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**ORIGINAL ARTICLE | HIV-I-SYPHILIS CO-INFECTION**

## **HIV-I-Syphilis Co-infection Associated with High Viral Load in Female Sex Workers in the Democratic Republic of the Congo**

**Godefroid M.A. Musema, MPH;<sup>1</sup>✉ Ali M. Mapatano, MD, MPH, PhD;<sup>1</sup> Desire K. Tshala, MD, MPH, PhD;<sup>2,3,4</sup> Patrick K. Kayembe MD, MPH, PhD<sup>1</sup>**

<sup>1</sup>Kinshasa School of Public Health, School of Medicine, University of Kinshasa, Democratic Republic of the Congo (DRC); <sup>2</sup>Department of Neurology, School of Medicine and School of Public Health, Oregon Health & Science University, Portland, Oregon, USA; <sup>3</sup>Department of Neurology, University of Kinshasa, Kinshasa, DRC; <sup>4</sup>Institut National de Recherches Biomédicales, Kinshasa, DRC

✉ Corresponding author email: [gmusema2014@gmail.com](mailto:gmusema2014@gmail.com)

### **ABSTRACT**

**Background:** Sexually transmitted infections (STI) and HIV co-infection are common in countries where resources are limited constituting a leading public health issue. The negative impact of HIV transmission and acquisition are known. The aim of this study was to determine whether HIV-I-syphilis co-infection is associated with high HIV-I viral load (VL) in female sex workers (FSWs) in the Democratic Republic of the Congo (DRC).

**Methods:** Sera from 411 FSWs tested HIV+ in a national DRC HIV/STI Integrated Biological and Behavioral Surveillance Survey (IBBS) conducted between December 2012 and January 2013. HIV and syphilis testing were performed according to validated DRC national testing algorithms used by the National AIDS Control Program (PNLS). VL was measured according to Abbot *m2000sp* and *m2000rt* protocols. HIV-I-syphilis co-infection proportion was determined and multivariate analyses were used to identify factors associated with higher VL in HIV-I-syphilis co-infected FSWs.

**Results:** Of 411 HIV-infected FSWs, 19.2% (95% CI: 15.4 – 23.0) were co-infected with syphilis. The mean HIV-I VL in HIV-I-positive FSWs co-infected with syphilis [2.9 log<sub>10</sub> HIV RNA/mL (95% CI: 2.49 – 3.29)] was higher compared with those not co-infected with syphilis [2.2 log<sub>10</sub> HIV RNA/mL (95% CI: 1.97 – 2.46)]. Multivariate analysis showed that syphilis co-infection was associated with high HIV-I VL (aOR [95% CI] = 1.90 [1.03, 3.52]) but HIV-I VL was not influenced by age, education level, duration in sex profession, abnormal fluid, and genital sore.

**Conclusion and Implications for Translation:** HIV-I Syphilis co-infection was associated with higher HIV-I VL. Preventing FSWs from getting STIs and screening HIV-infected individuals for STIs and providing them with appropriate treatment could impact the transmission of HIV from FSWs to their clients.

**Keywords:** • HIV-I • Syphilis • Co-infection • Viral Load • Female Sex Workers • DRC

## RESUME

**Contexte:** Les infections sexuellement transmissibles (IST) et la co-infection par VIH constituent un problème majeur de santé publique. L'impact négatif de la transmission et de l'acquisition du VIH étant connu, Cette étude voudrait déterminer si la co-infection VIH-I-syphilis était associée à une charge virale (CV) élevée du VIH-I chez les Professionnelles du Sexe (PS) en République Démocratique du Congo (RDC).

**Méthodologie:** Des sérums de 411 PS testées VIH positives dans une enquête nationale intégrée de surveillance biologique et comportementale du VIH / IST menée en 2012-2013 ont été analysés. La CV du VIH-I a été mesurée selon les protocoles Abbott m2000sp et m2000rt et des analyses multivariées ont été utilisées pour identifier les facteurs associés à une CV élevée du VIH-I chez les PS.

