Correlates of HIV Infection Among Transfemales, San Francisco, 2010: Results From a Respondent-Driven Sampling Study

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Objectives. We evaluated the use of respondent-driven sampling (RDS) among a high-risk population of transfemales. We also obtained up-to-date epidemiological data on HIV infection and related correlates among this population.

Methods. We evaluated the utility of RDS in recruiting a sample of 314 transfemales in San Francisco, California, from August to December 2010 by examining patterns of recruitment and assessing network sizes and equilibrium. We used RDS weights to conduct bivariate and multivariate analyses of correlates of HIV infection.

Results. The sample had moderate homophily and reached equilibrium at the eighth wave of recruitment. Weighted HIV prevalence among transfemales was 39.5%. Being a transfemale of color, using injection drugs, and having low educational attainment were independently associated with HIV infection and having a high number of sexual partners and identifying as female were not.

Conclusions. RDS performed well and allowed for analyses that are generalizable to the population from which the sample was drawn. Transfemales in San Francisco are disproportionately affected by HIV compared with all other groups except men who have sex with men who also inject drugs. (*Am J Public Health.* 2013;103:1485–1492. doi:10.2105/AJPH.2012.301109)

Over the years, many words have been coined to describe individuals born male who identify as female whether they engage in gender transition or enhancement procedures. These words have included "male-to-female transgender," "transgender women," and "transwomen." In some cases, these individuals no longer label themselves as "trans" but rather label themselves solely as "female" or "women." Furthermore, words such as "women" and "woman," with their adult association, may alienate adolescent individuals who feel their gender is something other than the one they had at birth. A community process was undertaken in San Francisco, California, to agree on the most inclusive terms. "Transfemales" was thought to capture the spectrum of male-to-female transgender identities while also respecting trans people along the age spectrum. In this article, we have used the word "transfemales" throughout, but we should note that participants identified both as transfemales and as females.

Available data on transfemales have suggested extremely high prevalence and incidence of HIV.[1] A study carried out by the San Francisco Department of Public Health in 1997 found HIV prevalence among transfemales who inject drugs to be 51.4%—the highest prevalence of any population ever studied in San Francisco—and 26.4% among transfemales who were not injection drug users (IDUs).[2] Analysis of voluntary counseling and testing data published in 2001 found HIV incidence to be the highest of any population measured in San Francisco at 13.2% per year among transfemale IDUs and 6.2% per year among transfemale non-IDUs.[3] Studies have also shown high rates of sexually transmitted infections among transfemales, particularly gonorrhea and syphilis.[4]

As of December 2010, 194 living AIDS cases and 123 HIV/non-AIDS cases among transfemales had been reported in San Francisco.[5] Case reporting conducted by the San Francisco Department of Public Health illustrates the racial/ethnic diversity among transfemales affected by HIV/AIDS. In cumulative reported cases, 29% were White, 31% were Black, 30% were Latino, and 10% were of some other race.[5] However, limitations exist to our understanding of HIV prevalence among transfemales on the basis of AIDS and HIV/non-AIDS case reporting alone. Private physicians may not always correctly record transfemales' gender identity in medical charts, and how many transfemales are misclassified as men who have sex with men or as women is unclear. Underreporting and misclassifications may be common, thus inhibiting accurate reporting of HIV/AIDS diagnoses among transfemales.[6]

