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HIV infection dynamics in rural Andhra Pradesh south India: A sexual-network analysis exploratory study

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Abstract

The southern state of Andhra Pradesh (AP) has one of the highest rates of HIV-1 infection in India. Estimates of HIV infection in rural areas have begun to approximate the urban. Methods of HIV transmission in rural India are poorly understood. We examined risk factors for HIV transmission in a group of rural villages in AP through the use of a sexual-network analysis survey—the Indian Health and Family Life Survey (IHFLS). The study sample included 20 HIV-positive and 40 HIV-negative matched controls randomly selected from a population-based, voluntary counselling and testing program in rural AP. HIV-1 status was confirmed by Western Blot. The 405-item IHFLS is based upon the National Health and Life Survey which has been validated in the US and China. The sample mean age was 37 years and 22% were of a tribal caste. Among female respondents, none were commercial sex workers (CSWs) and there were no significant social or behavioral associations with HIV infection. Among male respondents, ever having bought sex and having more than one lifetime partner were found to be significantly associated with HIV infection ($p = 0.002$ and $p = 0.017$). Amongst sub-populations, all men who had sex with men (MSM) were married. Tribals were more likely to report a concurrent sexual relationship ($p = 0.04$). All high-risk men, including MSM, men who buy sex and men with multiple lifetime female partners did not use condoms. Public health interventions aimed at reducing HIV transmission in rural AP should consider targeting sub-populations of men who engage in covert MSM or CSW, high-risk tribal caste members and at-risk wives.

Introduction

Situated in the middle of the country, AP, with a population of nearly 80 million, is one of six 'high-prevalence' states in India, defined as those in which HIV prevalence rates exceed 5% among high-risk groups and 1% among antenatal women (National AIDS Control Organization [NACO], 2004a).

Approximately 75% of the population in AP live in rural areas (Census, 2001) with recent estimates describing HIV infection rates approximating the urban (Maniar, 2000; NACO, 2004b). Despite this, there is little understanding of patterns of spread in these areas and few studies that describe risk factors for HIV infection in rural areas of India (Pallikadavath et al., 2005; Solomon et al., 1998). In urban areas, HIV transmission is thought to be predominantly heterosexual in nature and monogamous women married to high-risk partners are increasingly becoming infected (Gangakhedkar et al., 1997; Mehta et al., 2006; Newmann et al., 2000). Recent descriptions of MSM suggest that this may be contributing to HIV transmission in rural areas (Dandona et al., 2005; Verma & Collumbien, 2004), however, at-risk tribal sub-populations are often not included (Verma & Collumbien, 2004) and formal studies including HIV testing in this population have only occurred in the context of urban slums (Go et al., 2004). Concern for spread of HIV infection into vulnerable rural tribal sub-populations has been raised (Naik et al., 2005; Thomas & Bandyopadhyay, 1999).

Methods

Setting

This study built upon a recent community-based voluntary counseling and testing (VCT) program that took place in rural Ranga Reddy district in AP. With a population of 43,000, the study site included the 35 villages surrounding the major healthcare

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delivery center, Mediciti Hospitals. This center is located 40 kilometers from Hyderabad city, the state capital, and is considered by Indian governance to be rural (Census, 2001).

Study population

The VCT program used existing infrastructure, with community health volunteers providing information about the program from door to door in all villages of the catchment area. Voluntary counseling and testing and HIV awareness and education was provided daily over the program period and included both day and nighttime programs. Between 2003 and 2004, 5511 participants in the program from surrounding villages were screened for HIV infection. Fifty-three were found to be HIV-infected (0.96%), including thirty-four men and nineteen women (Saluja, 2004).

Following the completion of the VCT program, cases and controls were randomly selected from the total population participating in the program. Cases included ten HIV-infected men and ten HIV-infected women. Twenty male and female controls each were selected from the uninfected VCT participants and matched according to age and village of residence.

Data acquisition

All sixty subjects were re-tested for HIV-1 and HIV-2 using three sequential ELISAs (Genscreen HIV 1/2, Bio-Rad; Detect—HIV, Adaltis; HIV Tri-Dot, Biotech Inc.). Positive results were confirmed via Western Blot (HIV Blot 2.2, Genelabs Diagnostics Pvt Ltd).

The survey instrument, IHFLS, is based upon the Chinese Health and Family Life Survey, a 405-item sexual-network survey covering eighteen domains most recently used in a large population-based sexual-network study in China (Parish et al., 2003). The domains include items on personal health, demographic characteristics, attitudes towards marriage and sex, sexual partner information, sexual behavior, childhood sexual experiences, sexual harrassment and same-sex relationships. Caste grouping was based on the four recognized caste groups: 'other caste', 'backwards caste', 'scheduled caste' and 'scheduled tribe'. The majority of individuals in the 'scheduled tribe' group in this region self-identify as 'Banjara' or 'gypsy' and comprise nearly one quarter of the population. The IHFLS was translated bi-directionally from English to Telugu by experienced case managers who were knowledgable in the local dialect and language comprehension. Written informed consent was obtained from each respondent prior to starting the interview.

