Revolving Doors: Imprisonment Among the Homeless and Marginally Housed Population

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Objectives. We studied a sample of homeless and marginally housed adults to examine whether a history of imprisonment was associated with differences in health status, drug use, and sexual behaviors among the homeless.

Methods. We interviewed 1426 community-based homeless and marginally housed adults. We used multivariate models to analyze factors associated with a history of imprisonment.

Results. Almost one fourth of participants (23.1%) had a history of imprisonment. Models that examined lifetime substance use showed cocaine use (odds ratio [OR] = 1.67; 95% confidence interval [CI] = 1.04, 2.70), heroin use (OR = 1.51; 95% CI = 1.07, 2.12), mental illness (OR = 1.41; 95% CI = 1.01, 1.96), HIV infection (OR = 1.69; 95% CI = 1.07, 2.64), and having had more than 100 sexual partners were associated with a history of imprisonment. Models that examined recent substance use showed past-year heroin use (OR = 1.65; 95% CI = 1.14, 2.38) and methamphetamine use (OR = 1.49; 95% CI = 1.00, 2.21) were associated with lifetime imprisonment. Currently selling drugs also was associated with lifetime imprisonment.

Conclusions. Despite high levels of health risks among all homeless and marginally housed people, the levels among homeless former prisoners were even higher. Efforts to eradicate homelessness also must include the unmet needs of inmates who are released from prison. (*Am J Public Health.* 2005;95:1747–1752. doi:10.2105/AJPH.2005.065094)

People who were homeless at the time of arrest are overrepresented in prisons.[1] Additionally, homeless populations include higher proportions of former prisoners compared with the general population,[2] and inmates who are released from prison have a high risk for homelessness.[3–5] The association between homelessness and imprisonment is bidirectional: imprisonment may precipitate homelessness by disrupting family and community contacts and by decreasing employment and housing prospects.[5–7] Homelessness may increase the risk for imprisonment through shared risk factors and through increased likelihood of arrest.

Both substance abuse and mental illness are important risk factors for homelessness and imprisonment.[7–16] Homeless persons who have mental health and substance abuse disorders have low rates of receipt of treatment for their disorders.[17] Mentally ill inmates are more likely to have been homeless in the year before their arrest than non–mentally ill inmates,[1] and inmates who had been homeless were more likely to be mentally ill than inmates who had not been homeless immediately before their arrest.[18] Homelessness also increases the risk for recidivism among former prisoners.[19]

Homeless and prison populations have high rates of communicable diseases because of poor health, unsafe sexual practices, illicit drug use, and close living quarters.[20–23] Among homeless mentally ill persons, those who have a history of incarceration have elevated rates of psychiatric problems and substance abuse disorders.[24] It is not known whether homeless persons who have a history of imprisonment are more likely to have poor health status and to be more at-risk for infectious disease than homeless persons who do not have a history of imprisonment. We hypothesized that homeless persons who had a history of imprisonment would have higher rates of substance abuse disorders, mental health disorders, physical health problems, and illegal activities than those who did not have a history of imprisonment. We assessed a sample of homeless and marginally housed individuals to compare whether persons who had a history of imprisonment differed from persons who did not have a history of imprisonment regarding (a) lifetime health and illegal activities and (b) current health and illegal activities.

METHODS

Sampling Design

Our sample was composed of homeless and marginally housed adults in San Francisco, Calif. During a 12-month period beginning in April 1999, we surveyed 1426 English-speaking adults in 5 overnight shelters (50 adults per night minimum), 6 midday free-meal programs (100 adults at least 3 days per week minimum), and 28 low-income residential hotels (sampled with probability proportional to size). We included residential hotels in low-income San Francisco neighborhoods that rented rooms for less than $400 per month. We conducted systematic sampling within each sampling venue.

We invited recruits to participate in a comprehensive interview that was conducted at or near each sampling site. Rather than record names or other personal identifying information, we created a unique study ID code for each respondent, which was used to eliminate duplicate participants. Shelter and meal program recruits received a $20 cash incentive; hotel recruits received $25. We did not find significant gender or racial/ethnic differences between participants and nonparticipants.