On the basis of the available information, San Francisco's Centers for Disease Control and Prevention–funded HIV Prevention Community Planning Group ranked the transfemale population as the highest priority for HIV prevention funding for 2004–2008.[7] Despite the high priority for HIV prevention among transfemales in San Francisco, the population has not become a part of the Centers for Disease Control and Prevention's national HIV behavioral surveillance system. Yet updated, basic epidemiological data on the prevalence and incidence of HIV among transfemales are needed to determine whether prevention strategies have worked and to plan future efforts at the local level. Unfortunately, studies among transfemales to date have limited external validity because they have primarily been based on convenience samples.[1] To our knowledge, few studies have been conducted that could reliably represent the transfemale population. This omission has been understandable—obtaining representative data in hard-to-reach and often hidden populations, especially transfemales, is challenging. Although the 1997 San Francisco Department of Public Health study was rigorous in obtaining

a sample size of more than 300, it did not use population-based sampling methods.[2] Thus, our secondary aim was to assess the suitability of using a respondent-driving sampling (RDS) study among transfemales. In an effort to fill this gap in data and assess the use of RDS among transfemales, the San Francisco Department of Public Health conducted the Transfemales Empowered to Advance Community Health (TEACH) study to gather up-to-date and representative data on HIV prevalence, HIV incidence, and related risk behaviors among transfemales.

METHODS

Sampling for TEACH was conducted from August to December 2010. Study participants were recruited using RDS as a method to obtain a robust and diverse sample of hard-to-reach populations.[8–11] After a formative assessment phase, which included key informant interviews with transfemales, service providers, and health department staff, we selected 11 diverse (e.g., age, race/ethnicity, education, geography, and risk behaviors) transfemales to function as recruiter "seeds." They were asked to recruit as many as 3 participants, who in turn were asked to recruit a subsequent wave of as many as 3 participants, and so on, until sample size was reached and equilibrium was achieved on key variables. Recruitment of the entire sample was completed in 20 weeks with a mean of 6 recruitment waves for active seeds (range = 1–15). Each participant was given 3 to 5 recruitment coupons or cards with study information to hand to potential recruits, and the coupon return rate was 36.8%. A total of 319 individuals were presented with a recruitment coupon, 318 were screened (99.6%), and 303 (95.3%) were eligible. Individuals were eligible for the study if they (1) self-identified as male-to-female or transfemale, (2) were aged 18 years or older, and (3) reported living in San Francisco. Each study participant was screened for study eligibility before enrollment. Verbal informed consent was obtained before starting the behavioral survey. Interviewers administered surveys using hand-held computers. Rapid HIV testing was offered to all participants regardless of self-reported HIV status. Positive rapid HIV tests were confirmed using standard laboratory methods.

TABLE 1—Seed Characteristics, Transfemales: San Francisco, CA; August–December 2010

Seed ID	Race	Income, $	Education	Age, Years	Waves, No.	Recruits, No.
A	Native Hawaiian	21 000–39 999	High school	≥ 46	4	5
B	Latino	≤ 20 999	High school	26–45	3	5
C	White	≤ 20 999	High school	18–25	0	0
D	Latino	40 000–50 999	High school	≥ 46	10	20
E	Black	21 000–39 999	High school	26–45	15	208
F	Black	40 000–50 999	High school	26–45	0	0
G	Asian	≤ 20 999	<high school	26–45	3	8
H	White	21 000–39 999	High school	≥ 46	10	50
I	Asian	40 000–50 999	College	≥ 46	3	5
J	White	21 000–39 999	High school	≥ 46	0	0
K	Native Hawaiian	21 000–39 999	College	≥ 46	1	2

We evaluated recruitment processes by examining homophily, mean network size (MNS), waves of recruitment, crude sample stability by week of recruitment, and equilibrium by wave of recruitment. An RDS sample must fulfill a number of conditions to be considered for RDS estimation. Homophily describes the tendency of individuals in a group to recruit others like themselves, with −1 = all recruitments are people who are different, 0 = no tendency toward like or unlike, and 1 = the tendency is to recruit those only like themselves.[8] Homophily is used to adjust for biases in recruitment. Heckathorn[8] suggested that a moderate homophily is desirable because it indicates low levels of bias in recruitment. Additionally, we used Netdraw version 2.075 (Analytic Technologies, Lexington, KY) to visually examine recruitment chains for homophily. MNS is also used in RDS adjustment. MNS measures probability of inclusion in a given study; higher MNS suggests a greater chance of inclusion than a low MNS.[8] Waves of recruitment are measured to assess whether a given RDS sample has fulfilled the RDS assumption of increasing randomness suggested by Markov chain theory. Finally, an RDS sample must reach stability in regard to key variables that are proxies for network composition. We measured stability in 2 ways. First, during accrual of our crude sample we tracked sample composition for stability over week of recruitment. Second, after the sample was completed we examined composition for stability over wave of recruitment. We focused on race/ethnicity of our RDS sample for these metrics because a priori knowledge and information from our formative assessment suggested that networks of transfemales in San Francisco that were strongly based on race/ethnicity would play a key role in the accrual of a diverse sample of transfemales.

