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Smoking behavior and wellness among individuals in substance use disorder treatment

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Abstract

Tobacco-related morbidity and mortality disproportionately affect people with substance use disorders (SUD). Encouraging overall wellness may support tobacco use cessation. We investigated relationships between wellness (health status, physical activity, sugar-sweetened beverage (SSB) consumption), cigarette smoking, and smoking cessation among SUD treatment patients to inform clinical care. Cross-sectional surveys were conducted with 395 patients in 20 California residential SUD programs. Using multivariate regression, we examined associations between smoking status and wellness. Among smokers, we examined associations between lifetime smoking exposure, cessation behaviors and attitudes, and wellness. Compared to non-smokers (n = 121), smokers (n = 274) reported more SSB consumption, poorer physical health, and more respiratory symptoms. Among smokers, SSB consumption and respiratory symptoms increased per ten pack-years of smoking. Smokers with respiratory symptoms reported higher motivation to quit and more use of nicotine replacement therapy (NRT). Smokers with more days of poor mental health reported lower motivation to quit. Overall, cigarette smoking was associated with other health-risk behaviors among SUD treatment patients. Respiratory symptoms may increase, and poor mental health may decrease, SUD patients' intent to quit smoking. To reduce chronic disease risk among SUD patients, treatment programs should consider promoting overall wellness concurrently with smoking cessation.

Keywords

substance use disorder; treatment; smoking cessation; wellness; nutrition; physical activity

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Introduction

Smoking is the leading preventable cause of death worldwide and disproportionately affects vulnerable populations, including persons with substance use disorders (SUD). Despite recent decreases in smoking across the general US population, adults with SUD (Han et al., 2022) and adult patients in SUD treatment programs (Guydish et al., 2011) continue to smoke at three to four times the rate of the general population. SUD treatment patients are more likely to die of smoking-related causes than from alcohol or other drug use (Bandiera, Anteneh, Le, Delucchi, & Guydish, 2015). Quitting smoking during SUD treatment may improve treatment outcomes (McKelvey, Thrul, & Ramo, 2017) and reduce risk of relapse to other drugs (Weinberger et al., 2017).

Other health behaviors, including nutrition and physical activity, may also influence SUD treatment outcomes. Sugar-sweetened beverage (SSB) consumption is associated with poor nutrient intake, increased body mass index, and increased risk of health problems such as diabetes and cardiovascular disease (Malik, Popkin, Bray, Després, & Hu, 2010; Vartanian, Schwartz, & Brownell, 2007). Among persons with SUD, SSB intake has been linked to heightened drug cravings and relapse risk (Braun et al., 2021). Physical inactivity in SUD patients is associated with worse mental health (Tull, Lee, Geers, & Gratz, 2018) and poorer health-related quality of life, which may impact SUD outcomes (Marquez-Arrico, Navarro, & Adan, 2020; Schmitz, Kruse, & Kugler, 2004).

Wellness promotion, including physical activity or nutritional interventions, may support smoking cessation (Bock et al., 2019; Smits et al., 2016) and improve treatment outcomes for non-tobacco SUDs (Grant, Haughton, & Sachan, 2004; Weinstock, Barry, & Petry, 2008). For example, physical activity may reduce mental health symptoms and drug cravings in SUD treatment patients (Giménez-Meseguer, Tortosa-Martínez, & Cortell-Tormo, 2020; Patterson et al., 2022; D. Wang, Zhou, Zhao, Wu, & Chang, 2016). Physical exercise interventions for SUD treatment patients have been found to reduce use of alcohol and other drugs (Linke et al., 2019) including nicotine (Fallin-Bennett et al., 2018). Nutritional support can help to address nutrient deficiencies in people recovering from SUD, which may also help to reduce drug cravings and improve co-occurring mental health symptoms (Jeynes & Gibson, 2017). Healthy Recovery, an intervention designed to address smoking, diet, and physical activity in persons with SUD, yielded lower cigarette consumption, more NRT use, and improved nutrition among participants (Kelly et al., 2021).

