Migration, ethnicity and environment: HIV risk factors for women on the sugar cane plantations of the Dominican Republic

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Objective: To determine risk factors for HIV infection among women living in the sugar cane plantation communities (bateyes) of a large private sugar cane company in the Dominican Republic.

Design: Cross-sectional study of sexually active female volunteers living in the bateyes.

Methods: Of 98 bateyes, 23 were randomly selected and visited by a mobile medical unit, to interview, examine and test volunteers for seroreactivity to HIV and syphilis.

Results: The 490 subjects ranged in age from 16 to 72 years (median, 37 years); 53% were born in Haiti, 36% in Dominican Republic bateyes, and 12% elsewhere in the Dominican Republic; 58% had no formal education; and 87% had no income. HIV seropositivity was found in 28 women (5.7%), including 8.8% of those aged < 35 years. By logistic regression analysis, HIV infection was independently associated with age < 35 years [odds ratio (OR), 4.5; $P < 0.01$), being single with children (OR, 4.3; $P < 0.01$), more than one lifetime sex partners (OR, 3.4; $P = 0.06$), engaging in sex during menses (OR, 3.2; $P = 0.02$), and self-description as a prostitute (OR, 4.4; $P = 0.05$)]. For Haitian women, those coming to the Dominican Republic alone were more likely to have HIV infection than those coming with a male partner. Less than 4% of women reported condom use at last intercourse.

Conclusions: Women in the bateyes have a much higher rate of HIV infection than that estimated for women in the general population of Dominican Republic and a rate comparable to that of female sex workers in the Dominican Republic. AIDS prevention in the bateyes should address condom education and distribution as well as employment opportunities and education for women.

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Introduction

Migration represents one of many social factors contributing to the global AIDS pandemic [1]. International truck drivers and the commercial sex workers (CSW) who service them have been a source of HIV dissemination in East Africa [2,3]. In Europe, HIV-2 is most common in Portugal and France, former colonizers of the western African countries where HIV-2 has highest prevalence [1]. Internal seasonal migration is a risk for HIV infection among rural Senegalese workers [4,5], Ugandan workers [6], and South African miners [7,8]. Although tourism, war and commercial travel have all played a substantial role in the dissemination of HIV, the migration of the young, rural poor, both on a seasonal and long-term basis, has probably been of greater importance in developing countries [1]. Several studies in Africa have linked seasonal migration to increased HIV seroprevalence [4–8], citing the social disruption caused by the migration of young men without their partners, skewed sex ratios, and the exchange of sex for subsistence goods by impoverished women as the keys to this link.

Since the mid-1980s, residents of plantation-based communities for sugar cane workers ('bateyes') have had the highest rates of HIV infection in the Dominican Republic, comparable to rates among CSW, men who have sex with men (MSM), and prisoners [9]. These high rates in bateyes have been widely attributed to the large number of Haitian immigrants who have historically resided in the bateyes. The Dominican Republic occupies the eastern two-thirds and Haiti the western one-third of the island of Hispanola. Haiti lags behind the Dominican Republic in nearly every social and economic index (Table 1). The income gap between the two countries has long encouraged mainly young Haitian men from poor rural families to cross the border in search of income opportunities in the Dominican Republic [10]. The two countries are culturally distinct: the Creole-speaking Haitians are proud of their African heritage, while the Spanish-speaking Dominicans emphasize their Hispanic ancestry [11]. Since the early 1900s, sugar plantations in the Dominican Republic have recruited Haitian men as seasonal sugar cane workers, employment regarded as too arduous and poorly paid for the more prosperous Dominicans [12–15].

Over the decades, bateyes have become communities of year-round workers and their families, accommodating a surge in the adult male population of 20–40% during the 5–6-month harvest when approximately 30 000 young Haitian men cross the border to cut cane. Women, with fewer economic opportunities, account for less than 10% of migrants. Whereas most cane workers return to Haiti after the harvest, and many return in subsequent years, a substantial minority remain longer in the Dominican Republic, perhaps for a lifetime. Because many of both sexes remain in the Dominican Republic, batey residents include permanent and seasonal Haitians, along with Dominicans of Haitian descent, persons of mixed Dominican-Haitian ancestry, and poor Dominicans.

Table 1. Socioeconomic comparisons between Haiti and the Dominican Republic.

