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ORIGINAL PAPER

Condomless Sex and Psychiatric Comorbidity in the Context of Constrained Survival Choices: A Longitudinal Study Among Homeless and Unstably Housed Women

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Abstract
We sought to identify the prevalence and independent correlates of condomless sex within a cohort of community-recruited homeless and unstably housed cisgender adult women who were followed biannually for 3 years (N = 143 HIV+, N = 139 HIV−). Nearly half (44%) of participants reported condomless sex in the 6 months before baseline, which increased to 65% throughout the study period. After adjusting for having a primary partner, longitudinal odds of condomless sex among women with HIV were significantly higher among those reporting < daily use of alcohol or cannabis (AOR = 2.09, p = .002, and 1.88, p = .005, respectively) and PTSD (AOR = 1.66, p = .034). Among women without HIV, adjusted longitudinal odds of condomless sex were significantly higher for those reporting < daily methamphetamine use (AOR = 2.02, p = .012), panic attack (AOR = 1.74, p = .029), and homelessness (AOR = 1.67, p = .006). Associations were slightly attenuated when adjusting for sex exchange. Targeted HIV/STI programs for unstably housed women should address anxiety and trauma disorders, infrequent substance use, and housing challenges.

Keywords Unprotected sex · Condomless sex · Housing · Anxiety · Trauma · Substance use

Resumen
Tratamos de identificar la prevalencia y las características independientemente asociadas con tener sexo sin condón dentro de una cohorte de mujeres adultas cisgénero sin hogar o con un alojamiento inestable reclutadas en la comunidad, a quienes se les realizó un seguimiento bianual durante tres años (N = 143 VIH+, N = 139 VIH−). Casi la mitad (44%) de las participantes reportaron haber tenido sexo sin condón en los 6 meses previos al inicio del estudio. Éste aumentó a 65% durante todo el período de estudio. Después de ajustar por tener una pareja estable, las probabilidades longitudinales de tener sexo sin condón entre mujeres con VIH fueron significativamente más altas entre aquellas que informaron consumo no diario de alcohol o cannabis (RMA = 2.09, p = .002 y 1.88, p = .005, respectivamente) y PTSD (RMA = 1.66, p = .034). Entre las mujeres sin VIH, las probabilidades longitudinales ajustadas de tener sexo sin condón fueron significativamente más altas para aquellas que informaron uso no diario de metanfetamina (RMA = 2.02, p = .012), ataque de pánico (RMA = 1.74, p = .029), e indigencia (RMA = 1.67, p = 0.006). Las asociaciones se atenuaron levemente cuando se ajustaron por tener sexo transaccional. Los programas dirigidos a la prevención de VIH/ITS para mujeres alojadas de manera inestable deben abordar los trastornos de ansiedad y trauma, el uso infrecuente de sustancias y los problemas de vivienda.

Introduction

The Role of Constrained Life Choices in Health Risks

Despite extensive services for HIV prevention and treatment, low-income women residing in cities with high costs of living continue to have significantly elevated risks for HIV and sexually transmitted infections (STIs) [1, 2]. This elevated

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risk suggests that the presence of resources in well-resourced areas, such as health care, education, and behavior change programs, cannot be equated with "access" to those programs and may not equally benefit those lacking resources. Social and structural barriers that limit options and constrain choices have been posed as major contributors to elevated STI risk, along with conditions that are more common in impoverished populations such as mental illness and addiction [3, 4]. Related to specific barriers, a lack of sufficient resources is a major predisposing factor for experiencing homelessness, which in turn places people at greater risk for both acquiring STIs and experiencing barriers in accessing appropriate medical care [5]. Within this causal pathway, exchange of sex for money, food, drugs, shelter, or other unmet needs contributes to STI and HIV risk [6–8].

HIV and STI Risk Among Unstably Housed Women

Much of the existing literature reports broad categories of poverty and mental illness as correlates of sexually transmitted infections [9–12]. Our prior work, conducted exclusively among women with a history of housing instability (referred to from here on as "unstably housed women"), indicates disproportionately high levels of STIs and unique factors that predict STIs. For example, 88% of unstably housed women test positive for herpes simplex virus type 2 (compared to 21–24% of women in the general population), which differs in prevalence and correlates by HIV status and alcohol use [2]. In addition, 12% test positive for trichomonas vaginalis (compared to 3% of women in the general population), which is associated with recent homelessness [1]. Likewise, our previous work assessing mental health conditions and related issues also shows associations unique to this population of unstably housed women. For example, nearly every woman (97%) assesses positive for at least one psychiatric diagnosis, with a median count of eight diagnoses and recent violence predicting lower mental health status [13, 14]. Additionally, both violence and unstable housing predict stimulant use among women who do not use at baseline, [14] which has been shown in other vulnerable populations to be associated with condomless sex [15, 16].

HIV and Mental Illness

People with severe mental illness (SMI) are disproportionally affected by and at risk for HIV and other STIs [17–22] and prevalence of HIV is significantly higher among individuals with SMI [23]. SMI includes chronic recurring psychiatric disorders such as major depressive disorder, post-traumatic stress disorder (PTSD), schizophrenia, substance use disorders, and other conditions that result in substantial functional and cognitive impairment. People living with HIV/AIDS are also more likely to have mental health disorders, particularly depression, and HIV treatment outcomes are often worse for those with SMI [23–26]. Previous research has found significant associations between alcohol use and HIV in settings characterized by limited resources to cover health care costs [27, 28]. Research also shows significant associations between methamphetamine use and condomless sex among men who have sex with men [29], but less research has focused on risks of methamphetamine use among women [30]. Similarly, less is known about how specific psychiatric comorbidities and frequency of substance use may affect health risks distinctly among women.

With regard to sexual risk behaviors that transmit STIs (namely unprotected or condomless sex), some studies find lower rates of sexual activity among those with SMI, but higher rates of risk behaviors among those who are sexually active [17, 18]. However, other studies show that, rather than psychiatric symptoms alone, it is intimate partner violence, substance use, and constrained survival choices in the context of lower socioeconomic status that drive sexual risk behavior [18, 23]. Nevertheless, few studies have examined these issues exclusively among low-income women, which would facilitate a better understanding of issues that are gender-specific and germane in low-income populations but rare in the general population.