However, wellness services are infrequently offered in SUD treatment programs. A recent survey in a large public SUD treatment system found that 30% of programs provided nutrition services, with residential programs nearly three times more likely to offer them as compared to outpatient programs (Wiss, Schellenberger, & Prelip, 2019). While no data were found on the availability of physical activity services in SUD treatment facilities, researchers have noted that dedicated exercise time is rarely integrated into SUD treatment activities (Linke & Ussher, 2015), and utilization is low when treatment programs provide exercise equipment with no structured intervention (Dai, Chen, Richardson, & Gordon, 2020).

Little is known about the relationships between wellness, smoking behaviors, and smoking cessation factors among persons in SUD treatment. SUD programs address smoking cessation in multiple ways. Some approaches focus directly on tobacco use and cessation, and are designed to increase screening, assessment, and treatment of tobacco use in SUD treatment (Knudsen, 2017). Other approaches place tobacco use within a broader wellness context focused on multiple health behaviors (H. M. Baker, Ranney, & Goldstein, 2016; Lee et al., 2011; Prochaska et al., 2004; Williams et al., 2009). Some studies suggest that broader health and wellness approaches to smoking cessation may decrease stigma, reduce substance-related health harms, and increase motivation to stop smoking (A. L. Baker, Callister, Kelly, & Kypri, 2012; Smith, Seamark, & Beck, 2020).

This study examined relationships between smoking and other wellness measures among persons enrolled in California community-based residential SUD programs. First, we assessed whether smoking status (current smoker v. non-smoker) was associated with differences in self-reported health status, SSB consumption, or physical activity. Given clustering of health risk behaviors (Meader et al., 2016) and poorer health-related quality of life among smokers in the general population (Strine et al., 2005), we hypothesized that smokers would report worse health status, more SSB consumption, and less physical activity.

Second, among SUD patients who smoke, we assessed whether lifetime exposure to smoking (measured as pack-years) was associated with differences in health status, SSB consumption, or physical activity. Based on associations between smoking intensity and unhealthy lifestyle factors (Lohse, Rohrmann, Bopp, & Faeh, 2016), and research confirming dose-response associations of long-term smoking with health problems (Lubin et al., 2016), we hypothesized that smokers with more pack-years would report worse health status, more SSB consumption, and less physical activity.

Third, among smokers, we assessed whether cessation measures were associated with health status, SSB consumption, or physical activity. Cessation measures used in these analyses included intent to quit in the next 30 days, past year quit attempts, self-efficacy to quit, wanting help with quitting, and use of nicotine replacement therapy (NRT). Based on reported associations between healthier behaviors and higher readiness to quit (Boyle, O'Connor, Pronk, & Tan, 2000; Nguyet, Béland, & Otis, 1998), we hypothesized that SUD treatment patients with less SSB consumption and more physical activity would report more cessation-related attitudes and behaviors.

Methods

Program selection and recruitment

The sample for this study was drawn from 20 residential SUD treatment programs across California participating in three parent studies (Guydish, Kapiteni, et al., 2020). All programs were state-licensed, publicly funded and served mostly low-income patients covered by Medi-Cal, California's Medicaid program. Program recruitment procedures for all three projects are described in more detail in Guydish, Wahleithner, Williams, and Yip (2020).

The first parent study included California residential behavioral health programs with a minimum 20-bed capacity that applied to participate in a tobacco cessation and wellness policy development intervention (CTCP, 2018). Seven programs elected to participate. The second study examined tobacco-free policies among nine California-licensed residential SUD programs. The third parent study included four California-licensed, residential SUD treatment centers participating in a webinar-based intervention to address tobacco use among their patients (Guydish, Kapiteni, et al., 2020). The data reported in this study were collected at baseline before the program sites began any intervention activities.

Data collection

Cross-sectional client surveys were conducted during site visits to each participating program. All patients enrolled in the residential program at the time of the site visit were eligible to participate. Research staff members were present for each one- to two-day site visit. Patients in each program reviewed study information on an iPad and indicated their consent to participate by selecting “Yes” at the bottom of the electronic consent form. Participating patients then self-administered the surveys using iPads, and received a $20 gift card for study participation. All study procedures were approved by the institutional review board of the University of California, San Francisco.