Statistical analysis

Conditional logistic regression matching on gender, age and village of residence was used to estimate the odds ratio (OR) and corresponding 95% confidence interval (CI) for the relationship between the dichotomous HIV outcome and potential HIV risk factors. If the conditional logistic regression model did not converge, non-conditional logistic regression was then performed. For analysis of contingency tables with less than five observations per cell, two-sided Fisher's exact test was used to estimate the significance between the HIV outcome and categorical risk factor. For bivariate analyses that included all subjects, regardless of case or control designation, χ^2 tests were performed for categorical outcomes and two-sided t-tests for continuous outcomes. Statistical analyses were performed with SAS software (version 8.2; SAS Institute, Cary, NC) and p values <0.05 were considered statistically significant.

Results

Criteria for matching had comparable values in the cases and controls at baseline (Table I). All cases were infected with HIV-1.

Following the patrilocal pattern for the area, women were more likely than men to be born in another village, 86.7% versus 48.3% ($p=0.004$), more likely to receive less than a primary education, 86.7% versus 56.7% ($p=0.01$) and more likely to never have worked, 26.7% versus 0% ($p<0.0001$). In bivariate analyses, there were no significant differences between case and control groups with regards to sociodemographic characteristics after stratification by gender, however, there were some differences in other potential HIV risk factors between male cases and controls (Table II). Notably, for women, there were no additional selected known risk factors for HIV acquisition including attributes of their partner: employment type, income, time spent away from home or history of sexually transmitted diseases (data not shown). Furthermore, none of the female cases or controls reported ever having received a gift or money in exchange for sex.

For men, ever having bought sex and having more than one lifetime sexual partner were found to be significantly associated with HIV infection, $p=0.002$ and $p=0.017$ respectively. There was a non-statistically significant trend towards increased risk of HIV infection for men who were remarried divorced or widowed (OR 8.0; 95%CI: 0.69–92.70), reported a genital lesion (OR 4.75; 95%CI: 0.38–60.15) or

Table I. Sociodemographic characteristics (30 men and 30 women).

	Cases $n=20$		Controls $n=40$		OR*	(95%CI)
Age (mean, SD)	34.6 (12.9)		38.6 (11.2)		0.97	0.92–1.02
Gender	*n*	%	*n*	%	1.0	0.34–2.93
Female	10	50	20	50		
Male	10	50	20	50		
Caste					1.09	0.40–2.99
Other caste	3	15.0	5	12.5		
Scheduled caste	2	10.0	8	20.0		
Backwards caste	10	50.0	19	47.5		
Scheduled tribe	5	25.0	8	20.0		
Education					0.74	0.11–4.90
> Primary	6	30.0	11	27.5		
≤ Primary	14	70.0	29	72.5		
Birthplace						0.75–6.89
Outside this village	7	35.0	22	55.0	2.27	
This village	13	65.0	18	45.0		
Occupation type					1.00	0.34–2.93
Non-agriculture	9	47.4	19	47.5		
Agriculture	10	52.6	21	52.5		
Monthly income					0.80	0.26–2.45
>1,000 rupees ($23)	7	38.9	11	32.4		
≤1,000 rupees	11	61.1	23	67.6		
Overnight travel past year					1.44	0.34– 6.11
Never to less than a month	16	80.0	34	85.0		
More than a month	4	20.0	6	15.0		

*Conditional Logistic Regression

reported homosexual feelings (OR 4.75; 95%CI: 0.38–60.15). There was 0% condom usage amongst men who reported buying sex. Sexual-network examination for men traditionally thought to be at higher risk for HIV infection can be seen in Figure 1. All of these men (8/8) were married and all to individuals of the same caste. Seven out of eight of these men (87.5%) were found to be HIV-positive. All men who reported homosexual thoughts or having sex with other men uniformly had one female partner, their wife. All MSM reported multiple same-sex encounters and denied use of condoms during anal intercourse.

Our sample included 21.7% tribal individuals designated as belonging to the 'scheduled tribe' caste. Tribal individuals demonstrated a trend towards having less education (OR 0.16; 95%CI: 0.019–1.36), however they had equivalent income when compared to non-tribals (OR 0.93; 95%CI: 0.24–3.64). When compared to non-tribals, tribals demonstrated a non-significant trend towards having more lifetime sexual partners (5 versus 1.1 [$p=0.36$]) and were more likely to report a concurrent sexual relationship during their current relationship (22% versus 0% [$p=0.04$]). However, tribals were not at increased risk of HIV infection when compared to non-tribals (OR 0.75; 95%CI: 0.21–2.68).