We conducted analyses using SAS version 9.2 (SAS Institute, Cary, NC) and RDS Analysis Tool (RDSAT) version 6.0 (D. Heckathorn, Ithaca, NY; http://www.respondentdrivensampling.org). RDSAT adjusts for the probability of inclusion for each individual on the basis of reported social network size and for

TABLE 2—Seed, Sample, and Estimated Population Proportions, Mean Network Size, and Homophily by Race/Ethnicity, Transfemales: San Francisco, CA; August–December 2010

Race/Ethnicity	Seeds, %	Sample, %	Estimated Population, %	Network Size, Mean	Homophily
Asian	18	6.7	4.5	7.4	0.30
Black	18	28.0	22.4	8.6	0.48
White	27	16.6	17.5	6.8	0.26
Latino	18	30.6	38.1	7.0	0.63
Other	18	18.2	17.5	7.2	0.15

TABLE 3—Crude and RDS-Weighted Characteristics Among Transfemales: San Francisco, CA; August–December 2010

Characteristic	Crude (n = 314), No. (%)	Weighted, % (95% CI)
Race/ethnicity		
Asian	21 (6.7)	4.5 (1.5, 6.5)
Black	88 (28.0)	22.4 (14.1, 31.6)
White	52 (16.6)	17.5 (11.5, 25.1)
Latino	96 (30.6)	38.1 (26.2, 50.5)
Other	57 (18.2)	17.5 (11.6, 23.8)
Age, y		
18–20	5 (1.6)	1.6 (0.3, 3.5)
21–25	26 (8.3)	7.7 (4.3, 12.6)
26–30	31 (9.9)	9.3 (5.4, 13.3)
31–35	25 (7.9)	9.2 (5.8, 13.7)
36–40	46 (14.7)	16.6 (11.7, 21.5)
41–45	59 (18.8)	19 (14.2, 24.3)
46–50	51 (16.2)	14.2 (10.0, 19.4)
> 50	71 (22.6)	22.4 (15.8, 27.9)
Education		
< high school	84 (26.8)	30.6 (23.6, 36.3)
High school	198 (63.1)	62.2 (55.5, 69.6)
Some college	23 (7.3)	4.5 (2.4, 7.2)
College graduate	9 (2.9)	2.8 (0.9, 5.3)
Postgraduate	0 (0)	. . .
Income (yearly), $		
< 21 000	263 (83.8)	86.5 (81.9, 90.9)
21 000–39 999	42 (13.4)	11.2 (7.4, 16.3)
40 000–50 000	7 (2.2)	1.5 (0.1, 3.1)
51 000–75 000	1 (0.3)	0.4 (0, 0.9)
> 75 000	1 (0.3)	0.4 (0, 1.1)
Born in the United States		
Yes	222 (70.7)	71.6 (61.6, 81.7)
No	92 (29.3)	28.4 (18.3, 38.4)
Sex assigned at birth		
Male	313 (99.7)	99.4 (99.1, 100.0)
Not assigned	1 (0.3)	0.6 (0, 0.9)
Current gender identification		
Male	0 (0)	. . .
Female	150 (47.8)	48.1 (41.0, 55.5)
Transfemale	164 (52.2)	51.9 (44.5, 59.0)
Living full time as a woman		
Yes	285 (90.8)	88.7 (83.3, 93.9)
No	29 (9.2)	11.3 (6.1, 16.7)
Ever taken hormones		
Yes	292 (92.9)	93.2 (89.9, 96.3)
No	22 (7.1)	6.8 (3.7, 10.1)