Measures

Surveys included questions about demographics, reason for seeking treatment, time in treatment, smoking and quitting behaviors, and self-report items measuring health and wellness. Measures for this analysis were included in surveys for all three parent studies.

Demographics, primary reason for treatment entry, primary drug, time in treatment—Demographics assessed were age, gender, race/ethnicity (Hispanic, non-Hispanic Black, non-Hispanic White, multiracial/other), education, marital status, sexual orientation, and health insurance status (having versus not having health insurance). Reason for treatment entry included substance use disorder, or both substance use and mental health disorders. Primary drug of use included alcohol, stimulants, marijuana/cannabis, opioids, or other. Time in treatment included the number of weeks or months the patient had been in the current treatment program.

Smoking status—Participants reported their smoking status as current, former, or never smoker. Current smoking was defined as having smoked more than 100 cigarettes in one’s lifetime, and self-identification as a current smoker. Non-smokers included both self-reported never and former smokers.

Lifetime exposure to smoking—We operationalized lifetime exposure to smoking as pack-years, calculated as the number of packs of cigarettes smoked per day, multiplied by the total number of years smoked. Our decision to use pack-years was based on the importance of lifetime exposure to smoking-related health consequences (Lubin et al., 2016; Pleasants, Rivera, Tilley, & Bhatt, 2020).

Interest and ability to quit smoking—We assessed intent to quit smoking in the next 30 days (yes/no) as a measure of readiness to quit (DiClemente et al., 1991). Other measures asked whether the participant had ever used NRT or medications to quit smoking (yes/no) and the extent to which they agreed with the statement: "I have the required skills to quit." The latter measure, which assessed self-efficacy to quit, was reported using a Likert scale and then transformed into a binary yes/no variable for analysis. Other measures asked whether the participant had made at least one quit attempt lasting at least 24 hours in the past year (yes/no) and whether they wanted help from their treatment program to quit (yes/no).

Health and Wellness Measures—Health and wellness measures included health status, sugar sweetened beverage (SSB) consumption, and physical activity. We included measures used widely in community health research (e.g., the National Health and Nutrition Examination Survey, or NHANES) to support comparison with wellness studies conducted in other population groups.

NHANES health status measures included coughing on most days for three or more consecutive months in the past year (CDC, 2002b), shortness of breath in the past year (CDC, 2002a), and number of days in the past month that physical and mental health were not good (CDC, 2018).

To assess SSB consumption, participants answered questions from the National Cancer Institute's Dietary Screener Questionnaire (Thompson, Midthune, Kahle, & Dodd, 2017) about how many times in the past week they had consumed non-diet soft drinks/soda/pop, sweetened fruit drinks/energy drinks, coffee or tea with added sugar, and flavored milk or milk-type drink. For our analysis, participants' answers were summed across these four questions to determine the total number of SSB consumed in the past week.

Physical activity was assessed using measures from the International Physical Activity Questionnaire (Craig et al., 2003). Participants reported the number of times in the past week they had engaged in moderate aerobic exercise, such as carrying light loads, bicycling at a regular pace, or doubles tennis; and excluding walking.

Data analysis

Across all programs, 682 patients were enrolled in treatment at the time of the client survey, and 564 patients completed the survey (83% participation rate). Two of the participating programs included criminal justice patients who were enrolled as part of pre- or post-release treatment, and these patients (n = 68) sometimes reported being in treatment for criminal justice rehabilitation reasons rather than for substance use of mental health reasons. Patients not in treatment for substance use or mental health reasons were excluded from analysis. As some health behavior questions asked about behavior in the past 7 days, patients who had been in treatment less than 7 days were also excluded from analyses (n = 52). This left a total of 395 patients in the analysis.