	Haiti	Dominican Republic
Population	6500000	7800000
Population density per square mile	607	418
Percentage urban	31	60
Racial mix (%)		
Black	95	11
White		16
Mixed		73
Per capita gross domestic product (US$)	340	1120
Telephones per capita	1 per 126	1 per 14
Life expectancy (years)		
Men	43	66
Women	47	71
Physicians per capita	1 per 6083	1 per 934
Infant mortality per 1000	109	52
Literacy (%)	53	83

Source: World Almanac and Book of Facts (New Jersey: Funk and Wagnall's; 1995).

As the poorest country in the northern hemisphere, Haiti also bears a stigma as the country hit earliest and hardest by the HIV epidemic. Careful epidemiologic investigations by Johnson and Pape [16] indicated that the first probable case of AIDS in Haiti occurred in 1978. The first Dominican case was not noted until 1983 [17]. In both countries, most cases initially occurred among men, and MSM probably contributed significantly to the initiation of the epidemic (42.7% of initial AIDS cases in the Dominican Republic versus > 25% in Haiti) [16,17], but the epidemics have subsequently been fuelled by heterosexual transmission. However, HIV seroprevalence rates have been up to 10-fold higher in Haiti than in the Dominican Republic, affecting up to 10% of periurban slum-dwelling women attending prenatal clinics near Port au Prince compared with 1.25% of lower socioeconomic status women in the Dominican Republic [18,19]. Rates among CSW in Port au Prince are nearly 50%, whereas prostitutes in Santo Domingo and Puerto Plata have estimated rates of infection of below 6% [16,20]. Table 2 compares reported HIV seroprevalence rates for these and other populations in both countries.

The higher prevalence of HIV infection in Haiti has led many in the Dominican Republic to view the HIV epidemic in the bateyes as a 'Haitian problem'. However, the highest HIV seroprevalences have been found in urban Haiti, whereas rates among rural adults

Table 2. Reported HIV seroprevalence rates in the Dominican Republic and Haiti.

First author [reference]	Group under study	Year	n	% Seropositive
Dominican Republic				
Capellan [20]	Bateyes, Santo Domingo (male and female)	1989	397	9.3
Gomez [19]	Dominican Republic prenatal screen	1992	1056	0.9
	Female sex workers	1992		3
Tabet [21]	Men having sex with men (Santo Domingo)	1994	365	11.0
Sanchez (unpublished)	Female sex workers	1995	300	5.6
Haiti				
Boulos [8]	Urban slum prenatal	1988	1151	10.3
Pape [22]	Healthy rural adults (male and female)	1990	300	2
	Female sex workers	1990	110	49
Pape [16]	Rural/urban Haitian (male and female)	1993		5/10
Behets [23]	Urban slum prenatal	1995	663	8.4

(the origin of virtually all cane workers and year-round batey residents) were only about 2–3% up until the late 1980s (Table 2), when rates of 10% and higher were being reported in the bateyes. The present study suggests that while some Haitians are undoubtedly already infected when they arrive in the Dominican Republic, the social disruption inherent in a migratory cycle fuelled by poverty, and the resulting strategies for economic survival, are also of primary importance in the transmission of HIV within the bateyes. This makes increased HIV awareness and preventive measures of the utmost importance.

Thus, bateyes represent a unique setting in which to evaluate the determinants of HIV infection. Because of the high rates of HIV seroprevalence previously reported in batey residents and workers, together with conflicting data on risk determinants, and a lack of detailed information on sexual behavior, this study examined the ecological determinants of HIV infection among female batey residents, particularly those related to patterns of migration and sexual behaviors. Because this study was performed in the bateyes during the 'off' season, this analysis includes only long-term and permanent migrants (i.e., non-seasonal), their descendants, and native Dominicans.

Materials and methods

Study population and study design

The company collaborating in this study encompasses 98 bateyes in the southeastern sugar belt, ranging in population from 21 to 1700 per batey, with a total population of about 35 000 during the harvest of 1995 (December 1994–May 1995) with approximately 7800 women over the age of 15 years. During the study, conducted in July–August 1995, it was estimated that there were 20–30% fewer adult men than were present during the harvest season. During the 1995 harvest, 38% of the population was aged below 15 years, and for those aged above 15 years the sex ratio was 1.7 : 1. Assuming a 20% decrease in men aged above 15 years, the sex ratio would have been about 1.4 : 1. The company provided a mobile medical unit equipped with an examining table, portable generator, and medications.

