JOURNAL OF WOMEN'S HEALTH
Volume 19, Number 5, 2010

DOI: 10.1089/jwh.2008.1334

Economic Risk Factors for HIV Infection Among Women in Rural Haiti: Implications for HIV Prevention Policies and Programs in Resource-Poor Settings

M.C. Smith Fawzi, Sc.D.,[1,2] W. Lambert, M.D.,[3] F. Boehm, B.S.,[2] J.L. Finkelstein, M.P.H.,[2] J.M. Singler, M.D.,[4] F. Léandre, M.D.,[3] P. Nevil, B.Sc.,[3] D. Bertrand, M.A.,[3] M.S. Claude, R.N.,[3] J. Bertrand, R.N.,[3] M. Louissaint, R.N.,[3] L. Jeannis, R.N.,[3] P.E. Farmer, M.D., Ph.D.,[1,2] A.T. Yang, B.A.,[2] and J.S. Mukherjee, M.D., M.P.H.[1,2]

Abstract

Aims: The goals of this study were to (1) estimate the prevalence of HIV infection among women accessing services at a women's health center in rural Haiti and (2) to identify economic risk factors for HIV infection in this population.
Methods: Women who accessed healthcare services at this center between June 1999 and December 2002 were recruited to participate. The analysis was based on data from a case-control study of sexually transmitted diseases (STDs) in rural Haiti. HIV prevalence in the study population was 4%.
Results: In multivariate analyses, partner occupation was associated with HIV infection in women, with mechanic (OR 9.0, 95% CI 1.8-45) and market vendor (OR 4.2, 95% CI 1.6-11) reflecting the strongest partner occupational risk factors. Partner's occupation as a farmer reduced the risk of infection in women by 60% (95% CI 0.14-1.1). Factors indicating low socioeconomic status (SES), such as food insecurity (OR 2.0, 95% CI 0.75-5.6) and using charcoal for cooking (OR 1.7, 95% CI 0.72-3.8) suggested an association with HIV infection.
Conclusions: Given pervasive gender inequality in Haiti, women's economic security often relies on their partners' income earning activities. Our findings show that although factors reflecting poverty are associated with HIV-positive status, stronger associations are observed for women whose partners indicated a more secure occupation (e.g., mechanic or market vendor). Policies and programs that expand access to education and economic opportunities for women and girls may have long-term implications for HIV prevention in Haiti and other resource-poor settings.

Introduction

HIV prevention efforts focusing on behavior change and sexual mores have had limited impact in some contexts, particularly in resource-poor settings.[1–4] Although prevention strategies in some developing countries have been lauded as successful (e.g., Uganda's and Thailand's HIV programs),[5–7] many other countries have not been able to reduce the incidence of transmission.[8–10] Even in the case of Uganda, the reduction in HIV prevalence may have been related in part to the epidemic burning out from high HIV-related mortality rates rather than solely due to HIV prevention activities.[11–13] It is also likely that insufficient resources for broad-based prevention activities throughout the developing world have fueled the burgeoning epidemic.

The Global Fund to Fight AIDS, Tuberculosis, and Malaria (GFATM) and the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) are recent initiatives that have provided an unprecedented level of resources for HIV treatment and prevention in resource-poor settings.[14,15] In terms of prevention, it is important to examine factors that place the poorest communities at risk for HIV infection in order to develop effective interventions. In this regard, it may be worthwhile to return to the basic paradigm of epidemiological risk factors.

[1]Program in Infectious Disease and Social Change, Department of Global Health and Social Medicine, Harvard Medical School, Boston, Massachusetts.
[2]Partners In Health, Boston, Massachusetts.
[3]Zanmi Lasante, Cange, Haiti.
[4]University of California, San Francisco School of Medicine, San Francisco, California.

Perhaps a complete knowledge of modes of transmission followed by the ABC approach is not sufficient for effective HIV prevention in resource-poor settings. It may be important to understand the contextual factors that place individuals at risk for HIV infection.[16] Given the pervasive poverty throughout the developing world and the increasing incidence of HIV in many resource-poor settings, this broad ecological association warrants a closer examination of the relationship between economic factors and HIV risk at the local level. This is particularly salient for Haiti, which is the poorest country in the Western hemisphere and also has one of the highest prevalence rates of HIV in the region.[17–19] Haiti has a very low gross national income (GNI) per capita of $560, and 80% of the population lives below the poverty level.[19,20] In addition, gender inequalities are often inextricably linked with the socioeconomic situation in a given country. For example, as a result of limited literacy and access to education among women in Haiti, they often are more vulnerable economically compared with men and may seek greater financial security through their partners.[21]

Based on these premises, the goals of the present study are to estimate the prevalence of HIV infection among women accessing services at a women's health center in rural Haiti and to identify economic factors associated with HIV infection in this population. By examining the economic factors that are associated with HIV-positive status among women, we hope to reflect on some of the potential underlying structural dimensions that may fuel the HIV epidemic in resource-poor settings. In addition, this information may shed light on strategies for HIV prevention that may reduce the risk of infection among women living in Haiti and other impoverished settings.