Instrument

Trained interviewers conducted a structured interview (average = 45 minutes). We assessed background characteristics, including age, gender, racial/ethnic self-identification, education, marital/partner status, and income from all sources during the past 30 days. We defined health status by asking participants to

report their current perceived health status with a five-point scale; we dichotomized responses into "fair or poor" health and "excellent, very good, and good" health. After pretest counseling and receipt of informed consent, we tested all participants for HIV infection with enzyme-linked Immunosorbent assay (ELISA) antibody testing and Western blot confirmation (Unilab, Tarzana, Calif).

Imprisonment

We asked participants whether they had ever been in prison and, if so, how much time they had spent in prison, their last release date, and their current probation or parole status. We defined a lifetime history of imprisonment as having reported a prison stay in state or federal penitentiaries (we did not include incarceration in jails).

Housing status. Participants were given a 12-month follow-back calendar, with important dates as a guide, to identify types of places where they spent the night during the past 12 months and the number of nights spent in each type of place. We defined participants who spent at least 90% of nonincarcerated/nonhospitalized nights in a hotel, apartment, or private home *and* who spent no nights on the street or in a shelter as marginally housed. Anyone who had fewer than 90% of nonincarcerated nights in a hotel, apartment, or private home and who had spent any time staying on the streets or in shelters was defined as homeless. We also asked participants about their lifetime history of homelessness.

Substance use, sexual behaviors, and mental health. Participants were asked about their drinking history, including whether or not they thought that they had a drinking problem during the past year or ever. Those who said yes were classified as having an alcohol problem during the past year or ever.

We asked participants about their use of illicit drugs, including crack cocaine, cocaine, heroin, methamphetamines, other opiates (for which the participant did not have a physician's prescription, including illicit methadone), and use of injection drugs. We also asked participants whether they used these drugs during their lifetime and, if so, whether they had used illicit drugs during the past year. We classified those who reported any of these activities as having used illicit drugs.

Participants were asked about their sexual behaviors, including whether they had opposite and/or same-sex partners and how many partners they had (0–5, 6–10, 11–25, 26–50, 51–100, and >100). We considered those in the highest quintile of numbers of sexual partners as having high numbers of sexual partners.

Lastly, we asked participants whether they had ever been admitted to an inpatient psychiatric facility and whether they had been admitted during the past year. These answers were used as proxies for mental illness.

Sources of Income

Participants were asked to identify all sources of income during the past 30 days.

Details about the sampling strategy and the interview methods have been published elsewhere.[22,25,26]

Analysis

We tested for bivariate and multivariate associations with a lifetime history of imprisonment. We analyzed the association with lifetime history of behaviors to determine whether homeless and marginally housed persons who had a history of imprisonment also had different behavior patterns from those who did not have a history of imprisonment. We then analyzed the association with current behaviors to determine whether any differences persisted after release from prison. We used the Wilcoxon rank sum test for continuous variables and the χ^2 test for categorical variables to test for bivariate associations. Variables for the multivariate analyses were chosen on the basis of our hypotheses that persons who have a history of imprisonment will have worse health and mental health status and higher rates of drug use and multiple sexual partners ($P<.05$ in bivariate analyses). We tested for multicollinearity with Pearson correlation coefficients, and we validated final models with the Hosmer–Lemeshow test. All analyses were conducted with unweighted data.

RESULTS

We enrolled 1426 of 2029 respondents (response rate=70.3%); 1325 participants had complete data on imprisonment and were included in our analysis. The majority of respondents were White (40.2%) and Black (43.9%) men (74.9%) who were aged 30 to 39 years (24.3%) or 40 to 49 years (42.5%) and who reported a median monthly income of $650 (Table 1). More than one third (43.4%) met our criteria for being marginally housed and most (86.7%) reported that they had been homeless at some point.

Participants had high rates of mental illness and substance use. Twenty-five percent reported a lifetime history of psychiatric hospitalization, although less than 10% reported an inpatient psychiatric admission during the past year. Sixty percent of participants reported illicit drug use at least once during the past year. Crack cocaine was the most common drug used, with 50% of participants reporting use during the past year. Most participants (84.4%) reported drug use at some point during their life.

Almost a quarter of participants (23.9%) reported an alcohol problem during the past year, and almost half (44%) reported an alcohol problem during their lifetime. More than a quarter of participants (27.7%) reported sexual activity with same-sex partners, and 20.3% reported at least 100 sexual partners during their lifetime. More than a third of participants (37.7%) reported that their health was fair or poor, and 11.2% tested positive for HIV infection.

