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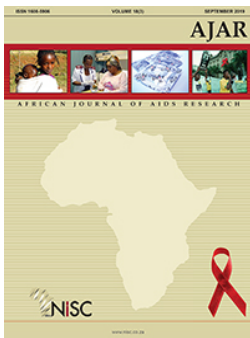
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## Sex work among female workers in the traditional mining sector in Mali – results from the ANRS-12339 Sanu Gundo cross-sectional study in 2015

Cheick Haïballa Kounta<sup>1,2\*</sup> , Luis Sagaon-Teyssier<sup>1,2</sup> , Hubert Balique<sup>1</sup>, Fodié Diallo<sup>3</sup>, Nikos Kalampalikis<sup>4</sup> , Marion Mora<sup>1,2</sup>, Michel Bourrelly<sup>1,2</sup>, Marie Suzan-Monti<sup>1,2</sup> , Bruno Spire<sup>1,2</sup>  and Bintou Dembélé Keita<sup>3</sup>

<sup>1</sup>Aix Marseille University, INSERM, IRD, SESSTIM, Sciences Economiques & Sociales de la Santé & Traitement de l'Information Médicale, Marseille, France

<sup>2</sup>ORS PACA, Observatoire régional de la santé Provence-Alpes-Côte d'Azur, Marseille, France

<sup>3</sup>ARCAD Sida, Bamako, Mali

<sup>4</sup>University Lyon 2, Social Psychology Research Group (EA4163), Lyon, France

\*Corresponding author email: [kountacheick80@yahoo.fr](mailto:kountacheick80@yahoo.fr)

Female sex workers (FSW) in mining sites are considered to be at very high risk of HIV infection. We aimed to characterize FSW at the Kôkôyô artisanal gold mining site in Mali, and identify factors associated with sex work using data from ANRS-12339 Sanu Gundo, a cross-sectional survey conducted in 2015 at the mine by ARCAD-SIDA, a Malian non-governmental organisation. People attending HIV-prevention activities were invited to participate in the quantitative and qualitative parts of the survey. A probit logistic regression was used for data analysis. Of 101 women who participated in the survey, 26.7% reported sex work as their main activity. Multivariate analysis showed that the probability of sex work as a main activity decreased by 1% per 1-year age increase ( $p = 0.020$ ). Sex work was significantly more likely to be reported by single, divorced and widowed women (25.4% probability;  $p = 0.007$ ). FSW were significantly more likely to be non-Malian (36.3% probability;  $p = 0.003$ ), more likely to have a secondary activity (77% probability;  $p = 0.002$ ), to work fewer than 56h/week (40.2% probability;  $p = 0.001$ ) and to be in good health (12.1% probability;  $p = 0.016$ ). In addition, being aware of the existence of sexually transmitted infection, using psychoactive substances, and having unprotected receptive anal sex during the previous six months were significantly associated with sex work (50.2%;  $p = 0.006$ ; 45.6%,  $p = 0.003$ ; and 7.4%,  $p = 0.016$  probability, respectively). Qualitative findings confirm that poverty and boyfriends' refusal to use condoms remain key barriers to systematic condom use among FSW.

**Keywords:** female sex workers, female non-sex workers, miners, Mali, STI/ HIV, West Africa

### Background

Some of world's poorest migrant populations live and work in informal artisanal small-scale gold mining (IASGM) sites located in remote areas. These sites are widely recognized as high-risk transmission areas for infectious diseases, particularly sexually transmitted infections (STIs) including the human immunodeficiency virus (HIV) (Desmond et al., 2005; Baltazar et al., 2015; Bose-O'Reilly et al., 2010; Campbell, 1997; Weine & Kashuba, 2012). Increasingly more artisanal and small-scale miners are working in these facilities worldwide, with numbers estimated at between 25–30 million (Buxton, 2013). The mines also provide indirect employment, including a flourishing sex work trade. Female sex workers (FSW) who come to the mines seeking work usually arrive alone. After a time they find accommodation in hostels close to the mines, either with new boyfriends they meet at the mine or with female co-workers (Campbell, 2000). Sex work takes many forms at the sites, whether formal, informal or occasional (Desmond et al., 2005). Although a great deal of heterogeneity exists in sex worker populations, in terms of exposure levels to HIV,

FSW are considered to be at very high risk of HIV infection due to risky sexual behaviours associated with migratory work patterns (Baltazar et al., 2015; Desmond et al., 2005). Despite this very high-risk context, little is currently known about FSW at IASGM sites, especially concerning their involvement in sex work, their social environment and sexual behaviours (Sagaon-Teyssier et al., 2017; Campbell, 1997; Desmond et al., 2005).

