The Impact of Migration on HIV-1 Transmission in South Africa

A Study of Migrant and Nonmigrant Men and Their Partners

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Background: **To investigate the association between migration and HIV infection among migrant and nonmigrant men and their rural partners.**

Goal: **The goal was to determine risk factors for HIV-1 infection in South Africa.**

Study Design: **This was a cross-sectional study of 196 migrant men and 130 of their rural partners, as well as 64 nonmigrant men and 98 rural women whose partners are nonmigrant. Male migrants were recruited at work in two urban centers, 100 km and 700 km from their rural homes. Rural partners were traced and invited to participate. Nonmigrant couples were recruited for comparison. The study involved administration of a detailed questionnaire and blood collection for HIV testing.**

Results: **Testing showed that 25.9% of migrant men and 12.7% of nonmigrant men were infected with HIV ($P = 0.029$; odds ratio = 2.4; 95% CI = 1.1–5.3). In multivariate analysis, main risk factors for male HIV infection were being a migrant, ever having used a condom, and having lived in four or more places during a lifetime. Being the partner of a migrant was not a significant risk factor for HIV infection among women; significant risk factors were reporting more than one current regular partner, being younger than 35 years, and having STD symptoms during the previous 4 months.**

Conclusion: **Migration is an independent risk factor for HIV infection among men. Workplace interventions are urgently needed to prevent further infections. High rates of HIV were found among rural women, and the migration status of the regular partner was not a major risk factor for HIV. Rural women lack access to appropriate prevention interventions, regardless of their partners' migration status.**

SOUTH AFRICA is experiencing one of the most rapidly growing HIV epidemics in the world. Among women attending antenatal clinics nationwide, the prevalence of HIV infection increased from 0.76% in 1990 to 24.5% in 2000.[1] Among the nine South African provinces, KwaZulu/Natal has consistently had the highest antenatal HIV prevalence, which in 2000 was 36.2%. As in the rest of sub-Saharan Africa, the predominant mode of transmission is heterosexual intercourse.

Over the past century, migration became common among rural men seeking employment in urban and mining centers, and this persists today. In the Hlabisa District of rural KwaZulu/Natal South Africa, the site of this study, for example, 62% of adult men spent the majority of nights away from their rural homes.[2] Men also migrate to South Africa from neighboring countries, and there are an estimated 2.5 million legal and many more undocumented migrants in South Africa today.[3] Twenty years ago the gold mines employed approximately 500,000 people, of whom about half were South African and the rest were from neighboring countries, including Botswana, Lesotho, Mozambique, and Malawi.[4] While the number of men employed in the gold mines has fallen to about 300,000, the southern Africa region is still linked by extraordinarily high levels of migration.[5]

Although there are many different types of migration, the predominant mode of migration in southern Africa is "circular" or "oscillating" migration, in which young men leave their rural partners to work in urban areas and return home periodically, depending on the distances involved.

The roots of migrant labor in South Africa run deep and can be traced to the discovery of gold on the Witwatersrand in 1886 and the associated demand for labor. The system of migrant labor was a cornerstone of apartheid policy, in which the movement of South Africa's black population was strictly controlled so as to maintain a separation of the races while ensuring a steady supply of laborers, who were prohibited from settling permanently in "whites-

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only" areas. Patterns of migration have changed dramatically, however, in the last decade. With the lifting of apartheid laws, the emergence of trade unions that were able to negotiate more flexible work contracts, and the rapid development of an extensive, informal, but efficient transport infrastructure, people are able to move more freely than before, and HIV, like other infectious diseases that spread from person to person, follows the movement of people.[6]

Migration is one of many social factors that have contributed to the AIDS epidemic.[7,8] Several studies have shown that people who are more mobile or who have recently changed residence tend to be at higher risk for HIV and other sexually transmitted diseases (STDs) than people in more stable living arrangements.[9–12] In Uganda, people who had moved within the last 5 years were 3 times more likely to be infected with HIV than those who had lived in the same place for more than 10 years,[13] and in South Africa, people who had recently changed their residence were 3 times more likely to be infected with HIV than those who had not.[14] Decosas and others have argued that it is not so much the movement itself but rather the "conditions and structure of the migration process" that put people at risk for HIV and other STDs.[7]

The role of migration in the spread of HIV has been described primarily as a result of men becoming infected while they are away from home and infecting their wives or regular partners when they return. In a study of seasonal migration in Senegal, Pison argued that the virus was "mainly transmitted first to adult men through sexual contacts met during their seasonal migration and second to their wives or regular partners once they are back home."[9] Other studies have shown that men who live away from their wives or regular partners are more likely than those who live with their wives or regular partners to have additional sex partners[11] and are therefore more likely to become infected with HIV[11] or other STDs.[8]

However, the precise way in which migration contributes to the spread of STDs is complex and not well understood. Previous studies have focused on the destinations of migrants, or, less often, on the areas from which migrants come[15]; few studies have considered both ends of the migration process—those who leave home as well as those who remain behind. These studies therefore tend to give a static view of what is essentially a complex and dynamic process. Understanding both ends of migration routes is essential if targeted interventions are to be successfully implemented.