Materials and Methods

Setting

The study population was recruited from the Proje Sante Fanm (women's health clinic) at Zanmi Lasante in Haiti's Central Plateau, affiliated with the Boston-based organization Partners In Health (PIH). The first Zanmi Lasante health facility was established in the commune of Cange, a squatter settlement located north of a dam built by an international aid project in the 1950s. The resulting flood displaced the communities living in the fertile Artibonite Valley to higher, less arable terrain. The impoverishment that resulted has persisted to the present day.

Study population, design, and data collection

Women who accessed services at Proje Sante Fanm between June 1999 and December 2002 were recruited to participate in the study. Prospective participants were asked to enroll in a case-control study of factors associated with sexually transmitted diseases (STDs) (chlamydia infection and gonorrhea). Informed consent was obtained in accordance with the Institutional Review Board at Harvard Medical School and the Zanmi Lasante Ethics Committee. A structured questionnaire was administered to study participants and included sections on sociodemographic characteristics, risk factors for STDs, gynecological history, and access to healthcare. The questionnaires were based on prior literature that documented risk factors for STDs in Haiti.[22,23] In addition to laboratory diagnosis of chlamydia and gonorrhea, HIV status was determined using the ELISA test. A more detailed description of the methods for this study of STDs is provided by Smith Fawzi et al.[24]

Statistical analysis

General descriptive statistics were calculated for sociodemographic, economic, sexual and gynecological history, and access to care characteristics for the women enrolled in the study, stratifying by HIV status. In this population, 34 women were HIV positive and 911 were HIV negative. Frequencies were calculated for HIV-positive and HIV-negative participants, and p values were based on Mantel-Haenszel chi-square statistics or Fisher's exact test when expected cell counts for 2×2 tables were <5. Corresponding odds ratios (OR) and 95% confidence intervals (CI) were calculated for these univariate analyses. Table 1 includes associations that demonstrated a p value of <0.10 for the univariate analyses. Economic factors that demonstrated a p value of <0.20 in univariate analyses were considered for the multivariate analysis. For example, different categories of women's occupation were not included in the multivariate analysis because they did not demonstrate an association with a level of significance <0.20. In addition, prior knowledge of socioeconomic status (SES) in Haiti guided selection of economic variables for inclusion in this analysis.[18] For example, it is understood in Haiti that the use of charcoal for cooking fuel is a reflection of lower SES in Haiti compared with the use of wood or gas.

Multivariate logistic regression analyses were performed to control for confounding factors. A set of logistic regression models was constructed for each economic variable. Each set of models included HIV status as the outcome variable and one economic and one noneconomic variable as the exposure and confounding variables, respectively. For confounding variables, we included those variables in which the confounder-disease association demonstrated a p value of <0.20. We also evaluated whether the potential confounder would be associated with the exposure variables of interest (i.e., the economic factors) and independently related to our disease outcome. The percent change in the exposure-disease OR estimate (comparing the OR of the exposure-disease relationship from the univariate logistic regression with the OR of the exposure-disease relationship from the model that included the confounding variable) was calculated. Those potential confounding variables that changed the exposure-disease OR estimate by $>10\%$ were retained in the final multivariate logistic regression models. This change-in-estimate approach was based on a strategy described by Greenland[25] in his article on modeling and variable selection. Statistical analyses were performed using SAS version 8.2 for Windows (SAS Institute, Cary, NC).

Results

The sociodemographic and economic characteristics of the study population reflected the pervasive and extreme poverty in rural Haiti. Most women lived in substandard housing conditions, with 44% residing in thatched houses and 18% in mud shelters; 37% of houses had thatched roofs, an indicator of extreme poverty. Only 32% of households had a latrine. Nearly 93% of the women were married or living with a

Table 1. Descriptive Statistics for Women Accessing Services at Proje Sante Fanm in Rural Haiti, Stratified by HIV Status ($N = 945$)