Discussion

In this exploratory sexual-network analysis within the context of a case-control study, we found that risk factors for HIV in this rural region are similar to that of Indian urban areas. Men who had multiple sex partners, or who paid for sex, were more likely to be infected with HIV than those who did not (Brahme et al., 2005; Rodrigues et al., 1995). Our findings also mirror those of larger studies in adjacent states that demonstrate infection among presumably low-risk monogamous women (Gangakhedkar et al., 1997; Newmann et al., 2000). Our sample is unique however, in that it is rural and community-based and includes rural tribal individuals, a marginalized sub-population of Indian society that is thought to be increasingly vulnerable to HIV infection (Murhekar et al., 2005; Naik et al., 2005; Thomas & Bandyopadhyay, 1999).

Our study was limited by the small sample size. Some important factors with a large point estimate of the association (OR) were not statistically significant in the models, which does not mean that there are no associations. This was especially true in regards to characteristics of sex partners such as occupation. Furthermore, this limited our ability to create more powerful multivariate regression models to control for potential confounding variables. There is the possibility that our results from analyses of

Table II. Potential predictors of HIV infection in rural Andhra Pradesh stratified by gender.[1]

	Female			Male		
Characteristic	Cases $n=10$	Controls $n=20$	OR (95%CI)	Cases $n=10$	Controls $n=20$	OR (95%CI)
Personal relationships						
Marital status (N, %)			2.666 (0.50–14.22)	n(%)*		8.000 (0.69–92.70)
Remarried/divorced/widowed	4 (40)	4 (20)		3 (33)	1 (6)	
First marriage	6 (60)	16 (80)		6 (67)	16 (94)	
Condom use in past year (N, %)			0.429 (0.09–2.051)			2.692 (0.261–27.82)
Yes	5 (50)	6 (30)		1 (13)	5 (28)	
No	5 (50)	14 (70)		7 (88)	13 (72)	
Life time sexual partners > 1month (N, %)			$p=0.33$†			$p=0.017$†
0–1	9 (90)	20 (100)		4(57)	17 (100)	
2 or more	1 (10)	0 (0)		3 (43)	0 (0)	
General health						
Genital lesion in the past year (N, %)			$p=0.33$†			4.75 (0.38–60.15)
Yes	1 (10)	0 (0		2 (20)	1 (5)	
No	9 (90)	20 (100)		8 (80)	19 (95)	
Hypodermic needle exposure (N, %)			2.154 (0.356–13.049)			0.47 (0.027–8.46)
Yes	8 (80)	13 (65)		9 (90)	19 (95)	
No	2 (20)	7 (35)		1 (10)	1 (5)	
Sexual consumption						
Used sexually explicit media (N, %)			$p=0.333$†			0.64 (0.13–3.25)
Yes	1 (10)	0 (0)		3 (30)	8 (40)	
No	9 (90)	20 (100)		7 (70)	12 (60)	
Bought sex (N, %)			–			$p=0.002$†
Yes	0 (0)	0 (0)		5 (50)		0 (0)
No	10 (100)	20 (100)		5 (50)		20 (100)
Received money or gift for sex (N, %)			–			–
Yes	0 (0)	0 (0)		0 (00)	0 (0)	
No	10 (100)	20 (100)		5 (50)	20 (100)	
Men who have sex with men						
Homosexual feelings (N, %)						4.75 (0.38–60.15)
Yes	–			2 (20)	1 (5)	
No	–			8 (80)	19 (95)	
Sex with other men (N, %)						2.11 (0.12–37.72)
Yes		–		1 (10)	1 (5)	
No		–		9 (90)	19 (95)	

[1]Conditional and unconditional logistic regression models.
*Percentages rounded to the nearest whole number.
†Fischer exact test.

sub-populations such as MSM and tribals may change given a greater sample size. However, many of our findings, such as HIV risk factors for men, are similar to those that have been found in urban settings. The remainder of our findings, such as potential differences in tribal sexual-network patterns, which may also include MSM, have not been previously explored or reported. These latter findings must be validated in larger population-based studies in rural settings that include vulnerable sub-populations.