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differential recruitment patterns within a given characteristic.[9] These adjustments allow for inference to be made to the population from which the sample was drawn. For bivariate and multivariate analysis, individualized RDS weights are exported from RDSAT and appended to the dataset in a statistical software program, in our case SAS. We then used the weights in SAS to conduct RDS weighted analysis. Statistics such as odds ratios and the χ^2 test are not available in RDSAT. We calculated individualized weights on the basis of HIV status in RDSAT, then exported and merged them with the crude data set for bivariate and multivariate analysis.[10]

RESULTS

Including the 11 seed participants, the final crude sample consisted of 314 transfemales. We provide detailed characteristics of seeds in Table 1. The majority of seeds had a high school education and were aged 46 years or older. Younger seeds were difficult to recruit, as evidenced by this study having only 1 seed aged 18 to 25 years. This seed did not produce any recruits. As in many RDS studies, the majority of recruitment stemmed from 1 or 2 seeds. Seed E produced the majority of recruits (208), and seed H produced 50 recruits. These 2 chains were reasonably long at 15 and 10 waves, respectively.

In Table 2, we show the racial/ethnic composition of our study at various points in recruitment. Although 18% of our seeds were Asian, only 6.7% of our crude sample was Asian, whereas the overall composition of transfemales in San Francisco was estimated to be 4.5%. Of note, with the exception of Whites, seed race/ethnicity was evenly distributed (18% of seeds in each category; 27% for Whites), and our sample grew to unique proportions of each race/ethnicity. We also show mean network size and homophily by race. Asian and White participants had a moderate positive homophily (approximately 0.3), suggesting a moderate tendency to recruit others of the same race. Latino and Black participants had a stronger positive homophily (approximately 0.6 and 0.5, respectively) suggesting a greater tendency to recruit others of the same race/ethnicity. Of note, Black transfemales had

TABLE 3—*Continued*

Ever had gender surgery		
Yes	73 (23.2)	21.1 (15.2, 26.4)
No	241 (76.8)	78.9 (73.6, 84.8)
Commercial sex work past 6 mo		
Yes	43 (13.7)	11.3 (7.1, 15.3)
No	271 (86.3)	88.7 (84.7, 92.9)
Has health insurance		
Yes	267 (85)	84.5 (79.8, 89.6)
No	47 (15)	15.5 (10.4, 20.2)
Ever injected substances not prescribed		
Yes	99 (31.5)	32.5 (25.5, 39.4)
No	215 (68.5)	67.5 (60.6, 74.5)
Injected in past 12 mo		
Yes	32 (10.2)	11.8 (7.3, 17.3)
No	282 (89.8)	88.2 (82.7, 92.7)
Alcohol use past 12 mo		
Yes	217 (69.1)	66.4 (59.4, 74.0)
No	97 (30.9)	33.6 (26.0, 40.6)
Non–injection drug use past 12 mo		
Yes	136 (43.3)	42.1 (35.1, 49.6)
No	178 (56.7)	57.9 (50.4, 64.9)
Arrested past 12 mo		
Yes	31 (9.9)	9.8 (5.9, 13.6)
No	283 (90.1)	90.2 (86.4, 94.1)
Ever hepatitis C		
Yes	65 (20.7)	22.8 (17.2, 28.8)
No	249 (79.3)	77.2 (71.2, 82.8)
Sex partners past 6 mo		
0	64 (20.4)	22.1 (15.6, 28.8)
1	74 (23.6)	23.6 (18.3, 30.0)
2	42 (13.4)	14.1 (9.7, 18.8)
3	36 (11.5)	11.8 (7.9, 16.3)
4	11 (3.5)	4.6 (1.6, 7.6)
≥ 5	87 (27.7)	23.9 (17.89, 29.3)
HIV-positive, self-report	99 (31.5)	36.2 (29.0, 45.3)
HIV-positive, tested	110 (35)	39.5 (31.8, 47.8)

Note. CI = confidence interval; RDS = respondent-driven sampling.

the second highest tendency to recruit among themselves (0.48) and the largest MNS (8.6) suggesting that Black transfemales made up a large number of the crude sample and may be slightly overrepresented.