**Résultats:** Sur 411 FSW, 19,2% (IC à 95%: 15,4 - 23,0) ont été coinfectedes par la syphilis. La CV moyenne du VIH-I chez les PS coinfectedes par la syphilis [2,9 log<sub>10</sub> HIV RNA / mL (IC 95%: 2,49 - 3,29)] était plus élevée comparativement à celles non coinfectedes [2,2 log<sub>10</sub> HIV RNA / mL (IC à 95%: 1,97 - 2,46)]. Les analyses multivariées ont montré que la co-infection avec la syphilis était associée à une CV élevée du VIH-I (OR<sub>a</sub> [IC à 95%] = 1,90 [1,03, 3,52]).

**Conclusion et implications de la translation:** la co-infection VIH-I - Syphilis était associée à une CV élevée du VIH-I. Prévenir les PS des IST et les dépister chez les personnes infectées par le VIH en leur fournissant une prise en charge appropriée pourrait avoir un impact sur la transmission du VIH.

**Mots clés:** • VIH-I • syphilis • charge virale • professionnelles de sexe • RDC

## I. Introduction

### 1.1. Background of the Study

Sexually transmitted infections (STIs), including HIV, have serious consequences for sexual and reproductive health. They are a leading public health concern throughout the world, particularly in limited resource settings associated with poverty, low education levels, and inaccessibility to medical care and prevention strategies. Each year, an estimated 357 million individuals worldwide are infected with one of the four major STIs, namely syphilis (5.6 million), gonorrhoea (78 million), chlamydia (131 million), and trichomoniasis (143 million).<sup>1,2</sup>

Both HIV and syphilis are transmitted through unprotected sex, unsafe blood transfusions, needle sharing, and from mother to child.<sup>3</sup> Syphilis causes genital lesions that are known to increase the risk of HIV transmission.<sup>4,5</sup> Although these two diseases share modes of transmission, the interaction between these two conditions is not yet fully understood.

African female sex workers (FSWs), including those in the Democratic Republic of the Congo

(DRC), remain extremely vulnerable to HIV infection. This HIV key population is characterized by extreme poverty and a lack of familial and social support.<sup>6</sup>

Previous research has shown that FSWs remain an epidemiological key population in terms of HIV and sexually transmitted infection (STI) related risks throughout the African Continent.<sup>7,8</sup> According to a meta-analysis, HIV prevalence among FSWs in African countries ranged from 19% to 60%.<sup>9</sup> This HIV prevalence is ten to twenty times higher compared to the general population.<sup>6,10</sup> Syphilis was associated with HIV infection. In Togo, Halatoko et al.<sup>11</sup> the estimated syphilis prevalence among FSWs was 2.2% while in Brazil was 1.09%.<sup>12</sup>

The DRC is experiencing a generalized HIV epidemic; its prevalence in the general population is estimated at 1.2%. Moreover, HIV prevalence is particularly high in some provinces (Maniema, 4.0%), but not in others (Bas-Congo, 0.2%).<sup>13</sup> A higher prevalence was documented in HIV at-risk groups: FSWs (6.9%) in 2012; male (3.8%) and female (7.5%) military personnel in 2008;<sup>14</sup> men having sex with men (17.9%); or injecting drug users (26.7%).<sup>15</sup>

The epidemiological data of HIV co-infection with syphilis was less documented in the DRC, both in general and in HIV key population. In 2011, Taylor et al.<sup>16</sup> estimated the prevalence of syphilis was 4.2% among pregnant women attending sentinel antenatal clinics (ANC). During 2014, a sero-surveillance survey showed that the mean prevalence of syphilis among women attending ANC was estimated at 2.8%.<sup>17</sup> According to data gathered from the sero-surveillance survey of 2017, the prevalence of co-infection of HIV-1-syphilis (0.21%) among pregnant women remains low<sup>18</sup> compared with FSWs.