The literature on HIV in IASGM sites mainly concerns people living or working directly in this field (Abdissa, Lemu & Nigussie, 2014; Cliff et al., 2003; Kiš, 2010; Rees, Murray, Nelson & Sonnenberg, 2010). In addition, the recent analysis of global trends in IASGM sites issues which is background material for intergovernmental mining policies did not focus on HIV, let alone specific groups like FSW (Fritz, McQuilken, Collins, & Weldegiorgis, 2014). This reflects the general lack of attention given to HIV transmission in IASGM related literature. Nevertheless, we found only one study related to HIV concerning FSW at the same IASGM site (Sagaon-Teyssier et al., 2017). It argued that female non-sex workers were at higher HIV risk than any other category. Thus, the study challenged the notion that specific groups, for example

FSW, are more likely to have risky behaviours than other groups, and revealed the necessity of focussing on different categories of workers at IASGM sites. Studies related to HIV conducted among FSW in contexts and communities other than IASGM sites have underlined factors contributing to the high HIV burden among FSW in Africa such as: (1) criminalisation and punitive policies on sex work, which strengthens (2) stigma, discrimination, economic insecurity, residential instability (due to evictions) and violence against FSW (gender-based violence and sex trafficking), and influencing (3) their access to resources and to better health services and HIV prevention commodities, as well as (4) psychoactive substance use (Kerrigan et al., 2013; Baral et al., 2012; Fawole & Dagunduro, 2014; Ngugi, Roth, Mastin, Nderitu & Yasmin, 2012; Scheibe, Drame & Shannon, 2012; Shannon et al., 2015; Sherwood et al., 2015).

IASGM is in full expansion in Mali following the security and political crises in 2012 which led to an economic slowdown and rising unemployment. It is still difficult to obtain reliable statistics on the actual number of miners on any given site (Keita, 2001; Traore, 2016; Jul-Larsen, Kassibo, Lange, Samset & Chr. Michelsen Institute, 2006). Mali is located in Sub-Saharan Africa, the region with the highest HIV prevalence in the world. In 2016, the HIV prevalence rate in Mali was estimated at 1.3% [1.1 – 1.7] in the general population aged 15–49 (UNAIDS, 2017). However, the epidemic remains concentrated in certain groups, particularly FSW, in whom HIV prevalence is estimated at 24.2% (Cellule Sectorielle de Lutte contre le Sida du Ministère de la Santé [CSLS/MS], 2010). This number gives us an idea of the prevalence in FSW living and working at IASGM sites in the country. The last available Integrated STI and Behavior Surveillance National Survey in Mali in 2009 found that FSW accounted for 22% of the five key populations studied (FSW, female street vendors, maids, truck drivers, and ticket resellers in bus stations called “coxeurs”). We hypothesize that this is also true for FSW at IASGM sites. Despite many studies and targeted prevention programmes aimed at FSW throughout Mali (focussing, among other things, on access to care, adapting service schedules to workers’ timetables, bringing services physically closer to the workplace, providing individually tailored consultations, and strengthening workers’ psychosocial skills), little attention has been paid to the sexual health of FSW at mining sites, as demonstrated by the presence of very few prevention interventions and the fact that these mining sites have poor medical and HIV services (Cellule de Planification et de Statistique, 2014). To our knowledge, our study is the first to investigate the characteristics of this population. Our objectives were to characterise FSW and identify factors associated with sex work to determine their HIV risk profile at the Kôkôyô mining site in Mali, using data from the ANRS-12339 Sanu Gundo cross-sectional survey.

## Methods

### *Participants and procedures*

The ANRS-12339 Sanu Gundo cross-sectional survey was conducted over two weeks in December 2015 at Kôkôyô, one of the largest IASGM sites in Mali, with a population oscillating between 6 000 and 10 000 people, depending on the season. In collaboration with the Chamber of Mines

