

HIV and Syphilis Infection among Gold and Diamond Miners – Guyana, 2004

N Seguy¹, M Denniston², W Hladik¹, M Edwards³, C Lafleur³, S Singh-Anthony³, T Diaz¹

ABSTRACT

Background: Guyana had an estimated HIV prevalence of 1.5% among pregnant women in 2006 (95% confidence interval [CI] = 1.1–1.9). However, a survey of miners in one mine found a 6.5% HIV prevalence in 2002. To determine whether Guyanese miners are at high risk for HIV infection we conducted a HIV and syphilis prevalence survey of miners in several mines.

Methods: Adult male consenting miners in 45 Guyanese mines were interviewed, counselled, tested for HIV and syphilis with rapid tests and provided onsite test results. The survey was cross-sectional and used a multi-stage cluster sampling design; population estimates were calculated using SUDAAN.

Results: Of 651 miners approached, 539 (83%) were interviewed and 509 (78%) tested. The estimated prevalence for HIV was 3.9% (CI = 2.1, 7.1) and for life-time syphilis exposure was 6.4% (CI = 4.5, 9.1). Fifty-four per cent (CI = 41.3, 66.7) of miners had casual sex during the preceding year, of whom 44.4% (CI = 34.3, 55.0) had always used condoms with these partners.

Conclusion: The estimated HIV prevalence among Guyanese miners was higher than that of the general population. Targeted interventions including condom promotion are recommended to prevent further spread of HIV and other sexually transmitted infections among miners.

La Infección por Sífilis o VIH entre los Mineros de oro y Diamante – Guyana, 2004

N Seguy, M Denniston, W Hladik, M Edwards, C Lafleur, S Singh-Anthony, T Diaz

RESUMEN

Antecedentes: Guyana tenía un estimado de prevalencia de VIH de 1.5% entre las mujeres embarazadas en 2006 (95% intervalo de confianza [CI] = 1.1–1.9). Sin embargo, una encuesta realizada a mineros en una mina, reveló una prevalencia de un 6.5% de VIH en 2002. Para determinar si los mineros guyaneses se hallan en un alto riesgo de infección por VIH, llevamos a cabo un estudio de la prevalencia de sífilis y VIH entre los mineros en varias minas.

Métodos: Mineros varones adultos en 45 minas guyanesas, fueron entrevistados previo consentimiento, recibieron aconsejamiento (counselling), y fueron sometidos a pruebas de detección de VIH y sífilis mediante tests rápidos que proveyeron resultados en el sitio. La encuesta fue transversal y usó un diseño de muestreo por conglomerados en etapas múltiples. Los estimados de la población fueron calculados usando SUDAAN.

Resultados: De 651 mineros abordados, 539 (83%) fueron entrevistados y a 509 (78%) se les aplicó la prueba. El estimado de la prevalencia de VIH fue 3.9% (CI = 2.1, 7.1) y la de la exposición a la sífilis de por vida fue 6.4% (CI = 4.5, 9.1). Cincuenta y cuatro por ciento (CI = 41.3, 66.7) de los mineros tuvieron sexo casual el año anterior, de los cuales 44.4% (CI = 34.3, 55.0) había usado siempre condones con sus parejas.

Conclusión: La prevalencia estimada de VIH entre los mineros guyaneses fue más alta que la de la población general. Se recomiendan intervenciones, incluyendo la promoción de condones, dirigidas a prevenir la ulterior difusión del VIH y otras enfermedades de transmisión sexual entre los mineros.

West Indian Med J 2008; 57 (5): 444

From: ¹Global AIDS Program/National Center for HIV, STD and TB Prevention, Centers for Disease Control and Prevention, Atlanta, Georgia, ²Statistics and Data Management Branch/Division of HIV/AIDS Prevention, Surveillance and Epidemiology, National Center for HIV, STD, and TB Prevention, Centers for Disease Control and Prevention, Atlanta, Georgia, ³Ministry of Health, Guyana.