### **1.2. Objectives of the Study**

The current study aimed to identify factors associated with high HIV-1 viral load (VL) in FSWs from the Democratic Republic of the Congo (DRC).

### **1.3. Specific Aims and Hypothesis**

The specific aims of this study were to: (1) determine the proportion of FSWs infected both with HIV-1 infection and syphilis; (2) measure the HIV-1 VL in HIV-positive FSWs; and (3) determine the association between HIV-1 VL and HIV-1 – syphilis co-infection in HIV-positive FSWs. FSWs are a key HIV population due to their biological, behavioral and structural risk factors. They are characterized by a lack of family, social or legal support. FSWs are often very young, poor, poorly educated, with a large number of sexual partners, and they also frequently suffer from STIs. Considering the above, we hypothesized that several factors, including certain HIV risk behaviors, and biological risk factors, are associated with high viral load among HIV-positive FSWs in the DRC.

## **2. Methods**

### **2.1. Data Source**

Data were obtained from the DRC HIV/STI Integrated Biological and Behavioral Surveillance Survey (IBBS) collected between December 2012 and January 2013 in FSWs. The purpose of the IBBS was to assess changes in HIV and syphilis behaviors and prevalence of risk behaviors associated with HIV

key populations, including street children, truckers, miners and FSWs.<sup>19</sup> According to the current study, variables of interest included age, education level, HIV-1-syphilis co-infection status, duration in sex profession, abnormal fluid and genital sore 12 months preceding the survey, and HIV-1 VL in plasma.

### **2.2. Study Population**

Four hundred and eleven (411) FSWs who tested HIV+ in the IBBS were included. Viral load (VL) was available for 273 (66.4%).

### **2.3. IBBS Design and Settings**

A cluster sampling design (time location sampling strategy) was used to conduct the IBBS across the country. The survey occurred in capital cities of all the former 11 provinces of the DRC, namely Kinshasa, Matadi, Kikwit, Mbandaka, Kisangani, Kindu, Mbuji-Mayi, Kananga, Goma, Bukavu, and Lubumbashi.

### **2.4. Laboratory Analyses**

Syphilis and HIV rapid testing were performed by trained laboratory technicians on-site using DRC nationally approved algorithm.

#### **2.4.1. Syphilis testing**

Syphilis status was determined on-site using both the Determine® Syphilis TP test (Inverness Medical Professional Diagnostics, Princeton, NJ) and the rapid plasma reagin (RPR) carbon test (Cypress Diagnostics, Langdorp, Belgium). Determine Syphilis TP (100.0%, sensitivity) was used as a screening test. All specimens positive with the Determine Syphilis TP test were subsequently tested with the RPR test for confirmation. Those reactive to RPR were reported as syphilis positive.

#### **2.4.2. HIV-1 testing**

To determine HIV status, three serial rapid tests (Determine, Uni-Gold, and Double-Check) were performed. Samples were first screened with Determine HIV-1/2 (Inverness Medical Professional Diagnostics, Princeton, NJ) (100.0%, sensitivity). All non-reactive samples were considered negative. Reactive samples were retested using the Uni-Gold

Recombigen HIV (Trinity Biotech, Bray, Ireland) (97.5%, sensitivity). Samples testing positive to both the Determine and Uni-Gold tests were considered positive. Samples that were reactive to Determine but negative to Uni-Gold were tested with the Double-Check Gold HIV 1&2 (Organics, Israel) (94.0%, sensitivity) test as a tie-breaker. The outcome of this third test was considered final. For quality control and to confirm the results obtained on-site, all HIV-positive and a randomly selected 10% of HIV-negative samples were tested at the National Reference Laboratory using Vironostika® HIV Uni-Form II Ag/Ab (BioMerieux Diagnostics, Marcy l'Etoile, France), and all non-reactive samples by Vironostika were considered negative.