	HIV positive n = *34*	*HIV negative* n = *911*	*OR (95% CI)*	p *value*
Sociodemographic and economic characteristics				
Age				
≤25	9/33 (27%)	350/838 (42%)	0.52 (0.24–1.1)	0.097
Schooling				
Ever attended school	24/34 (71%)	446/885 (50%)	2.4 (1.1–5.0)	0.021
Literacy				
Able to read and write	20/34 (59%)	342/883 (39%)	2.3 (1.1–4.5)	0.019
Occupation				
Farmer	12/34 (35%)	460/884 (52%)	0.50 (0.25–1.0)	0.055
None	9/34 (26%)	124/884 (14%)	2.2 (1.0–4.8)	0.076[a]
Home location				
Mirebalais or Port-au-Prince	6/34 (18%)	69/885 (8%)	2.5 (1.0–6.3)	0.051[a]
Partner's occupation				
Market vendor	11/30 (37%)	116/846 (14%)	3.6 (1.7–7.9)	0.002[a]
Farmer	19/30 (63%)	651/846 (77%)	0.52 (0.24–1.1)	0.084
Construction worker	8/30 (27%)	61/845 (7%)	4. 7 (2.0–11)	0.001[a]
Food and income				
≥2 share income	27/34 (79%)	795/885 (90%)	0.44 (0.18–1.0)	0.079[a]
Most/all of income spent on food	13/24 (54%)	245/732 (33%)	2.4 (1.0–5.3)	0.035
≥2 eat at house on average day	31/34 (91%)	859/885 (97%)	0.31 (0.09–1.1)	0.088[a]
Agriculture				
Unable to sell anything that family grows	6/26 (23%)	75/746 (10%)	2.7 (1.1–6.9)	0.046[a]
Family grows sugar cane	13/26 (50%)	515/749 (69%)	0.45 (0.21–1.0)	0.044
Household owns turkeys	1/34 (3%)	122/885 (14%)	0.19 (0.03–1.4)	0.073[a]
Household owns cows	8/34 (24%)	332/885 (38%)	0.51 (0.23–1.2)	0.098
Household owns ≤5 total livestock	20/33 (61%)	367/870 (42%)	2.1 (1.0–4.3)	0.036
Cooking fuel				
Charcoal	18/34 (53%)	314/884 (36%)	2.0 (1.0–4.1)	0.038
Wood	25/34 (74%)	786/885 (89%)	0.35 (0.16–0.77)	0.013[a]
Shelter				
Bamboo house	10/34 (29%)	398/885 (45%)	0.51 (0.24–1.1)	0.073
Wood house	7/34 (21%)	91/885 (10%)	2.3 (0.96–5.3)	0.081[a]
Aluminum roof	27/34 (79%)	521/885 (59%)	2.7 (1.2–6.3)	0.017
Thatched roof	7/34 (21%)	337/885 (38%)	0.42 (0.18–0.98)	0.039
Radio				
Owns a radio	16/34 (47%)	291/884 (33%)	1.8 (0.91–3.6)	0.087
Transport				
Has problems with transportation	27/34 (79%)	563/885 (64%)	2.2 (0.95–5.1)	0.060
Sexual/gynecological history and access to care				
≤15 years of age at first intercourse	13/28 (46%)	164/762 (22%)	3.2 (1.5–6.8)	0.002
>1 lifetime partner	28/34 (82%)	360/885 (41%)	6.8 (2.8–17)	<0.001
History of partner having an STD (yes/don't know)	11/12 (92%)	103/337 (31%)	25 (3.2–200)	<0.001[a]
≥1 birth complication	4/29 (14%)	18/725 (2%)	6.3 (2.0–20)	0.008[a]
>1 stillbirth/miscarriage	5/32 (16%)	60/803 (7%)	2.3 (0.85–6.2)	0.095[a]
History of STD	7/32 (22%)	55/818 (7%)	3.9 (1.6–9.4)	0.006[a]
STD in past year (yes/don't know)	9/34 (26%)	103/885 (12%)	2.7 (1.2–6.0)	0.027[a]
Vaginal pruritis	10/34 (29%)	398/885 (45%)	0.51 (0.24–1.1)	0.073
Syphilis	7/33 (21%)	48/876 (5%)	4.6 (1.9–11)	0.003[a]
History of difficulty receiving prenatal care	9/34 (26%)	118/885 (13%)	2.3 (1.1–5.1)	0.040[a]

$n = 945$ unless otherwise indicated; sample size <945 indicates missing values.
[a]Denotes that Fisher's exact test was used.
CI, confidence interval; OR, odds ratio; STD, sexually transmitted disease.

partner, and approximately 58% reported being with their spouse or partner for >4 years. Women were younger than their male partners (mean age of 28 vs. 33 years) and less educated (51% vs. 63% ever attended school). The majority of women were farmers (52%), followed by market vendor (48%) and domestic servant (22%) as the main occupations. Nearly 77% of women's partners were farmers, followed by market vendor (15%) and construction worker (8%) as the most common partner occupations. In the context of central Haiti, a reliable occupation would be one that offers a steady income, such as construction work. This is in contrast to farming, which is primarily subsistence farming on poor quality land. In addition, these occupational categories were not mutually exclusive, and women as well as their partners had the

opportunity to report involvement in more than one occupation. Over 80% of the women reported a monthly household income of ≤$40. Two thirds of participants spent at least half of their household income on food, and nearly 30% spent most or all of their income on food, reflecting a very high level of food insecurity in this context.

The prevalence of HIV infection was 4% in this population of impoverished Haitian women. Economic factors were significantly associated with risk of HIV infection. In univariate analyses, spending most or all of family income on food increased the woman's risk of HIV infection by 2.4-fold (95% CI 1.0-5.3). Similarly, a family's inability to sell what it grows demonstrated an OR of 2.7 (95% CI 1.1-6.9). Owning five or fewer livestock (per household) increased the woman's risk of HIV infection by 2-fold (OR 2.1, 95% CI 1.0-4.3). Interestingly, having an aluminum roof increased the risk of HIV among women (OR 2.7, 95% CI: 1.2-6.3), whereas having a thatched roof reduced the risk (OR 0.42, 95% CI 0.18-0.98). In addition, having ever attended school increased the risk of HIV-positive status (OR 2.4, 95% CI 1.1-5.0). However, these findings may be confounded by partner occupation, where partner occupation as a farmer demonstrated a protective effect on HIV risk (OR 0.52, 95% CI 0.24-1.1) compared with partner occupation as a market vender (OR 3.6, 95% CI 1.7-7.9) or construction worker (OR 4.7, 95% CI 2.0-11), which demonstrated an increase in risk of HIV infection among their female partners in rural Haiti (see univariate analyses in Table 1).