Correspondence: Dr T Diaz, Global AIDS Program, CDC, 1600 Clifton Road NE, MS E-30, Atlanta, GA 30333, USA. Fax: +1 (404) 639 8114; E-mail: txdl@cdc.gov

INTRODUCTION

Guyana (2003 population: 700 000) had a HIV prevalence of 1.5% (95% confidence interval (CI) = 1.1, 1.9) among pregnant women in 2006 (1). The gold and diamond mining industry employs thousands of men in hundreds of mines in remote interior regions. After a survey of miners conducted at a single mine in 2000 revealed a HIV prevalence of 6.5% [CI = 3.6, 10.6] (2), other miners were suspected of being at high risk for HIV infection.

The population of miners is often mobile. Mines that are no longer cost-effective are closed and operations moved to new locations within short periods of time. Mines located within the same area are supported by a common logistical base called a "landing", often consisting of a river landing site or an airstrip with industries servicing the miners.

In mining areas, the concentration of men with relatively high incomes attracts female sex-workers (FSWs). Some of them are from Guyana's coastland, including Georgetown, where a HIV seroprevalence of 44% was detected in 1997 among FSWs (3). Commercial sex-work is present at most landings. It has been recognized that miners also develop sexual relationships with local women from the surrounding mining communities. The sexual networks of miners, FSWs and local women may create ideal conditions for the spread of HIV and other sexually transmitted infections in these otherwise remote areas.

There is no specific intervention for HIV/AIDS targeting miners and health services are limited in mining areas. Government health centres based at landings offer sexually transmitted disease (STD) services but do not usually provide voluntary counselling and testing (VCT) for HIV. Mines are often located far away from the landings, limiting miners' access to health services.

The objectives of this survey were to estimate the HIV and syphilis prevalence in Guyanese miners, to identify the determinants of HIV and syphilis infection and to provide the necessary data for the planning of prevention services for these hard-to-reach communities.

SUBJECTS AND METHODS

From August 2004 to December 2004, a cross-sectional survey was conducted among miners from 45 selected Guyanese mines at 16 landings in the three regions with mining activity at the time of the survey (Fig. 1). A two-stage cluster sampling design was used, in which clusters at the first stage of sampling were landings and clusters at the second stage of sampling were mines. Simple random sampling was used to select landings within each active mining region. At each selected landing, a list of currently active mines linked to the landing was compiled and systematic sampling was used to select approximately one-third of the mines linked to each selected landing. Inaccessible mines (mines located at > 2 hours walk or > 3 hours motorized transportation from a landing) were replaced in the sample by the next eligible mine on the list of mines within the same landing. Mines (n



▲ visited villages

Fig. 1: Regions with mining activity, Guyana, August–December 2004.

= 18) with Brazilian workers were excluded due to the lack of Portuguese-speaking interviewers. At selected mines, all available miners aged 15 years or older were offered survey participation that included a standardized questionnaire and HIV and syphilis rapid testing with pre- and post-test counselling and provision of test results onsite. For treponemal syphilis testing, the Determine Syphilis TP[®] test (Abbott, IL, USA) was used. For HIV, two rapid tests were used: Determine[®] HIV-1/2 test (Abbott, IL, USA) and UniGold[®] HIV-1/2 (Trinity Biotech, Dublin, Ireland). If these two tests yielded discordant results, StatPak[®] HIV-1/2 (Chembio, NY, USA) was used to determine the final HIV test result. Syphilis treatment was provided onsite for miners with positive syphilis test results. HIV-positive miners were referred for follow-up to health facilities providing care and treatment services.

The survey was approved by the Caribbean Epidemiology Centre (CAREC) ethics committee and was reviewed by CDC and determined to be non-research.

All data were double-entered in Epi Info 2002 and analyzed in SUDAAN to account for the complex sampling design. The overall survey response rate was calculated as the product of the landing response rate (number of landings visited/ number of landings selected), the mine response rate (number of participating mines/ number of eligible mines selected) and the miner response rate (number of participating miners/number of eligible miners present). The miners' cooperation rate was calculated as the number of miners participating in the survey over the total number of miners offered survey participation. Estimates were weighted based on the overall probability of each miner being selected. This probability is the product of the proba-

bility of selection of the mine in which a miner was surveyed and the probability of selection of the landing to which that mine was linked. The weight for each miner is the inverse of his overall probability of selection and, after adjustment for non-response, is the number of miners that he represents in the total population of miners during the time of the survey. All findings presented here are weighted population estimates with 95% CI. Odds ratios (OR) and 95% CI were calculated to determine associations between demographic and behavioural characteristics and HIV infection. Factors with a crude OR > 2.0 in the univariate analysis were entered into a multivariate logistic regression model, after assessing for collinearity.

