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SMOKING BEHAVIORS IN A COMMUNITY-BASED COHORT OF HIV-INFECTED UNSTABLY HOUSED AND HOMELESS ADULTS

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# Smoking Behaviors in a Community-Based Cohort of HIV-Infected Indigent Adults

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**Abstract** We conducted a longitudinal study of a community-based cohort of HIV-infected indigent adults to examine smoking behaviors and factors associated with quitting. We assessed “hardcore” smoking behaviors associated with a low probability of quitting. Of the 296 participants, 218 were current smokers (73.6 %). The prevalence of “hardcore” smoking was high: 59.6 % smoked  $\geq 15$  cigarettes per day, and 67.3 % were daily smokers. During the study interval, 20.6 % made at least one quit attempt. Of these, 53.3 % were abstinent at 6 months. The successful quit rate over 2 years was 4.6 %. Illegal substance use (adjusted odds ratio, AOR 0.2, 95 % CI 0.1–0.6) and smoking within 30 min of waking (AOR 0.2, 95 % CI 0.1–0.7) were associated with lower likelihood of making a quit attempt. Interventions that reduce nicotine dependence prior to smoking cessation and those that are integrated with substance use treatment may be effective for this population.

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**Keywords** Hardcore smokers · HIV-infected persons · Nicotine dependence · Smoking cessation

## Introduction

Compared to the general population where the prevalence of smoking is estimated to be 19 % [1], rate of smoking among persons living with HIV/AIDS (PLWHA) is almost threefold higher (prevalence range 50–66 %) [2–4]. In the past three decades, with increasing use of anti-retroviral therapy (ART), AIDS-related mortality has declined [5]. However, the proportion of deaths due to tobacco-attributable conditions including cardiovascular, pulmonary, and non-AIDS defining cancers has increased significantly [6–11]. Smoking is associated with decreased adherence to ART [12, 13], a lower virological and immunological response to ART [14], a higher risk of AIDS-defining conditions, and a more rapid progression of HIV disease [14]. Cigarette smoking is an independent risk factor for all-cause mortality among PLWHA [10, 11].

Previous cross-sectional studies have found that PLWHA who smoke have higher cigarette consumption

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compared to those who are not HIV-infected [3, 15, 16]. While PLWHA who smoke are interested in quitting smoking and make quit attempts [2, 3], they are less successful in achieving sustained cessation after having made a quit attempt [3]. Risk factors for smoking such as low socioeconomic status [3, 17], mental health disorders [18], and substance use disorders [18] are common among PLWHA [4, 15, 19]. Social stressors such as inadequate housing pose additional barriers to smoking cessation: factors associated with inadequate housing such as illegal substance use, increased stress, and barriers to access to health care are also associated with high rates of smoking [20, 21].

Few studies have examined the reasons behind the low quit rates among PLWHA. The term “hardcore” smoking is used to describe smoking behaviors that are associated with low quit rates [e.g. daily smoking, heavy smoking (15 cigarettes per day (cpd)), smoking for a long time (>5 years), having a high level of nicotine dependence, having no intention to quit smoking, or never having made a quit attempt] [22–24]. While hardcore smoking behaviors have been studied in the general population [22–24], they have not been studied among PLWHA. Studying smoking behaviors among PLWHA will improve our understanding of low quit rates, and provide insights into the development of smoking cessation programs tailored to the needs of this population.

Thus, we conducted a longitudinal study of a community-based cohort of HIV-infected indigent adults to examine smoking and quitting behaviors over a 2-year study interval. Using multivariable logistic regression, we identified factors associated with quitting. We examined “hardcore” smoking behaviors to quantify and understand the reasons behind the resistance to smoking cessation among this population. We hypothesized that use of illegal substances and “hardcore” smoking behaviors would be associated with making fewer quit attempts.