#### 2.4.3. Viral load assessment

HIV-I VL was measured in plasma samples at the National AIDS Reference Laboratory according to Abbott M2000sp and M2000rt protocols. According to World Health Organization (WHO) policy<sup>20</sup> and adopted by the DRC's national policy, a threshold of 3.0 log<sub>10</sub> HIV RNA/mL is used to categorize HIV-I VL. VL ≥ 3.0 log<sub>10</sub> HIV RNA/mL and VL < 3.0 log<sub>10</sub> HIV RNA/mL considered as high VL and low VL respectively.

#### 2.5. Study Variables

The variables measured in the current study included the following: HIV-I viral load, as dependent variable, and age, education level, HIV-I – syphilis co-infection status, duration in the sex profession, and STIs history (abnormal fluid and genital sore during the 12 months prior to the survey), as independent variables.

#### 2.6. Statistical Analysis

Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) version 23.0 (IBM Statistics, Chicago, IL). Frequencies were computed for categorical variables and descriptive statistics for continuous variables. The chi-square test was used to test homogeneity and associations between different characteristics and co-infection. Comparison of means was made using Student's t test and one way ANOVA as appropriate. Variables associated with increased HIV-I VL were included

in a multivariable logistic regression model. P-values ≤ 0.05 were considered statistically significant.

#### 2.7. Ethical Approval

The HIV/STI IBBS protocol was approved by the Tulane Human Research Protection Program Institutional Review Boards Biomedical Social Behavioral FWA000002055 (IRB Reference #: 12-347922) and also obtained ethical clearance from the Kinshasa School of Public Health (KSPH) IRB.

### 3. Results

#### 3.1. Socio-demographic Characteristics and HIV-I - syphilis Co-infection Status

We found that half of the FSWs 50.6% [95% CI: 45.8 – 55.4] had attained secondary school; 34.3% [95% CI: 29.7 – 38.9] had attained primary school; 13.6% [95% CI: 10.3 – 16.9] had never attended school; and only 1.5% [95% CI: 1.2 – 1.9] had attained high school level. Seventy-nine [19.2% (95% CI: 15.4 – 23.0)] FSWs had dual HIV-I and syphilis infection. The mean ages were 31.3 ± 8.7 years and 29.8 ± 7.8 years, respectively, for HIV-positive FSWs who were co-infected with syphilis and those not co-infected. Overall, more than half (60.3%) of HIV-I infected FSWs reported having spent less than five years in the sex profession.

More than three-quarters (78.3%) of FSWs co-infected by HIV-I and syphilis recognized their health condition. Regarding the history of STIs, nearly one-third (29.1%) and 23.6% of HIV-positive FSWs had recognized, respectively, having abnormal fluid discharge and genital sore, the 12 months preceding the survey. According to the viral load, 43.6% of HIV-I-infected FSWs had a high viral load (≥ 3 log<sub>10</sub> HIV RNA/mL) (Table 1).

#### 3.2. Viral Load by Socio-demographic Groups and HIV/syphilis Status

The mean VL was higher in FSWs co-infected with HIV and syphilis [(2.89 (SD = 1.46) log<sub>10</sub> HIV RNA/mL] compared with those not co-infected [(2.22 (SD = 1.82) log<sub>10</sub> HIV RNA/mL] (p = 0.012). Distribution of VL among FSWs was homogeneous across age groups (p = 0.469), education level (p = 0.589), duration in the sex profession (p = 0.454),

**Table 1: Screening characteristics of HIV-I positive female sex workers from DRC**

Characteristics	n	%
Age category (years)		
< 20	23	5.6
20–24	67	16.3
25–49	321	78.1
Mean age : 30.08 (SD : 7.54)		
Education level		
Never attended school	56	13.6
Primary school	141	34.3
Secondary school	208	50.6
High school	6	1.5
HIV-I – syphilis co-infection status		
No	332	80.8
Yes	79	19.2
Duration in the sex profession		
≥ 5	162	39.7
< 5	246	60.3
Abnormal fluid the 12 months prior survey		
Yes	119	29.1
No	290	70.9
Genital sore the 12 months prior survey		
Yes	96	23.6
No	311	76.4
HIV-I Viral load (log <sub>10</sub> HIV RNA/mL)		
< 3.0	154	56.4
≥ 3.0	119	43.6

abnormal fluid ( $p = 0.085$ ) and genital sore ( $p = 0.329$ ) the 12 months prior to the survey (Table 2).