Comparing smokers v. non-smokers—We first compared smokers (n = 274) and non-smokers (n = 121) on demographics (age, gender, race/ethnicity, education, sexual orientation, marital status), health insurance status, primary drug, and reason and time in

treatment. Next, we compared smokers and non-smokers on health and wellness measures (health status, SSB intake, physical activity). Although participants were asked about three types of physical activity (vigorous, moderate, and strength-building), we included moderate only in the analyses due to skewness and missing data in responses for the other physical activity items. We used chi-square or Fisher's Exact tests for categorical variables, and t-tests or Wilcoxon tests for continuous variables.

We then used multivariate regression analyses to assess whether the unadjusted differences found between smokers and non-smokers on the health and wellness measures remained significant when all variables from Table 1 (demographics, health insurance status, primary drug, reason and time in treatment) were included. All models adjusted for nesting of participants within clinics. Logistic regression models were used for dichotomous outcomes and negative binomial regression models for counts.

Comparison of health and wellness measures among smokers—Among smokers only (n = 274), we assessed whether health and wellness outcomes were associated with pack-years as a measure of lifetime exposure to smoking. This analysis step used increments of ten pack-years as the predictor, and the six health and wellness outcomes described above. One regression analysis was used for each outcome, and all models adjusted for demographics, health insurance status, primary drug, reason and time in treatment, and for nesting of patients within clinics.

Comparison of cessation behaviors by health and wellness measures—Among current smokers (n = 274), we assessed whether the six health and wellness measures were associated with each of five cessation-related measures (past year quit attempt, past use of NRT, intent to quit, wanting help with quitting, and self-efficacy to quit). Each logistic regression model included all six health and wellness variables as predictors, and one of the cessation variables as an outcome. These analyses adjusted for lifetime exposure to smoking, demographics, health insurance status, primary drug, reason and time in treatment, and also controlled for nesting of participants within programs.

Results

Demographics, reason for treatment and primary drug

Comparison of demographics by smoking status (Table 1) showed that current smokers, as compared to non-smokers, had lower educational attainment ($p = 0.038$) and comprised more non-Hispanic whites than other racial/ethnic categories, while non-smokers comprised more Hispanics ($p = 0.012$). Compared to non-smokers, current smokers more often reported being in treatment for both substance use and mental health reasons ($p = 0.048$), and had been in treatment for shorter time periods ($p < 0.0001$). Current smokers were also more likely than non-smokers to endorse opioids or stimulants as their primary drug of use ($p < 0.0001$).

Health and wellness measures by smoking status

Compared to non-smokers, current smokers reported more SSB consumption ($p < 0.0001$), more days of poor physical ($p = 0.020$) and mental health ($p = 0.050$), more coughing ($p < 0.001$), and more shortness of breath ($p < 0.0001$) (Table 2).

Multivariate regression analyses (Table 3) confirmed significant differences for higher SSB consumption (Adjusted Mean Ratio, AMR = 1.72, 95% CI = 1.25, 2.35), poorer physical health (AMR = 1.57, CI = 1.03, 2.42), coughing (Adjusted Odds Ratio, AOR = 3.33, CI = 2.17, 5.14), and shortness of breath (AOR = 2.54, CI = 1.45, 4.46). Past 30-day mental health status was not associated with smoking status in these analyses.

Health and wellness measures among smokers by lifetime smoking exposure

Table 4 compares health and wellness variables among current smokers by lifetime smoking exposure (operationalized as pack-years). Among current smokers, odds of reporting SSB consumption (AMR = 1.17, CI = 1.04, 1.32), coughing (AOR = 1.31, CI = 1.08, 1.59), and shortness of breath (AOR = 1.68, CI = 1.25, 2.27) increased per ten pack-years of smoking. No trend was observed for physical activity or past 30-day physical or mental health status.