Findings from the multivariate analysis demonstrated a confounding effect of partner occupation on school attendance, whereby school attendance was no longer associated with HIV risk after accounting for the partner occupation variables (Table 2). Partner occupation as a farmer continued to remain protective in multivariate analyses (OR 0.4, 95% CI 0.14-1.1), whereas other partner occupations increased the risk of HIV among women. In particular, partner occupation as a mechanic increased the HIV risk by 9-fold (95% CI 1.8-45). In addition, partner occupation as a market vendor (OR 4.2, 95% CI 1.6-11) or construction worker (OR 2.6, CI 0.75-9.0) continued to be important predictors of HIV risk in multivariate models. Although for construction work there was a suggestion of an association, this finding was consistent with the other higher-wage occupations (e.g., mechanic and market vendor) that conferred an increased risk. Other economic factors, including spending most or all of household income on food (OR 2.0, 95% CI 0.75-5.6) and cooking with charcoal (OR 1.7, 95% CI 0.72-3.8), a proxy for low SES in Haiti, also suggested an association with HIV risk after controlling for confounding variables (Table 2).

Discussion

The burden of HIV infection in the present study's rural population is similar to the overall rate of HIV infection throughout Haiti (4% in the study population vs. 2.2% nationally).[26] Haiti is the poorest country and has one of the highest HIV prevalence rates in the Western hemisphere. Is this ecological association grounded in a true relationship between economic vulnerability and HIV risk in Haiti? Overall, the data indicate that SES is an important predictor of HIV risk among women. However, there are subtleties in the economic situation in rural Haiti that indicate that whereas poverty is important with respect to HIV risk, the associations between partners' occupational status and HIV among women are stronger in the present findings. This suggests that gender inequality and the potential link with economic vulnerability in women may play a role in HIV risk among women in this setting.[21]

In this study, socioeconomic factors were associated with an increase in risk of HIV infection among impoverished women in rural Haiti. There was a suggestion of an association between poverty, as reflected by severe food insecurity, and HIV infection. Controlling for confounding factors, women who spent most or all of their income on food had a 2-fold increase in HIV risk. In addition to food insecurity, there was a suggested 70% increase in risk of HIV infection among women who used charcoal as a cooking fuel. A number of studies have also identified a variety of socioeconomic risk factors for HIV infection in other developing countries, such as Kenya,[27] Zambia,[28] Ghana,[29] Uganda,[30] and Malawi.[31] In particular, low SES[27] and limited educational attainment[28,29,32,33] have been identified as factors associated with HIV-related risk behavior or HIV infection.

In addition to poverty in its own right, the current data also suggest a positive association between HIV status in women and their partners' occupation, with more secure occupations demonstrating stronger associations. After controlling for confounding factors, partner occupation as a market vendor was associated with a 4-fold increase in risk of HIV infection, and partner occupation as a mechanic was associated with a 9-fold increase in HIV risk. In contrast, we observed a protective effect of farming on risk of HIV infection: women whose partners were farmers had the lowest risk of HIV infection, although this finding was marginally significant (OR 0.40, 95% CI 0.14-1.1). Several studies have demonstrated an association between partner occupation or SES and risk of HIV infection among women.[34–37] In a study conducted in the Democratic Republic of Congo, for example, male employees working at a bank and their spouses demonstrated a higher prevalence of HIV infection compared with men working in a textile factory and their spouses.[36] Similarly, in Rwanda, Allen et al.[35] observed an increased risk of HIV among women whose partners had a higher income (OR 1.96, 95% CI 1.50-2.56). Studies in Malawi[31,38] and Tanzania[39,40] have also noted the protective effect of farming on risk of HIV infection.

The association between relative economic stability and risk of HIV infection may be linked with women's survival strategies in the face of absolute poverty. For example, in a study in South Africa, economic survival strategies (e.g., transactional sex, partner selection) were associated with a 1.5-fold increased risk of HIV infection, after controlling for sociodemographic characteristics (OR 1.54, 95% CI 1.07, 2.21).[41] In rural Haiti, women undertaking survival strategies to escape extreme poverty may considerably increase their risk of HIV infection. For example, in a study in the Artibonite Valley region, 30% of women reported entering a sexual relationship out of economic necessity; this was associated with a 5-fold increase in risk of HIV infection (OR 4.8). Because of a lack of economic opportunities in rural Haiti, women often enter serial *plasaj* (a long-term relationship with an unmarried partner) to support themselves and their children; *plasaj* was associated with an 8-fold increased risk of HIV infection (OR 8.3).[42]

In a recent review of 36 studies conducted in Africa, Wojcicki[43] concluded that partner socioeconomic characteristics

Table 2. Multiple Logistic Regression Analysis of Factors Associated with HIV Status