## Methods

### Study Participants and Sampling

We recruited participants from September 2007 through June 2008 from the Research on Access to Care in the Homeless (REACH) study, a longitudinal cohort of homeless and marginally housed HIV-infected adults in San Francisco [25]. Members of the REACH cohort were recruited in three waves (1996–1997, 1999–2000, 2003–2004) using systematic sampling from homeless shelters, free-meal programs, and single-room occupancy hotels. Each participant was tested for HIV infection and those who tested positive were invited to enroll. For this study, we recruited all REACH participants

who completed a quarterly REACH interview during the study enrollment period from September 2007 through June 2008 [26, 27]. Three hundred and thirty-seven participants were enrolled and active (i.e. had three previous follow-up visits) in the REACH study between September 2007 and June 2008. Of the 337 eligible participants, 296 enrolled in the current study (87.8 % response rate). The 296 participants were interviewed every 3 months for 2 years. All participants reported having a primary care provider. The University of California, San Francisco (UCSF) Institutional Review Board reviewed and approved all study protocols. We obtained a Certificate of Confidentiality from the National Institute on Drug Abuse. All participants provided written informed consent prior to participation.

### Study Procedures

We met with participants at the UCSF Clinical and Translational Research Institute’s Tenderloin Clinical Research Center (TCRC), a community-based university research site. The study included an enrollment interview and seven follow-up interviews over 2 years. All interviews took place within 1 calendar week of the corresponding REACH study interview. Trained research assistants administered structured questionnaires. We reimbursed participants \$20 for the baseline and \$5 for each quarterly interview, and \$20 for each REACH study quarterly interview.

### Smoking Behaviors

We used previously validated questions to obtain information on tobacco use. At enrollment, we asked participants whether they had ever smoked 100 cigarettes in their lifetime, and classified those who did as ever smokers. We classified ever smokers who reported smoking “every day or some days” as current smokers, and those who reported “not smoking at all” as former smokers. Among those who reported ever smoking, we calculated the quit ratio (former smoker/ever smoker). At enrollment, we asked current smokers about their intentions to quit smoking, and gave them the following responses as options: “never expect to quit”, “may quit in the near future, but not in the next 6 months”, “will quit in the next 6 months”, or “will quit in the next month”. We asked current smokers to report whether they had any quit attempts in the past 12 months that lasted 1 day or longer. At enrollment and at each quarterly visit, we asked current smokers whether they smoked any cigarettes during the past 30 days. We estimated average daily cigarette consumption based on self-reported numbers of cigarettes smoked on smoking days. At enrollment, we asked current smokers “How soon after you wake in the morning do you usually smoke your first cigarette?” Participants selected from the following response options:

“after 60 min”, “31–60 min”, “6–30 min”, and “within 5 min.” We calculated nicotine dependence using responses to average daily cigarette consumption and the time to first cigarette after waking using the Heaviness of Smoking Index (HSI) (a score of five or six is indicative of high nicotine dependence) [28].

We defined a quit attempt as a self-report of no cigarette consumption in the past 30 days at a study follow-up visit (i.e. point prevalence abstinence lasting for 30 days) [29–31]. We defined 6-month repeated point prevalence abstinence (“6-month abstinence”) as a self-report of no consumption in the past 30 days over two or more consecutive follow-up visits (i.e. repeated point prevalence abstinence lasting for 30 days over a 6 month interval) [29–31]. Repeated point prevalence abstinence has been used as a marker for prolonged abstinence [31]. We defined a relapse episode as self-report of smoking resumption after having made a quit attempt or after a 6-month abstinence period.

We used five of the six components of “hardcore” smoking outlined in previous studies [23, 24]. We assessed the following components of “hardcore” smoking separately and in aggregate: consumption  $\geq 15$  cpd, being a current daily smoker, high nicotine dependence (HSI score  $\geq 5$ ), no quit intention ever or in the next 6 months, and no past-year quit attempt. High nicotine dependence (HSI score  $\geq 5$ ), quit intention at enrollment, and quit attempt in the past year were measured at enrollment, and high daily cigarette consumption and daily smoking were reported as cumulative rates over the study interval.

#### Covariates

At the enrollment interview, we diagnosed lifetime alcohol abuse or dependence using the Diagnostic Interview Schedule-IV (DIS-IV) instrument for alcohol use disorders [32]. At each quarterly visit, participants self-reported the number of days they drank in the past 30 days and the average number of drinks consumed on days that they drank. We defined regular drinking as  $>7$  drinks per week for women and  $>14$  drinks per week for men [33]. Using the DIS-IV instrument [32], we diagnosed lifetime substance abuse or dependence for illegal substances (cocaine, methamphetamine, heroin/opiates). At each quarterly visit, participants self-reported whether they had used any illegal substances in the past 90 days. We identified those who did as current users of illegal drugs.