Study Objectives

We determined the degree to which factors related to poverty and mental health were independently associated with condomless sex over time within a cohort comprised entirely of community-recruited unstably housed women. We examined this behavior among all women enrolled in the study, not just among those who reported sexual activity, as abstinence has been promoted as a strategy to prevent transmission of HIV and STIs [31]. Abstinence is also a practice with parallel implications to intentional social isolation, which has been reported as one strategy to prevent sexual victimization [4]. Building on prior research, we hypothesized that the longitudinal odds of engaging in condomless sex would be higher among women with a greater number of mental health disorders, more frequent substance use, and recent homelessness.

Methods

Data Collection Procedures

The analysis described here used longitudinal cohort data from the "Shelter, Health, and Drug Outcomes among Women" study [14]. Three hundred women were recruited between 2008 and 2010 from free meal programs, homeless shelters, and a probability sample of single room occupancy

(SRO) hotels in San Francisco, California, and completed study visits in private at a storefront research center in the Tenderloin neighborhood, where many participants lived. Participants were followed biannually for up to 3 years (for a total of 7 visits). Eligibility criteria included being a cisgender woman, at least 18 years old, and having a history of housing instability (slept on the street, in a homeless shelter, or in someone else's place because there was no other place to sleep). Participants provided informed consent, which included being asked to restate their understanding of voluntary participation. HIV testing occurred during study screening and women with HIV were oversampled (50%) to meet HIV-specific study aims regarding violence and HIV risk behavior. Participants were reimbursed $15 for each interview completed and $5 for each monthly check-in visit to the storefront research center or via telephone during which participants updated contact information.

Questionnaires were administered by trained interviewers in a private setting. Drug use questions were asked using Audio Computer-Assistant Self-Interviews (ACASI). Given the lengthy time of assessment of psychiatric disorders via the Diagnostic Interview Schedule (DIS), these were assessed at a separate visit within 1 month of the baseline visit to reduce interview fatigue. Except for HIV status, all measures were self-reported. Study procedures were approved by the Institutional Review Board of the University of California, San Francisco.

Measures

All measures were time varying and assessed at each time point, except for race, highest level of education, and psychiatric diagnoses, which were only assessed at baseline.

Primary Outcome: Condomless Sex

The main outcome of interest was sex without a condom, assessed with the question: "Thinking about vaginal and anal sex only, were there times when you did not use a condom during the past 6 months?"

Primary Exposures: Psychiatric Comorbidity and Substance Use

Comorbid psychiatric conditions were assessed with the U.S. National Institute of Mental Health Diagnostic Interview Schedule (DIS) [32]. This computerized tool [33] was used to assess the presence of up to 39 current mental health disorders using DSM-IV diagnostic criteria. In this analysis we focused on six mental health diagnoses (major depression, manic episode, PTSD, panic attack, generalized anxiety, schizophrenia) and diagnoses related to five substances (alcohol, opioid, amphetamine, cocaine, cannabis) that were present in at least 10% of this population and excluded phobias. Because the diagnosis of substance use disorder may not capture less frequent or episodic use, we also assessed the frequency of substance use. Three-level indicator variables (no use, less than daily use, daily use) were used to measure the average level of use over the past 6 months for multiple substances (alcohol, heroin, non-medical prescription opioid painkillers, methamphetamine, crack cocaine, cannabis) at each study visit.

Other Exposures of Interest: Constrained Survival Choices and Social Determinants of Health

Other factors that have been associated with condomless sex and STI risk in previous research were considered as independent variables here, and included (within the past 6 months) having a primary intimate partner; experiencing violence; and reporting exchange of sex for money, drugs, housing, food, or protection [7, 14]. We also examined social determinants of health including age, race/ethnicity, high school completion, and housing stability (i.e., slept on the street or in a shelter during the prior 6 months) and unmet subsistence needs in the previous 6 months as potential confounders of the relationship between psychiatric diagnoses and condomless sex. Primary partner was assessed as "one person who you feel closest or most committed to." Experiences of physical, sexual, and emotional violence were assessed using questions based on the Severity of Violence against Women Scales [34] that had been previously tested in this population [14]. Race and ethnicity were self-reported and grouped for analysis purposes into African-American, White/Caucasian, Asian/Pacific Islander, Hispanic/Latina, and Other/Mixed. Although all women in the study had a lifetime history of housing instability, women who reported sleeping in a shelter or public place in the past 6 months were considered to have recently experienced homelessness. Unmet subsistence needs included insufficient access to food, clothing, a restroom, a place to wash, or a place to sleep [35].

Data Analysis

Given a standing tradition of separating HIV prevention programs by serostatus (e.g., "prevention for positives" and prevention for negatives) [36], which is based on prior research showing differences in HIV risk behaviors by HIV serostatus [37], and given prior women-specific research showing differences in condomless sex by HIV status [37], as well as our own research showing differences in prevalence and correlates of herpes simplex virus type 2 by HIV status [2], we restricted all analyses by HIV status.

Descriptive statistics at baseline were examined with Chi-squared and Wilcoxon rank-sum tests to determine

differences in prevalence or medians by HIV status, respectively. We used generalized estimating equation (GEE) logistic regression analyses to estimate population level associations between exposures of interest and condomless sex for women with and without HIV, accounting for repeated measures with an exchangeable correlation matrix. Analyses were performed in R 3.2.2 [38] using the *geepack* package [39].

GEE logistic regression analyses were conducted separately for women with and without HIV given different implications of condomless sex (e.g., transmission to others vs. acquiring HIV) and a significant interaction ($p = .022$) between HIV status and having a primary partner on condomless sex. Psychiatric diagnoses were assessed at baseline and the effect of diagnoses at both baseline and over time (by interacting diagnosis with time) were modeled. After estimating unadjusted GEE models with each of the independent variables listed above and condomless sex, we conducted adjusted GEE analyses with all variables significantly associated with the outcome in unadjusted models at $p < .25$ and removed variables by largest p value until all p-values were less than .05 [40].