Methods

This study tested the hypothesis that migrants and their partners are at greater risk for HIV infection than are nonmigrants and their partners, and we investigated potential risk factors for HIV infection. We measured the prevalence of HIV-1, syphilis, chlamydia, and gonorrhea (although here we report only on HIV-1) among migrant men and their rural partners, as well as among nonmigrant men and their rural partners. We also conducted a behavioral survey with the same study participants to identify social, behavioral, and biomedical risk factors associated with HIV infection.

Between October 1998 and November 2000, male migrants from two adjacent rural districts (Hlabisa and Nongoma) were recruited at two migration destinations, Carletonville and Richards Bay (Figure 1), 700 km and 100 km away, respectively, from their rural homes. These sites were chosen because they are common destinations for migrant men from rural KwaZulu/Natal[2] and because they represent the two common types of migration prevalent in the area: long-distance migration with infrequent trips home (Carletonville) and short-distance migration with more frequent trips home (Richards Bay). Carletonville is a gold-mining town southwest of Johannesburg with a population of roughly 220,000 people, of whom 80,000 are migrant men living in single-sex hostels and working in the gold mines. Because of the distances involved, these men tend to return home only three to four times a year. Richards Bay, an industrial town on the north coast of KwaZulu/Natal, is also a common migration destination for these rural men, but because of the proximity to their rural homes, they are able to return home more frequently, on average at least once a month.

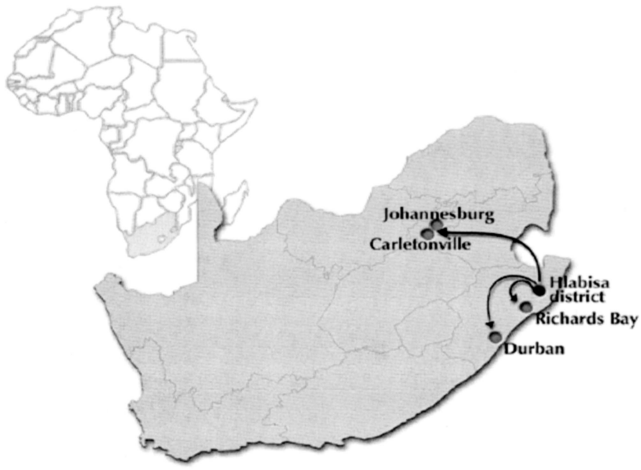

Fig. 1. Map of South Africa with study sites.

Three gold mines in Carletonville and three factories in Richards Bay were selected because they employ large numbers of people from the Hlabisa and Nongoma districts. Lists of workers' origins were generated through a census in Richards Bay and through a list provided by the Employment Bureau of Africa, the agency responsible for recruiting men to work in the gold mines. Men from the Hlabisa and Nongoma districts were invited to the project offices, where the purpose of the study was explained and they were invited to participate. Men were included only if they were from the Hlabisa/Nongoma districts, if they had been a migrant for at least 6 months, and if they had at least one "regular" partner living in Hlabisa/Nongoma. A regular partner was defined through prior focus group discussions[16] as a stable sex partner with whom one envisions a future (*maqondana*, in Zulu). Those who were eligible and who agreed to participate were administered a detailed questionnaire and offered voluntary counseling and testing for HIV and STDs.

In addition, migrant men were asked a series of questions in order to locate and identify their rural partners. These included questions about the name of the head of the rural household, the nearest clinic and school, and specific directions to the household of the migrant's rural partner. This information was sent to the project field office, where field-workers visited these women and invited them to participate in the study. Once a participating partner of a migrant man was identified, a nonmigrant couple living within a radius of one kilometer of each migrant household was identified and invited to participate in the study. A nonmigrant man was defined as a person who spends most nights at home and who had not been a migrant for a total of more than 6 months over the last 5 years. All women were residents of the Hlabisa/Nongoma districts and none were migrants. The number of men and women participating in the study was not equal because of refusal to participate and inability to trace some partners.