RESULTS

Survey participation

Of the 22 selected landings, 16 (73%) were visited whereas 6 (27%) were inaccessible (Fig. 2). The 16 visited landings

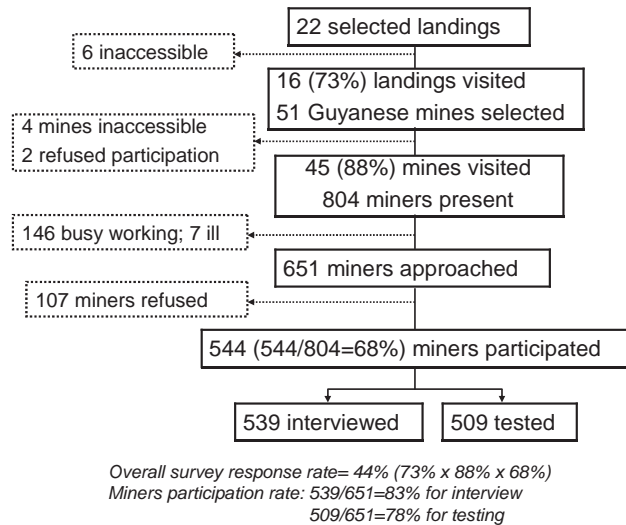


Fig. 2: Miners survey participation, Guyana, 2004

served a total of 151 mines with Guyanese miners; 51 mines were selected for inclusion in the survey. Forty-five (88%) of the selected mines participated; four were inaccessible and at two mines, chiefs refused participation. Of the 804 miners present at the participating mines during the survey, 146 were working at sites where they could not be reached and seven were ill, thus they were not approached and were recorded as non-respondents. Of the 651 miners who were offered survey participation, 544 (68% of all miners present) consented to survey participation; 539 to the interview and 509 to HIV and syphilis testing (504 were both tested and interviewed). The overall survey response rate, with inaccessible landings and mines counted as non-respondents, was 44% (73% x 88% x 68%). The cooperation rate among the 651 miners who were offered survey participation was 83% (539/651) for interview and 78% (509/651) for testing. This sample

represented an estimated 5618 (CI = 3271, 7964) Guyanese miners present at mines during the survey.

Miners' characteristics

Demographics

The estimated median age of miners was 30.9 years (CI = 28.6, 33.3; range: 15–85 years). About one-third of miners were Afro-Guyanese, (31.5%, CI = 24.7, 39.3), 25.5% (CI = 17.9, 34.9) were Amerindian, 8.5% (CI = 5.7, 12.3) Indo-Guyanese and 32.3% (CI = 27.7, 37.3) of mixed ethnicity. Less than half (46.5%; CI = 35.9, 57.3) were married or in common-law relationships. Nearly half (49.4%; CI = 37.1, 61.8) were migrant workers, 42.8% (CI = 31.0, 55.4) were permanent residents (born in the mining area) and 6.6% (CI = 4.0, 10.6) were new residents (living in the mining area for more than one year). The majority (70.1%; CI = 63.3, 76.0) had been employed in mining for at least five years.

HIV and syphilis prevalence

The estimated HIV prevalence was 3.9% (CI = 2.1, 7.1). The estimated proportion of miners with a positive treponemal syphilis test which reflects the prevalence of life-time history of syphilis, whether treated or not, was 6.4% (CI = 4.5, 9.1).

Knowledge and attitude about HIV/AIDS

Most miners (77.7%, CI = 74.0, 81.0) knew that they could protect themselves from HIV/AIDS by using condoms and 88.5% (CI = 84.5, 91.5) knew that they could protect themselves by being faithful. Also, 89.4% (CI = 83.2, 93.5) of miners knew that a healthy looking person could be infected with HIV. More than half (53.4%, CI = 45.0, 61.7) would not continue buying food from a shopkeeper if they knew he/she was infected with HIV.