Sex exchange has been consistently associated with condomless sex in previous research [7, 41]. Because sex exchange lies in the causal pathway between housing instability and condomless sex, we first assessed independent associations with psychiatric diagnoses and substance use without controlling for sex exchange using adjusted GEE logistic regression models as described above. We then compared these adjusted analyses to identical adjusted analyses but also controlling for sex exchange.

Results

Participant Characteristics

Of 300 study participants, 9 did not complete psychiatric diagnosis assessments at baseline and an additional eight had missing data on condom use throughout the study, leaving an analysis sample of 283. The median number of completed visits was 6 (IQR = 4–7). During the course of the study, 8.8% of this analysis sample were lost to follow up, 3.9% passed away, and 1.8% withdrew from the study. Among analysis sample participants, the median age was 48 (IQR = 42–53) and 69.8% were women of color (44.5% African American, 5.3% Latina, 3.5% Asian American/Pacific Islander, 19.1% Other/Mixed). While all women had a lifetime history of housing instability, almost half of participants (47.7%) reported sleeping in the street or a shelter in the past 6 months at baseline, which declined substantially to 14.7% in the final 36 month/7th visit, as women experiencing chronic homelessness were more likely to be lost to follow up. Sex exchange was reported by 24.4% of women at baseline and by 27.9% of women during the study period, but also declined substantially to 12.0% at the final visit. At baseline, 55.8% of participants reported having a primary intimate partner, which remained consistent over time at the population level (52.9–60.0% at follow up visits 2–7) (Table 1).

In accordance with over-sampling of women with HIV in the original study design, half the women (N = 144) had HIV. While women with HIV were less likely to have completed high school, they were also less likely to have experienced recent (past 6 months) violence, unmet subsistence needs, or homelessness at baseline.

Condomless sex was reported by 43.5% of participants at baseline and by 65.0% at any time point during the 3 year study period. Differences in the proportions of participants reporting condomless sex between women with HIV (39.6%) and women without HIV (47.5%) at baseline and at any time point (63.1% of women with HIV and 66.9% of women without HIV), did not differ significantly (Chi square $p = .18$ at baseline, $p = .51$ over time). Over the 3 year follow up period, however, the unadjusted longitudinal odds of reporting condomless sex was marginally lower (OR = 0.70, $p = .06$) for women with HIV versus women without HIV.

At baseline, women had a median of 8 (IQR: 5–11) psychiatric diagnoses [13, 14], with the most common mental health disorders being major depression (65.4%) and PTSD (50.9%). Cocaine (64.3%) and alcohol (62.9%) use disorders were the most common substance use disorders, and alcohol (59.7%) and crack cocaine (44.3%) were the most commonly used substances in the past 6 months. Less than daily use was more commonly reported than daily use for all substances. There were no significant differences in prevalence of current psychiatric diagnoses or substance use in women with HIV versus women without HIV, with the exception that women without HIV were more likely to report less than daily alcohol use versus no use ($p < .05$).

Unadjusted Associations with Condomless Sex

In bivariate analysis among women with HIV, PTSD was the only psychiatric diagnosis significantly associated with condomless sex (OR = 1.72, $p = .033$). Among women without HIV, manic episode (OR = 2.33, $p = .002$), panic attack (OR = 1.98, $p = .011$), and alcohol use disorder (OR = 1.76, $p = .047$) were significantly associated with condomless sex (Table 2). No significant associations were found between groups with respect to condomless sex for number of diagnoses, major depression, generalized anxiety, schizophrenia, or other substance use disorders. (Interactions between baseline diagnoses and time were not significant, indicating that the decrease in proportion of women reporting condomless sex over time was not related to any specific diagnosis.)

Table 1 Social determinants, psychiatric diagnoses, and substance use frequency at baseline visit among unstably housed women (N = 283)

	Overall		HIV+		HIV−	
	N	%	N	% of 144	N	% of 139
Social determinants & HIV sexual risk factors (past 6 months)						
Age (median, IQR)	48	(42, 53)	48	(42, 53)	48	(42, 54)
Race/ethnicity+						
Caucasian	87	30.7	39	27.1	46	33.1
African American	126	44.5	71	49.3	52	37.4
Latina	15	5.3	5	3.5	10	7.2
Asian American/Pacific Islander	10	3.5	2	1.4	8	5.8
Other/mixed	54	19.1	27	18.8	23	16.5
Completed high school***	184	65.0	77	53.5	107	77.0
Slept on street/in shelter[a]***	135	47.7	46	31.9	89	64.0
Unmet subsistence needs**	118	41.7	48	33.3	70	50.4
Condomless sex	123	43.5	57	39.6	66	47.5
Sex exchange	69	24.4	33	22.9	36	25.9
Any violence[b]**	170	60.1	74	51.4	96	69.1
Primary partner	158	55.8	78	54.2	80	57.6
HIV+***	144	50.9	144	100.0	0	0.0
Psychiatric diagnoses (past 2 weeks)						
Number of diagnosis (median, IQR)	8	(5, 11)	8	(5, 11)	7	(4, 10)
Major depressive disorder	185	65.4	89	61.8	98	70.5
Manic episode	68	24.0	33	22.9	36	25.9
Post-traumatic stress disorder (PTSD)	144	50.9	72	50.0	74	53.2
Panic attack	103	36.4	53	36.8	50	36.0
Generalized anxiety	32	11.3	13	9.0	19	13.7
Schizophrenia	55	19.4	25	17.4	30	21.6
Alcohol use disorder	178	62.9	93	64.6	85	61.2
Opioid use disorder	111	39.2	63	43.8	48	34.5
Amphetamine use disorder	106	37.5	57	39.6	49	35.3
Cocaine use disorder+	182	64.3	100	69.4	82	59.0
Cannabis use disorder	44	15.5	24	16.7	20	14.4
Substance use frequency (past 6 months)						
Alcohol use: none	114	40.3	71	49.3	43	30.9
< Daily*	122	43.1	52	36.1	70	50.4
Daily	47	16.6	21	14.6	26	18.7
Heroin use: none	236	83.4	120	83.3	116	83.5
< Daily	32	11.3	14	9.7	18	12.9
Daily	15	5.3	10	6.9	5	3.6
Opioid painkiller use: none	210	74.2	111	77.1	99	71.2
< Daily	58	20.5	24	16.7	34	24.5
Daily	15	5.3	9	6.3	6	4.3
Methamphetamine use: none	255	90.1	117	81.3	108	77.7
< Daily	53	18.7	23	16.0	30	21.6
Daily	5	1.8	4	2.8	1	0.7
Crack cocaine use: none	159	56.2	83	57.6	76	54.7
< Daily	85	30.0	38	26.4	47	33.8
Daily	39	13.8	23	16.0	16	11.5
Cannabis use: none	139	49.1	70	48.6	69	49.6
< Daily	97	34.3	46	31.9	51	36.7
Daily	47	16.6	28	19.4	19	13.7