Structured, face-to-face interviews were held with each participant and included socioeconomic and demographic questions,

migration histories, details of stable (regular) and casual sex partnerships, condom use, age at sexual debut, and history of and health-seeking behavior for current or previous urogenital disease symptoms.

All participants were offered pretest and posttest HIV counseling, free condoms at each visit, and free treatment for symptomatic or laboratory-diagnosed STDs. Participants were encouraged to receive their HIV test results but were also given the option of not receiving them should they so desire.[17] Trained nurses treated symptomatic STDs at the time of enrollment, using the KwaZulu/Natal provincial syndromic management guidelines.[18] Laboratory-diagnosed syphilis, chlamydia, and gonorrhea were treated at 10-day follow-up visits. The presence of symptomatic STDs is a major risk factor for HIV transmission,[19] and treatment therefore is likely to confer some protection against HIV infection. Those who agreed to participate were followed-up every 4 months. In this article we present an analysis of the cross-sectional enrollment data.

Specimen Collection and Processing

Two milliliters of venous blood were taken from those who consented to participate and were tested for HIV-1 by means of the Determine Rapid Test (Abbott Diagnostics). Positive tests were confirmed by two additional ELISAs (HIV 1.2.0, Abbott/Murieux; Vironosticka HIV uniform 2 + 0, Omnimed). A random sample of 10% of the specimens that were negative on the Determine Test were also subjected to ELISA confirmation to validate the specificity of the testing methodology; all of those tests remained negative by ELISA. Specimens collected in Richards Bay and the Hlabisa and Nongoma districts were transported daily from the Hlabisa office to the laboratory in Durban. Specimens collected in Carletonville were flown nightly via courier to the same Durban laboratory.

The study was approved by the human subjects committees of The Johns Hopkins University School of Hygiene and Public Health and the University of Natal, Durban.

Data Management and Statistical Analysis

Data were double-entered and analyzed with SAS version 6.12 (SAS Institute, Cary, NC). The primary outcome was HIV-1 infection. The analysis was done separately by gender. Differences in quantitative variables were assessed with Student *t* test. Tests of significance for categorical variables were based on chi-square test or Fisher exact test, as appropriate. Logistic regression was used to estimate the adjusted odds ratios for HIV seropositivity. Confidence intervals are given as 95%. All *P* values were derived from two-sided tests. A *P* value of ≤ 0.05 was considered statistically significant.

Results

Between October 1998 and November 2000, 260 men and 228 women were recruited for the study; 196 migrant men from the Hlabisa/Nongoma districts were recruited at their workplaces, 64 nonmigrant men were recruited in Hlabisa/Nongoma, and 130 female partners of migrants and 98 female partners of nonmigrants were recruited in the Hlabisa/Nongoma districts. Not all study participants were matched to a partner because some partners refused to participate, and in some cases it was not possible to find the partner.

The overall prevalence of HIV-1 infection was 20.1%. Prevalence among men was not significantly different from that among women (22.7% versus 19.1%, respectively; $P = 0.34$; OR = 1.2; 95% CI = 0.80–1.93). The prevalence of HIV-1 among migrants and their partners, however, was significantly higher than among nonmigrants and their partners (24.0% versus 15.0%, respectively; $P = 0.02$; OR = 1.8; 95% CI = 1.1–3.0). Results are presented by gender.

Males

The sociodemographic and biomedical data for migrant and nonmigrant men are shown in Table 1. The median age was 39.1 years (mean = 37.4; SD = 8.4) and migrants were, on average, 6 years younger than nonmigrants ($P < 0.001$). Most men had some education, and migrants tended to be better educated than nonmigrants. Almost 40% of nonmigrants but only 20% of migrants had never attended school, while less than 20% of nonmigrants and nearly 30% of migrants had attended secondary school. Nearly all men were either married or living as married, with similar proportions among migrants and nonmigrants. Four men were widowed, divorced, or separated, and 14% were single, although, because of the study's enrollment criteria, the single men had to have at least one regular partner in Hlabisa/Nongoma. Migrant men were significantly more likely than nonmigrant men to derive an income from formal employment; all of the migrant men but only 43% of nonmigrant men had a formal income.

Almost all of the nonmigrant men lived with their wives or regular partners most of the time, while very few of the migrant men did. In Carletonville, all but three of the men lived in single-sex hostels provided by employers (data not shown), while in Richards Bay only three men lived in employer-provided accommodation, and the majority lived either alone (36%), with other workers (17%), or with relatives (22%).