This study is the first to describe HIV infection in tribals. This is important, as tribals are potentially at increased risk for HIV or hepatitis B infection given less access to healthcare, lower education and potential differences in sex partnering (Bhattacharjee

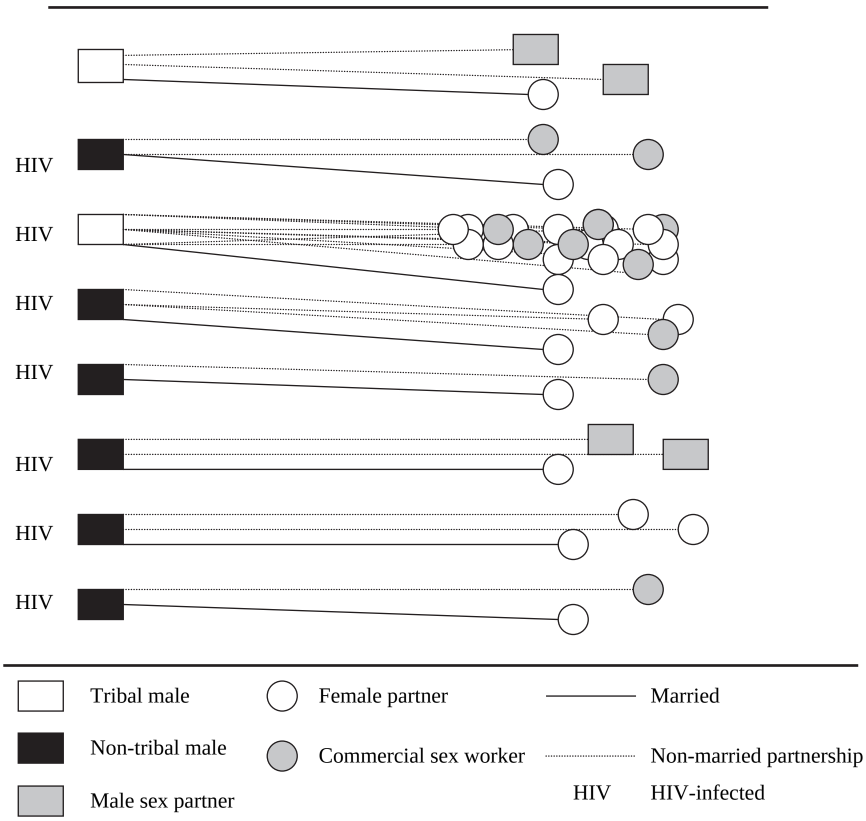

Figure 1. Sexual matching patterns of men with multiple lifetime female partners, men who have sex with men and men who buy sex.

et al., 2000; Kumar et al., 1995). In one study (Naik et al., 2005), tribal communities did not have a structured marital system; instead members practiced a form of serial monogamy in which they changed partners and remarried every four to five years. Additionally, 35% of the respondents reported either premarital or extramarital affairs and 20% of the male participants reported having had sex with a CSW during the period when his wife had had a child. In our sample there were also increased numbers of concurrent sex partners amongst tribals, most often with CSWs, and a trend towards increased numbers of lifetime sex partners. While there was not an increase in HIV infection amongst tribals, HIV is now prevalent within this component of the caste system and may be further exacerbated by the continued lack of shift of health preventive resources from urban to rural areas (Patil et al., 2002). It is important to note, however, that tribals are a heterogeneous population even within this study's 'Banjara' sub-group, and sexual matching patterns and risk for HIV infection may differ between tribal sub-groups. Comprehensive information on sexual practices amongst tribals are often not available (Singh, 1992) or, when present, may be outdated (Thurston, 1909). Interdisciplinary efforts that include anthropologic and sociologic research methods may help us better understand the sexual-networks and determinants of HIV infection amongst tribals.

There appears to be a different network for MSM in our rural sample compared to traditional western networks or those previously described in urban slums in India (Go et al., 2004), where a homosexual identity may predominate. In our rural sample, all individuals who reported same sex thoughts or activity were married and reported only one lifetime female sex partner. This is also in contrast to other reports that suggest increased extramarital sex with women amongst MSM when compared to other married men (Verma & Collumbien, 2004). This finding may be due to local differences in sexual practices. The multiple same-sex partners, non-commercial nature of the interaction and low condom use in our sample follow findings in other settings (Dandona et al., 2005; Go et al., 2004; Verma & Collumbien, 2004). For example, none of the MSM engaging in anal sex in another sample reported condom use (Verma & Collumbien, 2004). We also demonstrated a complete lack of condom usage amongst MSM, as well as men who paid for sex. As in other contexts, condom use remains quite low in men paying for sex (Basu et al., 2004) or in men engaging in anal sex (Dandona et al., 2005). This finding may be exacerbated in rural areas where a lack of access to healthcare compounds this situation (Pallikadavath et al., 2005), with the closest access to condoms often being kilometers away. However, increased access to condoms may not necessarily predict uptake. Use of condoms may be illogical or socially unacceptable in the Indian context, especially amongst heterosexual couples (Bhattacharya, 2004). Creative and novel methods of HIV prevention must be developed in rural settings where the majority of HIV infection exists in India. These modalities must target all segments of the population that often overlap, including monogamous women, MSM and marginalized sub-populations.

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