+p < .1, *p < .05, **p < .01, ***p < .001

[a]All women have a lifetime history of homelessness; this measure refers to the previous 6 months

[b]Includes physical, sexual, and emotional violence

Table 2 Unadjusted and adjusted longitudinal correlates of unprotected sex among unstably housed women living with HIV (N = 144) and without HIV (N = 139)

	HIV+						HIV−					
	Unadjusted		Adjusted (M1)		Adjusted—with sex exchange (M2)		HIV uninfected Unadjusted		Adjusted (M3)		Adjusted—with sex exchange (M4)	
	OR	p-value	AOR	p-value	AOR	p-value	OR	p-value	AOR	p-value	AOR	p-value
Social determinants & HIV sexual risk factors (past 6 months, all visits)												
Age	**0.93**	< .001	**0.94**	< .001	**0.94**	< .001	**0.96**	0.008				
Race/ethnicity (ref: Caucasian)												
African American	1.57	0.170					0.73	0.312				
Latina	0.55	0.422					**0.32**	0.027				
Asian/Pacific Islander	5.17	0.255					**0.25**	0.014				
Other/mixed	**2.29**	0.038					0.94	0.879				
Completed high school	1.21	0.446					0.85	0.567				
Slept on street/in shelter[a]	1.42	0.149					**1.63**	0.002	**1.67**	0.006	**1.56**	0.014
Unmet subsistence needs	1.11	0.594					1.13	0.437				
Any violence[b]	1.30	0.106					1.12	0.492				
Primary partner	**2.77**	< .001	**2.76**	< .001	**2.73**	< .001	**5.96**	< .001	**5.88**	< .001	**6.25**	< .001
Sex exchange	**2.81**	< .001	**–**	–	**2.73**	< .001	**3.00**	< .001	–	–	**3.13**	< .001
Psychiatric diagnoses (past 2 weeks, baseline visit)												
Number of diagnoses	1.00	0.968					1.05	0.121				
Major depression	0.90	0.686					1.24	0.464				
Manic episode	1.26	0.429					**2.33**	0.002				
PTSD	**1.72**	0.033	**1.66**	0.034	*1.58*	*0.056*	1.42	0.191				
Panic attack	1.47	0.140					**1.98**	0.011	**1.74**	0.029	**1.67**	0.043
Generalized anxiety	0.70	0.476					1.43	0.327				
Schizophrenia	1.50	0.217					0.62	0.143				
Alcohol use disorder	1.04	0.883					**1.76**	0.047				
Opioid use disorder	0.68	0.141					0.90	0.704				
Amphetamine use disorder	*1.56*	*0.087*					1.23	0.461				
Cocaine use disorder	0.96	0.869					0.89	0.686				
Cannabis use disorder	1.28	0.488					1.34	0.403				
Substance use frequency (past 6 months, all visits), Ref: no use												
Alcohol use, < daily	**2.17**	< .001	**2.09**	0.002	**1.98**	0.002	1.13	0.628				
Alcohol use, daily	1.45	0.179	1.50	0.208	1.52	0.203	1.05	0.796				
Heroin use, < daily	1.34	0.334					1.34	0.364				
Heroin use, daily	1.22	0.617					1.26	0.726				
Opioid painkiller use, < daily	1.28	0.234					1.37	0.152				
Opioid painkiller use, daily	0.80	0.531					1.72	*0.066*				
Methamphetamine use, < daily	1.42	0.219					**1.95**	0.009	**2.02**	0.012	**1.56**	0.013
Methamphetamine use, daily	1.73	0.274					0.97	0.954	0.76	0.696	0.73	0.650
Crack cocaine use, < daily	**1.75**	0.013					**1.63**	0.033				
Crack cocaine use, daily	1.15	0.617					*1.96*	*0.096*				
Cannabis use, < daily	**2.10**	<.001	**1.88**	0.005	**1.73**	0.012	1.17	0.487				
Cannabis use, daily	1.47	0.118	1.02	0.937	1.01	0.944	1.28	0.420				

Bold p < .05, Italics p < .1

[a]All women have a lifetime history of homelessness; this measures refers to the previous 6 months

[b]Includes physical, sexual, and emotional violence

With respect to substance use frequency, when compared to no use, less than daily use of alcohol (OR = 2.17, $p < .001$), crack cocaine (OR = 1.75, $p = .013$), and cannabis (OR = 2.10, $p < .001$) were associated with an increased odds of condomless sex over time among women with HIV, while less than daily use of crack cocaine (OR = 1.95, p = .009) and methamphetamine (OR = 1.63, $p = .033$) were associated with an increased odds of reporting condomless sex over time among women without HIV. Compared to no use, daily use of substances were not significantly associated with condomless sex in this population (Table 2).

In examining social determinants of health and known risk factors for condomless sex, there were some notable differences with respect to age and race/ethnicity: among women with HIV, younger women and mixed/other race women had higher odds of reporting condomless sex, whereas among women without HIV, younger, Latina, and Asian/Pacific Islander women had lower odds of reporting condomless sex. We also found that the odds of reporting condomless sex were almost three times higher among women both with and without HIV reporting sex exchange (OR = 2.81 and OR = 3.00, respectively, $p < .001$) and among women with HIV reporting a primary partner (OR = 2.77, p < .001). These odds were six times higher for women without HIV reporting a primary partner (OR = 5.96, $p < .001$) (Table 2).