### 3.3. Determinants of Increased Viral Load

We assessed the association between VL and age, education level, co-infection status, duration in sex profession, abnormal fluid genital sore, the 12 months preceding the survey. In multivariate analysis, only co-infection with HIV-I and syphilis was associated with high VL [crude aOR: 1.90 (95% CI: 1.03 – 3.52)] ( $p = 0.042$ ) (Table 3).

## 4. Discussion

In sub-Saharan Africa, FSWs are known as a key population for HIV and other STIs.<sup>21</sup> The aim of this

study was to determine whether HIV-I-syphilis co-infection was associated with changes in HIV-I VL. The current study can claim to be among the first in the DRC, to assess factors associated with high VL in HIV-I and syphilis co-infection among seropositive FSWs.

The proportion of HIV-I-syphilis co-infection was 19.2%. There was no significant difference in age between HIV-syphilis co-infected FSWs ( $31.3 \pm 8.7$  years) and those not HIV-syphilis co-infected ( $29.8 \pm 7.8$  years),  $p = 0.120$ . Overall, more than three quarters (78.3%) of the co-infected FSWs reported having spent less than five years in the sex profession.

In general, the mean VL was  $2.35 \log_{10}$  HIV RNA/mL (SD =  $1.77 \log_{10}$  HIV RNA/mL). The mean VL was higher ( $2.89 \log_{10}$  HIV RNA/mL) in co-infected FSWs compared with those not co-infected ( $2.22 \log_{10}$  HIV RNA/mL). However, there was no significant difference across age groups or according to duration in the sex profession. HIV-I/syphilis co-infection and mean VL distribution were homogeneous throughout age groups, education level, duration in the sex profession, having abnormal fluid or genital sore, the 12 months preceding the survey.

The prevalence of HIV-I – syphilis co-infection was homogeneous across age groups ( $p = 0.469$ ). In contrast, other studies showed that FSWs aged 25 years or older were at higher risk of acquiring HIV and STIs. Papworth et al.<sup>9,22</sup> also found that this age group was more concerned with HIV-I and other STI co-infections than other age groups. Mutangoma et al.<sup>22</sup> have observed an association between HIV-I – syphilis co-infection and a lower education and urban residence of pregnant women in Rwanda.

Scorgie et al.<sup>23</sup> have shown that a duration of around three years in the sex profession is a major risk factor for acquiring HIV and STIs. In this study, almost half of co-infected FSWs had already spent at least five years in the sex profession. These data diverge from those reported by McKinnon et al.,<sup>24</sup> who established an association between a short period in sex work with the acquisition of HIV and STIs. This finding can be explained by intense HIV prevention programs targeting FSWs in the DRC to reduce HIV epidemic impact in this key population.

**Table 2: Viral load by age category, education level, co-infection status, duration in sex profession, abnormal fluid, and genital sore 12 months preceding survey**

Characteristics	n	Mean VL (log <sub>10</sub> HIV RNA/mL)	p-value
Age category (years) (N=273)			0.469*
< 20	19	2.36	
20–24	38	2.68	
25–49	216	2.30	
Education level (N=273)			0.589*
Never attended school	43	2.46	
Primary school	94	2.33	
Secondary school	136	2.35	
HIV-I–syphilis co-infection status (N=273)			0.012**
No	219	2.22	
Yes	54	2.89	
Duration in the sex profession (years) (N=272)			0.454**
< 5	164	2.43	
≥ 5	108	2.26	
Abnormal fluid the 12 months prior survey (N=272)			0.085**
No	198	2.48	
Yes	74	2.06	
Genital sore the 12 months prior survey (N=271)			0.329**
No	212	2.43	
Yes	59	2.17	