These tendencies to recruit from among the same racial/ethnic group are also visually displayed in Figure A (available as a supplement to the online version of this article at http://www.ajph.org). Figure A shows long chains of recruitment within Black and Latina transfemales while also showing shorter chains among Whites. Finally, we focus on crude sample stability and equilibrium. Stability was reached in age, income, education, commercial sex work, IDU status, born in the United States, neighborhood, HIV status, and race/ethnicity during recruitment. We feature stability in terms of race/ethnicity in Figure B (available as a supplement to the online version of this article at http://www.ajph.org). In terms of both recruitment by week (crude sample stability) and wave (equilibrium), our sample became generally stable in terms of race/ethnicity at week 6 and wave 7 of recruitment.

Overall Demographic and Risk Characteristics

Table 3 shows crude and RDS-weighted characteristics of transfemales in San Francisco. Overall, RDS weighting appears to have had the largest effect on race/ethnicity, living full time as a woman, and HIV status by both self-report and laboratory testing. Our RDS-weighted estimates suggest that the population of transfemales in San Francisco was 38.1% Latino (95% confidence interval [CI] = 26.2, 50.5), 22.4% Black, 17.5% each for White and other race, and 4.5% Asian. The majority of transfemales were older than 35 years, had a high school education or less, had incomes of $21 000 or less per year, were born in the United States, and were born male or assigned to male sex at birth. About half identified as female or transfemale each, and a majority (88.7%; 95% CI = 83.3, 93.9) were living full time as a woman. A majority had taken hormones to enhance their gender presentation (93.2%; 95% CI = 89.9, 96.3), and fewer than one quarter (21.1%; 95% CI = 15.2, 26.4) had engaged in surgical procedures to enhance their gender presentation. A majority of transfemales in San Francisco also had health insurance (84.5%; 95% CI = 79.8, 89.6). Only about one tenth (11.3%; 95% CI = 7.1, 15.3) of transfemales had engaged in sex work in the past 6 months. About two thirds had ever injected substances not prescribed by medical professionals (32.5%; 95% CI = 25.5, 39.4), and 11.8% (95% CI = 7.3, 17.3) had injected in the past 12 months. Alcohol (66.4%; 95% CI = 59.4, 74.0) and non–injection drug use (42.1%; 95% CI = 35.1, 49.6) in the past 12 months were high among transfemales in San Francisco. Prevalence of hepatitis C was also high among transfemales in San Francisco (22.8%; 95% CI = 17.2, 28.8). Only about one quarter (23.9%; 95% CI = 17.9, 29.3) had more than 4 sex partners in the past 6 months. Finally, self-reported HIV prevalence was estimated to be 36.2% (95% CI = 29.0, 45.3), and tested HIV prevalence was estimated to be 39.5% (95% CI = 31.8, 47.8) among transfemales in San Francisco. This finding suggests that only approximately 3% of HIV

TABLE 4—RDS-Weighted Bivariate Associations With HIV Infection Among Transfemales: San Francisco, CA; August–December 2010