Independent Correlates of Condomless Sex

Adjusting for age and primary partner, the longitudinal odds of having condomless sex were significantly greater for women with HIV who reported less than daily of use of alcohol (AOR = 2.09, $p = .002$) and cannabis (AOR = 1.88, $p = .005$) versus no use, and with PTSD (AOR = 1.66, $p = .034$) (Table 2). Also adjusting for primary partnership, the odds of having condomless sex were significantly greater for women without HIV who used methamphetamine less than daily compared to no use (AOR = 2.02, $p = .012$), who experienced panic attacks (AOR = 1.74, $p = .029$), and who recently slept on the street or in a shelter (AOR = 1.67, $p = .006$). Independent associations were attenuated slightly after adjustment for sex exchange, but associations remained strong and significant (Table 2).

Discussion

In a population previously reported to experience disproportionately high rates of herpes simplex virus-2 and Trichomonas vaginalis [1, 2], two-thirds of homeless and unstably housed women reported condomless sex in a three-year period and this did not differ significantly by HIV status over time. Condomless sex was consistently associated with less than daily substance use relative to no use for alcohol and cannabis in women with HIV and for methamphetamine in women without HIV. Higher frequency use (vs. no use) and specific substance use disorder diagnoses did not reach conventional thresholds of significance. Even after adjusting for substance use and having a primary partner, PTSD was a significant correlate of condomless sex among women with HIV, while panic attack and recent homelessness were significant correlates of condomless sex among women without HIV. Finally, even after adjusting for sex exchange, the odds of condomless sex were greater among women without HIV experiencing homelessness compared to those with stable housing.

Results reported here are consistent with previous work with unstably housed San Francisco adults, which found that methamphetamine use was associated with sex exchange in women but not men [7]. The results presented here extend this research by suggesting that women's risk surprisingly lies in less frequent use. Moreover, this unexpected finding was also observed for use of alcohol and cannabis. The fact that daily use of these substances was not significant is noteworthy and has clinical implications. Less frequent substance use may present differently in a clinical setting than a substance use disorder, reinforcing the importance of substance use screening. Results suggest that including substance use assessment and counseling in interventions and risk reduction messages may nevertheless address this modifiable risk factor for STI transmission.

While much research has focused on depression as a predictor of HIV risk and treatment outcomes [23, 25, 42], less research has focused on anxiety- or trauma-related disorders as distinct from depression in the context of condomless sex [43, 44]. The few extant studies that have done so did not include women and did not highlight unstable housing [43, 45–47]. Our findings show only slightly attenuated independent associations with panic attack or PTSD in the presence of sex exchange. While absolute differences in adjusted odds are less than 10%, they may suggest evidence of partial mediation of the relationship between these disorders and condomless sex through sex exchange. Alternatively, participation in sex exchange may lead to panic attack and PTSD symptoms that affect efficacy for condom use. Thus, low-income women faced with constrained survival choices also experience worry and fear that may impact their STI risk.

The finding of an association between PTSD and condomless sex over time among women with HIV indicates a need to address traumatic life experiences in this population. Chu et al. have proposed that traumatic events, especially in childhood, are linked to dissociative symptoms (as a coping mechanism) that can make it harder for adult women to assess or evaluate risk in dangerous situations [48,

49]. Previous research with this cohort of unstably housed women found that 43% of participants have elevated levels of dissociation at baseline, which was significantly associated with recently experiencing physical or sexual violence [50]. These results reiterate the calls for trauma-informed care in primary care, OB-GYN, psychiatric, and substance use disorder treatment settings [51–56], especially in an HIV treatment context [57]. The Substance Abuse and Mental Health Services Administration (SAMHSA) has specified six principles of trauma-informed care: safety; trustworthiness and transparency; peer support; collaboration and mutuality; empowerment, voice, and choice; and cultural, historic, and gender issues [58].

While some symptoms of panic attack may be attributable to stimulant use, the DIS diagnostic assessment process excludes panic attack symptoms related to substance use. In addition, the association between panic attack and condomless sex persisted even after adjusting for stimulant use. The frequent victimization of unstably housed women [13, 14] as well as constrained choices due to limited housing and healthcare options for women without HIV may contribute to the increased risk for panic attack. In addition to addressing interpersonal violence and unmet subsistence needs, results suggest that promotion of in-the-moment stress reduction techniques, coping and coping-efficacy interventions [59], cognitive behavioral [60] and compassion focused therapy [61], and medication [62] for anxiety may potentially decrease condomless sex among impoverished women.

Principles of trauma-informed care may also be applied to settings where unstably housed women receive social services. For example, in supportive housing, this may include having flexible curfews and guest policies [63], as well as features that facilitate privacy (such as private rooms and locks) and maximizing choice whenever possible [64]. At a homeless shelter this may mean providing a daytime refuge (but not forcing people to leave during the day) and at a free meal program this may mean having women-only mealtimes or providing meal delivery services. Women-only spaces (that include staff and management) in all service provision settings may facilitate both agency and social support that expand choices, safety, and recovery [63].

Our finding that women without HIV who experienced recent homelessness had greater longitudinal odds of condomless sex than housed women, even after adjusting for sex exchange and having a primary partner, provides additional support for the importance of housing in promoting wellbeing of impoverished women [3, 7, 65]. The lack of such an association in women with HIV may be due to individual abstaining, serosorting, or other STI prevention behaviors. It may also be a reflection of the greater linkage to housing, healthcare, counseling, and case management [14] that HIV-infected individuals receive via the Housing Opportunities for Persons with AIDS (HOPWA) program and other programs [66–68], and that subsequently increase women's choices and options. Related clinical implications include the importance of assessing and documenting patients' homelessness or risk of becoming homeless [69], understanding the competing needs for survival that may negatively influence health behaviors, and being prepared to coordinate referrals to social services case managers and local legal and civil rights advocates [3].