Imprisonment

Almost a quarter of respondents (23.1%) had been incarcerated in a prison during their lifetime. Participants who had a history of imprisonment had a median time of 6.4 years since last being released. They had spent a median time of 4 years in prison; 3.8% of participants reported having been released from prison during the past year, and 4.4% reported being on parole.

Lifetime Behaviors Associated With Lifetime Imprisonment

There was a strong bivariate association between a history of imprisonment and lifetime history of drug use: 93.1% of all persons who had a history of imprisonment reported drug use during their lifetime compared with 81.7% of all persons who did not have a

TABLE 1—Characteristics of the Study Sample: San Francisco, California, April 1999

	Overall Sample No. (%) (N = 1325)	Never Imprisoned No. (%) (n = 1019)	Ever Imprisoned No. (%) (n = 306)	P[a]
Age, y				
< 30	69 (5.3)	62 (6.2)	7 (2.3)	.05
30–39	319 (24.3)	245 (24.3)	74 (24.2)	
40–49	559 (42.5)	428 (42.5)	131 (42.8)	
≥ 50	367 (27.9)	273 (27.1)	94 (30.7)	
Gender				
Male	990 (74.9)	728 (71.7)	262 (85.6)	<.001
Female	332 (25.1)	288 (28.4)	44 (14.4)	
Race/ethnicity				
Non-Latino White	530 (40.2)	410 (40.4)	120 (39.3)	.81
Black	580 (43.9)	446 (43.9)	134 (43.9)	
Latino	81 (6.1)	58 (5.7)	23 (7.5)	
Asian/Pacific Islander	31 (2.4)	25 (2.5)	6 (2.0)	
Other	98 (7.7)	76 (7.5)	22 (7.2)	
Education				
< High School	368 (27.9)	265 (26.1)	103 (33.8)	.011
High school graduate	483 (36.6)	371 (36.5)	112 (36.7)	
> High school	470 (35.6)	380 (37.4)	90 (29.5)	
Marital status				
Never married/partnered	711 (53.8)	553 (54.5)	158 (51.6)	.04
Married/partnered	93 (7.0)	60 (5.9)	33 (10.8)	
Separated/divorced/widowed	517 (39.1)	402 (39.6)	115 (37.6)	
Gay or bisexual	364 (27.7)	296 (29.3)	68 (22.3)	.02
Men who have sex with men[b]	280 (28.5)	233 (32.3)	47 (18.0)	<.001
Women who have sex with women[c]	82 (24.9)	61 (21.3)	21 (47.7)	<.001
No. of sex partners (lifetime)				
0–100 sexual partners	1044 (79.7)	818 (81.4)	226 (74.1)	.01
Men[b]	759 (77.3)	563 (78.2)	196 (74.8)	.26
Women[c]	284 (87.4)	254 (90.1)	30 (69.8)	<.001
> 100 sexual partners	266 (20.3)	187 (18.6)	79 (25.9)	<.01
Men[b]	223 (22.7)	157 (21.8)	66 (25.2)	.26
Women[c]	41 (12.6)	28 (9.9)	13 (30.2)	<.001
Housing status				
Marginally housed (past year)[d]	575 (43.4)	449 (44.1)	126 (41.2)	.37
Homeless (ever)	1148 (86.7)	879 (86.4)	269 (87.9)	.48
Income (monthly)				
Median	610 (355–780)	600 (355–770)	672 (364–780)	
Health status				
Fair or poor pealth	500 (37.7)	361 (35.4)	139 (45.4)	.002
HIV infection	147 (11.2)	102 (10.1)	45 (14.9)	.02
Mental health				
Psychiatric hospitalization (lifetime)	341 (25.8)	250 (24.6)	91 (29.7)	.07
Psychiatric hospitalization (past year)	110 (8.4)	81 (8.0)	29 (9.5)	.41