and the Mines Ministry, this geographic site was chosen because of its large cultural heterogeneity, as people come not only from other Malian regions but also from neighboring countries (Burkina Faso, Guinea, Nigeria and Niger). The main objective was to test the feasibility of setting up community-based HIV prevention and screening activities in IASGM areas in Mali. A community-based research approach was adopted in collaboration with the Association de Recherche de Communication et d’Accompagnement à Domicile of people living with HIV (ARCAD-Sida), a local non-governmental organisation (NGO). The first step was to develop conversations, facilitated by ARCAD-SIDA members, about global health topics with a focus on HIV/STI prevention. Participants in the conversations were informed about the community-based services provided by the mobile ARCAD-SIDA unit, including the provision of a medical check-up, rapid tests for HIV, and essential medicines including those for treating STI. Participants in the conversations were then invited to participate in the qualitative and quantitative surveys (they could choose either or both) which formed the basis of the ANRS-12339 Sanu Gundo survey. The ARCAD-SIDA unit members referred those interested in participating to the survey’s team of Malian researchers, who in turn provided detailed information about the content of the survey, its main objectives and the advantages/risks of participating. Eligibility criteria included being: (1) aged 18 years or older; (2) able to speak French, Bambara or English; (3) able to provide written consent to participate. Persons under the effects of alcohol and/or drugs were excluded. For the quantitative survey, 101 women constituted the convenience sample. In order to reduce any potential over- and under-representation sampling bias, the conversations led by ARCAD-SIDA were conducted every day at different time slots and locations at the site, in order to adapt participant recruitment to the work schedule of the different categories of people living there. A brief face-to-face questionnaire was administered to eligible participants by trained investigators. The following information was collected: (1) socio-demographic and socioeconomic characteristics: age, gender, marital status, country of residence, educational level and weekly earnings; (2) type of activity and mobility between sites; (3) HIV status awareness; (4) risky sexual behaviours: alcohol and drugs consumption, self-defined sexuality, types and frequency of intercourse; (5) perceived health status. For the qualitative survey, which included 11 women, purposive sampling was considered to be the most suitable sampling method, as the main objective of the qualitative survey was to collect information about prevention and access to care for HIV/STI among the following two specific groups: FSW and female non-sex workers. Two focus groups were conducted by ARCAD-Sida members with these two specific groups. The sample size for each group was fixed between five and six survey participants in order to ensure diversity within them. Survey participants provided written formal consent to participate in the survey(s) by signing a letter of consent. All procedures and documents used were validated by both French (CCTIRS 15.917) and Malian (2015/65/CE/FMPOS) ethics committees. Our analysis therefore focused on 101 women who participated in the quantitative survey and 11 women who participated in the qualitative survey.

ANRS-12339 Sanu Gundo is described in detail elsewhere (Sagaon-Teyssier et al., 2017).

### **Outcome**

The main outcome of this analysis was constructed on the basis of the question “What is your main job at the Kôkôyô site?” with the following possible responses: gold-digger (digger, rope shooter and mud washer), trader, gold financier and sex worker. Participants who replied “sex worker” were considered to engage in sex work in contrast to those who replied they had one of the other three professions cited above. In addition, another question helped identify women practicing sex work as a secondary activity.

### **Explantatory variables**

#### *Socio-demographic and economic characteristics*

These included age (as a continuous variable), educational level (using a four-category variable: no schooling, primary level, secondary level, and Koranic school), marital status (married or living in a couple versus single, divorced or widowed), native country (Mali versus other countries), main country of residence (Mali versus other countries), and length of stay at the mining site (dichotomised at a median of six months). Economic characteristics included information about main and secondary activities, total weekly income (dichotomised at its median of 10 000 Francs de la Communauté Financière en Afrique (FCFA), approximately US\$17.90 in 2017, in a standard way), and the number of hours worked per week at Kôkôyô (constructed from the variables ‘number of hours worked per day’ and ‘number of days worked per week’ at Kôkôyô).

#### *Behavioural characteristics*

These included HIV status (positive versus negative); awareness of the existence of STI evaluated using the following question: “Have you heard about STI? (yes/no); risky sexual behaviours including condom use depending on type of intercourse (oral, vaginal, anal) during the previous six months (yes/no); alcohol or drug consumption and smoking tobacco (yes/no); and number of male sexual partners during the previous six months (none or one partner versus more than one partner versus not documented). A “self-perceived health status” variable was also constructed (good health status versus poor health status).

### **Statistical analysis**

First, a descriptive analysis was conducted to compare socio-demographic and economic characteristics and sexual behaviour between women who declared sex work as their main activity and those who did not. Categorical variables were compared between these two groups using Pearson’s  $\chi^2$  test or Fisher’s exact test when appropriate. Continuous variables were compared using Student’s *t*-test.

Second, univariate and multivariate analyses were performed using a probit regression to estimate the factors associated with the probability of having sex work as a main activity. Given the nature of the normal distribution assumption of the error term in the probit estimation, coefficients are not affected by the presence of extreme values in independent variables. Furthermore, probit regression allows the computation of marginal effects that

are more flexible and more informative than odds ratios (ORs) (Onukwugha, Bergtold, & Jain, 2015a; Onukwugha, Bergtold, & Jain, 2015b) which tend to be larger in the presence of rare events and are preferred for small samples (Greene, 1997). Marginal effects (ME),  $dF/dX$ , are interpreted as instantaneous rates of change: for a dichotomous explanatory variable, a marginal effect shows how predicted probabilities change when the variable changes from 0 to 1. In our study, potential variables for the multivariate model were selected with a *p*-value < 0.2 in the univariate probit regression. The final multivariate model was estimated using the forward procedure. All candidate variables were entered into the model one by one and retained when the *p*-value was < 0.05. All statistical analyses were performed using Stata Version 12.1 (StataCorp, 2013).