Most men reported only one current regular sex partner, but about 30% of both migrant and nonmigrant men said that they had two or more regular partners. Nonmigrant men were more likely to have regular partners in Hlabisa/Nongoma, while migrant men were more likely to have regular partners outside of Hlabisa/Nongoma, mostly at their migration destination. Migrant men were significantly more likely ($P = 0.02$) than nonmigrant men to have at least one current casual partner, but only 20% of migrant men and 6% of nonmigrant men reported having one or more casual partners. Most of the men who had casual partners were migrants younger than 35 years of age. The median reported age of sexual debut for migrant men was 18 years, and for nonmigrant men, 19 years. Nonmigrant men reported a significantly higher number of lifetime partners than did migrant men, although this may be partly confounded by age.

Condom use was low; fewer than 20% of men in both groups reported that they had ever used a condom. Men who were younger than 35 years of age were significantly more likely than older men to have ever used a condom (OR = 2.4; 95% CI = 1.2–4.6), and men who reported having many casual partners were more likely than men who reported few casual partners to have ever used condoms. Compared to men who had no casual partners, the odds of ever having used a condom was 1.7 (95% CI = 1.1–2.7) for those who had one casual partner and 8.4 (95% CI = 1.5–49.0) for those who had four casual partners. Nonmigrant men were more likely than migrant men to have used condoms in regular relationships (10.9% versus 23.7%; $P = 0.04$).

Approximately one quarter of men said that they ever had a genital ulcer and 35% said they had ever experienced genital discharge. Approximately 7% of men said that they were experiencing ulcers, discharge, swollen testes, or swollen lymph nodes at the time of the survey. These symptoms were equally common among migrant and nonmigrant men.

The prevalence of HIV among migrant men was significantly higher than among nonmigrant men (25.9% versus 12.7%; $P =$

TABLE 1. Selected Sociodemographic and Sexual Behavior Variables for Migrant and Nonmigrant Men, Partners of Migrants, and Partners of Nonmigrants*

	Men			Women		
Variable	Migrant	Nonmigrant	*P* Value	Partners of Migrants	Partners of Nonmigrants	*P* Value
Mean age (y)	37.4	43.6		34.2	39.1	
SD	8.4	9.5	<0.001	8.4	11.0	<0.001
n	196	64		130	98	
Level of education						
(completed)	n = 192	n = 63		n = 128	n = 97	
None	39 (20.3%)	23 (37.5%)		22 (19.2%)	30 (30.9%)	
Grades 1–5	83 (43.2%)	27 (42.2%)	0.02	62 (48.4%)	45 (46.4%)	0.05
Grades 6–9	55 (28.6%)	12 (18.8%)		34 (25.6%)	19 (19.6%)	
Matric; Matric + Cert/Dip	15 (7.8%)	1 (1.6%)		10 (7.8%)	3 (3.1%)	
Current marital status	n = 191	n = 62		n = 127	n = 98	
Married—civil	55 (28.8%)	21 (33.3%)		40 (31.5%)	18 (18.4%)	
Married—traditional	80 (41.9%)	23 (38.1%)		55 (43.3%)	54 (55.1%)	
Unmarried but committed or living as married	23 (12.0%)	11 (17.5%)	0.59	8 (6.3%)	19 (19.4%)	0.001
Widowed/divorced/separated	3 (1.6%)	1 (1.6%)		0	0	
Single	30 (15.7%)	6 (9.5%)		24 (18.9%)	7 (7.1%)	
Total no. of current regular partners	n = 193	n = 64		n = 130	n = 98	
1	133 (68.9%)	40 (62.5%)		130 (100%)	97 (98.9%)	
2	42 (21.8%)	16 (25%)	0.54	0	1 (1.1%)	0.25
≥3	10 (5.2%)	6 (9.4%)		0	0	
Refused	8 (4.2%)	2 (3.1%)				
Total no. of current casual partners	n = 195	n = 64		n = 130	n = 98	
0	155 (79.9%)	60 (93.8%)	0.02	127 (97.6%)	98 (100%)	0.13
1	16 (8.3%)	3 (4.7%)		3 (2.3%)		
≥2	23 (11.8)	1 (1.6%)				
Age (y) at first sex	n = 158	n = 55		n = 94	n = 102	
Mean	18.2	18.7	0.07	17.6	17.1	0.19
SD	2.9	3.8		2.6	2.4	
No. of lifetime partners	n = 121	n = 56		n = 96	n = 91	
Mean	13.4	18.2	<0.0001	1.8	2.0	0.36
SD	13.1	23.4		1.3	1.8	
Condoms						
Ever used	32/182 (17.6%)	14/63 (22.2%)	0.41	14/123 (11.4%)	11/93 (11.8%)	0.92
Ever used with wife	6/92 (6.5%)	5/56 (8.9%)	0.59	10/96 (10.4%)	6/76 (7.9%)	0.57
Ever used in regular relationship	14/129 (10.9%)	9/38 (23.7%)	0.04	3/25 (12%)	5/17 (29.4%)	0.16
Ever used in casual relationship	12/56 (21.4%)	0/6 (0%)	0.21	2/2 (100%)	0/0	
STD history: ulcer						
Currently	7/191 (3.7%)	1/63 (1.6%)	0.41	5/128 (3.9%)	3/96 (3.9%)	0.76
In last 4 mo	21/194 (10.8%)	4/63 (6.3%)	0.29	16/124 (12.9%)	5/90 (5.6%)	0.07
Ever	45/192 (23.4%)	21/63 (33.3%)	0.12	34/128 (26.6%)	20/98 (20.4%)	0.28
STD history: discharge						
Currently	2/192 (1.0%)	0/64 (0%)	0.41	11/127 (8.7%)	11/96 (11.5%)	0.49
Last 4 mo	10/193 (5.2%)	1/64 (1.6%)	0.38	39/122 (31.9%)	15/88 (17.1%)	0.02
Ever	82/191 (42.9%)	23/64 (35.9)	0.33	64/128 (50%)	35/97 (36.1%)	0.04
One or more STD symptoms†						
Currently	15/192 (7.8)	3/64 (4.7)	0.39	26/128 (20.3%)	21/98 (21.4%)	0.84
Last 4 mo	34/194 (17.5)	6/64 (9.4)	0.12	56/130 (43.1%)	28/98 (28.6%)	0.03
Ever	95/192 (47.9)	29/64 (45.3)	0.56	84/128 (65.6%)	50/98 (51.0%)	0.03