Continued

history of imprisonment ($P<.001$). Former prisoners were more likely to have HIV infection than those who had never been imprisoned (14.9% versus 10.1%; $P=0.02$) and were slightly more likely to have been hospitalized in a psychiatric facility (29.7% versus 24.6%; $P=0.07$). In a multivariate model that examined factors associated with a lifetime history of imprisonment, ever having used crack or cocaine (odds ratio [OR]=1.67; 95% confidence interval [CI]=1.04, 2.70) and ever having used heroin (OR=1.51; 95% CI=1.07, 2.12) were associated with a history of imprisonment. Ever having been hospitalized in a psychiatric facility (OR=1.41; 95% CI=1.01, 1.96), being in fair or poor health (OR=1.47; 95% CI=1.09, 1.99), and having HIV infection (OR=1.69; 95% CI=1.07, 2.64) also were associated with a history of imprisonment, as were being older, having less than a college education, and being a man (OR=4.28; 95% CI=2.60, 7.05). Having a lifetime history of more than 100 sexual partners was associated with a history of imprisonment (OR=1.44; 95% CI=1.02, 2.02). The odds for a history of imprisonment were lower among men who had sex with men (OR=0.35; 95% CI=0.23, 0.53), but the odds increased among women who had sex with women (OR=2.35; 95% CI=1.12, 4.91) (Table 2).

Current Behaviors Associated With Lifetime Imprisonment

Participants who had a history of imprisonment had high rates of past-year drug use, with more than two thirds (69.6%) reporting illicit drug use during the previous year. Almost ten percent (9.6%) reported having sold drugs during the previous month compared with 2.7% who did not have a history of imprisonment. There was a strong independent association between currently selling drugs and a history of imprisonment (OR=2.57; 95% CI=1.36, 4.85). Both past-year heroin use (OR=1.65; 95% CI=1.14, 2.38) and methamphetamine use (OR=1.49; 95% CI=1.00, 2.21) were associated with ever having been imprisoned, but past-year crack or cocaine use were not. Other significant factors included older age, lower educational attainment, fair or poor health status, HIV infection, psychiatric hospitalization, being

TABLE 1—*Continued*

Substance use (lifetime)				
Illicit drug use	1116 (84.4)	832 (81.7)	284 (93.1)	<.001
Injection drug use	604 (45.8)	424 (41.8)	180 (59.4)	<.001
Powder or crack cocaine use	1024 (77.4)	757 (74.4)	267 (87.5)	<.001
Methamphetamine use	692 (52.3)	496 (48.8)	196 (64.3)	<.001
Heroin use	595 (45.0)	410 (40.3)	185 (60.7)	<.001
Drinking problem[e] (ever)	580 (44.0)	438 (43.1)	142 (47.0)	.23
Substance use (past year)				
Illegal drug use	791 (59.7)	578 (56.7)	213 (69.6)	<.001
Injection drug use	367 (27.7)	247 (24.2)	120 (39.2)	<.001
Powder or crack cocaine use	675 (51.0)	495 (48.6)	180 (59.0)	.001
Methamphetamine use	247 (18.7)	174 (17.1)	73 (23.9)	<.01
Heroin use	304 (23.0)	199 (19.6)	105 (34.4)	<.001
Alcohol problem[e] (past year)	315 (23.9)	246 (24.3)	69 (22.7)	0.57
Income from selling drugs (past 30 days)	56 (4.3)	27 (2.7)	29 (9.6)	<.001

[a]*P* = comparison between never imprisoned and ever imprisoned.
[b]Denominator = total number of men (n = 990).
[c]Denominator = total number of women (n = 332).
[d]Spent more than 90% of noninstitutionalized nights in a residential hotel, apartment, or private home.
[e]Self-reported.

male, and having had more than 100 sexual partners (Table 3). In a model that adjusted both for lifetime history and past-year drug use, the association with past-year drug use was no longer significant (data not shown). Currently selling drugs remained strongly associated with a history of imprisonment (OR=2.90; 95% CI=1.56, 5.39), even after adjustment for a lifetime history of drug use. We did not collect data on lifetime history of selling drugs.

DISCUSSION

In our study, participants reported high rates of lifetime imprisonment: approximately one quarter had been imprisoned in a state or federal prison at some point during their lifetime. Those who had been imprisoned were more likely to have a history of psychiatric hospitalizations, drug use, multiple sexual partners (>100), and HIV infection than those who had not been imprisoned. The proportion who had ever been imprisoned was slightly higher than the proportion found in a national sample of homeless persons[2] and was significantly higher than the proportion found in the general US population.[27] The association between homelessness and imprisonment is complex because of shared risk factors and causal pathways in both directions.

