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Authors

Alizaga, Natalie M
Hartman-Filson, Marlena
Elser, Holly
et al.

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Alternative flavored and unflavored tobacco product use and cigarette quit attempts among current smokers experiencing homelessness

Natalie M. Alizaga[a], Marlena Hartman-Filson[b], Holly Elser[c], Bonnie Halpern-Felsher[d], Maya Vijayaraghavan[b],*

[a] Cañada College, Humanities and Social Sciences Division, Department of Psychology, 4200 Farm Hill Blvd., Bldg 03-139, Redwood City, CA 94061, USA
[b] University of California, San Francisco, Division of General Internal Medicine, 1001 Potrero Avenue, San Francisco, CA 94110, USA
[c] UC Berkeley School of Public Health, Division of Epidemiology, 2121 Berkeley Way, Berkeley, CA 94720, USA
[d] Stanford University, Division of Adolescent Medicine, Department of Pediatrics, 770 Welch Road, Suite 100, Palo Alto, CA 94304, USA

A B S T R A C T

Introduction: Alternative tobacco product (ATP) use is common in the general population; however, few studies have explored ATP among individuals experiencing homelessness. We recruited individuals experiencing homelessness who were current cigarette smokers to explore flavored and unflavored ATP use and its association with past-year cigarette quit attempts.
Methods: Using time-location sampling, we recruited participants from eight service sites in San Francisco, CA between December 2017 and July 2018. We explored type of ATP use and perceptions of product addiction, harm and risk between cigarette-only smokers and those who used cigarettes and ATPs ('ATP users'). We used logistic regression to examine the association between ATP and past-year quit attempts, adjusting for demographics, substance use disorders, depressive symptoms, and cigarette use characteristics.
Results: Among the 470 participants, 34.5% were cigarette-only users and 65.5% were ATP users. Among ATP users, 74.0% used cigars and 29.8% used e-cigarettes in the past month, with fruit-flavored products being the most common. ATP users were more likely to perceive cigars, blunts, and smokeless tobacco to be quite to extremely harmful or addictive compared to cigarette-only users. ATP use was not associated with past-year quit attempts, whereas hazardous alcohol use (OR = 2.07; CI 1.07–4.02) was associated with higher odds and and amphetamine use (OR = 0.50; CI 0.26–0.98) was associated with lower odds of past-year attempts.
Conclusions: High rates of ATP use highlight a need for studies that explore motivations for use, beyond use as a smoking cessation aid, among people experiencing homelessness.

1. Introduction

The smoking prevalence among the general U.S. population is estimated to be 14% (Creamer, Wang, & Babb, 2019); however, the prevalence of smoking among individuals experiencing homelessness in the U.S. is 70% (Baggett & Rigotti, 2010). Smoking-caused cancer and cardiovascular disease are the leading causes of death among individuals experiencing homelessness (Baggett, Chang, & Singer, 2015). Previous studies estimating tobacco prevalence among homeless adults have focused exclusively on cigarette smoking. However, with the increasing availability and popularity of alternative tobacco products (ATPs) (Schneller et al., 2019), defined as flavored and unflavored non-

cigarette tobacco products such as electronic cigarettes ("e-cigarettes"), cigars, or blunts (cannabis rolled in a tobacco leaf), use of these products have increased among individuals experiencing homelessness (Baggett, Campbell, Chang, & Rigotti, 2016; Kish, Reitzel, Kendzor, Okamoto, & Businelle, 2015; Neisler, Reitzel, Garey, Kenzdor, Hébert, Vijayaraghavan, & Businelle, 2018).

Between 51% and 68% of individuals experiencing homelessness have used one or more forms of ATP in the past 30 days (Baggett et al., 2016; Kish et al., 2015; Neisler et al., 2018). More than 50% of homeless smokers acknowledge high risk to health from non-cigarette combustible tobacco (e.g., cigars) (Kish et al., 2015; Neisler et al., 2018). Studies have explored associations between ATP use and past-

year cigarette quit attempts and have found mixed results. In one study among homeless smokers, ATP use was not associated with readiness to quit or past-year quit attempts (Kish et al., 2015), whereas in a more recent study, ATP use was associated with a higher number of past-year quit attempts compared to cigarette only smokers (Neisler et al., 2018).

While these studies have contributed to tobacco research by showing that ATP use is common among individuals experiencing homelessness, there are still gaps in our understanding of patterns of ATP use and its consequences. Flavored non-cigarette tobacco use is increasing among the general population, and flavors are the primary motivators for initiation and continued use of ATPs (Landry et al., 2019). However, flavors are also associated with long-term addiction and difficulty with smoking cessation (Weaver et al., 2018). We know of no studies to date that have examined flavored non-cigarette tobacco use among individuals experiencing homelessness.

Individuals experiencing homelessness face substantial barriers to smoking cessation, and the use of ATP could make smoking cessation more difficult (Kalkhoran & Glantz, 2016; Popova & Ling, 2013). However, some people may consider ATPs such as e-cigarettes as a lower risk alternative to cigarettes (McNeill et al., 2015), potentially reducing harm (Fairchild, Bayer, & Colgrove, 2014). Given the varied uses for ATPs, there is a need for studies that explore how ATP use intersects with cigarette smoking behaviors among individuals experiencing homelessness.