Of 98 bateyes, 23 were randomly selected for study. During a 6-week period the van went without advance notice to each selected batey accompanied by two physicians, two laboratory technicians and two interviewer/health promoters. Women who appeared for consultation were invited to participate in a study of women's health. Women aged at least 16 years, sexually active within the past year, not pregnant and not currently menstruating were eligible to participate. The study procedure was explained, and 99.3% women gave informed consent to participate in the study and undergo HIV testing. Typically, 20 women were examined daily on a first-come-first-served basis. Depending on population, bateyes were visited for up to three consecutive days.

Risk factors and clinical assessment

Each woman was interviewed using a structured questionnaire, delivered either in Spanish or Haitian-Creole, to obtain data on sociodemographic characteristics, medical and sexual history, partner characteristics and knowledge and attitudes about AIDS and sexually transmitted diseases (STD). Interviews were conducted by two Afro-Dominican women who were born, raised and residing in the bateyes; these women were fluent in Spanish and Creole, and were employed by the state public health sector as health promoters. The interviewers underwent 2 days of intensive training, after which the questionnaire was revised to better reflect the bateyes' popular vernacular. The questionnaire was

pretested in 20 women, revised, and then administered to each participant in a private setting.

Clinical evaluation

Each woman underwent examination of the external genitalia, speculum and bimanual examination, and microbiologic studies for genital infection. Observations were made on (i) quantity and characteristics of vaginal discharge, including pH (ColorpHast strips, Boehringer Mannheim, Indianapolis, Indiana, USA); (ii) appearance of endocervical discharge; (iii) cervical characteristics including bleeding induced by swabbing; and (iv) findings on bimanual examination. Cervical swabs were cultured for *Neisseria gonorrhoeae* and tested for *Chlamydia trachomatis* by enzyme immunoassay (EIA).

Fifteen milliliters of blood were obtained from each participant for serologic testing for syphilis and HIV infection. Trained laboratory technicians used a portable generator-supplied microscope to examine wet mounts of vaginal discharge for *Trichomonas vaginalis*, fungal hyphal forms, and clue cells. Amine-like odor was detected after adding a 10% KOH solution.

Laboratory methods

For isolation of *N. gonorrhoeae*, cervical specimens were inoculated onto modified Thayer–Martin medium (Baltimore Biological Laboratories; Becton Dickinson, Cockeysville, Maryland, USA) in the mobile unit, stored immediately in candle jars and kept at ambient temperature in the mobile unit (~30°C) until the unit returned from the field each day. In the laboratory, plates were incubated at 36°C and inspected at 24 and 48 h. Colonies suspicious for *N. gonorrhoeae* were replicated and sent by courier to the Institute for Dermatology and Sexually Transmitted Diseases in Santo Domingo for Gram's stain, oxidase testing, fermentation testing (ApiQuad Ferm, Analytab Products, Plainview, New York, USA) and susceptibility testing. Endocervical specimens for chlamydial antigen detection were stored in iced coolers in the field until transported to the laboratory at the end of the day for storage at 4°C. Micro Trak EIA (Syva, Behring Diagnostics, Inc., San Jose, California, USA) were run weekly according to manufacturer's instructions to detect chlamydial antigen.

Sera reactive in the Venereal Disease Research Laboratory (VDRL) slide test were titrated to endpoint reactivity, and confirmed by fluorescent treponemal antibody absorbed (FTA-Abs) test. Sera repeatedly reactive to HIV-1 enzyme-linked immunosorbent assay (ELISA; Pasteur Diagnostics, Marnes-la-Coquette, France) were confirmed HIV-positive by Western blot.

Women found to have a curable STD were given free treatment, and encouraged to send their partners for treatment. All women received colored, illustrated educational materials in Haitian-Creole/Spanish concerning HIV and STD risk reduction, free condoms and education on condom use. HIV test results were delivered to an independent HIV social service organization, which provided notification and counseling.