*Participants with unknown response, with "don't know" response, or who refused to answer were excluded.
†One or more of the following symptoms: ulcer, discharge, swollen testes, swollen lymph nodes.

0.03; OR = 2.4; 95% CI = 1.1–5.3), and the prevalence was higher among migrant men than among nonmigrant men when stratified according to age (Table 2), although the individual within-age-group differences were not statistically significant because of the limited sample size.

Table 3 shows univariate analyses for risk factors associated with HIV infection. The most important risk factors for HIV among men were being a migrant, being <35 years old, having one or more casual partners, having symptoms of STDs in the last 4 months, and ever having used a condom. Those with current

TABLE 2. Age-Specific HIV Prevalence (%) for Migrant and Nonmigrant Men, Partners of Migrants, and Partners of Nonmigrants

Group	% HIV$^+$ (n)		
Men: Age (y)	22–34	35–49	50–66
Migrant	33.8% (77)	21.2% (99)	17.7% (17)
Nonmigrant	22.2% (9)	13.8% (36)	5.6% (18)
Women: Age (y)	18–34	35–49	50–66
Partners of migrants	25.7% (70)	15.1% (53)	20% (5)
Partners of nonmigrants	34.5% (29)	7.6% (53)	14.3% (14)

STD symptoms, symptoms in the last 4 months, or a history of STD symptoms were more likely to be HIV-infected than those who had never had STD symptoms. Those who had ever used condoms were more likely to be HIV-positive than those who had not. The probability of being infected with HIV was not significantly associated with income, education, lifetime number of partners, age at sexual debut, or the number of places lived over the course of a lifetime.

A multivariate, forward-stepwise logistic regression was carried out, including all those variables that were found to be significant in the univariate analysis, as well as other variables of potential importance, leading to the model given in Table 4. In the multivariate analysis the risk of HIV infection remains higher among migrants than among nonmigrant men (OR = 2.65; $P = 0.026$), among those who report recently having STD symptoms (OR = 2.09; $P = 0.029$) and among those who have lived in more than four places (OR = 3.56; $P = 0.001$) rather than only one place. Having lived in four or more places was not significant on bivariate analysis but became significant in the multivariate model. Those who said that they have ever used condoms were also at greater risk of HIV infection than those who said that they had not (OR = 2.18; $P = 0.045$), but this is confounded by the fact that those who reported having used condoms were also likely to have had more casual partners than those who said that they had never used condoms.