The high prevalence of condomless sex reinforces prior calls for heightened attention to STI prevention for unstably housed adults, for example, including homeless women as an HSV-2 high-risk population in testing guidelines [2], and integrating sexual health care into housing and support services [70]. This may also include individual-level social approaches such as skill-based interventions to improve condom use [71] and structural interventions to improve educational and economic prospects in resource-poor communities [72]. An additional implication of findings is that many women in this study would meet the American College of Obstetricians and Gynecologists and Centers for Disease Control and Prevention candidacy recommendations for pre-exposure prophylaxis (PrEP) [73, 74]. This underscores the importance of improving PrEP uptake and education among impoverished women, particularly those facing housing challenges [75, 76].

Limitations

These findings should be considered in light of several limitations. A major limitation for HIV implications is that we do not have information on serosorting behavior by women either with or without HIV, so we do not know to what degree condomless sex was reported when women had the same HIV status as their partner. Another limitation is that all behaviors except HIV status are self-reported. As behaviors may be under-reported, our estimates of associations are likely at least as strong as reported here. A related consideration is that there may have been some social desirability bias for women with HIV to deny condomless sex. Additionally, we may have been underpowered to detect differences in condomless sex when comparing daily substance use to no substance use. Finally, we urge caution in over-interpreting the impact of individual diagnoses, as they were not confirmed by more formal clinical assessment and there is a high level of comorbidity, which may have resulted in confounding. Furthermore, the Diagnostic Interview Schedule used in assessment is reflective of the DSM-IV, and not the

updated DSM-5, which categorizes PTSD as a trauma and stressor disorder rather than as an anxiety disorder [77]. Nevertheless, notable strengths of this study include use of longitudinal data to determine correlates of condomless sex over time and a detailed assessment of mental health (rather than report of mental health services utilization).

Conclusions

Assessing and addressing infrequent substance use and anxiety- and trauma-related disorders may reduce subsequent condomless sex among homeless and unstably housed women. In addition, more targeted approaches are needed to address homelessness among women, particularly women without HIV who have fewer resources.

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Compliance with Ethical Standards

Conflict of interest None for all authors.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Riley ED, Cohen J, Dilworth SE, Grimes B, Marquez C, Chin-Hong P, et al. Trichomonas vaginalis infection among homeless and unstably housed adult women living in a resource-rich urban environment. Sex Transm Infect. 2016;92(4):305–8.
2. Kelly JD, Cohen J, Grimes B, Philip SS, Weiser SD, Riley ED. High rates of herpes simplex virus type 2 infection in homeless women: informing public health strategies. J Women's Health (2002). 2016;25(8):840–5.
3. Riley ED, Gandhi M, Hare C, Cohen J, Hwang S. Poverty, unstable housing, and HIV infection among women living in the United States. Curr HIV/AIDS Rep. 2007;4(4):181–6.
4. Knight KR, Lopez AM, Comfort M, Shumway M, Cohen J, Riley ED. Single room occupancy (SRO) hotels as mental health risk environments among impoverished women: the intersection of policy, drug use, trauma, and urban space. Int J Drug Policy. 2014;25(3):556–61.
5. Aidala AA, Wilson MG, Shubert V, Gogolishvili D, Globerman J, Rueda S, et al. Housing status, medical care, and health outcomes among people living with HIV/AIDS: a systematic review. Am J Public Health. 2016;106(1):e1–23.
6. Dunkle KL, Jewkes RK, Brown HC, Gray GE, McIntryre JA, Harlow SD. Transactional sex among women in Soweto, South Africa: prevalence, risk factors and association with HIV infection. Soc Sci Med (1982). 1982;59(8):1581–92.
7. Weiser SD, Dilworth SE, Neilands TB, Cohen J, Bangsberg DR, Riley ED. Gender-specific correlates of sex trade among homeless and marginally housed individuals in San Francisco. J Urban Health. 2006;83(4):736–40.
8. Edwards JM, Halpern CT, Wechsberg WM. Correlates of exchanging sex for drugs or money among women who use crack cocaine. AIDS Educ Prev. 2006;18(5):420–9.
9. Pratt L, Xu F, McQuillan G, Robitz R. The association of depression, risky sexual behaviours and herpes simplex virus type 2 in adults in NHANES, 2005–2008. Sex Transm Infect. 2012;88(1):40–4.
10. Ameli N, Bacchetti P, Morrow RA, Hessol NA, Wilkin T, Young M, et al. Herpes simplex virus infection in women in the WIHS: epidemiology and effect of antiretroviral therapy on clinical manifestations. AIDS (London, England). 2006;20(7):1051–8.
11. Buchacz K, McFarland W, Hernandez M, Klausner JD, Page-Shafer K, Padian N, et al. Prevalence and correlates of herpes simplex virus type 2 infection in a population-based survey of young women in low-income neighborhoods of Northern California. The Young Women's Survey Team. Sex Transm Dis. 2000;27(7):393–400.
12. Sutton M, Sternberg M, Koumans EH, McQuillan G, Berman S, Markowitz L. The prevalence of Trichomonas vaginalis infection among reproductive-age women in the United States, 2001–2004. Clin Infect Dis. 2007;45(10):1319–26.
13. Tsai AC, Weiser SD, Dilworth SE, Shumway M, Riley ED. Violent victimization, mental health, and service utilization outcomes in a cohort of homeless and unstably housed women living with or at risk of becoming infected With HIV. Am J Epidemiol. 2015;181(10):817–26.
14. Riley ED, Cohen J, Knight KR, Decker A, Marson K, Shumway M. Recent violence in a community-based sample of homeless and unstably housed women with high levels of psychiatric comorbidity. Am J Public Health. 2014;104(9):1657–63.
15. Neblett RC, Davey-Rothwell M, Chander G, Latkin CA. Social network characteristics and HIV sexual risk behavior among urban African American women. J Urb Health. 2011;88(1):54–65.
16. Hittner JB. Meta-analysis of the association between methamphetamine use and high-risk sexual behavior among heterosexuals. Psychol Addict Behav. 2016;30(2):147–57.
17. Meade CS, Sikkema KJ. HIV risk behavior among adults with severe mental illness: a systematic review. Clin Psychol Rev. 2005;25(4):433–57.
18. Hobkirk AL, Towe SL, Lion R, Meade CS. Primary and secondary HIV prevention among persons with severe mental illness: recent findings. Curr HIV/AIDS Rep. 2015;12(4):406–12.
19. Blank MB, Mandell DS, Aiken L, Hadley TR. Co-occurrence of HIV and serious mental illness among Medicaid recipients. Psychiatr Serv. 2002;53(7):868–73.
20. Carey MP, Carey KB, Kalichman SC. Risk for human immunodeficiency virus (HIV) infection among persons with severe mental illnesses. Clin Psychol Rev. 1997;17(3):271–91.
21. Hughes E, Bassi S, Gilbody S, Bland M, Martin F. Prevalence of HIV, hepatitis B, and hepatitis C in people with severe mental illness: a systematic review and meta-analysis. Lancet Psychiatr. 2016;3(1):40–8.
22. Helleberg M, Pedersen MG, Pedersen CB, Mortensen PB, Obel N. Associations between HIV and schizophrenia and their effect on HIV treatment outcomes: a nationwide population-based cohort study in Denmark. Lancet HIV. 2015;2(8):e344–50.