Studies have shown that prisoners are at high risk for becoming homeless at the time of their release. Exiting prisoners face important challenges to successfully reestablishing community life, including difficulties with securing housing and employment.[28–32] They also have difficulty obtaining medical, mental health, and substance abuse treatment after their release.[33] A report released in 1998 stated that 10% of parolees in California were homeless; in San Francisco and Los Angeles, the estimates were 30% to 50%.[34] The fact that former prisoners remained in the homeless and marginally housed community more than 6 years after their release is the result of (1) the persistence of risk factors common to imprisonment and homelessness and (2) the difficulties ex-prisoners experience when they reintegrate into community life.

We found that having a history of psychiatric hospitalization was independently associated with a history of imprisonment. Mental illness is a risk factor for both homelessness and imprisonment.[11] People who have mental illnesses have higher rates of imprisonment than the general population: an estimated 5% of the overall population has a serious mental

TABLE 2—Characteristics and Multivariate Lifetime Behaviors Associated With Ever Being Imprisoned (N = 1325): San Francisco, April 1999

	Adjusted Odds Ratio (95% Confidence Interval)
Characteristics	
Age, y	
<30 years	1.00
30–39 years	2.23 (0.94, 5.31)
40–49 years	2.39 (1.02, 5.59)
≥50 years	3.04 (1.27, 7.26)
Gender	
Female	1.00
Male	4.28 (2.60, 7.05)
Race/ethnicity	
Non–Latino White	1.00
Black	1.02 (0.72, 1.43)
Other	1.15 (0.75, 1.75)
Education	
<High school	1.00
High school graduate	0.78 (0.55, 1.11)
>High school	0.56 (0.38, 0.81)
Health status	
Good, very good or excellent	1.00
Fair or poor health	1.47 (1.09, 1.99)
No HIV infection	1.00
HIV infection	1.69 (1.07, 2.64)
Mental health	
No psychiatric hospitalization	1.00
Psychiatric hospitalization in lifetime	1.41 (1.01, 1.96)
Lifetime behaviors[a] associated with ever being imprisoned[b]	
Substance use (lifetime)	
Never used crack/cocaine	1.00
Crack/cocaine use	1.67 (1.04, 2.70)
Never used methamphetamines	1.00
Methamphetamines use	1.33 (0.92, 1.93)
Never used heroin	
Heroin use	1.51 (1.07, 2.12)
Sexual behaviors	
Men who have sex with women	1.00
Men who have sex with men	0.35 (0.23, 0.53)
Women who have sex with men	1.00
Women who have sex with women	2.35 (1.12, 4.91)
0–100 sexual partners	1.00
>100 sexual partners	1.44 (1.02, 2.02)

[a]Models adjusted for all variables listed.
[b]Includes lifetime substance use variables.

TABLE 3—Characteristics and Multivariate Past-Year Behaviors Associated With Ever Being Imprisoned (N = 1325): San Francisco, April 1999

	Adjusted Odds Ratio (95% Confidence Interval)
Characteristics	
Age, y	
< 30	1.00
30–39	2.64 (1.09, 6.39)
40–49	3.14 (1.32, 7.51)
≥ 50	3.69 (1.51, 9.01)
Gender	
Female	1.00
Male	4.68 (2.83, 7.72)
Race/ethnicity	
Non-Latino White	1.00
Black	1.05 (0.75, 1.47)
Other	1.12 (0.74, 1.71)
Education	
< High school	1.00
High school graduate	0.76 (0.53, 1.07)
> High school	0.54 (0.37, 0.78)
Income	
Other sources	1.00
Selling drugs (past 30 days)	2.57 (1.36, 4.85)
Health status	
Good, very good or excellent	1.00
Fair or poor health	1.44 (1.07, 1.96)
No HIV infection	1.00
HIV infection	1.65 (1.04, 2.62)
Mental health	
No psychiatric hospitalization	1.00
Psychiatric hospitalization (lifetime)	1.40 (1.00, 1.95)
Past-year behaviors[a] associated with ever being imprisoned[b]	
Substance use (past year)	
Never used crack/cocaine	1.00
Crack/cocaine use	1.07 (0.78, 1.48)
Never used methamphetamines	1.00
Methamphetamines use	1.49 (1.00, 2.21)
Never used heroin	1.00
Heroin use	1.65 (1.14, 2.38)
Sexual behaviors	
Men who have sex with women	1.00
Men who have sex with men	0.34 (0.22, 0.52)
Women who have sex with men	1.00
Women who have sex with women	2.81 (1.33, 5.90)
0–100 sexual partners	1.00
> 100 sexual partners	1.46 (1.04, 2.06)