Model		*OR*	*95% CI*
Model 1	Partner is farmer vs. other occupation	0.4	0.14–1.1
Partner is farmer vs. all other occupations ($n = 680$)	Age ≤25 vs. >25	0.24	0.07–0.85
	Ever attended school, yes vs. no	1.6	0.43–5.9
	Able to read and write, yes vs. no	1.2	0.32–4.2
	Live in Mirebalais or Port-au-Prince vs. elsewhere	6.2	0.73–52
	Partner works in Mirebalais or Port-au-Prince vs. elsewhere	0.31	0.04–2.6
	>1.5 children per room in house, yes vs. no	0.47	0.19–1.2
	Has problems with education, yes vs. no	2.2	0.81–5.8
	>1 lifetime sexual partners vs. ≤1	3.7	1.4–9.6
	Trichomonas infection	1.2	0.41–3.6
Model 2	Partner is market vendor vs. other occupation	4.2	1.6–11
Partner is market vendor vs. all other occupations ($n = 704$)	Has problems with getting health care, yes vs. no	0.93	0.31–2.8
	Has problems with education, yes vs. no	2.0	0.79–5.3
	Age at first intercourse ≤15 vs. >15	1.9	0.79–4.7
	Ever had an STD, yes vs. no	4. 7	1.4–16
	Vaginal pruritis, yes vs. no	0.33	0.12–0.90
	Has had difficulty receiving prenatal care during past year	1.7	0.47–5.8
Model 3	Partner is mechanic	9.0	1.8–45
Partner is mechanic vs. all other occupations ($n = 601$)	Age ≤25 vs. >25	0.06	0.01–0.38
	Ever attended school, yes vs. no	0.81	0.17–3.9
	Able to read and write, yes vs. no	2.5	0.57–11
	Partner works in Mirebalais or Port-au-Prince vs. elsewhere	3.3	1.1–10
	>1.5 children per room in house, yes vs. no	0.38	0.14–0.99
	Has problems with education, yes vs. no	2.7	0.90–8.4
	Age at first intercourse ≤15 vs. >15	3.6	1.4–9.1
	Abdominal pain	5.0	1.0–24
Model 4	Partner is construction worker	2.6	0.75–9.0
Partner is construction worker vs. all other occupations ($n = 670$)	Age ≤25 vs. >25	0.21	0.07–0.69
	Ever attended school, yes vs. no	2.0	0.43–9.3
	Able to read and write, yes vs. no	1.8	0.44–7.5
	Live in Mirebalais or Port-au-Prince vs. elsewhere	1.3	0.32–5.4
	Age at first intercourse ≤15 vs. >15	2.6	1.0–6.9
	>1 lifetime sexual partners vs. ≤1	3.3	1.1–9.5
	Ever had an STD, yes vs. no	1.3	0.33–4.8
	Syphilis infection	4.0	1.1–14
Model 5	Most or all of income was spent on food, yes vs. no	2.0	0.75–5.6
Food insecurity ($n = 668$)	Partner works in Mirebalais or Port-au-Prince vs. elsewhere	0.66	0.14–3.0
	>1 lifetime sexual partners vs. ≤1	4.3	1.4–13
	Ever had chronic pelvic pain	2.2	0.69–6.8
	Ever had an STD, yes vs. no	2.4	0.61–9.5
	Vaginal pruritis, yes vs. no	0.57	0.20–1.7
	Has had difficulty receiving prenatal care during past year	2.1	0.72–5.9
	Syphilis infection	2.4	0.63–9.1
Model 6	Cooks with charcoal, yes vs. no	1.7	0.72–3.8
Cooks with charcoal ($n = 871$)	Ever attended school, yes vs. no	1.9	0.58–5.9
	Able to read and write, yes vs. no	1.4	0.47–4.1
	Live in Mirebalais or Port-au-Prince vs. elsewhere	1.8	0.42–7.8
	Partner works in Mirebalais or Port-au-Prince vs. elsewhere	1.2	0.33–4.1
	Has problems with education, yes vs. no	2.6	1.2–5.8

CI, confidence interval; OR, odds ratio.

(i.e., income, employment, education) were stronger predictors of female HIV serostatus than individual female socioeconomic characteristics. Although some of the studies reviewed observed no association between SES and HIV infection, the majority of the studies found either positive or negative associations with SES. The negative studies that found that poverty placed women at greater risk were consistent with our observations that food insecurity and type of cooking fuel were associated with HIV status among women in rural Haiti. The positive studies in this review corroborate the finding that more stable occupations among men may result in their female partners being more vulnerable to infection. In Haiti, the role of serial *plasaj* as an attempt by women to secure financial resources for themselves and their children provides a context-specific understanding of the complex relationship between HIV and poverty.

A related question concerns what may be the factors potentially mediating this observed increase in HIV risk among women whose partners have more stable occupations in economic terms. The first consideration is that men in these occupations are more likely to travel (compared with farmers, for example), placing them at greater risk of infection. A number of studies have demonstrated an increased risk of HIV infection among men who are truck drivers.[44–46] In the current study, however, these relationships persist after controlling for partner's mobility. An alternative interpretation is that women whose partners are more stable economically may be more vulnerable to sustained physical or sexual abuse, particularly if the woman has limited education or employment opportunities. In this case, the woman may stay longer in an abusive relationship, including tolerance of other sexual partners, if she believes that staving off hunger, particularly for her children, is a higher priority than protecting herself from acquiring HIV infection.[41,47]

A case from complementary qualitative data from Haiti in Zanmi Lasante's catchment area[48] supports these findings, suggesting that for women living in poverty, economic dependency on a partner may increase the risk of becoming infected with HIV. As related by a 37-year-old woman:

> Overall it is the type of life that I have had that put me where I am today. The lack of possibilities. I have five children and no one to help me. I was working as a domestic [servant], and while there, I met the man who told me that he would take me out of working as a domestic. He did not take care of any of his responsibilities. When I met my third partner, he saw that I was alone, pregnant, and with one child. He talked to me and I accepted him, and we started a life together. I say if God had given me the means after the second child, I would never have taken another man, and there are some things that I would never find myself in at all. I think if it is possible that I have this sickness [HIV], without a doubt it is from my last partner.