23. Weiser SD, Wolfe WR, Bangsberg DR. The HIV epidemic among individuals with mental illness in the United States. Curr HIV/AIDS Rep. 2004;1(4):186–92.
24. Carrico AW, Bangsberg DR, Weiser SD, Chartier M, Dilworth SE, Riley ED. Psychiatric correlates of HAART utilization and viral load among HIV-positive impoverished persons. AIDS (London, England). 2011;25(8):1113–8.
25. Cook JA, Grey D, Burke J, Cohen MH, Gurtman AC, Richardson JL, et al. Depressive symptoms and AIDS-related mortality among a multisite cohort of HIV-positive women. Am J Public Health. 2004;94(7):1133–40.
26. Gonzalez JS, Batchelder AW, Psaros C, Safren SA. Depression and HIV/AIDS treatment nonadherence: a review and meta-analysis. J Acquir Immune Defic Syndr (1999). 2011;58(2):181–7.
27. Hahn JA, Woolf-King SE, Muyindike W. Adding fuel to the fire: alcohol's effect on the HIV epidemic in Sub-Saharan Africa. Curr HIV/AIDS Rep. 2011;8(3):172–80.
28. Fisher JC, Bang H, Kapiga SH. The association between HIV infection and alcohol use: a systematic review and meta-analysis of African studies. Sex Transm Dis. 2007;34(11):856–63.
29. Shoptaw S, Reback CJ. Associations between methamphetamine use and HIV among men who have sex with men: a model for guiding public policy. J Urb Health. 2006;83(6):1151–7.
30. Corsi KF, Booth RE. HIV sex risk behaviors among heterosexual methamphetamine users: literature review from 2000 to present. Curr Drug Abuse Rev. 2008;1(3):292–6.
31. Underhill K, Operario D, Montgomery P. Systematic review of abstinence-plus HIV prevention programs in high-income countries. PLoS Med. 2007;4(9):e275.
32. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. DSM-IV. 4th ed. Philadelphia: APA; 1994.
33. Blouin AG, Perez EL, Blouin JH. Computerized administration of the diagnostic interview schedule. Psychiatr Res. 1988;23(3):335–44.
34. Marshall LL. Development of the severity of violence against women scales. J Fam Violence. 1992;7(2):103–21.
35. Gelberg L, Gallagher TC, Andersen RM, Koegel P. Competing priorities as a barrier to medical care among homeless adults in Los Angeles. Am J Public Health. 1997;87(2):217–20.
36. Fisher JD, Smith L. Secondary prevention of HIV infection: the current state of prevention for positives. Curr Opin HIV AIDS. 2009;4(4):279.
37. Marks G, Crepaz N, Senterfitt JW, Janssen RS. Meta-analysis of high-risk sexual behavior in persons aware and unaware they are infected with HIV in the United States: implications for HIV prevention programs. JAIDS J Acquir Immune Defic Syndr. 2005;39(4):446–53.
38. R Development Core Team R. A language and environment for statistical computing. 3.2.2 ed. Vienna: R Development Core Team; 2017.
39. Halekoh U, Højsgaard S, Yan J. The R package geepack for generalized estimating equations. J Stat Softw. 2006;15(2):1–11.
40. Hosmer DW Jr, Lemeshow S, Sturdivant RX. Applied logistic regression. Hoboken, NJ: Wiley; 2013.
41. Fishbein M. Demographic and behavioral predictors of sexual risk in a multisite HIV prevention trial. NIMH Multisite HIV Prevention Trial. AIDS (London, England). 1997;11(Suppl 2):S21–7.
42. Gonzalez JS, Batchelder AW, Psaros C, Safren SA. Depression and HIV/AIDS treatment nonadherence: A review and meta-analysis. J Acquir Immune Defic Syndr (1999). 2011;58(2):181–7.
43. Peixoto ER, Barros FC, Guimaraes MD. Factors associated with unprotected sexual practice among men and women with mental illnesses in Brazil. Cad de saude publ. 2014;30(7):1475–86.
44. Walsh JL, Senn TE, Carey MP. Longitudinal associations between health behaviors and mental health in low-income adults. Transl Behav Med. 2013;3(1):104–13.
45. Armstrong G, Jorm AF, Samson L, Joubert L, Nuken A, Singh S, et al. Association of depression, anxiety, and suicidal ideation with high-risk behaviors among men who inject drugs in Delhi, India. J Acquir Immune Defic Syndr (1999). 2013;64(5):502–10.
46. Yi H, Sandfort TG, Shidlo A. Effects of disengagement coping with HIV risk on unprotected sex among HIV-negative gay men in New York City. Health Psychol. 2010;29(2):205–14.
47. Kutner BA, Nelson KM, Simoni JM, Sauceda JA, Wiebe JS. Factors associated with sexual risk of HIV transmission among HIV-positive Latino men who have sex with men on the U.S.-Mexico Border. AIDS Behav. 2017;21(3):923–34.
48. Chu AT, Deprince AP, Mauss IB. Exploring revictimization risk in a community sample of sexual assault survivors. J Trauma Dissoc. 2014;15(3):319–31.
49. Chu JA. The revictimization of adult women with histories of childhood abuse. J Psychother Pract Res. 1992;1(3):259–69.
50. Young DA, Shumway M, Flentje A, Riley ED. The relationship between childhood abuse and violent victimization in homeless and marginally housed women: the role of dissociation as a potential mediator. Psychol Trauma. 2017;9(5):613–21.
51. Meshberg-Cohen S, Presseau C, Thacker LR, Hefner K, Svikis D. Posttraumatic stress disorder, health problems, and depression among African American women in residential substance use treatment. J Women's Health (2002). 2016;25(7):729–37.
52. Torchalla I, Linden IA, Strehlau V, Neilson EK, Krausz M. "Like a lots happened with my whole childhood": violence, trauma, and addiction in pregnant and postpartum women from Vancouver's Downtown Eastside. Harm Reduct J. 2015;12:1.
53. Rosenberg L. Addressing trauma in mental health and substance use treatment. J Behav Health Serv Res. 2011;38(4):428–31.
54. Mills KL. The importance of providing trauma-informed care in alcohol and other drug services. Drug Alcohol Rev. 2015;34(3):231–3.
55. Elliott DE, Bjelajac P, Fallot RD, Markoff LS, Reed BG. Trauma-informed or trauma-denied: principles and implementation of trauma-informed services for women. J Commun Psychol. 2005;33(4):461–77.
56. Machtinger EL, Cuca YP, Khanna N, Rose CD, Kimberg LS. From treatment to healing: the promise of trauma-informed primary care. Women's Health Issues. 2015;25(3):193–7.
57. Sikkema KJ, Mulawa MI, Robertson C, Watt MH, Ciya N, Stein DJ, et al. Improving AIDS care after trauma (ImpACT): Pilot outcomes of a coping intervention among HIV-infected women with sexual trauma in South Africa. AIDS Behav. 2017;22(3):1039–52.
58. SAMHSA. Trauma-informed approach and trauma-specific interventions. Rockville: SAMHSA; 2018.
59. Meuret AE, Wolitzky-Taylor KB, Twohig MP, Craske MG. Coping skills and exposure therapy in panic disorder and agoraphobia: latest advances and future directions. Behav Ther. 2012;43(2):271–84.
60. Pompoli A, Furukawa TA, Efthimiou O, Imai H, Tajika A, Salanti G. Dismantling cognitive-behaviour therapy for panic disorder: a systematic review and component network meta-analysis. Psychol Med. 2018;48(12):1945–53.
61. Gilbert P. The origins and nature of compassion focused therapy. Br J Clin Psychol. 2014;53(1):6–41.
62. Bandelow B, Baldwin DS, Zwanzger P. Pharmacological treatment of panic disorder. Modern Trends Pharmacopsychiatr. 2013;29:128–43.
63. Lazarus L. Risky health environments: women sex workers' struggles to find safe, secure and non-exploitative housing in Canada's poorest postal code. Soc Sci Med. 2011;73(11):1600–7.