Association between health and wellness measures and smoking cessation behaviors

As shown in Table 5, current smokers who reported frequent coughing had increased odds of wanting help with quitting while in SUD treatment (AOR = 2.78, CI = 1.52, 5.09). Those who reported shortness of breath were more likely to have used NRT (AOR = 2.34, CI = 1.41, 3.88) and to endorse intent to quit in the next 30 days (AOR = 2.74, CI = 1.64, 4.61). Smokers with more days of poor mental health had increased odds of lifetime NRT use (AOR = 1.07, CI = 1.02, 1.11), while the opposite trend was observed for smokers with more days of poor physical health (AOR = 0.93, CI = 0.90, 0.97). Finally, smokers with more days of poor mental health were less likely to intend to quit in the next 30 days (AOR = 0.92, CI = 0.87, 0.96). No significant associations were found for SSB consumption, physical activity, self-efficacy to quit, or past year quit attempts.

Discussion

Among people in SUD treatment, we found associations between smoking status and wellness measures, between lifetime smoking exposure and wellness, and between wellness and cessation behaviors. These findings align with research in non-SUD populations showing that smoking tends to cluster with other health risk behaviors (Poortinga, 2007), and that poor respiratory health may strengthen motivation to quit smoking (Borrelli, Hayes, Dunsiger, & Fava, 2010).

Compared to non-smokers, current smokers reported higher SSB consumption, poorer physical health, and more respiratory symptoms (i.e., shortness of breath and coughing). Current smokers in the general population also reported more SSB intake (Lundeen, Park, Pan, & Blanck, 2018). Both higher SSB intake (M. Wang, Yu, Fang, & Hu, 2015) and greater lifetime smoking exposure (Kim et al., 2014) are linked to increased risk for Type II diabetes.

Current smokers with more pack-years of smoking also reported more SSB consumption and respiratory symptoms than those with fewer pack-years. A population-based survey found that clustering of health risk behaviors increased with smoking intensity (Chiolero, Wietlisbach, Ruffieux, Paccaud, & Cornuz, 2006). These findings suggest that smokers in SUD treatment, and especially those with more lifetime smoking exposure, may benefit from interventions to address unhealthy behaviors that co-occur with smoking.

Current smokers who endorsed coughing or shortness of breath were more likely to want to quit, intend to quit, or to have taken concrete steps to quit smoking (i.e., NRT use) as compared to those who did not report these health symptoms. In studies of non-SUD populations, respiratory symptoms predicted both intent to quit (Melzer et al., 2016) and smoking cessation (Finocchio et al., 2021). In previous research with SUD samples, patients who reported health concerns as a reason for smoking cessation were more likely to quit smoking during treatment (Campbell, Le, Tajima, & Guydish, 2017).

Smokers reporting more days of poor mental health were more likely to have used NRT, compared to those with better past 30-day mental health. Research with non-SUD populations also found that smokers with mental health diagnoses had increased odds of NRT use, as compared to smokers without mental health concerns (Morris, Burns, Waxmonsky, & Levinson, 2014). Higher rates of NRT use may reflect the increased nicotine dependence associated with mental health comorbidity (Hollands, Sutton, & Aveyard, 2022; John, Meyer, Rumpf, & Hapke, 2004).

Smokers with poorer mental health reported less intent to quit in the next 30 days. This finding differs from other studies suggesting that smokers with mental health issues are as motivated (Siru, Hulse, & Tait, 2009) or even more motivated (Morris et al., 2014) to quit than the general population. However, it is possible that smokers with comorbid mental and substance use disorders may be more dependent on nicotine for emotional self-regulation than smokers with SUD alone or mental health disorders alone (Kalman, Morissette, & George, 2005; Tidey & Rohsenow, 2009). Our finding suggests that patients with co-occurring mental health problems may need additional motivational enhancement and/or higher NRT dosages to quit.

Smokers with poorer physical health were less likely to report lifetime NRT use. Poor physical health may be indicative of poor health care access or coverage (Gelberg, Andersen, & Leake, 2000; Shi, 2001), which in turn may reduce opportunities to obtain NRT or other pharmacotherapy for smoking cessation.