Females

Of the 228 women recruited for the study, 130 were partners of migrants and 98 were partners of nonmigrants (Table 1). Because of the study design, none of the women were migrants. The women were, on average, about 4 years younger than their male partners. The level of education of women was similar to that of their male partners; a quarter of women had had no formal education, and 23.5% had had at least some secondary education. Partners of migrants were significantly more educated than the partners of nonmigrants ($P = 0.05$). Few women in either group were formally employed. The partners of migrants were significantly more likely than partners of nonmigrants to receive financial support from their partners, which is to be expected since men still migrate largely for economic reasons. Nevertheless, only half of the partners of migrant men said that they received financial support from their partner.

As with the men, most of the women were married or living as married; 19% of the regular partners of migrants and 7% of the regular partners of nonmigrants said that they were single ($P = 0.01$). Only one woman said that she had more than one regular partner, and only three women said that they had any casual partners. The median age at sexual debut, 17 years, was 1 year younger for women than for men. Women reported having, on average, only two lifetime partners, fewer than reported by the men, suggesting that they had ever had only one partner apart from their current regular partner.

Reported use of the male condom was lower among women than it was among men ($P = 0.07$); almost 90% of women said that they had never used a condom. Women who reported ever having used a condom had slightly more lifetime partners than women who had never used a condom (1.9 versus 2.0; $P = 0.096$).

STD symptoms were also common among women, with 24% saying that they had ever had a genital ulcer and 44% that they had ever experienced a discharge. Two thirds of all women said that they had experienced discharges, ulcers, and/or swollen lymph nodes, and partners of migrants were more likely to have experienced these symptoms than partners of nonmigrants ($P = 0.03$).

HIV infection was more frequent in partners of migrants than partners of nonmigrants (21.1% and 16.5%, respectively), although these differences were not statistically significant ($P = 0.39$). Among the youngest group of women (Table 2), HIV infection prevalence was higher for partners of nonmigrants (34.5%) than partners of migrants (25.7%); again, this difference was not significant ($P = 0.39$). In the two older age groups, partners of migrants had a higher prevalence of HIV infection than partners of nonmigrants; these differences were not significant.

Table 3 shows risk factors for HIV infection among women. The strongest association was with the number of lifetime partners: women who reported having had more than one lifetime sex partner were five times more likely to be infected with HIV than women who said that they had only had one lifetime partner (OR = 5.1; 95% CI = 2.2–11.5). Age was also a significant risk factor for HIV, with younger women more likely to be infected than older women (OR = 2.3; 95% CI = 1.2–4.5). Women who reported having sexual intercourse for the first time at or before the age of 17 years were more likely to be HIV-positive (24.5%) than those who reported a later age at sexual debut (14.3%), although this was only marginally significant ($P = 0.07$; OR = 2.0; 95% CI = 1.0–4.1).

The prevalence of HIV among women was not significantly associated with being the partner of a migrant, receiving financial support from the husband or regular partner, level of education, STD symptoms, or ever having used a condom. Women who had used a condom were as likely to be HIV-infected as those who had not.

Table 4 shows the results of the multivariate forward-stepwise logistic regression model for women. Young women, and those who had had more than one lifetime partner, were at particularly high risk of infection.

Discussion

The exceptionally high prevalence of HIV in most southern African countries has raised important and complex questions about the factors that have contributed to the rapid spread of HIV in the region and about the eventual prevalence the epidemic might reach. This cross-sectional, community-based study of migrant and nonmigrant men and their rural partners has revealed a very high

TABLE 3. HIV Prevalence (%) in Relation to Important Risk Factors, for Men and Women*