### **Qualitative data analysis**

Focus group discussions were audio-recorded, transcribed and translated into French. Data were coded, categorised and analysed. As other studies have done for focus group analyses, we used the thematic encoding principle developed by Flick (Flick, 2008; Caillaud & Kalampalikis, 2013). Thematic and pragmatic dimensions were combined into one dialogical unit to highlight patterns specific to the different groups (i.e., FSW and female non-sex workers) (Kalampalikis & Moscovici, 2005). A lexical analysis was performed using both Alceste (Reinert Software, 2015) and MAXQDA (VERBI Software, 2016) software. The different dimensions investigated were cross-classified to generate new insights into the organisation of the data.

## **Results**

### **Overall sample description**

Of 101 women included in the present analysis (Table 1), 27 (26.7%) reported that sex work was their main activity. No participants declared sex work as a secondary activity. With respect to FSW ( $n = 27$ ), 44.4% were unmarried, 44.4 % had no schooling and 55.6% came from countries outside Mali. FSW were younger than female non-sex workers (average age 23.3 years versus 25.6 years;  $p = 0.085$ ). Although two-thirds of the FSW had a weekly income above or equal to the median (66.7%), three out of five worked fewer than 56 hours a week (59.3%). A third of FSW had a secondary activity and 70.4% reported having a good health status.

### **Factors associated with sex work**

M-E from the multivariate analysis showed (Table 2) that the probability of sex work as a main activity decreased by 1% per 1-year age increase ( $p = 0.020$ ). FSW were significantly more likely to be single, divorced or widowed, with a probability of 25.4% ( $p = 0.007$ ) compared with female non-sex workers. FSW were also significantly more likely to be non-Malian (36.3% probability;  $p = 0.003$ ), to have a secondary activity (77% probability;  $p = 0.002$ ), to work fewer than 56h/week (40.2% probability;  $p = 0.001$ ) and to have a good health status (12.1% probability;  $p = 0.016$ ). In addition, awareness of the existence of STI, a higher consumption of alcohol and/or drugs, and unprotected receptive anal sex during the previous six months, were all significantly more associated with sex work (50.2% probability;  $p = 0.006$ ), 45.6% ( $p = 0.003$ ) and 7.4% ( $p = 0.016$ ), respectively.

**Table 1:** Comparative analysis of the sample characteristics of participants living at the Kôkôyô informal gold mining site in Mali ( $N = 101$ )