While smoking, substance use, and SSB consumption clustered in this sample, lower SSB consumption and more physical activity were not associated with greater self-efficacy to quit smoking or more quit attempts among current smokers. This finding may support the theory that motivation for multiple health behavior change clusters by domain (Flay, Snyder, & Petraitis, 2009). Motivation for smoking cessation may cluster most easily with motivation to stop other substance use, while motivation to improve nutrition and physical activity may converge more readily because both relate to a “metabolic” cognitive domain focused on weight and physical appearance (Lippke, Nigg, & Maddock, 2012).

Findings should be interpreted in the context of study limitations. All programs were California residential SUD programs, limiting generalizability. However, focusing on residential programs is strategic for informing future wellness interventions because residential programs have more opportunities than outpatient programs to address patients' health behaviors. The use of a cross-sectional study design precludes causal interpretation, and measures of health risk behaviors were based on self-report. Wellness measures used in this study also were limited to smoking behavior, SSB consumption, and moderate exercise. SSB consumption and moderate exercise are very limited measures of nutrition and physical activity, respectively. These were the measures available in the context of secondary analyses of existing datasets. As the literature related to wellness in SUD treatment develops, it will be important to include more robust measures of wellness behaviors (e.g., fruit and vegetable consumption) and attitudes (e.g., self-assessment of diet and physical activity, self-efficacy and motivation for wellness improvement). It is also important to note that patients' wellness behaviors while in residential treatment do not necessarily reflect their typical behaviors, and program characteristics may influence nutrition and physical activity access. Despite these limitations, our study provides novel data regarding wellness and smoking among SUD treatment patients and may inform future multi-pronged wellness interventions in SUD treatment.

Conclusion

Patients in SUD treatment often have multiple physical and mental health problems (Keaney et al., 2011; Ross, Wilson, Banks, Rezannah, & Daglish, 2012). Tobacco use compounds these health problems and may worsen SUD treatment outcomes (Weinberger et al., 2017). Our findings indicate that SUD treatment patients who smoke often engage in other health risk behaviors, and may experience smoking-related health problems that increase their interest in receiving help.

When designing wellness interventions, SUD programs can emphasize measurable, short-term improvements in respiratory symptoms as well as physical fitness gains to increase patients' motivation for smoking cessation. Physical activity also can be promoted for stress reduction and to assist with tobacco cravings during cessation attempts (Taylor, Ussher, & Faulkner, 2007).

Further, programs can educate patients on physical health risks associated with high SSB consumption, emphasizing that people with SUD who also smoke may have increased vulnerability. Programs also can provide nutritional counseling focused on identifying hidden sugars in foods and beverages and making healthier choices when possible (e.g., drinking water or sugar-free drinks; choosing fruit over candy to quell sugar cravings) (Chavez & Rigg, 2020; Wiss & Waterhous, 2014). Residential SUD programs can additionally reduce the availability of sugary foods and beverages at their facilities, and provide more whole grains, vegetables, and fruits.

Given evidence of efficacy for wellness interventions addressing multiple health risk factors simultaneously (James et al., 2016), more research is needed on the design, efficacy, and implementation of multi-pronged wellness interventions in SUD treatment. An expanded

evidence base could lead to clinical guidelines on specific approaches to wellness promotion within SUD treatment. In the meantime, SUD treatment programs should consider nutrition and physical activity services in concert with tobacco and other SUD treatment. To support implementation, federal and state agencies that fund SUD treatment should include or increase funds for nutrition, physical activity, and smoking cessation services. Doing so may help to address the chronic diseases that present the greatest risk to long-term morbidity and mortality among people recovering from substance use disorders (Callaghan, Gatley, Sykes, & Taylor, 2018).

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Table 1.