Sexual behaviour

During the preceding year, 89.0% (CI = 81.2, 93.8) of miners had been sexually active; of these, almost half (49.7%, CI = 43.1, 56.3) had been monogamous. During the preceding year, 54.3% (CI = 41.3, 66.7) had casual sex partners. Of those who had casual sex, 44.4% (CI = 34.3, 55.0) had always used condoms with these partners. The two main reasons for not using a condom with the last casual partner were that the miner thought that it was not necessary or that condoms were not available at that time. However, with the small number of eligible respondents our estimates are very imprecise and percentages are therefore not shown for reasons why condom were not used. During the same period, 14.8% (CI = 10.7, 20.0) of miners had commercial sex-partners and 62.9% (CI = 50.4, 73.9) had always used condoms with these partners. Because of the small number of eligible respondents, results were too imprecise to identify the reasons for not using condoms with commercial sex-workers. Only 5.5% (CI = 3.4, 8.7) of miners had ever had sex with men. Of these, only 24.9% (CI = 5.7, 64.6) had used

a condom the last time they had sex with a man. This last estimate however was based on the responses of only 16 of the 25 miners who indicated that they ever had sex with a man. Seventy-four per cent (CI = 67.9, 79.3) of miners knew where to obtain male condoms in the area. Among those, 59.2% (CI = 53.4, 64.8) had obtained condoms at the local shop, 22.5% (CI = 18.5, 26.9) at the local health facility and 11.7% (CI = 7.2, 18.5) got them from a friend.

Substance abuse

Most miners (92.4%; CI = 88.3, 95.1) had 'ever drunk' alcohol, 49.6% (CI = 44.8, 54.4) had 'ever used' Marijuana and 8.3% (CI = 5.2, 13.1) had 'ever used' cocaine; none of the respondents reported having injected drugs during the past 12 months.

Health-seeking behaviour

An estimated 26.5% (CI = 21.2, 32.7) of miners have previously been tested for HIV. Of those, 43.1% (CI = 33.3, 53.5) were tested at the regional public hospital, 38.0% (CI =

27.3, 50.1) at a private laboratory and 5.8% (CI = 2.2, 14.2) at a local health center. Nearly half (46.3%; CI = 34.8, 58.2) of miners would prefer voluntary counselling and testing (VCT) services to be available through mobile VCT services visiting mines and 23.8% (CI = 14.9–35.8) would prefer VCT services at the local health centre. Thirteen per cent (13.3%, CI = 9.1, 19.1) of miners had STD symptoms (ulcer or discharge) during the preceding year, and less than half (36.2%, CI = 19.0, 57.8) of those with symptoms had received treatment. Of those treated, 61.3% (CI = 37.6, 80.7) were treated by a health worker; 6.4% (CI = 1.4, 24.3) sought medications at a local shop; and 10.3% (CI = 2.8, 31.5) treated themselves with home remedies.

Determinants of HIV infection

In univariate analysis (Table 1), factors significantly associated with HIV infection were: (1) being Afro-Guyanese (OR = 6.3, CI = 1.2, 33.2); (2) not having used a condom with the last casual partner (OR = 4.3, CI = 1.5, 12.1); and (3) having a positive Determine syphilis test (OR = 6.5, CI = 1.8,