Variable	HIV-Negative, %	HIV-Positive, %	*P*
Race/ethnicity			
Asian	6.9	4.8	< .001
Black	13.3	46.3	
White	27.6	4.6	
Latina	29.7	32.3	
Other	22.6	11.9	
Age, y			
18–20	2.0	1.1	.01
21–25	10.2	4.4	
26–30	8.9	8.0	
31–35	5.3	15.0	
36–40	12.9	17.3	
41–45	12.5	21.4	
46–50	18.2	11.2	
> 50	29.9	21.6	
Education			
< high school	28.0	36.0	.04
High school	61.3	61.5	
College graduate	7.1	1.7	
Postgraduate	3.6	1.0	
Income (yearly), $			
< 21 000	85.3	87.9	.2
21 000–39 999	12.3	11.4	
40 000–50 000	2.4	0.01	
51 000–75 000	0	0	
> 75 000	0	100	
Born in United States			
Yes	65.9	78.4	.02
No	34.1	21.6	
Sex assigned at birth			
Male	100	99.4	.3
Not assigned	0	0.7	
Current gender identification			
Female	56.4	33.7	< .001
Transfemale	43.6	66.3	
Living full time as a woman			
Yes	91.1	87.6	.3
No	9.0	12.4	
Ever taken hormones			
Yes	97.2	88.0	.002
No	2.8	12.0	
Ever gender surgery			
Yes	30.0	9.2	< .001
No	70.0	90.8	

Continued

infections were unrecognized (i.e., not yet diagnosed).

Associations With HIV Infection

RDS-weighted bivariate analysis (Table 4) has suggested that HIV-positive status is significantly associated with race/ethnicity, and Black and Latina transfemales had the highest HIV prevalence ($P<.001$). HIV-positive status is also significantly associated with older age ($P=.01$), having a high school or less education ($P=.04$), being born in the United States ($P=.02$), identifying as a transfemale versus female ($P<.001$), ever taking hormones ($P=.002$), never having gender-enhancing surgery ($P<.001$), having health insurance ($P=.02$), not having injected in the past 12 months ($P=.001$), and having 1 sexual partner in the past 6 months ($P=.001$).

In RDS-weighted multivariate analysis of demographics and risk behaviors adjusted for all variables in the model, being any race/ethnicity other than White, having less than a high school education, identifying as transfemale, and injection drug use in the past 12 months remained significantly associated with HIV infection (Table 5). Black transfemales had the highest odds (adjusted odds ratio [AOR] = 29.9; $P<.001$) of being HIV infected compared with White transfemales. Transfemales with less than a high school education (AOR = 9.4; $P=.02$) and a high school education (AOR = 11.4; $P=.01$) had higher odds of being HIV infected than did those with a college education. Age as a correlate of HIV infection was not significant but suggested that transfemales aged 31 to 35 years (AOR = 11.7; $P=.07$) and 36 to 40 years (AOR = 10.5; $P=.08$) may have greater odds of being HIV infected than do other age groups. We found no significant associations with HIV infection in terms of number of sexual partners in the past 6 months with the exception of having 5 or more partners, which was negatively associated with HIV infection (AOR = 0.3; $P=.005$).

DISCUSSION

In San Francisco, HIV prevalence among transfemales is higher than in any other behavioral risk population except men who have sex with men who are IDUs. These data

TABLE 4—*Continued*

Commercial sex work past 6 mo			
Yes	9.5	11.9	.5
No	90.5	88.1	
Has health insurance			
Yes	82.4	91.5	.02
No	17.6	8.5	
Ever injected substances not prescribed			
Yes	29.3	35.6	.2
No	70.7	64.4	
Injected in past 12 mo			
Yes	6.8	16.5	.001
No	93.2	83.5	
Alcohol use past 12 mo			
Yes	63.1	66.6	.5
No	36.9	33.4	
Non–injection drug use past 12 mo			
Yes	38.9	40.9	.7
No	61.1	59.1	
Arrested past 12 mo			
Yes	7.3	9.5	.5
No	92.7	90.5	
Ever hepatitis C			
Yes	23.1	24.8	.7
No	76.9	75.2	
Sex partners past 6 mo			
0	31.5	17.3	.001
1	20.1	28.9	
2	11.3	16.1	
3	7.3	18.3	
4	3.7	2.3	
≥ 5	26.1	17.0	
Any unprotected vaginal intercourse			
Yes	2.2	0.4	.2
No	97.8	99.6	
Any unprotected anal intercourse			
Yes	24.5	31.9	.2
No	75.5	68.2	