Demographics, Primary Drug, Reason and Time in Treatment among Patients in Substance Use Disorder Treatment by Smoking Status (N = 395)

	Mean (SD) or n (%)		
	Current Smokers (N=274)	**Non-Current Smokers (N=121)**	**p-value[1]**
Age	37.8 (11.4)	40.0 (11.9)	0.079
Gender			0.413
Male	196 (71.8%)	81 (66.9%)	
Female	72 (26.4%)	39 (32.2%)	
Other	5 (1.8%)	1 (0.8%)	
Race/ethnicity			**0.012**
Hispanic	93 (33.9%)	60 (49.6%)	
Non-Hispanic Black	45 (16.4%)	20 (16.5%)	
Non-Hispanic White	107 (39.1%)	29 (24.0%)	
Multiracial/Other	29 (10.6%)	12 (9.9%)	
Education			0.128
<HS	79 (28.8%)	26 (21.5%)	
HS/GED	94 (34.3%)	38 (31.4%)	
>HS	101 (36.9%)	57 (47.1%)	
Marital status			0.105
Married	23 (8.4%)	18 (14.9%)	
Divorced/Separated/Widowed	76 (27.7%)	32 (26.4%)	
Not married but in a long-term relationship	40 (14.6%)	10 (8.3%)	
Never married	135 (49.3%)	61 (50.4%)	
Sexual orientation			0.116
Straight/Heterosexual	243 (89.7%)	101 (85.6%)	
Gay or Lesbian	12 (4.4%)	12 (10.2%)	
Bisexual	13 (4.8%)	5 (4.2%)	
Something else	3 (1.1%)	0 (0.0%)	
Has health insurance	238 (86.9%)	101 (83.5%)	0.287
Primary drug of use			**<0.0001**
Alcohol	50 (18.5%)	37 (31.4%)	
Stimulants	138 (51.1%)	45 (38.1%)	
Marijuana/Cannabis	13 (4.8%)	9 (7.6%)	
Opioids	62 (23.0%)	10 (8.5%)	
Other/mental health only	7 (2.6%)	17 (14.4%)	
Reason in treatment			**0.048**
Substance use disorder	191 (70.0%)	94 (79.7%)	
Both substance use and mental health disorders	82 (30.0%)	24 (20.3%)	
Time in treatment			
How long have you been in your current treatment program?			**<0.0001**
≥ 1 week to less than 1 month	62 (22.6%)	25 (20.7%)	

	Mean (SD) or n (%)		
	Current Smokers (N=274)	**Non-Current Smokers (N=121)**	**p-value[1]**
1 month to 3 months	156 (56.9%)	43 (35.5%)	
More than 3 months	56 (20.4%)	53 (43.8%)	

[1] From Chi-Square tests/Fisher's Exact test for categorical variables and t-test for the continuous variable

Table 2.

Health and Wellness Measures among Patients in Substance Use Disorder Treatment by Smoking Status (N = 395)

	Median (IQR)/n(%)		p-value[1]
	Current Smokers (N=274)	Non-Current smokers (N=121)	
Health status			
Days of physical health not good in past month	0.0 (5.0)	0.0 (2.0)	**0.020**
Days of mental health not good in past month	3.0 (10.0)	1.0 (7.0)	**0.050**
Nutrition			
Number of sugary beverages per week	9.0 (19.0)	5.0 (8.0)	**<0.0001**
Physical activity			
Any physical activity in past week	225 (84.3%)	103 (86.6%)	0.562
	n (%)		p-value[2]
Respiratory symptoms			
In the past year, have you coughed on most days for 3 consecutive months or more?			**<0.001**
Yes	85 (31.0%)	16 (13.2%)	
No/don't know	189 (69.0%)	105 (86.8%)	
Have you had shortness of breath either when hurrying on level ground or while walking up a slight hill?			**<0.0001**
Yes	147 (53.6%)	38 (31.4%)	
No/don't know	127 (46.4%)	83 (68.6%)	

[1] From Wilcoxon tests

[2] From Chi-square tests

Table 3.