Background characteristics	Female sex workers $n = 27$ (26.7 %) $n$ (%)	Female non-sex workers $n = 74$ (73.3 %) $n$ (%)	$p$ -value*
Age [mean $\pm$ standard deviation]	[23.3 $\pm$ 4.6]	[25.6 $\pm$ 8.0]	0.085
Educational level			
No schooling	12 (44.4 %)	46 (62.2 %)	0.067
Koranic school	4 (14.8 %)	5 (6.8 %)	
Primary	5 (18.6 %)	18 (24.2 %)	
Secondary	6 (22.2 %)	5 (6.8 %)	
Marital status			
Married or living in a couple	15 (55.6 %)	57 (77.0 %)	<b>0.035</b>
Single, divorced, widowed	12 (44.4 %)	17 (23.0 %)	
Had a secondary activity			
No	18 (66.7 %)	66 (89.2 %)	<b>0.007</b>
Yes	9 (33.3 %)	8 (10.8 %)	
Number of hours worked per week at Kôkôyô			
More than or equal to 56 hours	11 (40.7 %)	51 (68.9 %)	<b>0.010</b>
Fewer than 56 hours	16 (59.3 %)	23 (31.1 %)	
Weekly income relative to the median			
Lower than the median (10 000 Fcfa)	9 (33.3 %)	36 (48.6 %)	0.171
Equal to or above the median (10 000 Fcfa)	18 (66.7 %)	38 (51.4 %)	
Nationality			
Malian	12 (44.4 %)	63 (85.1 %)	<b>&lt;0.001</b>
Other	15 (55.6 %)	11 (14.9 %)	
Main country of residence			
Mali	15 (55.6 %)	57 (77.0 %)	<b>0.035</b>
Other	12 (44.4 %)	17 (23.0 %)	
Length of time working at Kôkôyô relative to the median			
Above the median (6 months)	13 (48.2 %)	48 (64.9 %)	0.128
Lower or equal to the median (6 months)	14 (51.8 %)	26 (35.1 %)	
Self-perceived health status			
Poor health status	8 (29.6 %)	33 (44.6 %)	0.175
Good health status	19 (70.4 %)	41 (55.4 %)	
Awareness of existence of STI			
No	5 (18.5 %)	5 (6.8 %)	0.080
Yes	22 (81.5 %)	69 (93.2 %)	
HIV status			
Positive	1 (3.7 %)	10 (13.5 %)	0.161
Negative	26 (96.3 %)	64 (86.5 %)	
Smoking			
No	22 (81.5 %)	71 (95.9 %)	<b>0.017</b>
Yes	5 (18.5 %)	3 (4.1 %)	
Drugs and/or alcohol consumption			
No	15 (55.6 %)	68 (91.9 %)	<b>&lt;0.001</b>
Yes	12 (44.4 %)	6 (8.1 %)	
Number of male sexual partners in the previous 6 months			
None	0 (0.0 %)	4 (5.4 %)	<b>&lt;0.001</b>
1 partner	11 (40.7 %)	65 (87.8 %)	
More than 1 partner	16 (59.3 %)	5 (6.8 %)	
Condom use during vaginal intercourse in the previous 6 months			
No	19 (70.4 %)	46 (62.2 %)	0.424
Yes	8 (29.6 %)	24 (32.4 %)	
Not documented**	0 (0.0 %)	4 (5.4 %)	
Condom use during anal sex in the previous 6 months			
No	25 (92.6 %)	49 (66.2 %)	<b>0.028</b>
Yes	2 (7.4 %)	21 (28.4 %)	
Not documented**	0 (0.0 %)	4 (5.4 %)	
Condom use during oral sex in the previous 6 months			
No	23 (85.2 %)	47 (63.5 %)	<b>0.093</b>
Yes	4 (14.8 %)	23 (31.1 %)	
Not documented**	0 (0.0 %)	4 (5.4 %)	

\* $p$ -value calculated with  $\chi^2$  test or Fisher's exact test for qualitative variables, and Student's  $t$ -test for quantitative variables

\*\*Includes missing data, "does not know" and "no response" terms

### Main findings of the qualitative survey

Two professional status-specific focus groups were conducted by ARCAD-Sida members with 11 women as follows: five FSW and six female non-sex workers. Three common discourse types were identified in the analysis of all two focus group discussions about women's health issues: (a) risky sexual practices, (b) lack of health centres and lack of information and awareness programmes focussing on STI, in particular HIV, and (c) use of traditional medicine. With focus groups, discussion about sexual risk behaviours came up spontaneously, for example, the non-systematic condom use among FSW as follows: (1) boyfriends' refusal to use

condoms because of the nature of the relationship between them and FSW: trustful relationships being considered 'safer' than strictly 'riskier' commercial sex relationships, (2) agreeing, because of poverty, to have unprotected sexual intercourse with clients in return for more money. This was manifested in phrases such as 'lack of money' and 'look after my family', as well as in language about needing to support themselves for their own basic needs, including food, despite being aware of the risks of HIV and other STI; and (3) disliking the female condom because of the difficulties related to its use. In addition, comments related to condom use by FSW were also identified in the discussion

**Table 2:** Factors associated with sex work among female workers living at the Kôkôyô informal gold mining site in Mali ( $N = 101$ ): univariate and multivariate analyses