Participants self-reported information on demographics (age and sex), race/ethnicity (White, African American, Hispanic or mixed/other), education (less than high school versus high school or more), lifetime history of chronic homelessness (homeless at least 1 year since the age of 18), and lifetime history of prison stays (state or federal prison). At each quarterly visit, we obtained information on

monthly income and current homelessness (living on the street or in a shelter in the past 90 days). We assessed depression at each quarterly visit using the Beck Depression Inventory-II (BDI-II), and categorized participants as having no (BDI-II score  $\leq 13$ ), mild (BDI-II score 14–18), or moderate to severe (BDI-II score  $\geq 19$ ) depression [34]. At each quarterly visit, participants self-reported whether they had a visit with their primary care provider (PCP) in the past 90 days.

#### Statistical Analysis

We described sample characteristics and reported smoking and quitting behaviors using means for continuous variables and proportions for categorical variables. We reported the proportion of participants who made a quit attempt that lasted for 30 days and who were abstinent from smoking for at least 6 months during the 2-year study interval. We reported the proportion of participants who relapsed after making a quit attempt or achieving 6-month abstinence. Among participants who achieved 6-month abstinence, we described whether they did so by reducing consumption prior to quitting or by stopping smoking abruptly [35]. Among current smokers, we used random-effects multivariable logistic regression for repeated binary outcomes to examine factors associated with making a quit attempt. The model included current smokers who had at least one follow-up visit after the enrollment visit ( $n = 210$ ). We included variables that were found to be associated with quit attempts in previous studies among populations similar to those represented in our study [4, 15, 19, 23, 36]. We adjusted for age, sex, race/ethnicity (white versus non-white), education, intention to quit smoking (intention to quit smoking within the next 1–6 months versus not), time to first cigarette in the morning ( $<30$  min vs.  $\geq 30$  min), and recent quit attempt (quit attempt in the past year versus not) using values from the enrollment visit. In addition, we controlled for the following time-varying covariates: current homelessness, regular drinking, current use of illegal substances, depression, and PCP visit. Because the outcome of quit attempts was present only among those who reported no cigarette consumption or had a value of zero on the HSI scale, we were unable to adjust for these variables in our multivariable model. We used time to first cigarette in the morning as a proxy for nicotine dependence [28]. We estimated the prevalence of “hardcore” smoking. We examined the bivariate association of “hardcore” smoking (individual components and in aggregate) and the outcome of quit attempts using the Chi square statistic. Among those who made a quit attempt, we examined the bivariate association of “hardcore” smoking and 6-month abstinence using the Chi square statistic. We conducted these analyses using Stata, version 11 [37].

## Results

Among the 296 participants, the mean age was 49.4 years; 71.9 % were male, and 41.2 % were African American (Table 1). The majority (82.1 %) of the participants reported a lifetime history of chronic homelessness, more than two-thirds (69.8 %) met criteria for a diagnosis of lifetime illegal substance abuse or dependence, and more than half (58.5 %) met criteria for a diagnosis of lifetime alcohol abuse or dependence.

**Table 1** Sample characteristics at enrollment ( $N = 296$ )

Characteristics at enrollment	$N$ (%)
Age (mean, SD)	49.4 (7.5)
Male	213 (71.9)
Race/ethnicity	
White	114 (38.5)
Black/African American	122 (41.2)
Latino	23 (7.8)
Other/mixed	37 (12.5)
Education	
Less than high school	84 (28.8)
High school graduate	114 (39.0)
More than high school	94 (32.2)
Monthly income (mean, SD)	\$946 (414)
Lifetime history of prison stay	53 (18.9)
Residential history	
Lifetime history of chronic homelessness	239 (82.1)
Current homelessness (street and shelter use in the past 90 days)	30 (10.1)
Substance use	
Lifetime drug abuse or dependence <sup>a</sup>	199 (69.8)
Crack/cocaine use in the past 90 days	70 (23.7)
Heroin use in the past 90 days	17 (5.7)
Methamphetamine use in the past 90 days	47 (15.9)
One or more illicit substance use in the past 90 days <sup>b</sup>	103 (34.8)
Problem drinking	
Lifetime alcohol abuse or dependence <sup>c</sup>	167 (58.5)
Regular drinking in the past 30 days <sup>d</sup>	21 (7.1)
Depression in the past 90 days	
Beck Depression Inventory-II score (BDI-II) (mean, SD)	12.7 (11.4)
No depression (BDI-II score $\leq 13$ )	155 (59.9)
Mild depression (BDI-II score 14–18)	33 (12.7)
Moderate to severe depression (BDI-II score $\geq 19$ )	71 (27.4)