Data analysis

Data were entered into EpiInfo version 6.0 (Centers for Disease Control and Prevention, Atlanta, Georgia, USA), and analyzed using EpiInfo and SAS software (SAS Institute, Cary, North Carolina, USA). Records with missing data for specific variables were excluded for particular analyses, and therefore denominators varied. Risk factors for HIV infection identified by univariate analysis were analyzed by multiple logistic regression analysis.

Results

During the 6-week period, 513 women approached the mobile unit in 23 different bateyes, 509 agreed to participate, and 503 completed interviews and physical examinations from whom 490 (with completed questionnaires, physical examination and HIV serology) were included in analyses of HIV risk factors.

Characteristics of the study population

Mean age was 36.3 years, with 75% aged between 22 and 50 years (Table 3). Fifty-four per cent of the women were born in Haiti, 34% in the Dominican Republic bateyes, and 12% elsewhere in the Dominican Republic. Mean years of education was only 1.4 years, with 58% having received no formal education. Only 10.8% of women were considered single, with 74.4% being in consensual unions, 14.2% in legally recognized unions, and the remainder widowed or separated. Only 13.4% reported independent generation of income. Although the mean number of pregnancies per subject was five, only 20.8% had ever had a pelvic examination; 99 (20%) reported current contraception (43 tubal ligation, 37 oral contraception, four hormonal injections, and two each condom/intrauterine device use). Nearly 20% had a history of exchanging sex for money/goods, including 2.6% who defined themselves as prostitutes. Only 11% perceived themselves at any risk for having an STD, although 18.3% of the sample were VDRL- and FTA-Abs-positive and 35% had either a positive ELISA test for *C. trachomatis*, positive culture for *N. gonorrhoeae* from endocervical specimens, or motile *T. vaginalis* on microscopy. Only 3.2% reported condom use at last intercourse. When asked, 'Have you ever used a condom and it broke?', 89.2% answered that they had never used a condom; of the remainder, one said, 'yes' and the rest said, 'no'. Therefore, 10.8% at most had ever used a condom, since some women who answered 'no' had probably never used one.

Table 3. Demographic and behavioral characteristics and current evidence of sexually transmitted disease (STD) among 503 women interviewed.

Characteristics	
Mean (range) age (years)	36.3 (16–72)
Place of birth [n/total (%)]	
Haiti	271/502 (54.0)
Bateyes	173/502 (34.3)
Elsewhere in the Dominican Republic	59/503 (11.8)
Mean (SD) years of education	1.4 (2.0)
Single [n/total (%)]	54/500 (10.8)
Generating income [n/total (%)]	67/501 (13.4)
Head of own household [n/total (%)]	27/500 (5.4)
Ever had a gynecologic examination [n/total (%)]	104/500 (20.8)
Mean (SD) no. pregnancies	5.0 (3.3)
Mean (SD) age at first intercourse (years)	16.4 (3.1)
Condom use last intercourse [n/total (%)]	16/502 (3.2)
Exchanged sex for money [n/total (%)]	96/501 (19.2)
More than one sex partner in past month [n/total (%)]	37/500 (7.4)
Three or fewer lifetime sex partners [n/total (%)]	381/498 (76.5)
Self-perceived risk for STD [n/total (%)]	56/496 (11.3)
Positive for syphilis and treponemal antibody* [n/total (%)]	87/475 (18.3)
Positive for chlamydia, gonorrhea, or trichomonas* [n/total (%)]	175/499 (35.1)

*Syphilis by Venereal Disease Research Laboratory test, *Treponema pallidum* by fluorescent treponemal antibody absorbed test, and *Chlamydia trachomatis* by enzyme-linked immunosorbent assay, *Neisseria gonorrhoeae* by culture, or *Trichomonas vaginalis* by microscopy.

Factors associated with HIV infection

Of all women, 5.7% were HIV-seropositive, including 8.8% of those aged below 35 years, and 23% of 13 women who described themselves as prostitutes. HIV seropositivity was found in 7.4% of women born in Haiti, compared with 3.9% of those born in the Dominican Republic [odds ratio (OR), 2.0; $P = 0.08$]. Amongst the latter, HIV seropositivity was found in 4.6% of women born in bateyes, and 1.7% of those born elsewhere in the Dominican Republic.