64. Bebout RR. Trauma-informed approaches to housing. New Dir Ment Health Serv. 2001;2001(89):47–55.
65. Fitzpatrick-Lewis D, Ganann R, Krishnaratne S, Ciliska D, Kouyoumdjian F, Hwang SW. Effectiveness of interventions to improve the health and housing status of homeless people: a rapid systematic review. BMC Publ Health. 2011;11:638.
66. Dickson-Gomez J, McAuliffe T, Convey M, Weeks M, Owczarzak J. Access to housing subsidies, housing status, drug use and HIV risk among low-income U.S. urban residents. Subst Abuse Treat Prev Policy. 2011;6:31.
67. CDPH. Housing opportunities for persons with AIDS program. 2018. https://www.cdph.ca.gov/Programs/CID/DOA/Pages/OA_care_hopwa.aspx. Accessed 16 Mar 2018.
68. Leaver CA, Bargh G, Dunn JR, Hwang SW. The effects of housing status on health-related outcomes in people living with HIV: a systematic review of the literature. AIDS Behav. 2007;11(6 Suppl):85–100.
69. Kushel M, Hepatitis A. Outbreak in California—addressing the root cause. N Engl J Med. 2018;378(3):211–3.
70. Williams SP, Bryant KL. Sexually transmitted infection prevalence among homeless adults in the U.S.: a systematic literature review. Sex Transm Dis. 2018;45(7):494–504.
71. Wenzel SL, Cederbaum JA, Song A, Hsu HT, Craddock JB, Hantanachaikul W, et al. Pilot test of an adapted, evidence-based HIV sexual risk reduction intervention for homeless women. Prev Sci. 2016;17(1):112–21.
72. Raiford JL, Herbst JH, Carry M, Browne FA, Doherty I, Wechsberg WM. Low prospects and high risk: structural determinants of health associated with sexual risk among young African American women residing in resource-poor communities in the south. Am J Community Psychol. 2014;54(3–4):243–50.
73. ACOG. Committee Opinion No 595: preexposure prophylaxis for the prevention of human immunodeficiency virus. Obstet Gynecol. 2014;123(5):1133–6.
74. CDC. Interim guidance for clinicians considering the use of preexposure prophylaxis for the prevention of HIV infection in heterosexually active adults. MMWR Morb Mortal Weekly Rep. 2012;61(31):586–9.
75. Wenzel SL, Henwood B, Harris T, Winetrobe H, Rhoades H. Provider perceptions on HIV risk and prevention services within permanent supportive housing. AIDS Care. 2017;29(10):1331–5.
76. Seidman D, Weber S. Integrating preexposure prophylaxis for human immunodeficiency virus prevention into women's health care in the United States. Obstet Gynecol. 2016;128(1):37–43.
77. Kilpatrick DG, Resnick HS, Milanak ME, Miller MW, Keyes KM, Friedman MJ. National estimates of exposure to traumatic events and PTSD prevalence using DSM-IV and DSM-5 criteria. J Trauma Stress. 2013;26(5):537–47.