Variable	n	% HIV+	*P*	OR (95% CI)
Men				
Migrant				
Yes	193	25.9	0.03	2.4 (1.1–5.3)
No	63	12.7		
Monthly income ($)				
0–2000	163	23.3	0.73	0.9 (0.5–1.7)
2000+	79	25.3		
Age (y)				
≤35	95	30.5	0.02	2.0 (1.1–3.6)
>35	161	18.0		
Level of education†				
None	61	18.0	0.73	0.87 (0.4–1.9)
Grades 1–5	110	26.4	0.43	1.3 (0.7–2.5)
Grades 6–10+	81	22.2	1	
No. of lifetime partners				
≤5	52	15.4	0.23	0.6 (0.3–1.4)
>5	124	23.4		
No. of regular partners				
1	170	22.9	0.81	1.1 (0.6–2.0)
≥2	74	24.3		
No. of casual partners				
0	212	19.8	0.001	2.7 (1.4–5.3)
≥1	43	37.2		
Age at first intercourse (y)				
≤17	81	25.9	0.33	1.4 (0.7–2.7)
>17	129	20.2		
STD symptoms				
Ever	131	27.5	0.07	1.7 (0.95–3.1)
Never	122	18.0		
STD symptoms currently				
Yes	18	38.8	0.09	2.3 (0.9–6.2)
No	238	21.4		
STD symptoms, last 4 mo				
Yes	40	42.5	0.001	3.2 (1.6–6.3)
No	216	19.0		
Condom use				
Ever	36	32.6	0.03	2.3 (1.1–4.8)
Never	196	19.8		
Number of places lived, lifetime				
<4	150	22.0	0.77	1.3 (0.7–2.3)
≥4	106	23.6		
Women				
Partner of Migrant				
Yes	128	21.1	0.39	1.4 (0.7–2.7)
No	97	16.5		
Monthly income from husband				
Yes	101	14.9	0.18	1.6 (0.8–3.2)
No	123	21.9		
Age (y)				
≤35	110	25.5	0.02	2.3 (1.2–4.5)
>35	114	13.2		
Level of education†				
None	50	18.0	0.42	0.7 (0.3–1.7)
Grades 1–5	107	16.8	0.23	0.6 (0.3–1.4)
Grades 6–10+	66	24.2	1	
No. of lifetime partners				
1	92	7.6	0.001	5.0 (2.2–11.5)
>1	93	29.0		
Age at first intercourse (y)				
≤17	102	24.5	0.07	2.0 (1.0–4.1)
>17	92	14.3		
STD symptoms				
Ever	133	20.3	0.56	1.2 (0.6–2.4)
Never	92	17.4		
STD symptoms currently				
Yes	47	19.1	0.99	1.0 (0.4–2.3)
No	178	19.1		
STD symptoms last 4 mo				
Yes	84	23.8	0.17	1.6 (0.8–3.1)
No	141	16.3		
Condom use				
Ever	25	28.0	0.27	0.6 (0.2–1.5)
Never	188	18.6		

*Participants with unknown response, with "don't know" response, or who refused to answer were excluded.
†Reference group: grades 6–10+.

TABLE 4. Multiple Logistic Regression Model for HIV Prevalence Among Men and Women

Variable	*P*	OR	95% CI
Men*			
Migration status	0.026	2.65	1.12–6.26
STD symptoms in last 4 mo	0.029	2.09	1.69–7.53
Lived in 4 or more places	0.001	3.56	1.08–4.06
Ever used a condom	0.045	2.18	1.02–4.67
Women†			
No. of lifetime partners >1	0.033	1.26	1.02–1.58
Age ≤35 y	0.036	2.46	1.07–5.65
STD symptoms in last 4 mo	0.042	2.29	1.03–5.11

*Hosmer and Lameshow Goodness of Fit statistic = 4.7304 with 7 *df* (*P* = 0.693).
†Hosmer and Lameshow Goodness of Fit statistic = 9.2394 with 6 *df* (*P* = 0.1606).

prevalence of HIV among both men and women. The study provides evidence of the importance of migration in the spread of HIV in southern Africa and shows that migration is a significant risk factor for HIV-1 for men.

For men, being a migrant and having lived in four or more places were independent and significant risk factors for HIV-1 infection. Thus, not only is labor migration—with its associated separation of families—an important risk factor for HIV-1 transmission, but so too is the social disruption caused by repeated relocation, in some cases forced as a result of apartheid policies and political violence.

These findings are particularly interesting, given the mature stage of the southern African HIV/AIDS epidemic. It is likely, for example, that the role of migration in the spread of HIV was more important—and more easily measured—in the early stages of the epidemic than in the later stages.[20] Indeed, isolating a single causal factor in a mature epidemic, when prevalence is already very high, was likely to be difficult. The fact that the odds of a migrant man being infected was 2.4 times the odds of a nonmigrant man being infected, even at this advanced stage of the epidemic, highlights the importance of migration as one explanation for the size and rapidity of spread of the southern African epidemic.

For women, being a partner of a migrant confers a slight but not statistically significant risk for being HIV-infected. There are several possible reasons why the higher rates of HIV observed among migrant men versus nonmigrant men do not translate into significantly higher rates among their rural partners. The study was not powered to measure a 5% difference in HIV prevalence between partners of migrants and partners of nonmigrants, but whether a larger sample size would confirm a difference is unclear. The fact that, for young women, HIV prevalence was higher among partners of nonmigrants than among partners of migrants shows that there is transmission occurring in the rural areas, regardless of the migration status of the women's partners. This conclusion is supported by the patterns of HIV-1 discordance among these same couples.[21] In addition, the fivefold increased risk for HIV infection among women reporting more than one lifetime partner suggests that women are more likely to be infected by someone other than their regular partner.