Note. RDS = respondent-driven sampling. Weighted with individualized weights generated for HIV status in RDS Analysis Tool.

showed an upward trend in HIV infection in the transfemale population when compared with previously collected data. The 2001 study by Clements-Nolle et al.[2] of 392 transfemales in San Francisco found that 35% of the sample was HIV-positive. Similar to patterns of HIV prevalence among men who have sex with men and in other studies of transfemales, Black transfemales were at elevated risk for HIV compared with other racial/ethnic groups.[5,12]

In our multivariate analysis, race/ethnicity other than White remained significantly associated with HIV-positive status, as did injection drug use in the past 12 months and having less than a high school education, which were all factors that remained independently associated with HIV risk in the study by Clements et al.[5] Interestingly, lower numbers of sexual partners were associated with HIV infection. Transfemales have been found to be most at risk in main rather than casual and commercial partnerships.[5,12] Transfemales in our study who had fewer partners may have been most at risk because they were in main partnerships, which may suggest a protective effect of not having a main partner. However, analyses were not conducted by partnership type so we cannot conclude that transfemales in this sample were most at risk when in main partnerships. Further analysis of partnerships may elucidate this finding.

Our study was unique in finding that those who identify as transfemale as opposed to female are more likely to be HIV infected. The relationship between lower HIV risk and identification as female may be an indicator of the protective effect of gender transition processes. As such, this finding points to the potential importance of access to gender-related services for reducing HIV infections among this population. Although only marginally significant, transfemales in the group aged 31 to 40 years were more likely to be HIV infected than were other age groups. Findings from this study on age group correspond with aggregate data of national estimates showing those aged 30 to 44 years have the highest percentage of diagnosed HIV/AIDS cases.[13] Evidence among men who have sex with men has similarly shown increasing incidence among those in their 40s and older.[14] Most importantly, the numerous variables that remained significant in the multivariate analysis of these data speak to the complexity of determining what factors have the most impact on HIV risk among transfemales.

An interesting phenomenon we observed from recruitment was that few participants were Asian. The ability to "pass" more readily than transfemales of other racial/ethnic groups has been observed among some Asian/Pacific Islander (API) transfemales.[15] Being able to pass as female helps transfemales avoid the negative effects of stigma, and to maintain a nonstigmatized status, Asian transfemales may not socially network with other transfemales.[16] In fact, some researchers have reasoned that Asians' ability to pass explains their relatively low rates of engagement in HIV risk behavior and higher socioeconomic status.[15] Although we have inadequate data to corroborate such findings, research on gender identity and social networking within the transfemale

TABLE 5—RDS-Weighted Adjusted Multivariate Associations With HIV Infection Among Transfemales: San Francisco, CA; August–December 2010