Factors associated with HIV infection by univariate analysis ($P < 0.1$ or OR >2 or <0.5) included age below 35 years, coming to the Dominican Republic without a partner, being single with children, having more than one lifetime sex partner, engaging in sex during menses, and self-description as a prostitute (Table 4). Potential protective factors included being born in the Dominican Republic (excluding bateyes) and considering oneself Dominican. Compared with women who migrated from Haiti with a sex partner, those who migrated to the Dominican Republic without a partner were at increased risk for HIV infection. Factors found not to be associated with HIV infection included history of ever returning to Haiti, receiving a blood transfusion, history of genital ulcer disease, having a most recent partner who is Haitian, or who cuts cane or seasonally migrates, history of anal sex, legal versus consensual union, informal exchange of sex for money/goods, or having positive VDRL and FTA-Abs on serologic testing. Although 20% of women acknowledged experiencing religious trances, this was not associated with HIV infection.

Multiple logistic regression analysis, adjusting for factors identified as associated with HIV by univariate analysis, revealed significant independent associations of HIV seropositivity with age below 35 years, being single with children, coming to the Dominican Republic without a partner, engaging in sexual intercourse during menses, having more than one lifetime sexual partner, and self-description as a prostitute.

Although prostitution was a significant risk factor for HIV infection, only three (11%) HIV-infected women were self-described prostitutes. Three additional HIV-positive women gave a history of exchange of sex for money. Thirteen (46%) out of 28 infected women acknowledged only one or two lifetime sex partners.

Of women from Haiti, 55% came to the Dominican Republic with a partner and 45% without a partner, including women who either came alone or with a family member. Those coming without a partner were at significantly increased risk of HIV infection.

Characteristics of Haitian women with and without HIV infection

To assess why Haitian women who came to the Dominican Republic with a partner had lower rates of

Table 4. Univariate and multivariate analyses of risk factors associated with HIV infection.

Risk factor	Univariate [OR (95% CI)]	*P*	Multivariate* [OR (95% CI)]	*P*
Age < 35 years	3.1 (1.3–7.9)	0.01	4.5 (1.8–11.3)	0.001
Born in Dominican Republic	1.0	–	1.0	–
Came to Dominican Republic†				
With partner	1.0 (0.3–3.3)	0.9	1.7 (0.6–5.5)	0.3
Without partner	3.2 (1.4–3.5)	0.006	5.9 (2.2–15.9)	< 0.001
Single with children	3.0 (1.2–7.6)	0.02	4.3 (1.5–12.7)	0.007
Multiple lifetime sex partners	3.3 (1.0–17.4)	0.03	3.4 (1.0–12.0)	0.06
Sex with menses	2.5 (1.0–6.5)	0.04	3.2 (1.2–8.3)	0.02
Describe self as prostitute	5.3 (1.1–23.2)	0.04	4.4 (1.0–19.2)	0.05

*Multiple logistic regression, adjusting for the other factors. †Versus reference category of born in the Dominican Republic. OR, Odds ratio; CI, confidence interval.

Table 5. Demographic and behavioral characteristics and HIV seroprevalence for women born in Haiti who migrated to the Dominican Republic with or without a partner.

Characteristic	Born in Haiti, came with partner (n = 146)	Born in Haiti, came without partner (n = 116)	Came with versus without partner [OR (95% CI)]*	*P*
Mean ± SD age at arrival (years)	26.3 ± 8.9	19.8 ± 10.4	–	0.03
Exchanged sex for money [n/total (%)]	15/146 (10.3)	23/116 (19.8)	0.5 (0.2–1.0)	0.03
Describe self as prostitute [n/total (%)]	1/146 (0.7)	4/116 (3.5)	0.2 (0.0–1.6)	0.12
Mean lifetime no. partners	5	8		0.2
More than 10 lifetime partners [n/total (%)]	9/146 (6.1)	12/116 (10.3)	0.6 (0.2–1.4)	0.2
Mean residence in Dominican Republic (years)	11.8	18.7		< 0.001
HIV-positive [n/total (%)]				
All ages	6/142 (4.2)	13/114 (11.4)	0.3 (0.1–1.0)	0.03
< 35 years	3/54 (5.6)	11/40 (27.5)	0.2 (0.1–0.8)	< 0.01
≥ 35 years	3/88 (3.4)	2/74 (2.7)	1.2 (0.1–15.6)	0.6

*Odds ratios (OR) and 95% confidence intervals (CI) for association of the characteristic in Haitian women coming to the Dominican Republic with versus without a partner.