Associated factors	Univariate analysis <sup>a</sup>			Multivariate analysis <sup>b</sup>		
	ME(dF/dX) <sup>c</sup>	Coeff[95% IC] <sup>d</sup>	p-value <sup>e</sup>	ME(dF/dX) <sup>c</sup>	Coeff[95% IC] <sup>d</sup>	p-value <sup>e</sup>
Age	-0.010	-0.030[-0.1; 0.0]	0.155	-0.010	-0.136[-0.3; -0.0]	<b>0.020</b>
Marital status						
Married or living in a couple	Ref			Ref		
Single, divorced, widower	0.205	0.594[0.0; 1.2]	<b>0.039</b>	0.254	1.679[0.5; 2.9]	<b>0.007</b>
Nationality						
Malian	Ref			Ref		
Other	0.417	1.188[0.6; 1.8]	<b>&lt;0.001</b>	0.363	2.019[0.7; 3.3]	<b>0.003</b>
Main country of residence						
Mali	Ref			Ref		
Other	0.205	0.594[0.0; 1.2]	<b>0.039</b>			
Had a secondary activity						
No	Ref			Ref		
Yes	0.315	0.865[0.2; 1.5]	<b>0.011</b>	0.771	3.126[1.1; 5.2]	<b>0.002</b>
Number of hours worked per week at Kôkôyô						
More than 56 hours	Ref			Ref		
Fewer than 56 hours	0.233	0.698[0.2; 1.2]	<b>0.011</b>	0.402	2.577[1.0; 4.2]	<b>0.001</b>
Self-perceived health status						
Poor health status	Ref			Ref		
Good health status	0.122	0.382[-0.2; 0.9]	0.173	0.121	1.642[0.3; 3.0]	<b>0.016</b>
Awareness of the existence of STI						
No	Ref			Ref		
Yes	0.258	0.701[-0.1; 1.5]	0.097	0.502	2.089[0.6; 3.6]	<b>0.006</b>
HIV status						
Positive	Ref					
Negative	0.253	0.779[-0.3; 1.9]	0.155			
Smoking						
No	Ref					
Yes	0.388	1.036[0.1; 2.0]	<b>0.029</b>			
Drugs and/or alcohol consumption						
No	Ref			Ref		
Yes	0.486	1.343[0.7; 2.0]	<b>&lt;0.001</b>	0.456	2.127[0.7; 3.5]	<b>0.003</b>
Number of male sexual partners in the previous 6 months						
1 partner	Ref					
More than 1 partner	0.624	1.804[1.1; 2.5]	<b>&lt;0.001</b>			
Condom use during anal sex in the previous 6 months						
Yes	Ref					
No	0.264	1.028[0.3; 1.8]	<b>0.008</b>	0.074	1.465[0.3; 2.7]	<b>0.016</b>
Condom use during oral sex in the previous 6 months						
Yes	Ref					
No	0.200	0.687[0.0; 1.3]	<b>0.035</b>			

<sup>a</sup>Univariate analysis using a logistic regression with probit model and marginal effect

<sup>b</sup>Multivariate analysis using a multivariate stepwise logistic regression with probit model and marginal effect.

<sup>c</sup>ME(dF/dX) = Marginal Effect is the change in the probability given the discrete change for dichotomous variables (dy/dx is for discrete change of dummy variable from 0 to 1)

<sup>d</sup>Coeff = Coefficient; IC = confidence interval

<sup>e</sup>p-value calculated with probit regression

among participants in other focus groups. More specifically, gold-diggers and *tombolomas* [traditional guards] indicated that, in their opinion, (1) FSW working in bars were more likely to use condoms than those working in the streets; (2) Nigerian FSW were stricter about condom use than Malian and Guinean FSW; (3) Malian FSW disliked condoms in general and saw it as an insult to even suggest using a condom; and (4) that Nigerian FSW did not work in the same bars as FSW from Mali and Guinea.

With regard to barriers to accessing health services, focus group participants indicated that health services were geographically distant, that there was a lack of medical equipment and of specialised care providers, and that medicine prices were high, all of which forced workers to travel long distances in case of serious illness or lack of money. FSW mentioned the presence of very few prevention interventions at the IASGM site as the main obstacle to access HIV prevention information. For example, in focus group discussions, they indicated that they were provided with condoms only by the NGO Soutoura, which plays a role in the marketing of condoms. Finally, FSW indicated that the high price of medicines was the main reason why they used traditional medicine against STI. Indeed, some indicated that a seller of this medicine came from the country's capital Bamako, providing treatments which they believed to be very effective against STI and which were cheaper than those provided by health service unit at the IASGM site. Moreover, they were easy to use, being simply placed in the vagina at bedtime followed by washing the next day in order to be cured.

## Discussion

Despite the several studies conducted to date on FSW in different urban areas, and the growing amount of literature exploring their risky behaviours, very few have focussed on FSW living in gold mining sites. To our knowledge, our study is the first to investigate FSW in an IASGM site in Mali. Our findings add to the literature by providing information regarding the socio-demographic and economic characteristics of this population, and show that 26.7% of the women participating in the ANRS-12339 Sanu Gundo cross-sectional survey were involved in sex work at the mine in Kokoyo. Although our study sample is not representative of the whole population in IASGM sites in Mali, the percentage of FSW in our study is in line with the national proportions highlighted by the most recent Integrated STI and Behaviour Surveillance National Survey among five key populations in Mali (22%) (CSLS/MS, 2010). Our results suggest that migration is a central feature of life in Kôkôyô, characterised by the fact that 25.7% of our study sample were non-Maliens. Migration also concerned FSW, as they were also significantly more likely to be non-Malian. With a highly mobile population attracted to Kôkôyô by economic opportunities related to gold, Kôkôyô may be considered a high-risk environment (Goldenberg, Duff & Krusi, 2015; Rees, Murray, Nelson & Sonnenberg, 2010). We found that most FSW arrive alone at IASGM sites (i.e. they are geographically single) and rarely bring stable partners to live with them. This finding is in line with the literature (Baltazar et al., 2015; Sagaon-Teyssier et al., 2017). More