Variable	AOR (95% CI)	*P*
Race/ethnicity		
Asian	16.8 (2.9, 96.3)	.002
Black	29.9 (8.9, 100)	< .001
White (Ref)	1.0	
Latina	10.9 (2.8, 42.4)	< .001
Other	4.4 (1.3, 14.8)	.02
Age, y		
18–20 (Ref)	1.0	
21–25	1.5 (0.09, 24.0)	.8
26–30	2.7 (0.2, 39.5)	.5
31–35	11.7 (0.8, 173.5)	.07
36–40	10.5 (0.7, 150.6)	.08
41–45	8.6 (0.6, 118.6)	.1
46–50	3.0 (0.2, 43.2)	.4
> 50	4.1 (0.3, 55.9)	.3
Education		
< high school	9.4 (1.4, 62.3)	.02
High school	11.4 (1.8, 72.6)	.01
College graduate (Ref)	1.0	
Postgraduate	5.4 (0.2, 134.4)	.3
Born in the United States	1.8 (0.7, 4.5)	.2
Current gender identification		
Female	0.5 (0.3, 0.9)	.05
Transfemale (Ref)	1.0	
Ever taken hormones	0.3 (0.1, 1.3)	.11
Ever gender surgery	0.5 (0.2, 1.2)	.1
Injected in past 12 mo	7.3 (2.4, 22.2)	< .001
Sex partners past 6 mo		
0	0.4 (0.2, 11.0)	.07
1 (Ref)	1.0	
2	1.3 (0.4, 3.9)	.7
3	2.1 (0.7, 6.0)	.2
4	0.6 (0.1, 4.1)	.6
≥ 5	0.3 (0.1, 0.7)	< .001

Note. AOR = adjusted odds ratio; CI = confidence interval; RDS = respondent-driven sampling. Weighted with individualized weights generated for HIV status in RDS Analysis Tool and adjusted for all other variables in the model.

community may make important contributions to understanding why certain racial/ethnic groups are more affected by HIV than others and more likely to participate in research.

Although all transfemales are at higher risk for HIV infection than other at-risk groups, HIV prevention programs should focus on the highest risk segments of the population such as Black transfemales. In their call for multicomponent interventions for transfemales, Operario and Nemoto[16] recently hypothesized that transfemales' risk for HIV is embedded in a syndemic of poor mental health, substance use, violence, discrimination, and economic hardship resulting from having a transgender identity. These authors have argued that HIV-protective behaviors are low on transfemales' priority list because their competing needs are immediate. If multicomponent interventions are the answer for prevention of HIV among transfemales, then data are needed to determine which syndemic factors have most impact on HIV risk and how, especially for Black transfemales. One important step toward obtaining such data is to prioritize transfemales for routine behavioral surveillance surveys to establish trends in HIV infection and identify associated risks in this population.

We have demonstrated that RDS is a suitable sampling method for transfemales residing in an urban area. We met several of the basic criteria for an RDS study, and equilibrium was achieved in key variables, specifically race/ethnicity; long recruitment chains were possible; homophily was generally moderate; and the probability of inclusion (represented by mean network size) was similar in many variables, particularly race/ethnicity.

This study is not without limitations. First, although this study is the first successful RDS among transfemales, we acknowledge that certain subpopulations of transfemales, particularly API transfemales, may have been underrepresented in our crude sample and as a consequence did not provide the RDS estimators with enough data to accurately infer population parameters of all transfemales. Thus, our data may be more accurately said to represent transfemales in San Francisco with the exception of API transfemales. Future studies using RDS must endeavor to increase participation of API transfemales by choosing more API seeds and raising awareness in the API transfemale community. Second, as with all cross-sectional studies, we cannot determine what behaviors are most likely contributing to HIV infection in this population. Nonetheless, our study does provide correlates of infection that may assist in planning for HIV prevention and care.

Despite these limitations, we have shown the acceptability and feasibility of conducting RDS among transfemale populations and have demonstrated that obtaining data that can be used to describe high-risk populations of transfemales is feasible. With a more accurate understanding of the population and the risks they engage in, those involved in HIV prevention planning and HIV prevention intervention development have a better chance of addressing the particular needs of this high-risk and underserved population. ■

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Contributors

H. F. Raymond, J. Rapues, T. Packer, and G. N. Colfax designed, implemented, and supervised the conduct of this study. E. C. Wilson and H. F. Raymond conducted analyses. J. Rapues, T. Packer, G. N. Colfax, E. C. Wilson, and H. F. Raymond contributed to the writing and editing of initial drafts and approved the final draft of the article.

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Human Participant Protection

This study received human participants review and approval from the University of California, San Francisco's Committee on Human Research. All participants provided informed consent to participate in this research.

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