HIV infection than women who came without a partner, we further compared these two groups (Table 5). For those who arrived without a partner, the age at the arrival was significantly younger, a significantly higher percentage reported sex for money, the reported number of sex partners was somewhat higher, and the mean length of residence in the bateyes was longer. For Haitian women aged below 35 years, the mean duration of residence in the Dominican Republic was 14 years for those with and 8.8 years for those without HIV infection; amongst those aged below 35 years, the prevalence of HIV seropositivity was two (7.4%) out of 27 with 0–3 years in the bateyes, five (17%) out of 29 with 4–7 years, two (9%) out of 23 with 8–11 years, and four (40%) out of 10 with ≥ 12 years in the bateyes (age-adjusted $P = 0.05$). About half of the HIV-positive women migrating from Haiti without a partner came to the Dominican Republic in the same year they initiated sexual intercourse or before their first sexual experience. These data, taken together, are most consistent with acquisition of HIV infection by many Haitian women in the Dominican Republic, rather than in Haiti prior to migration.

Overall, Haitian women were significantly less likely than women born in the bateyes or other parts of the Dominican Republic to report exchanging sex for money/goods [OR, 0.5; 95% confidence interval (CI), 0.3–0.8; $P < 0.001$]. For women coming from Haiti with a partner, the mean lifetime number of sex partners was five, whereas the corresponding number was eight for those coming without a partner, and 10 for women born in the Dominican Republic ($P = 0.006$ comparing all Haitian women with women born in the Dominican Republic).

Characteristics of self-described prostitutes and women exchanging sex for goods

When asked, 'What kind of work do you do?', 13 women spontaneously described themselves as prostitutes. By univariate analysis, these women were significantly more likely than other women to consider themselves heads of their family (OR, 28.4; $P \leq 0.01$), and non-Catholic (OR, 4.0; $P = 0.03$), to have increased perceived risk of STD (OR, 5.3; $P = 0.01$), and a history of genital ulcer disease (OR, 5.2; $P = 0.02$) or knowledge of having had a positive blood test for syphilis (OR, 6.0; $P = 0.03$). They reported a median of 65 partners during their lifetime and 24 during the past year. For 22 other women who acknowledged exchanging sex for money/goods more than 10 times during the past year but not self-described as prostitutes, the prevalence of HIV infection was not increased. The median lifetime number of partners reported was 48 with a median of nine partners over the last year. For 83 women who reported having ever exchanged sex for money/goods at least once, the median lifetime number of partners reported was 15, with a median of one partner during the past year. Women who had exchanged sex for money/goods more than 10 times in the past year did not differ significantly from prostitutes in other characteristics except in more often considering themselves Catholics.

Factors associated with reported condom use

Only 16 (3.2%) women acknowledged condom use at last intercourse, including 8% of those reporting more than one partner in the last 3 months and 11% of single women. Factors significantly associated with condom use at last intercourse include age ≤ 35 years (OR, 3.1; 95% CI, 1.0–11.3; $P = 0.04$), single marital status (OR, 5.5; 95% CI, 1.7–17.5; $P = 0.01$), and self-description as a prostitute (OR, 6.2; 95% CI, 0.85–32.3; $P = 0.07$).

Variations among bateyes

The HIV seroprevalence ranged from 0 to 14% in the 23 bateyes studied. Although HIV prevalence, condom use and formal/informal exchange of sex varied considerably by batey, varying rates of HIV seroprevalence could not be ascribed to recorded differences between bateyes, such as size, the presence of bars or self-defined prostitutes on a given batey.

Discussion

The mean HIV seroprevalence of 5.7% in sexually active women in these bateyes was much higher than the overall rate amongst other women in published reports from the Dominican Republic, and roughly equal to that of CSW in the Dominican Republic. While the seropositive female population is heterogeneous, women most likely to be infected were those below 35 years of age, single with children, had engaged in sex during menses, had more than one lifetime sexual partner, or were self-described prostitutes. Amongst those migrating from Haiti, migrating without a partner, and for those aged below 35 years, duration of residence in the bateyes were risk factors for HIV infection.