specifically, we found that FSW were significantly more likely to be single, divorced or widowed. This group with high exposure to HIV infection might be considered a "bridging population" cohabiting with high-risk groups at the IASGM site at Kôkôyô, constituting a potential source for the spread of STI, particularly HIV, when they return to their home countries. We also found that younger participants were significantly more likely to be FSW (average age of 23.3 years versus 25.6 years for female non-sex workers). This result is in line with another study analysing the typology of groups at risk of HIV/STI in a gold mining town in Tanzania, which reported that FSW were characterised by young age (Desmond et al., 2005). Indeed, young FSW are particularly vulnerable to the risk of HIV because of their innocence, less sexual experience and their inability to negotiate condom use. This is exacerbated by a context of difficult access to information on safe sexual behaviours in commercial sex relationships, insecurity reinforced by the questioning of their presence in public spaces, and the absence of social norms (Luke, 2003). Condom use during vaginal intercourse was not statistically significant in our analyses. Our results highlight that FSW were significantly more likely to practice unprotected receptive anal sex (7.4 % probability;  $p = 0.016$ ) than female non-sex workers. This was supported by our qualitative findings from focus groups, confirming that accepting more money in exchange for condomless sex, because of poverty, and their stable partner's (i.e., boyfriend, sex work venue manager or bodyguard) refusal to use condoms, remain two key barriers to systematic condom use in FSW. This difficulty to negotiate condom use with their partner is most likely due to FSW desire to be in a stable relationship or even to get married. Condom use is also conditional on the place where sexual intercourse takes place, something also mentioned by participants in the female non-sex workers focus group. FSW working in bars were more likely to use condoms than those working in the streets. This could be explained by the lack of any regulatory framework in street work and therefore less control, making these FSW more vulnerable. In addition to unprotected sex, our study showed that FSW had a higher consumption of alcohol and drugs, increasing the risk of HIV acquisition and transmission and reducing their ability to negotiate protection measures (Wojcicki & Malala, 2001; Heravian et al., 2012). Our findings are consistent with other studies showing a decreased prevalence of condom use among FSW and an increased prevalence of psychoactive substance use (alcohol and drugs) before or during sex. ANRS-12339 Sanu Gundo is the first survey to estimate HIV prevalence in an IASGM site in Mali as part of an HIV prevention intervention feasibility project. Our results showed a HIV prevalence of 10.9% in our study sample of 101 women, which is much higher than the Malian national prevalence of 1.2% estimated in 2016 (UNAIDS, 2017), but is in line with the estimated 7% for the IASGM site of Tenkoto in the Kédougou region of Senegal (Sagaon-Teyssier et al., 2017). We found that HIV prevalence varied for the different categories studied, ranging from 3.7% for FSW to 13.5% for female non-sex workers. The latter value is similar to prior research in Burkina Faso which estimated 13% for female street vendors (i.e., female non-sex workers), although that value was not specific to IASGM sites (Secrétariat



Permanent du Conseil National de Lutte contre le sida et les IST, 2011). The high prevalence among female non-sex workers confirms results from the few qualitative studies performed to date on different mining populations in IASGM sites, which suggest a high prevalence of HIV, and highlight that 'less studied' groups are at higher risk (Desmond et al., 2005). Most of the efforts in the fight against HIV/AIDS in Mali are concentrated on FSW and men who have sex with other men, both identified as most vulnerable groups (EDSM, 2014; CSLS/MS, 2010). These arguments could explain, at least in part, the low HIV prevalence rate among FSW in Kôkôyô IASGM and the higher prevalence among female non-sex workers. This low rate may also be explained by our results which highlighted that participants aware of the existence of STI and those reporting good health status were more likely to practice sex work. The high prevalence rates found across our two studied groups may reflect the lack of prevention programmes adapted to populations living in gold mining sites in Mali. Our results also showed that sex work was more likely to be reported by those with a secondary activity, and those who worked fewer than 56 hours per week. This could be explained by the fact that FSW reported a higher weekly income obtained from sex work and other activities. As sex work is primarily practiced at night, FSW can engage in daytime work activities such as cooking, small-scale retailing and the supplying of sites with food and water. Moreover, employment in the IASGM sector is often under frequent short-term recurring contracts. Accordingly, one or more supplementary jobs are required. Our results suggest that sex work is lucrative and could encourage other women to start the activity. That is why it is important to study FSW particularly in IASGM sites. This situation of this sub-population in Mali is very characteristic of the conditions for female workers in the informal economy in most low-resource countries, underscored by the absence of legal and social protection, and of safety standards (Jul-Larsen et al., 2006; Keita, 2001; Kumah, 2006). Poverty pushes women living in both urban and rural areas to engage in sex work in IASGM, where they risk further marginalisation and poverty (Buxton, 2013; Yakovleva, 2007; Pinho, Sampaio, Monteiro, Murray & Bastos, 2016).