\*ANOVA test; \*\*Student t-test

The prevalence of HIV-I – syphilis co-infection among FSWs was 19.2% (95% CI: 15.4 - 23.0). The distribution of this proportion is modeled on the HIV prevalence distribution estimated by the IBBS.<sup>19</sup> Although the prevalence of HIV-I–syphilis co-infection in pregnant women is generally low in sub-Saharan Africa compared to that found in FSWs in the DRC,<sup>24,25</sup> it can constitute HIV transmission risk to baby during childbirth and congenital syphilis. HIV-I – syphilis co-infection proportion estimated in the current study was much lower than that observed in Rwanda in FSWs (27.4% [95% CI: 25.4 – 29.4])<sup>25</sup> but higher than that observed in pregnant women (1.0% [95% CI: -0.001 – 2.1]) in that country.<sup>26</sup> This can be explained by the fact that, according to maternal health prevention strategies, in the DRC and other countries in sub-Saharan Africa, pregnant women benefit from HIV / STI awareness, testing and medical care sessions that were not available for FSWs, thus, high HIV and other STI prevalence in this key population can

be observed.<sup>27,28</sup> In addition, Rwandan FSWs use condoms less and are usual victims of sexual and physical violence.<sup>29</sup>

The mean HIV-I VL in HIV-positive FSWs was higher in those co-infected with syphilis than those who were not, similar to the findings of de Almeida et al.<sup>30</sup> and Taylor et al.<sup>31</sup> Nevertheless, there were no significant differences in HIV-I VL according to: age (p = 0.469); duration in the sex profession (p = 0.454); or level of education (p = 0.589). Conversely, co-infected FSWs had higher VLs than HIV+ without syphilis (p = 0.012). This may be because FSWs in the DRC are highly knowledgeable about HIV.<sup>19</sup> At the threshold of 3.0 log<sub>10</sub> HIV RNA/mL, syphilis was associated with a high HIV-I VL. HIV-positive FSWs co-infected with syphilis were twice as likely to have a high HIV-I VL compared with FSWs who were not co-infected. Several studies have shown that syphilis is statistically associated with increasing HIV-I VL and decreasing CD4 in

**Table 3: Factors associated with high VL among HIV-seropositive FSWs from DRC**

Characteristics	Viral load		Crude OR (95% CI)	Adjusted OR (95% CI)
	$\geq 3 \log_{10}$ HIV RNA/mL	$< 3 \log_{10}$ HIV RNA/mL		
Age category (years)				
< 20	8 (42.1)	11 (57.9)	1	1
20–24	20 (52.6)	18 (47.4)	1.53 (0.50–4.64)	1.62 (0.52–5.04)
25–49	91 (42.1)	125 (57.9)	1.00 (0.39–2.59)	1.03 (0.38–2.78)
Education level				
No instruction	19 (44.2)	24 (55.8)	1	1
Primary school	44 (46.8)	50 (53.2)	1.11 (0.54–2.30)	1.22 (0.58–2.58)
Secondary school	56 (41.5)	79 (58.5)	0.90 (0.45–1.79)	0.96 (0.47–1.95)
HIV-1-syphilis co-infection status				
No	88 (40.2)	131 (59.8)	1	1
Yes	31 (57.4)	23 (42.6)	2.01 (1.10–3.67)	1.90 (1.03–3.52)
Duration in the sex profession (years)				
< 5	74 (45.1)	90 (54.9)	1	1
$\geq 5$	45 (41.7)	63 (58.3)	1.15 (0.71–1.88)	1.04 (0.62–1.77)
Abnormal fluid the 12 months prior survey				
No	89 (44.9)	109 (55.1)	1	1
Yes	30 (40.5)	44 (59.5)	1.20 (0.70–2.06)	1.02 (0.54–1.91)
Genital sore the 12 months prior survey				
No	96 (45.3)	116 (54.7)	1	1
Yes	23 (39.0)	36 (61.0)	1.30 (0.72–2.33)	1.12 (0.60–2.35)