<sup>a</sup> Lifetime history of cocaine, amphetamine, or heroin/opiate abuse or dependence determined by the DIS-IV instrument

<sup>b</sup> History of cocaine, amphetamine, or heroin/opiate use in the past 90 days

<sup>c</sup> Lifetime alcohol abuse or dependence determined by the DIS-IV instrument

<sup>d</sup> Regular drinking defined as >7 drinks for women and >14 drinks for men in the past 30 days

Of the 296 participants, 251 (84.8 %) were ever smokers (Table 2). Almost three-fourths (73.6 %) of the participants were current smokers, and 11.1 % were former smokers. The quit ratio was 13.1 %. Of the 218 current smokers at enrollment, 82.1 % were present at all follow-up visits. On average, current smokers consumed 12.2 cpd (SD = 11.9). Almost two-thirds (63.3 %) of current smokers reported having to smoke within 30 min of waking up. The majority of participants who reported smoking currently expressed some intention to quit smoking: 54.9 % expressed an intention to quit, but not in the next 6 months; 13.9 % expressed an intention to quit in the next 2–6 months; and 6.5 % expressed an intention to quit in the next month. One-fourth (24.7 %) of the participants stated that they never expected to quit smoking. Of current smokers, 42.3 % reported having made a quit attempt that lasted for at least 1 day in the past year.

Of all current smokers, 20.6 % made at least one quit attempt that lasted for 30 days during the study interval. Of the 45 current smokers who made a quit attempt, 24 participants (53.3 %) were abstinent at 6 months. Among those who were abstinent at 6 months, the majority (83.3 %) had stopped smoking abruptly without reducing consumption. Of those who were abstinent for 6 months during the study interval ( $n = 24$ ), 58.3 % (14/24) relapsed back to smoking by the end of the study interval. The successful quit rate during the 2-year study interval was 4.6 % (10 smokers who were abstinent at end of the study interval/218 current smokers at enrollment).

In adjusted repeated measures analysis, older age (adjusted odds ratio (AOR) 1.1, 95 % CI 1.0–1.2) and an intention to quit smoking within the next 1–6 months at enrollment (AOR 4.3, 95 % CI 1.2–16.0) were associated with making a quit attempt during the study interval (Table 3). A history of illegal substance use in the past 90 days (AOR 0.2, 95 % CI 0.1–0.6) and smoking within 30 min of waking (AOR 0.2, 95 % CI 0.1–0.7) were associated with lower odds of making a quit attempt. Having a PCP visit in the past 90 days was not associated with making a quit attempt (AOR 0.8, 95 % CI 0.3–2.0).

The prevalence of the components of hardcore smoking varied between 40.3 and 79.5 %; 78.4 % of current smokers reported at least one component, and 21.6 % had all five (Table 4). Among current smokers, all of the measures of “hardcore” smoking except for quit attempt in the past-year were associated with making a quit attempt during the study interval. Current smokers who consumed  $\geq 15$  cpd or who smoked daily were less likely to make a quit attempt compared to those who consumed <15 cpd or were non-daily smokers. Of those who made a quit attempt, current daily smoking was the only measure of “hardcore” smoking that was associated with a lower

likelihood of 6-month abstinence during the study interval (30.4 % for current daily vs. 77.3 % current non-daily,  $p < 0.05$ ).