The data provide support for the association between socioeconomic factors, such as partner occupation and food insecurity, and HIV-positive status among women residing in rural Haiti. However, because of the cross-sectional design of the study, it is not possible to determine the temporal relationship between economic factors and HIV infection. In particular, findings presented originate from a case-control study designed to examine risk factors for STDs; this is a limitation, given that the current analysis focuses on factors associated with HIV. This has resulted in a relatively small sample size of HIV-positive women, potentially biasing some results toward the null. Although it is not possible to make causal inferences about the relationship between various risk factors and HIV infection, these results are corroborated by evidence from complementary ethnographic data from other studies.[21,48–50] Additionally, although we controlled for partner mobility in multivariate analyses, there may potentially be some residual confounding, which may affect the observed association between economic factors and risk of HIV infection. Finally, there may be limitations in the generalizability of these findings, given that women were recruited from a women's health clinic rather than from the general population. Given the broad range of services provided (e.g., family planning services, STD screening, prenatal visits), however, the sample is not limited to a sick population and, therefore, resembles the general population more closely than a hospital-based study.

Conclusions

The present study suggests that such factors as poverty, food insecurity, and partner occupation are associated with HIV-positive status among women in rural Haiti. Economic vulnerability and gender inequality may increase the risk of HIV infection among women in rural Haiti. Programs and policies that improve the economic and social status of women (e.g., access to basic education, adult literacy programs, income-generating opportunities) may have an impact on reducing the risk of HIV infection in Haiti and similar resource-poor settings. Through more economic independence, women may have a greater capacity to protect themselves against the risk of HIV infection. In a study of forced sex in the same population in rural Haiti, longer time in a steady relationship demonstrated an increased risk of forced sex and potentially greater vulnerability to HIV and other STDs; economic vulnerability also played a significant role in the risk of forced sex in this study population.[49] Similarly, a randomized trial of a microfinancing intervention among women in South Africa resulted in a 55% reduction in the risk of intimate-partner violence.[51] Ultimately, broader educational and economic policy initiatives that target girls and women may have tremendous potential for reducing HIV transmission in rural Haiti and similar resource-poor settings throughout the world.

Acknowledgments

We would like to acknowledge the women who participated in the study and the staff at Zanmi Lasante and Harvard Medical School who contributed significantly to this study. Special thanks are extended to Ledgy Astrel, Donna Barry, Jennifer Birk, Augustin Bosquet, Arachu Castro, Friga François, Jean François, Kelourde Gracia, Yolène Gracia, René Guerrier, Kathryn Kempton, Lenéus Joseph, Michelle Li, Tania Louis Jean, Coeurlida Louis, Julie Mann, Ludie Marcellus, Deogratias Niyizonkiza, Cynthia Orélus, Catherine Oswald, Ulric Pierre, Sherly Pierre Louis, Sophonie Predestin, Maxi Raymonville, Lana Sloutsky, Cheri Verrilie, and Loune Viaud. This study was supported by a grant provided by the Fogarty International Center (D43-TW00018, Principal Investigator Dr. Warren Johnson, Cornell University Medical School; Principal Investigator of Harvard substudy Dr. Paul Farmer, Department of Social Medicine, Harvard Medical School). The work at Zanmi Lasante has been made possible in large part

through the generosity of private foundations and donors, especially Thomas J. White.

Disclosure Statement

The authors have no conflicts of interest to report.