Some study limitations should be taken into account when interpreting our results. First, the study sample is not representative of the whole population in IASGM sites in Mali and may not be generalisable to the whole population of Kôkôyô. However, the percentage of FSW in our study (26.7%) reflects the national proportion of FSW found by the most recent Integrated STI and Behavior Surveillance survey among key populations in Mali (22%). Second, the ANRS-12339 Sanu Gundo survey was designed to test the feasibility of setting up community-based HIV prevention and screening activities in IASGM areas. It was not specifically designed to explore the issue of sex work. Therefore, our analysis lacked elements which could have provided further useful information, such as frequency of sex work, age at first episode of sex work, how long FSW had practiced sex work and information about potential clients. Despite this lack of information, the information collected from this feasibility survey allowed us to characterise this vulnerable group and identify factors associated with sex work. Third, social desirability bias was possible, given the

declarative nature of the data and the fact that respondents participated in face-to-face interviews. Accordingly, sexual risk behaviours may have been under reported. However, we implemented procedures upstream of these face-to-face interviews to minimise this bias. We preferred simple, short, neutral and unambiguous questions to make the collection of our data more comfortable. This is also the reason why we multiplied our interviews with different socio-professional categories of people to ensure as many different points of view as possible. This bias may also have been minimised by the fact that the trained investigators involved all had a wealth of field experience, worked close to the ground, and came from a recognised NGO. Finally, the cross-sectional design of the survey prevented us from analysing changes over time concerning trends in sex work and different types of sex workers (i.e., regular, occasional).

Despite these limitations, our results provide useful information for the optimisation of future prevention interventions. Systematic condom use among FSW at the IASGM site in Kôkôyô in Mali is still hampered by economic and relationship factors. Mass screening and access to care provided by mobile health teams, as well as interventions to increase condom use and reduce clandestine multi-partner sexual relations are priority actions to mitigate HIV transmission.

As part of implications for policy and practices, HIV prevention interventions at IASGM sites are an important component of larger efforts to reduce rates of new HIV infections in Mali. It is also critical to conduct a strategic environmental assessment for all new programmes, policies and plans in IASGM sites that needs to include HIV and gender as transversal problems for most government policies, plans and programmes. At these sites, sex work takes many forms and is an important source of income for many women. As a result, FSW are particularly vulnerable to the risk of HIV/AIDS and STI. Furthermore, they are not always able to negotiate using appropriate prevention tools, and accordingly relegate their own health concerns, in favour of financial needs and the needs of their families. Inconsistent condom use among FSW has important implications for policy, sexual practices, and the long-term health and well-being of these women and families. The specific factors contributing to these practices need further investigation. In this study, we present associated gaps and barriers in terms of prevention among FSW in IASGM sites, in order to inform future HIV prevention policy and programmes focussing on sex work in Mali. Integrated policymaking should pay special attention to infectious diseases among populations in IASGM sites. Bringing information and prevention activities closer to people working in gold-mining zones constitutes an urgent public health action.

## Conclusion

Our results contribute to the literature by providing characteristics related to sex work among women at the IASGM site of Kôkôyô. They suggest the importance of HIV prevention interventions for all female workers at IASGM sites, including those who do not officially declare themselves to be sex workers. Efforts to target FSW in

this specific context need to be maintained in order to develop more effective interventions at the individual level. Systematic condom use and new prevention measures (e.g. pre-exposure prophylaxis, treatment as prevention and post-exposure prophylaxis) need to be encouraged. Our work could pave the way for future in-depth studies exploring the key barriers to systematic condom use among FSW.

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## Note

1. Datasets and statistical codes generated and/or used during this study are available from the corresponding author on reasonable request.

## ORCID

Cheick Haïballa Kounta  <https://orcid.org/0000-0001-6800-0742>  
 Luis Sagaon-Teyssier  <https://orcid.org/0000-0001-7318-6596>  
 Nikos Kalampalikis  <https://orcid.org/0000-0002-5373-1355>  
 Marie Suzan-Monti  <https://orcid.org/0000-0003-2507-2863>  
 Bruno Spire  <https://orcid.org/0000-0001-7318-6596>

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