## Discussion

In this community-based cohort of HIV-infected indigent adults, the prevalence of current smoking was 73.6 %. This rate is comparable to those observed among clinic-based samples of low-income HIV-infected patients (50–66 %) [2–4] and almost four times higher than that in the general population (19 %) [1]. The lifetime quit ratio was 13.2 %, lower than that among clinic-based samples of HIV-infected patients (22 %) [4] and almost 4 times lower than that in the general population (51 %) [38]. The prevalence of “hardcore” smoking was much higher than that in the general population (0.03 % and 14 % in the general population depending on the definition) [22–24]. The high level of resistance to smoking cessation suggests that current population-wide tobacco control efforts may be insufficient to reduce smoking rates among this high-risk population.

The classification of “hardcore” smokers stems from the “hardening hypothesis”, which states that as the prevalence of smoking declines from population-wide tobacco control efforts, less dependent smokers will quit, leaving behind a group of highly dependent smokers [22, 24, 39]. The low quit rates observed in our study could be related to the high rates of “hardcore” smoking. Factors associated with “hardcore” smoking including male sex and having low educational attainment [23, 40] were common among participants in our study as were mental health and substance use disorders, which are associated with higher levels of nicotine dependence and lower likelihood of cessation [36, 41].

Of the “hardcore” smoking measures, intention to quit smoking was associated with making subsequent quit attempts, but not with 6-month abstinence [22, 42, 43]. Smoking daily, a measure of high level of nicotine dependence, was associated with a low likelihood of 6-month abstinence [22, 42, 43]. These results suggest that for highly dependent smokers, smoking reduction interventions [44–46] that focus on reducing the level of nicotine addiction prior to a quit attempt may increase the likelihood of prolonged abstinence. A previous study

**Table 2** Smoking and quitting behaviors at enrollment and during the study interval ( $N = 296$ )

	<i>N</i> (%)
Ever smoker	251 (84.8)
Current smoker	218 (73.6)
Former smoker	33 (11.1)
Quit ratio (former/ever smoker)	13.1
Smoking behaviors among current smokers at enrollment	
Average daily cigarette consumption (mean, SD)	12.2 (11.9)
Time to first cigarette in the morning <30 min	136 (63.3)
High nicotine dependence <sup>a</sup>	52 (23.9)
Intention to quit at baseline	
Never expect to quit	53 (24.7)
May quit but not in the next 6 months	118 (54.9)
Expect to quit within the next 6 months	30 (13.9)
Expect to quit within the next 1 month	14 (6.5)
Previous quit attempt for at least 1 day in the past year	91 (42.3)
Cumulative proportion of quitting behaviors among current smokers during the study interval	
Quit attempt <sup>b</sup>	45 (20.6)
Among those who made a quit attempt	
Smokers who achieved 6-month abstinence <sup>c</sup>	24 (53.3)
Relapse rate	21 (46.7)
Among those who achieved 6-month abstinence	
Stopped smoking abruptly (i.e. without reducing consumption)	20 (83.3)
Relapse rate	14 (58.3)

<sup>a</sup> Heaviness of smoking index score  $\geq 5$

<sup>b</sup> Self-report of no consumption during the past 30 days during a follow-up visit

<sup>c</sup> Self-report of no consumption during the past 30 days during two or more consecutive follow-up visits

**Table 3** Factors associated with making a quit attempt among current smokers during the study interval ( $N = 210$ )

	Unadjusted odds ratio 95 % CI	Adjusted odds ratio 95 % CI
Age (mean, SD)	1.1 (1.0–1.1)	1.1 (1.0–1.2) <sup>a</sup>
Male	0.8 (0.2–2.8)	1.6 (0.5–5.9)
Race/ethnicity		
Non-white (ref)		
White	0.2 (0.6–1.0)	0.5 (0.1–1.6)
Education		
Less than high school (ref)		
High school graduate	1.2 (0.3–4.8)	2.2 (0.5–8.6)
More than high school	1.8 (0.4–7.6)	3.6 (0.9–15.5)
Current homelessness (street and shelter use in the past 90 days) <sup>b,d</sup>	0.6 (0.2–1.8)	0.8 (0.2–2.4)
Regular drinking in the past 30 days <sup>b,c</sup>	0.7 (0.3–1.7)	0.8 (0.3–2.2)
Illegal drug use in the past 90 days <sup>b,d</sup>	0.2 (0.1–0.5) <sup>e</sup>	0.2 (0.1–0.6) <sup>e</sup>
Depression in the past 90 days <sup>b</sup>		
No depression (BDI-II score $\leq 13$ ) (ref)		
Mild depression (BDI-II score 14–18)	1.2 (0.5–3.2)	1.2 (0.5–3.2)
Moderate to severe depression (BDI-II score $\geq 19$ )	0.7 (0.3–1.8)	0.7 (0.3–1.7)
Intention to quit smoking at enrollment		
Never expect to quit or may quit, but not in the next 6 months (ref)		
Expect to quit in the next 1–6 months	7.1 (2.0–25.2) <sup>e</sup>	4.3 (1.2–16.0) <sup>a</sup>
Time to first cigarette in the morning <30 min	0.2 (0.1–0.6) <sup>e</sup>	0.2 (0.1–0.7) <sup>e</sup>
Quit attempt in the past year	1.7 (0.6–5.3)	0.8 (0.2–2.4)
PCP visit in the past 90 days <sup>b</sup>	0.9 (0.4–2.2)	0.8 (0.3–2.0)