[a]Models adjusted for all variables listed.
[b]Includes past year substance use variables.

illness compared with 10% to 20% of the imprisoned population.[11,35] However, within prison and following release, there are limited resources for receiving mental health care.[36] Community-based mental health care facilities may be unable to offer care to certain ex-offenders, including those who have a history of dangerous behavior.[37] Among homeless persons, this tendency to not receive mental health care may be exacerbated.[17]

We found that illicit drug use was associated with imprisonment. More than 70% of federal inmates and 80% of state and local inmates reported a lifetime history of substance abuse[38]; however, only a small proportion received substance abuse services while incarcerated.[39] Imprisonment for drug offenses increased 16-fold between the early 1980s and the late 1990s[40] and accounted for much of the rise in prison populations. Currently selling drugs remained highly associated with a history of imprisonment, even after we controlled for drug use. Selling drugs puts an individual at higher risk for involvement with the criminal justice system; after prison release, persons who have a history of imprisonment may find it particularly difficult to gain employment in the legitimate labor market.[28]

HIV infection remained independently associated with a history of imprisonment. Former prisoners had higher rates of HIV infection, had high numbers of sexual partners, and had higher rates of active drug use compared with the homeless population at large. Studies have estimated that 2.3% of imprisoned persons are known to be HIV positive,[7] although these rates may underestimate the true prevalence. We found rates 10 times that high among homeless and marginally housed persons who had been imprisoned. Homeless persons who had a history of imprisonment also had higher rates of HIV infection and were in fair or poor health, even after we controlled for drug use, injection drug use, sexual preference, and number of sexual partners. HIV, tuberculosis, and hepatitis C are common in both the homeless and prison populations.[23,41,42] Both homelessness and imprisonment may foster environments in which communicable diseases are easily spread by placing high-risk persons in close proximity to one another.

We did not find an association between being Black and imprisonment among the homeless population. Black Americans are more likely than White Americans to be imprisoned and are more likely to be homeless.[2,27] We believe our not finding a difference between rates of imprisonment on the basis of race/ethnicity may be the result of the differential effect of race/ethnicity on homelessness and the effect of imprisonment as a causal factor for homelessness. Within the homeless population, the differences among the general population in rates of imprisonment no longer hold.

Limitations

Our study has several limitations that affected our ability to draw conclusions. Because the study is cross-sectional, we were unable to draw causal conclusions about the association between homelessness and imprisonment. We did not know whether imprisonment preceded or followed episodes of homelessness. All results, except for HIV status, were self-reported; estimates of imprisonment and reported participation in illegal activities may have been underreported. We did not have diagnostic information on mental illness; rather, we used psychiatric hospitalization as a proxy for mental illness, which likely underestimated the true rate of mental illness. We used a 1-question assessment of drinking status; however, the use of 2 positive responses to the CAGE questionnaire or the use of 5 or more drinks daily did not change our results. Our study excluded non-English-speaking homeless people; we do not know if non-English speakers are at higher or lower risk for imprisonment.

Conclusion

High rates of imprisonment among homeless populations may be the end result of a system that does not provide access to timely services, including access to housing, health care, mental health care, and substance abuse treatment, and systems that have obstacles preventing receipt of these services by people exiting prison. High rates of HIV infection among homeless ex-prisoners and high rates of continued risky behavior provide motivation for targeting risk reduction efforts at persons exiting prison. The intersection of

substance abuse, unemployment, imprisonment, and homelessness is potent and lasting. Efforts to eradicate homelessness also must include the many unmet needs of persons exiting prison. ■

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Contributors

M.B. Kushel originated the study, led the writing, and synthesized the analysis. J.A. Hahn and J.L. Evans conducted the analysis. All the authors originated ideas and designed the study. J.A. Hahn, D.R. Bangsberg, and A.R. Moss interpreted findings; contributed to writing; obtained funding; and originated, designed, and supervised data collection and analysis.

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Human Participant Protection

The committee on human research at the University of California, San Francisco, approved this study.

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