References

1. Sloan NM, Myers JE. Evaluation of an HIV/AIDS peer education programme in a South African workplace. S Afr Med J 2005;95:261–264.
2. de Guzman A. Reducing social vulnerability to HIV/AIDS: Models of care and their impact in resource-poor settings. AIDS Care 2001;13:663–675.
3. Kumar MS, Pradeep K, Uma S. Factors for change: A comparative study of AIDS interventions among sex workers in an organised setting with an unorganised setting. 10th International Conference on AIDS, Vancouver, Canada, 1996: Abstract Pub.D.1295.
4. Coates TJ, Richter L, Caceres C. Behavioral strategies to reduce HIV transmission: How to make them work better. Lancet 2008;372:669–684.
5. UNDP. Thailand's response to HIV/AIDS: Progress and challenges. Thematic MDG report. Geneva, Switzerland: United Nations Development Programme, 2004. Available at www.undp.org/hiv/docs/alldocs/Asia%20-%20Thailand%20-%20National%20Human%20Dev%20Report%20-%20Thailands%20Response%20to%20HIV-AIDS%20-%20Progress%20and%20Challenges%20(2004).pdf
6. UNAIDS. Thailand: Country situation analysis. 2004 report on the global HIV/AIDS epidemic: 4th Global Report. Geneva, Switzerland: United Nations Programme on HIV/AIDS (UNAIDS), 2004. Available at www.unaids.org/bangkok2004/GAR2004_pdf/UNAIDSGlobalReport2004_en.pdf
7. UNAIDS. Uganda: Country situation analysis. 2004 report on the global HIV/AIDS Epidemic: 4th Global Report. Geneva, Switzerland: UNAIDS, 2004. Available at www.unaids.org/bangkok2004/GAR2004_pdf/UNAIDSGlobalReport2004_en.pdf
8. UNAIDS/WHO. China: Epidemiological fact sheets on HIV/AIDS and sexually transmitted infections, 2009 update. Geneva, Switzerland: UNAIDS/World Health Organization, 2008. Available at www.who.int/globalatlas/predefinedReports/EFS2008/full/EFS2008_CN.pdf
9. UNAIDS/WHO. Russian Federation: Epidemiological fact sheets on HIV/AIDS and sexually transmitted infections, 2008 update. Geneva, Switzerland: UNAIDS/World Health Organization, 2008. Available at www.who.int/globalatlas/predefinedReports/EFS2008/full/EFS2008_RU.pdf
10. UNAIDS/WHO. Ukraine: Epidemiological fact sheets on HIV/AIDS and sexually transmitted infections, 2008 update. Geneva, Switzerland: UNAIDS/World Health Organization, 2008. Available at www.who.int/globalatlas/predefinedReports/EFS2008/full/EFS2008_UA.pdf
11. Wawer M, Gray R, Serwadda D, et al. Declines in HIV prevalence in Uganda: Not as simple as ABC. 12th Conference on Retroviruses and Opportunistic Infections, Boston, MA, February 22–25, 2005: Abstract 27LB.
12. Sewankambo NK, Gray RH, Ahmad S, et al. Mortality associated with HIV infection in rural Rakai District, Uganda. AIDS 2000;14:2391–2400.
13. Wawer MJ, Serwadda D, Gray RH, et al. Trends in HIV-1 prevalence may not reflect trends in incidence in mature epidemics: Data from the Rakai population-based cohort, Uganda. AIDS 1997;11:1023–1030.
14. Office of the U.S. Global AIDS Coordinator. Engendering bold leadership: The President's emergency action plan for AIDS relief. First Annual Report to Congress. Washington, DC: Office of the United States Global AIDS Coordinator, 2005. Available at www.state.gov/documents/organization/43885.pdf
15. GFATM. About the Global Fund: The road to the fund. Geneva, Switzerland: The Global Fund to Fight AIDS, Tuberculosis, and Malaria, 2004. Available at www.theglobalfund.org/en/about/road/history/default.asp
16. Gupta GR, Parkhurst JO, Ogden JA, et al. Structural approaches to HIV prevention. Lancet 2008;372:764–775.
17. UNAIDS. Haiti: Country situation analysis. 2004 Report on the global HIV/AIDS epidemic: 4th Global Report. Geneva, Switzerland: UNAIDS, 2004. Available at www.unaids.org/bangkok2004/GAR2004_pdf/UNAIDSGlobalReport2004_en.pdf
18. The World Bank Group. Haiti: The challenges of poverty reduction. Executive summary. Washington, DC: The World Bank Group, 1998. Available at lnweb18.worldbank.org/External/lac/lac.nsf/3af04372e7f23ef6852567d6006b38a3/8479e9126e3537f0852567ea000fa239?OpenDocument
19. The World Bank Group. Country brief: Haiti. Washington, DC: The World Bank Group, 2000. Available at lnweb18.worldbank.org/external/lac/lac.nsf/3af04372e7f23ef6852567d6006b38a3/e34108284560c0208525686d0062266c?OpenDocument
20. UNICEF. The state of the world's children 2009. New York: UNICEF, 2008. Available at www.unicef.org/sowc09/docs/SOWC09-FullReport-EN.pdf
21. Farmer PE, Connors M, Simmons J. Women, poverty, and AIDS: Sex, drugs, and structural violence. Monroe, ME: Common Courage Press, 1996.
22. Deschamps MM, Pape JW, Hafner A, et al. Heterosexual transmission of HIV in Haiti. Ann Intern Med 1996;125:324–330.
23. Behets FM, Desormeaux J, Joseph D, et al. Control of sexually transmitted diseases in Haiti: Results and implications of a baseline study among pregnant women living in Cite Soleil shantytowns. J Infect Dis 1995;172:764–771.
24. Smith Fawzi MC, Lambert W, Singler JM, et al. Prevalence and risk factors of STDs in rural Haiti: Implications for policy and programming in resource-poor settings. Int J STD AIDS 2003;14:848–853.
25. Greenland S. Modeling and variable selection in epidemiologic analysis. Am J Public Health 1989;79:340–349.
26. UNAIDS. 2008 report on the global AIDS epidemic: Geneva, Switzerland: UNAIDS, 2008. Available at data.unaids.org/pub/GlobalReport/2008/JC1510_2008GlobalReport_en.zip
27. Hargreaves JR, Morison LA, Chege J, et al. Socioeconomic status and risk of HIV infection in an urban population in Kenya. Trop Med Int Health 2002;7:793–802.
28. Fylkesnes K, Musonda RM, Sichone M, et al. Declining HIV prevalence and risk behaviours in Zambia: Evidence from surveillance and population-based surveys. AIDS 2001;15:907–916.
29. Sauve N, Dzokoto A, Opare B, et al. The price of development: HIV infection in a semiurban community of Ghana. J Acquir Immune Defic Syndr 2002;20;402–408.
30. Kilian AH, Gregson S, Ndyanabangi B, et al. Reductions in risk behaviour provide the most consistent explanation for declining HIV-1 prevalence in Uganda. AIDS 1999;13:391–398.