In previous reports from the bateyes, Koening *et al.* [24] and Capellan *et al.* [20] found HIV seroprevalence rates of 3–14% and 9.3%, respectively, on bateyes in different areas of the country. Capellan *et al.* [20] also found that HIV infection among Haitians was associated with prolonged residence in the Dominican Republic, but reported that participation in voodoo-related trances with 'probable unconscious sexual intercourse and exchange of blood' was significantly associated with HIV infection, a finding not supported by our data, or by numerous studies carried out among Haitians in Haiti [16,18,25]. Unlike Capellan *et al.* [20], we found a significant increase of HIV infection among prostitutes.

Our study is the first to focus on the influence of migration history among women in the bateyes, and to document the particular risk of migrating without a partner. Such women were nearly six times more likely than other migrating Haitian women to have HIV infection. Although those migrating without a partner might have been more likely to have HIV infection before leaving Haiti, the evidence suggests otherwise. Nearly half of these women came to the Dominican Republic before 1978 or in the same year they initiated sexual activity, or prior to initiation of sexual activity, making infection in Haiti highly unlikely.

The influence of migrating without a partner is probably related to the dependence of single women in the bateyes on exchange of sex for money/goods for survival. Haitian women were also more likely than women born elsewhere in the Dominican Republic to have Haitian male partners; the seroprevalence of HIV in the bateyes has been found to be higher for Haitian men than for Dominican men, with the rate for men of mixed Dominican-Haitian ancestry being intermediate [20]. Women born in the bateyes were more likely than Haitian women to give a history of exchange of sex for money/goods, and were also more likely to identify themselves as prostitutes. It is possible that being a 'daughter of the batey' [15], born and raised in an environment where the exchange of sex for money is common, might predispose to such activity.

Haitian women, while poor, have been described as the most economically autonomous in the Caribbean, noted for their prominent roles in the marketplace [26]. Despite the relative wealth of the Dominican Republic in comparison to Haiti, women's autonomy is severely limited on the bateyes due to more stereotyped roles for women [15]. Because agricultural work is considered men's work in the Dominican Republic, women have few economic opportunities on the bateyes, which helps sustain the unequal sex ratio; they have been described as an 'economic burden for cane workers' [14,15]. In the 'off' season, we found only 13% of women acknowledging current income-generating activities, similar to the 15% found in 1986 [15]. Such activities are undoubtedly more common during the harvest season, when increased company wages put more money into circulation locally, making it possible for women to offer the cane cutters a variety of informal services, including preparing meals, doing laundry, and offering sexual services.

Recent field studies carried out in the bateyes by social scientists suggest that women play an important role in supplementing the meager wages men earn in the cane fields by pursuing a variety of petty commercial activities, and that at any given time most batey women are not engaged in sex work [13,27]. Yet these findings may be more representative of women firmly settled on the sugar estates than of those who have only recently arrived. When Haitian women first enter the sugar estates, many are in desperate poverty, cross the border without a husband, and at times cannot immediately establish contact with friends of family to aid them in settling and finding work. Single women arriving in the bateyes are not eligible to receive housing either as individuals or in groups. Newly arriving women without relatives or friends for access to housing 'almost always take up union with a cane worker immediately on arrival' [13]. However, most of these unions are short-lived and represent 'an interim survival strategy' [13].

Conversation with the respondents after the structured questionnaire disclosed a distinction between prostitution and the exchange of sex for money/goods in the bateyes. For example, one woman in her late thirties had been left alone since her last partner migrated elsewhere in the Dominican Republic; since she was single her survival strategy involved regularly exchanging sex for money/goods with three different men, yet this was not prostitution in her mind and she could imagine no other way for a single woman to survive in the bateyes. Another young women said she had exchanged sex for money on numerous occasions over the past year but

acknowledged only one sex partner. When questioned about this 'inconsistency' she responded that she receives money for sex only from her common-law husband. This illustrates the common occurrence of exchange of sex for money as the basis of some consensual unions in the bateyes. Only the professional who accepts cash for sex from any man as the principal source of income is considered a prostitute in the bateyes. These attitudes are in keeping with rural Haitian sexual mores reported by anthropologists [28]. The fact that more than 40% of women with a history of exchange of sex for money/goods had not done so in the past year suggests that the exchange of sex for money/goods is an interim survival strategy for many women.

