]. This sexual transmission can be facilitated in FSW by repeated exposure of vaginal mucosa to the virus particularly when they are injured [41]. Also, the risk of contracting HCV among those infected with HIV people has previously been studied [42]. In a systematic review of studies on HIV and the viral hepatitis co-infections in sub-Saharan Africa, the authors reported that those who were HIV infected were estimated to be 60% higher risk of HCV coinfection compared to HIV seronegative people (RR = 1.60) [42].

The limitations of our study are the fact that risky sexual behaviors are self-reported and subject to recall bias. We do not have the possibility to check the reliability of these responses. However, the study staff was well-trained to minimize this risk of bias and obtain quality data. Secondly, the RDS method used to recruit the FSW is an estimate of the population and does not account for the entire population of FSW in Ouagadougou. Thirdly, the cross-sectional nature of this study does not allow us to establish temporality between risky sexual behavior and HBV or HCV infection. We also do not know when the FSW contracted these diseases and if it was before or after they started sex work. Finally, a positive HBV or HCV antibody test does not confirm the stage of infection or the presence of the virus during the study.

## CONCLUSION

Our study suggests that HBV and HCV infection are a public health concern among FSW. Comprehensive prevention for HBV and HCV among FSW should be implemented in order to meet the objectives of the viral hepatitis global program [43]. These prevention programs must take into account their unique needs and behaviors that put them at increased vulnerability. We recommend vaccination against HBV, bloodborne exposure training, and sexual exposure training. Vaccination against HBV virus should be promoted to those at highest risk of blood and sexual exposures. In addition, sexual education to use barrier methods, such as condoms and avoid unprotected intercourse, is required. And finally, preventing blood exposures and encouraging treatment for HCV must be included in future public health program planning, particularly among FSW. With a comprehensive and inclusive HBV and HCV prevention program, this could also be part of HIV related programming and services among FSW in Burkina Faso.

## LIST OF ABBREVIATIONS

**CERS** = Ethics Committee for Health Research of Burkina Faso

**CI** = Confidence Interval

**ELISA** = Enzyme Linked Immunoassay

**HBsAg** = Hepatitis B Virus Surface Antigen

**HBV** = Hepatitis B Virus

**HCV** = Hepatitis C Virus

**HDV** = Hepatitis D Virus

**HIV** = Human Immunodeficiency Virus

**FSW** = Female Sex Worker

**OR** = Odds Ratio

**aOR** = Adjusted Odds Ratio

**RDS** = Respondent Driven Sampling

**RDSAT** = RDS Analysis Tool

**USD** = United States Dollars

## AVAILABILITY OF DATA AND MATERIAL

The datasets used during the current study are available from the corresponding author on reasonable request.

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## AUTHORS' CONTRIBUTION

HGO, SK, NB, SB conceived and designed the study; HGO, BCS supervised data collection; HGO, CD, MC performed lab analysis; HGO prepared the manuscript and it was reviewed by SK, NB, SG, OK, HL, BCS, YT, SB.

## ETHICS APPROVAL AND CONSENT TO PART-ICIPATE

The study received ethical approval from the Ethics Committee for Health Research (CERS) of Burkina Faso and The Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

## HUMAN AND ANIMAL RIGHTS

No Animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experi-mentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

## CONSENT FOR PUBLICATION

Written informed consent was obtained from all the participants prior to publication.

## CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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