<sup>a</sup>  $p$  value <0.05

<sup>b</sup> Time-varying covariates included current homelessness, regular drinking, illegal drug use, depression, and PCP visit

<sup>c</sup> Regular drinking defined as >7 drinks for women and >14 drinks for men in the past 30 days

<sup>d</sup> History of cocaine, amphetamine, or heroin/opiate use in the past 90 days

<sup>e</sup>  $p$  value <0.005

showed that moderate to heavy smokers who reduced their consumption to less than 15 cigarettes per day were more likely to successfully quit smoking compared to those who had not [46].

Consistent with previous studies among high-risk individuals who shared similar characteristics with participants in our study (e.g. HIV-infection, unstable housing, and substance use disorders) [2, 3, 20, 47–49], we found that the majority of the participants were interested in quitting smoking. While motivation to quit smoking was associated with making a quit attempt, less than one-quarter made a quit attempt during the 2-year study interval. PLWHA may face other barriers to making a quit attempt such as having decreased confidence or self-efficacy to quit smoking despite being motivated to quit [50, 51]. Our results suggest a need for tailored interventions that target individuals in the earlier stages of quitting (e.g. pre-contemplative or contemplative) to move them along the continuum of quitting [52, 53]. Interventions may include practice quit

attempts to induce smokers in the earlier stages of quitting to engage in smoking cessation, without requiring immediate abstinence [53, 54]. These types of interventions may build self-efficacy in quitting and increase the likelihood of successful quitting after an attempt has been made [53, 54].

Relapse rates were high both among persons who made a quit attempt that lasted for 30 days and among those who were abstinent for 6 months. Previous studies identified limited access or poor adherence to smoking cessation aids, depression, anxiety, illegal substance use, and stress from social stressors as factors associated with relapse [55, 56]. Whether the method of smoking cessation or the use of smoking cessation aids could have influenced relapse among highly dependent smokers merits further exploration. The high rates of relapse highlight a need for relapse prevention strategies to ensure that quit attempts lead to prolonged abstinence and successful quitting.

Our findings that illegal substance use was associated with a low likelihood of making quit attempts confirm those from

**Table 4** Association of “hardcore” smoking components and quit attempts and 6-month abstinence ( $N = 218$ )

“Hardcore” components	Total $N = 218$ $N (%)$	Made a quit attempt <sup>a</sup> $N = 45$ $N (%)^c$	6-Month abstinence <sup>b</sup> $N = 24$ $N (%)^d$
High daily cigarette consumption			
$\geq 15$ cigarettes per day	130 (59.6)	19 (14.6) <sup>e</sup>	7 (36.8)
$< 15$ cigarettes per day	88 (40.3)	26 (29.6)	17 (65.4)
High nicotine dependence <sup>f</sup>			
HSI score $\geq 5$	88 (40.3)	11 (12.5) <sup>e</sup>	4 (36.4)
HSI score $< 5$	130 (59.6)	34 (26.2)	20 (58.8)
Being a daily smoker			
Current daily	169 (67.3)	23 (13.6) <sup>g</sup>	7 (30.4) <sup>g</sup>
Current non-daily	49 (19.5)	22 (44.9)	17 (77.3)
Quit intention at enrollment			
Never expect to quit or may quit, but not in the next 6 months	171 (79.5)	26 (15.2) <sup>g</sup>	14 (53.9)
Expect to quit in the next 1–6 months	44 (20.5)	17 (38.6)	8 (47.1)
Quit attempt in the past year			
Did not make a quit attempt	124 (57.7)	21 (16.9)	10 (47.6)
Made a quit attempt in the past year	91 (42.3)	22 (24.2)	12 (54.6)
Composite “hardcore” <sup>h</sup>			
All “hardcore” components	47 (21.6)	4 (8.5) <sup>e</sup>	2 (50.0)
Any “hardcore” components	171 (78.4)	41 (23.9)	22 (53.7)