31. Glynn JR, Ponnighaus J, Crampin AC, et al. The development of the HIV epidemic in Karonga District, Malawi. AIDS 2001;15:2025–2029.
32. Manjunath JV, Thappa DM, Jaisankar TJ. Sexually transmitted diseases and sexual lifestyles of long-distance truck drivers: A clinico-epidemiologic study in south India. Int J STD AIDS 2002;13:612–617.
33. Kapiga SH, Lugalla JL. Sexual behaviour patterns and condom use in Tanzania: Results from the 1996 Demographic and Health Survey. AIDS Care 2002;14:455–469.
34. Wannan GJ, Cutting W, Fischer PR. HIV seroprevalence amongst pregnant women in northeastern Zaire. Int J STD AIDS 1997;8:317–319.
35. Allen S, Lindan C, Serufilira A, et al. Human immunodeficiency virus infection in urban Rwanda. JAMA 1991;266:1657–1663.
36. Ryder RW, Ndilu M, Hassig SE, et al. Heterosexual transmission of HIV-1 among employees and their spouses at two large businesses in Zaire. AIDS 1990;4:725–732.
37. Fabiani M, Nattabi B, Pierotti C, et al. HIV-1 prevalence and factors associated with infection in the conflict-affected region of North Uganda. Conflict Health 2007;1:3.
38. Crampin AC, Glynn JR, Ngwira BM, et al. Trends and measurement of HIV prevalence in northern Malawi. AIDS 2003;17:1817–1825.
39. Quigley M, Munguti K, Grosskurth H, et al. Sexual behaviour patterns and other risk factors for HIV infection in rural Tanzania: A case-control study. AIDS 1997;11:237–248.
40. Bloom SS, Urassa M, Isingo R, et al. Community effects on the risk of HIV infection in rural Tanzania. Sex Transm Infect 2002;78:261–266.
41. Dunkle KL, Jewkes RK, Brown HC, et al. Transactional sex among women in Soweto, South Africa: Prevalence, risk factors and association with HIV infection. Soc Sci Med 2004;59:1581–1592.
42. Fitzgerald DW, Behets F, Caliendo A, et al. Economic hardship and sexually transmitted diseases in Haiti's rural Artibonite Valley. Am J Trop Med Hyg 2000;62:496–501.
43. Wojcicki JM. Socioeconomic status as a risk factor for HIV infection in women in East, Central and Southern Africa: A systematic review. J Biosoc Sci 2005;37:1–36.
44. Pandey A, Benara SK, Roy N, et al. Risk behavior, sexually transmitted infections and HIV among long-distance truck drivers: A cross-sectional survey along national highways in India. AIDS 2008;22:S81–90.
45. Lacerda R, Gravato N, McFarland W, et al. Truck drivers in Brazil: Prevalence of HIV and other sexually transmitted diseases, risk behavior and potential for spread of infection. AIDS 1997;1:S15–S19.
46. Bwayo J, Plummer F, Omari M, et al. Human immunodeficiency virus infection in long distance truck drivers in east Africa. Arch Intern Med 1994;154:1391–1396.
47. Krishnan S, Dunbar MS, Minnis AS, et al. Poverty, gender inequities, and women's risk of human immunodeficiency virus/AIDS. Ann NY Acad Sci 2008;1136:101–110.
48. Louis C, Ivers L, Freedberg K, et al. Factors associated with late presentation for HIV care among patients in Hinche, on Haiti's central plateau. 3rd International AIDS Society Conference on HIV Pathogenesis and Treatment, Rio de Janeiro, Brazil, July 2005: Abstract MoPe11.1C24.
49. Smith Fawzi MC, Lambert W, Singler JM, et al. Factors associated with forced sex among women accessing health services in rural Haiti: Implications for the prevention of HIV infection and other sexually transmitted diseases. Soc Sci Med 2005;60:679–689.
50. Farmer PE. AIDS and accusation: Haiti and the geography of blame. Berkeley, CA: University of California Press, 1992.
51. Pronyk P, Hargreaves JR, Kim JC, et al. Effect of a structural intervention for the prevention of intimate-partner violence and HIV in rural South Africa: A cluster randomised trial. Lancet 2006;368:1973–1983.

Address correspondence to:
Mary C. Smith Fawzi, Sc.D.
Harvard Medical School
Department of Global Health and Social Medicine
641 Huntington Avenue
Boston, MA 02115

E-mail: mary_smith-fawzi@hms.harvard.edu