persons living with HIV co-infected with syphilis, even in industrialized countries.<sup>32,33</sup> By studying the influence of HIV-syphilis co-infection on CD4, HIV-1 VL, and response to syphilis treatment, Kofoed et al.<sup>32</sup> also demonstrated that syphilis was strongly associated with decreasing CD4 and increasing HIV-1 VL and that these two parameters improved after effective syphilis treatment.

Several studies have demonstrated the role of HIV-1 VL and syphilis in increasing the risk of HIV transmission. Quinn et al.<sup>34</sup> observed that HIV transmission was rare when the HIV-1 VL was under  $3.18 \log_{10}$  HIV RNA/mL. Here, however, over half of FSWs co-infected with syphilis (57.4% [95% CI: 46.5 – 68.3]) had an HIV-1 VL greater than  $3.0 \log_{10}$  HIV RNA/mL. Following the estimated probability of HIV sexual transmission, a study by Gray et al.<sup>35</sup> found that the risk of sexual transmission of HIV from HIV-infected FSWs to their clients could be in the range of 0.001 to 0.023 in the DRC.

High plasma HIV VLs in HIV-positive patients in sub-Saharan Africa is essentially due to high rates of co-infection and contributes to the HIV epidemic in this region.<sup>36,37</sup> The prevalence of HIV-STI co-infections among FSWs are insufficiently documented in the DRC, the current study was among the first to focus on this issue.

Ulcerative STIs such as syphilis increase susceptibility to HIV by attracting immune cells such as CD4+ T cells to the infection site, which may be infected by virus, and can also alter mucosal barrier integrity. They increase HIV infectivity by facilitating systemic viral dissemination.<sup>38</sup> Adoption of responsible sexual behaviors, introduction of a syndromic approach, and increased antibiotics use in STI management over ten years (1990 to 2001) has reduced bacterial STIs and HIV incidence in Burkina Faso.<sup>39</sup> The fact that one-fifth of FSWs in DRC are co-infected with syphilis indicates inconsistent use of condoms and that FSWs are not benefitting from

existing services for STI treatment. Although the sex profession has been legalized in the DRC, it is often considered a stigmatized activity. FSWs are not identified by the Government, their exact numbers are unknown in DRC cities, and many of them operate in hiding. They do not benefit from services offered to prevent or to manage STIs and HIV.

#### 4.1. Limitations

The current study is limited. Since this is a cross-sectional study, it is difficult to establish whether HIV or syphilis infection came first. Both may increase the risk of becoming infected with the other. This study does not include other key population such as men who have sex with men and people who inject drugs. Researchers may conduct further national studies on HIV transmission and HIV-1 drug resistance for these study groups.

#### 5. Conclusion and Implications for Translation

In this study, we showed that a fifth of FSWs infected with HIV in the DRC were co-infected with syphilis. Syphilis was associated with HIV-1 VL increases in HIV-syphilis co-infected subjects. Our findings underscore the importance of systematically screening and adequately managing STIs that may interact with HIV. An effort must be made to improve the prevention programs for HIV and other STIs for FSWs and to strengthen HIV epidemic control in the DRC.

#### Compliance with Ethical Standards

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**Disclaimer:** None.

#### Key Messages

- Syphilis is associated with high HIV-1 VL in HIV-positive FSWs from the DRC.
- It is very important to systematically screen and properly manage other STIs susceptible to HIV in the general population and especially in HIV key population.
- In case of HIV-1 high VL not responding to antiretroviral treatment, providers should look for, among other things, HIV-1 – STIs co-infection in general and more particularly HIV-1 – syphilis co-infection.

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