<sup>a</sup> Made a quit attempt defined as self-report of no consumption in the past 30 days at a study follow-up visit

<sup>b</sup> 6-Month abstinence defined as a self-report of no consumption in the past 30 days over two or more consecutive follow-up visits

<sup>c</sup> Among current smokers, % represent row percentages of the total

<sup>d</sup> Among current smokers who made a quit attempt, % represent row percentages of those who made a quit attempt

<sup>e</sup>  $p < 0.05$  for difference between the two groups for each outcome

<sup>f</sup> Heaviness of smoking index score (HSI)  $\geq 5$

<sup>g</sup>  $p < 0.005$  for difference between the two groups for each outcome

<sup>h</sup> Composite “hardcore” defined as smoking  $\geq 15$  cigarettes per day, having an HSI score  $\geq 5$ , being a current daily smoker, never expecting to quit or may quit but not in the next 6 months, and no recent quit attempt in the past year

previous studies [36, 57]. The adverse consequences of illegal substance use on smoking cessation among PLWHA who smoke highlights the importance of integrating smoking cessation programs with substance use treatment. We did not find an association between PCP visits and quit attempts after adjusting for covariates. While we were unable to assess whether participants were counseled to quit smoking during each visit, our results suggest that engagement in primary care may be insufficient to trigger quit attempts in the presence of other risk factors for smoking (e.g. illegal substance use, or dependence). Previous studies have suggested that PCPs of HIV-infected patients compared to those who are not HIV-infected were less aware of their patient’s smoking status [58]. Studies have also suggested a need for increased smoking cessation training among providers of HIV-infected patients [59]. These factors merit further exploration.

Our study had several limitations. By using self-reports of smoking, we may have underestimated prevalence of

smoking. Our measure of quit attempts and 6-month abstinence relied on self-reports of consumption in the past 30 days. This approach may lead to recall bias, although we may have minimized this bias by restricting the time of recall to the past 30 days. Our measure of 6-month abstinence was not reflective of prolonged abstinence; we were unable to determine smoking relapse during the 30-days period and in between measurement time points. We did not have information on the use of smoking cessation aids and were unable to assess whether this could have affected quitting behaviors. We were unable to assess the sixth component of “hardcore” smoking, length of smoking  $> 5$  years, because we did not have information on numbers of years smoked or initiation of smoking. The variables for quit attempts and the HSI were defined using the same variable for average daily cigarette consumption. Doing so made it impossible for us to adjust for the full HSI measure, as individuals who made a quit attempt



would have had values of zero on the HSI scale and self-reported no daily cigarette consumption in the past 30 days. To address this limitation, we used time to first cigarette after waking as a proxy for nicotine dependence in our multivariable model. While losses to follow-up could have resulted in an underestimation of quit attempts and 6-month abstinence, the resulting bias should be limited because these outcomes may be less likely after dropout. Similarly, our repeated measures analysis of factors associated with quit attempts could be biased if the underlying assumption that the data are missing at random is violated. However, this is less likely because we have no reason to suspect that the relationship between risk factors and quit attempts would change significantly after dropout.

The high prevalence of “hardcore” smoking and concurrent illegal substance use poses significant challenges to smoking cessation among indigent PLWHA. Our results demonstrated that the majority of the cohort were in the earlier stages of quitting, suggesting a need for staged interventions that focus on smoking reduction prior to cessation. Such interventions may induce highly dependent smokers to engage in the cessation process, thereby increasing their likelihood of a future successful quit attempt. These interventions need to be integrated with substance use treatment, and incorporate relapse-prevention strategies to minimize risk of relapse and maximize efforts at successful cessation.

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