Table 1: Factors associated with HIV infection among miners, Guyana, 2004

Stratum		Total number in stratum	Number with HIV positive result	Estimated % ² with HIV positive result ³ and 95% CI	Univariate analysis Crude OR and 95% CI	Multivariate analysis ¹ Adjusted OR and 95% CI
Characteristics						
Age (years)	< 30	210	3	2.0 (0.9 – 4.6)	Ref	
	≥ 30	289	17	5.5 (2.5 – 11.4)	2.9 (0.8 – 10.1)	NA ⁴
Ethnic group	Afro Guyanese	162	11	8.1 (3.4 – 18.1)	6.3 (1.2 – 33.2)	NA
	Amerindian	111	5	3.5 (1.6 – 7.4)	2.6 (0.6 – 11.0)	
	Other	230	4	1.4 (0.4 – 4.5)	Ref	
Marital status	Married/Common law	254	11	5.3 (2.2 – 12.3)	2.1 (0.6 – 7.1)	NS ⁵
	Others	249	8	2.6 (1.3 – 5.3)	Ref	
Type of worker	Permanent resident	250	11	5.6 (2.3 – 13.2)	3.2 (0.8 – 12.5)	NS
	Other	252	8	1.8 (0.6 – 5.2)	Ref	
Condom with last casual sex partner	Yes ⁶	466	16	2.8 (1.5 – 5.3)	Ref	Ref
	No	43	4	11.0 (3.9 – 27.3)	4.3 (1.5 – 12.1)	4.0 (1.5 – 10.9)
Determine Syphilis status ⁷	Negative	478	16	3.0 (1.6 – 5.4)	Ref	Ref
	Positive	30	4	16.8 (5.2 – 42.4)	6.5 (1.8 – 23.0)	6.1 (1.8 – 20.8)
Cocaine use	Yes	38	4	10.3 (2.8 – 30.8)	3.3 (0.9 – 12.6)	NS
	No	466	16	3.3 (1.8 – 5.9)	Ref	

¹ Variables found to be collinear were ethnicity and syphilis status; and age and marital status. Age and ethnicity were not included in the logistic regression models

² Estimated proportion with HIV positive test or crude odds ratio (OR) for the population of miners represented by the sample.

³ Estimated overall HIV prevalence was 3.9% (CI = 2.1, 7.1).

⁴ NA = no applicable; not included in the logistic regression models.

⁵ NS = no statistically significant association in initial logistic regression model, therefore not included in the final model.

⁶ Yes response includes miners who did not have casual partners.

⁷ Overall life-time syphilis exposure was 6.4% (CI = 4.5–9.1).

23.0). These three factors and all others with a crude OR of 2.0 or higher (age, marital status, type of worker and cocaine use) were considered for inclusion in a multivariate logistic regression model and were assessed for collinearity. Variables found to be collinear were ethnicity and syphilis status; and age and marital status, therefore, age and ethnicity were not included in the logistic regression modelling. In the final multivariate model, only having a positive syphilis test (adjusted OR = 6.1, CI = 1.8, 20.8) and not having used a condom with last casual sex partner (adjusted OR = 4.0, CI = 1.5, 10.9) remained significantly associated with HIV infection.

DISCUSSION

The estimated HIV prevalence in Guyanese miners was 3.9% (CI = 2.1, 7.1), higher than the 2006 HIV prevalence of 1.5% (CI = 1.1, 1.9) among pregnant women at antenatal clinics. Our survey was conducted in 45 mines and was designed to be representative of the miners in Guyana. It should therefore provide a more reliable estimate of the HIV prevalence in the miner population than the one from the previous survey (2) that was only conducted in a single mine.

Knowledge of HIV/AIDS transmission was relatively good. Most miners knew that they could protect themselves from HIV/AIDS by being faithful and by using condoms. On the other hand, high-risk behaviour was taking place in mining areas. The proportion of miners having had commercial sex-partners in the past year was relatively low (14.8%) and the level of consistent condom use with these partners was relatively high (62.9%). However, more than half had engaged in casual sex in the past year and less than half (44.4%) had always used condoms with casual partners. This study also found a high rate of syphilis infection among miners which suggests that these miners were practising high-risk sexual behaviours. Although being Afro-Guyanese was found to be associated with HIV infection in the univariate analysis, ethnicity was collinear with syphilis infection, a factor that is well known in the literature to be associated with HIV infection (4, 5) and thus being Afro-Guyanese was not included in the multivariate analysis. The final multivariate model showed that only syphilis infection and lack of condom use with casual sex partners were independently associated with HIV infection.