Comparison of Health and Wellness Measures among Smokers and Non-Smokers in Substance Use Disorder Treatment[1,2]

	Smoker vs. Non-Smoker	
	OR (95% CI)	**p**
Coughed on most days for 3 consecutive months or more in the past year	3.33 (2.17, 5.14)	**<0.0001**
Had shortness of breath either when hurrying on level ground or while walking up a slight hill	2.54 (1.45, 4.46)	**0.001**
	Mean ratio (95% CI)	**p**
Days of physical health not good in past month	1.57 (1.03, 2.42)	**0.038**
Days of mental health not good in past month	1.26 (0.88, 1.80)	0.202
Number of sugary beverages per week	1.72 (1.25, 2.35)	**<0.001**

[1]Adjusted for demographics (age, race/ethnicity), reason in treatment, primary drug, and time in treatment; and also controlled for nesting of participants within clinics.

[2]Presented are odds ratios for categorical data, and mean ratios for count data.

Table 4.

Comparison of Health and Wellness Measures among Smokers based on Pack Years[1,2,3]

	OR (95% CI)	p
Coughed on most days for 3 consecutive months or more in the past year	1.31 (1.08, 1.59)	**0.006**
Had shortness of breath either when hurrying on level ground or while walking up a slight hill	1.68 (1.25, 2.27)	**<0.001**
Any physical activity in past week	0.92 (0.71, 1.18)	0.491
	Mean ratio (95% CI)	**p**
Days of physical health not good in past month	0.99 (0.88, 1.12)	0.880
Days of mental health not good in past month	0.98 (0.86, 1.13)	0.788
Number of sugary beverages per week	1.17 (1.04, 1.32)	**0.009**

[1]Adjusted for demographics (age, race/ethnicity), reason in treatment, primary drug, and time in treatment; and also controlled for nesting of participants within clinics.

[2]Presented are odds ratios for categorical data, and mean ratios for count data.

[3]The unit of analysis is 10 pack-years

Table 5.

Association between Health and Wellness Measures and Smoking Cessation Behaviors[1]

	Coughed on most days for 3 consecutive months or more in past year (ref: no)		Had shortness of breath either when hurrying on level ground or while walking up a slight hill (ref: no)		Any physical activity in past week? (ref: no)		Days of physical health not good in past month		Days of mental health not good in past month		Number of sugary beverages per week	
	OR (95% CI)	**p**	**OR (95% CI)**	**p**	**OR (95% CI)**	**p**	**OR (95% CI)**	**p**	**OR (95% CI)**	**p**	**OR (95% CI)**	**p**
Have you ever used the following NRT products to help quit smoking?	1.37 (0.91, 2.07)	0.136	2.34 (1.41, 3.88)	**<0.001**	0.99 (0.51, 1.93)	0.987	0.93 (0.90, 0.97)	**<0.001**	1.07 (1.02, 1.11)	**0.003**	1.00 (0.99, 1.01)	0.629
I have the required skills to quit smoking	0.60 (0.28, 1.29)	0.193	0.84 (0.47, 1.50)	0.556	1.65 (0.81, 3.35)	0.169	0.98 (0.95, 1.00)	0.078	1.00 (0.97, 1.04)	0.959	0.99 (0.97, 1.00)	0.079
In your current treatment program, did you want help with quitting smoking?	2.78 (1.52, 5.09)	**<0.001**	2.00 (0.92, 4.34)	0.081	1.88 (0.61, 5.79)	0.269	1.01 (0.97, 1.05)	0.614	0.97 (0.93, 1.00)	0.048	1.00 (0.99, 1.01)	0.978
Intent to quit in the next 30 days	1.02 (0.53, 1.95)	0.956	2.74 (1.64, 4.61)	**0.0001**	0.65 (0.26, 1.61)	0.355	1.01 (0.99, 1.04)	0.385	0.92 (0.87, 0.96)	**<0.001**	0.99 (0.98, 1.00)	0.206
Past year quit attempt	0.90 (0.43, 1.88)	0.778	0.93 (0.52, 1.65)	0.780	1.25 (0.52, 2.99)	0.615	0.98 (0.95, 1.01)	0.281	0.97 (0.94, 1.00)	0.088	0.99 (0.98, 1.01)	0.413

[1]Adjusted for demographics (age, race/ethnicity), reason in treatment, primary drug, pack years, and time in treatment; and also controlled for nesting of participants within clinics.