As in epidemiologic studies carried out in other parts of the world where HIV transmission is primarily heterosexually transmitted [29], we found that many women infected with HIV had not engaged in 'high risk' behavior (i.e., prostitution or exchange of sex for money, or having more than two lifetime sex partners). Aral *et al*. [30] have pointed out 'a strong ecological component to an individual's risk for exposure to sexually transmitted infections,' independent from one's own behavior. Thus, a study in Haiti of 38 HIV-positive men with HIV-positive spouses [22] found 43% of the men had more than 10 sex partners in the past year, whereas none of 136 female sex partners interviewed had multiple sex partners. Batey women probably have had a greater lifetime number of sex partners on average, and a higher frequency of exchanging sex for money/goods, than most women in Haiti. For example, Behets *et al*. [23] reported that only 0.7% of women in a shanty town outside of Port au Prince reported exchanging sex for money/goods. Nonetheless, amongst a small sample of 38 men recruited in the bateyes for HIV testing during the present study, the mean lifetime number of female sex partners was 28 (median, 20), far greater than the lifetime number of male partners for women in the study (mean, eight; median, two).

This study had certain limitations as well as strengths. First, the sample comprised women who voluntarily approached the mobile unit, met eligibility criteria and agreed to participate in the study. Although women were eager to participate and take advantage of the opportunity to receive a pelvic examination from physicians and free HIV testing, some high-risk women may have avoided the mobile unit, not wanting to know their HIV status or worrying about confidentiality. However, few women could have known their HIV status, since serologic testing has been nearly inaccessible in this setting. Second, the prevalences of HIV varied considerably amongst the bateyes sampled, and this was not explained. However, the random selection of bateyes from a large sugar cane company, and the use of mobile vans for outreach, both contributed to making this a representative sample that may have generalizability to other bateyes. Although the rates of pay and living conditions were somewhat better on this estate than in the bateyes of the state-owned Consejo Estatal de Azucar, the seasonal influx of unaccompanied men and lack of housing and economic opportunities for women are constants that suggest that similar conditions would be found in the public sector.

The two interviewers usually established an excellent rapport with the subjects who showed little reluctance to openly discuss sexual histories. However, the low level of education of the subjects was a limitation; many women found it difficult to state their age, or estimate their lifetime number of sex partners, the number of times they had exchanged sex for money, and the age at which various life events had occurred, for example. Some women answered 'yes' to questions about condom use until it was discovered that they were trying to conceal their unfamiliarity with condoms.

Globally, HIV has increasingly become a disease of poor women as nearly all countries evolve towards a heterosexual HIV epidemic. As heterosexual spread increases, women are at greatest risk not only because the virus may be spread more efficiently from male-to-female than from female-to-male in some settings, but because of multiple factors that may limit women's ability to negotiate safe sexual behavior, such as those described here. Short-term objectives for HIV prevention in this population and in similar settings in the Dominican Republic should entail education projects in Spanish and Creole for men and women on the magnitude of the problem of HIV infection, methods of transmission, and the use of condoms as prevention. Condoms must be made widely available in all bateyes at the lowest possible price. Algorithms for syndromic management of STD, and improved access to STD services are also essential, as is health education promoting healthcare-seeking behavior for men and women. Improved syndromic management of STD has been shown to reduce heterosexual HIV transmission [31]. In addition, women need greater economic opportunities in the bateyes. Dominican economist Moya Pons concluded that women must be brought into the formal economic sector of the bateyes to both improve the quality of life for all, and to utilize a large pool of untapped labor. While the short-term objectives are of immense immediate importance, only by tackling the larger issues of structural barriers to housing and employment of women in the bateyes can this problem be meaningfully addressed.

Decosas *et al*. [32] have noted that the contribution of migration to HIV dissemination is not as straightforward as it might seem, in that, 'it is not the origin, or the destination of migration, but the social disruption

which characterizes certain types of migration which determines vulnerability to HIV'. Although the origin of the migrants is undoubtedly a contributing factor to the HIV epidemic in the bateyes, unequal sex ratios, conjugal separation, poverty and poor economic opportunities for women cannot be ignored as important contributors. Amelioration of these conditions, as well as education and promotion of condoms, is imperative to the control of HIV in this setting.

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