Since most research on migration and AIDS has taken place only at male migration destinations and has excluded the rural end of the migratory routes, there has been a suggestion that interventions for migrants should be targeted at male migration destinations. Indeed, operational issues, including the ease of finding and following people, make this an attractive option. Our findings, however, demonstrate the complexity of HIV transmission in the presence of large-scale male migration and the need to address the spread of disease, especially among young rural women—not just women living in migrant relationships. What has not been acknowledged to date is the role of local, rural transmission in this complex epidemic. The findings of this study show that it is important to include rural areas if HIV treatment and prevention programs are to succeed in reducing the spread of HIV. In addition, further work is necessary to more fully explore the complex patterns of sexual networking, particularly among women in rural areas. Some of this work is under way within the context of the current project.[16]

By design, this study included only women who were not migrants. This was partly for operational reasons, since tracing women to many different rural districts would have been logistically challenging. Nevertheless, it raises important questions about whether female migrants are at increased risk for HIV infection and the extent to which nonmigrant, rural women who are infected became infected as a result of contact with returning migrants as opposed to contact with men who are resident in the rural communities. The latter question cannot be answered with the available data, but in a study carried out in a township near Carletonville, women who were self-identified as being migrants were 1.6 times more likely (95% CI = 1.1–2.3) to be HIV-positive than women who were self-identified as not being migrants.[22]

This study also shows that migrant men were significantly more likely than nonmigrant men to have casual sex partners and to be HIV-positive. That more men than expected reported currently having no casual partners may indicate underreporting or that casual relationships are of short duration. For women, there was a marked reluctance—for obvious social reasons, including the fear of violence—to admit to having additional sex partners. It is likely that, in keeping with the findings of other behavioral surveys,[23] women in this study underreported the extent of their own sexual networks. The reluctance of women to speak openly about whether they had casual relationships—even in qualitative interviews—has already been documented in this setting.[2,16] For example, Dladla found that women spoke of *others* taking on additional sex partners, although few would acknowledge having done so themselves. It is likely that this reluctance would be further exacerbated in the more formal setting of a survey. Further research and perhaps the development of additional methods for the study of female sexual behavior in rural areas are urgently needed to shed more light on social arrangements that underlie the complex epidemiologic patterns identified in this study.

Findings in this study about the age at sexual debut and the number of lifetime partners were consistent with those of other South African studies.[24,25] A community-based survey in Carletonville[25] found the age at first sex to be slightly younger (a year for girls, a year and a half for boys) than in our own study, but this may be a result of the urban composition of the former study's sample. The Carletonville study also found similar high rates of reported STD symptoms and numbers of lifetime and casual partners.[25]

The high rates of self-reported STD symptoms may highlight a possible target for intervention strategies. Successful syndromic management of symptomatic STDs can significantly reduce the incidence of HIV[19] and should be a central component of HIV infection prevention programs in this setting.[26] In addition, presumptive STD treatment among sex workers in some South African gold mines has been reported to reduce the prevalence of STDs among miners.[27]

Although this study focused only on male circular migration within South Africa, from the perspective of two rural health districts, circular migration is in fact extremely common through-

out southern Africa. It is important to recognize, however, that other types of migration do exist and may play an important role in facilitating the dissemination of HIV throughout the southern African region. Further studies that focus on other types of migration—particularly female migration—are urgently needed.

Finally, the value of HIV prevalence data in isolating risk factors is limited, given the difficulty of interpreting the complex temporal relationship. Incidence data from this ongoing cohort study will therefore be useful in validating the current findings.

The high prevalence of HIV among migrant men indicates that this group is an appropriate target for focused intervention strategies. At the same time, migrant interventions that concentrate exclusively at the workplace are likely to have only limited success, given that a significant amount of HIV transmission among rural women occurs irrespective of the migration status of a woman's partner. Interventions are most likely to be effective if they include both men at the workplace and women in rural communities.

Despite the fact that migrancy is acknowledged to be a major determining factor in the social conditions in the region,[28] few studies have explicitly considered the impact that migrancy has on the health of people, even though the health consequences of migration may be critical to health outcomes. This study highlights the importance of migrancy as a risk factor for HIV and probably other diseases[28] and the need to fully incorporate a good understanding of public health in studies on migration.

It is ironic that the lifting of apartheid laws has led to increased mobility throughout southern Africa and has contributed to the spread of HIV in the region. However, while migration spreads disease, it can also be used to spread messages and interventions that can positively impact on the epidemic. Unless ways are found to deal with the combined effects of HIV and migration, it is unlikely that HIV transmission in southern Africa will be substantially reduced.

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