Although miners are a hard-to-reach population, non-probability sampling methods such as venue-based sampling, snowball sampling or respondent driven sampling (6) would not have been appropriate for this group. Recruiting miners from venues (*eg* bars in landings) could introduce biases due to selection of higher-risk miners who frequent sex-workers often associated with bars. Using survey methods that rely on recruitment by participants (*eg* snowball sampling or respondent driven sampling) would not be possible as groups of miners are relatively isolated. This survey used a cluster sampling method that was designed to be representative of the mines in Guyana. However, in the field, there were difficulties reaching all mines sampled because of inaccessi-

bility. This method was the most appropriate given the previously stated limitations of alternative methods.

During the survey, nearly 80% of miners approached accepted HIV and syphilis testing. The high testing uptake supports the use of onsite rapid HIV testing with a diagnostic algorithm and provision of test results to individuals (7) as a feasible surveillance strategy, even though it requires additional resources. Moreover, for hard-to-reach and underserved populations, such surveys provide an opportunity for HIV testing and counselling that otherwise may be unavailable.

The survey had several limitations. Analysis using SUDAAN accounted for the differing sampling probabilities of miners and for clustering in the sampling design, allowing for valid population estimates. However, the survey results are only representative of Guyanese miners. Brazilian miners, who are present in large numbers in Guyana, could not be included due to language barriers. The overall survey response rate of 44%, which might have introduced a bias in the HIV prevalence estimate, was mostly due to inaccessibility of some landings and mines and the unavailability of some miners, rather than to refusal to participate. We believe that the most hard to reach and therefore missed miners due to mine inaccessibility do not have a higher risk of being HIV-infected because their access to sex-workers and casual sex is also more difficult.

Finally, 22% of miners approached refused HIV testing. The most often reported reasons for refusing testing were "fear of blood draw" or "fear of test results." This might have led to an under-estimation of HIV prevalence if miners who rejected testing for fear they would have a positive HIV test result were actually more likely to be HIV positive. Finally, the precision of some estimates, as measured by the width of 95% confidence intervals, was not adequate. Imprecise estimates were obtained mainly for small sub-populations of miners such as those who had a commercial sex-partner during the past year or those who had sex with men. Similarly, the precision of the Odds ratio for HIV infection and syphilis status was poor because only 30 miners had a positive Syphilis Determine test and only 20 had a positive HIV test.

In conclusion, the estimated HIV prevalence in the Guyanese miner population was higher than that in the general population and high-risk behaviours were taking place in mining areas that could result in increased HIV transmission. Of particular concern were the lack of condom use with casual sex-partners and the high rate of syphilis infection. Targeted public health interventions are recommended to prevent further spread of HIV and other STDs among miners and local communities. This may include health education, condom promotion, improved access to STD treatment and VCT services at landings' health centres, periodically supplemented with mobile services when local health staff visit mines for other health issues such as malaria.

REFERENCES

1. Ministry of Health. Guyana antenatal care (ANC) HIV seroprevalence survey 2006. Guyana; 2006.
2. Palmer CJ, Validum L, Loeffke B, Nicholson D. HIV prevalence in a gold mining camp in the Amazon region, Guyana. *Emerg Infect Dis* 2002; **8**: 330–1.
3. Carter KH, Harry BP, Jeune M, Nicholson D. HIV risk perception, risk behavior, and seroprevalence among female commercial sex workers in Georgetown, Guyana. *Rev Panam Salud Publica* 1997; **1**: 451–9.
4. Stamm WE, Handsfield HH, Rompalo AM, Ashley RL, Roberts PL, Corey L. The association between genital ulcer disease and acquisition of HIV infection in homosexual men. *JAMA* 1988; **260**: 1429–33.
5. Greenblatt RM, Lukehart SA, Plummer FA, Quinn TC, Critchlow CW, Ashley RL et al. Genital ulceration as a risk factor for human immunodeficiency virus infection. *AIDS* 1988; **2**: 47–50.
6. Magnani R, Sabin K, Saidel T, Heckathorn D. Review of sampling hard-to-reach and hidden populations for HIV surveillance. *AIDS* 2005; **19 Suppl 2**: S67–72.
7. Respass RA, Rayfield MA, Dondero TJ. Laboratory testing and rapid HIV assays: applications for HIV surveillance in hard-to-reach populations. *AIDS* 2001; **15 Suppl 3**: S49–59.