Moreover, ATP use is high among persons with mental health and substance use disorders and may be used to alleviate mental health and/or substance use cravings or may be a marker of severity of illness (Conway et al., 2017). ATP users have reported severe and pervasive externalizing outcomes comorbidity (mania, rash action during positive affect, and alcohol and drug use/abuse) compared to cigarette-only users (Leventhal et al., 2016). ATP use may also increase the risk of developing substance use disorders compared to cigarette only or e-cigarette only users (Veliz et al., 2020). Mental health disorders such as depression, anxiety, bipolar disorder, schizophrenia, and post-traumatic stress disorder are common among populations experiencing homelessness and have also been shown to be associated with tobacco use (Baggett, Campbell, Chang, Magid, & Rigotti, 2016; Baggett, Lebrun-Harris, & Rigotti, 2013; Fazel, Geddes, & Kushel, 2014; Fazel et al., 2008; Martens, 2001). Moreover, substance use disorders are highly prevalent among homeless adults (Baggett et al., 2016; Baggett et al., 2013; Fazel et al., 2014; Fazel et al., 2008; Martens, 2001). Given the high rates of mental health and substance use disorders among people experiencing homelessness (Fazel et al., 2014; Fazel et al., 2008; Martens, 2001), examining use patterns of ATPs in this sub-population of smokers could be helpful with developing targeted interventions.

In this study, we recruited a community-based sample of individuals experiencing homelessness who were current cigarette smokers to explore patterns of ATP use, including in-depth patterns of e-cigarette use, and association with past-year quit attempts. In addition to providing a larger sample size than previous studies to explore these associations, this study is also the first to report on the use of flavored tobacco and absolute perceptions of harm and addiction (as opposed to relative perceptions compared to cigarettes) among individuals experiencing homelessness. Homeless adults are motivated to quit cigarette smoking (Arnsten, Reid, Bierer, & Rigotti, 2004; Baggett et al., 2013) and may use ATP as a cessation method (Neisler et al., 2018); therefore, we hypothesized that ATP use would be associated with increased past-year quit attempts.

2. Methods

2.1. Study setting, design, and participants

We conducted a cross-sectional study of individuals experiencing homelessness who were recruited from eight sites, including emergency shelters, navigation centers (i.e., low entry, short-term residential facilities), day-time referral programs, and community centers serving homeless adults in San Francisco, California (Elser et al., 2019). These sites primarily offered emergency shelter or referral services for individuals experiencing homelessness; no study site offered an on-site smoking cessation program. Individuals were eligible to participate if they were 18 years or older, had smoked at least 100 cigarettes in their lifetime, currently smoked cigarettes (defined as having smoked in the past 30 days), were receiving services at the recruitment site, and were currently homeless as defined by the Homeless Emergency Assistance and Rapid Transition to Housing Act (United States Department of Housing and Urban Development, 2012).

We recruited participants between November 2017 and July 2018. We aimed to include participants who would express "typical" or "average" perspectives, and therefore recruited participants using typical case sampling (Draucker, Martsolf, Ratchneewan, & Rusk, 2007; Malterud, 2001; Patton, 1990). Participants were chosen to reflect typical perspectives: they were recruited from common spaces where most participants gathered, almost all participants approached during recruitment agreed to participate, and service staff at recruitment sites helped identify participants who were representative of their clientele. For each of the eight venues, staff chose random days and time periods for recruitment. During the allotted time for recruitment at each of the eight study sites, staff screened clientele for eligibility and invited eligible participants to enroll into the study. All participants who were approached and were eligible were included in the study; we did not gather information on the total number of participants approached at each session. On each recruitment day, study staff reviewed the list of individuals recruited to ensure there were no duplicate records. On instances where there were duplicates, we retained only the first record for that participant. Staff administered a 20-minute questionnaire on a tablet computer. Participants who completed the questionnaire received a $15 gift card for their participation. All study procedures were approved by the University of California, San Francisco Committee on Human Research.

2.2. Socio-demographic characteristics

Participants self-reported their age, gender (male, female, or transgender), race/ethnicity (African American/Black, White, Hispanic/Latinx, Asian/Pacific Islander, American Indian/Alaska Native, more than one race), and place of shelter the night before the interview (street, shelter, short-term SRO, residential treatment facility, transitional housing, or with friends or family). Participants reported their monthly income, including salary, pension, interests, or disability income.

2.3. Cigarette smoking behaviors

Participants reported whether they were daily smokers, the average number of cigarettes smoked per day, and the time to their first cigarette after waking (within 5 min, 6–30 min, 31–60 min, or after 60 min). Participants reported any past-year quit attempts, and the length of the last quit attempt. We also asked participants to report past 30-day use of flavored cigarettes (e.g., mint, wintergreen, and menthol).

2.4. Patterns and frequency of use of flavored and unflavored ATP

Participants reported past 30-day use of ATP, including e-cigarettes, smokeless tobacco, cigars, cigarillos, and little cigars, tobacco pipes, hookah, and blunts. We also asked participants to report past 30-day use of non-cigarette products including e-cigarettes and cigars (e.g., mint, wintergreen, menthol, fruit, coffee, dessert, spice, and alcohol). We classified ATP users as those who reported use of one or more forms of non-cigarette tobacco or nicotine products in the past 30 days in addition to cigarettes.

Table 1

Sample characteristics (N = 470).

	Total	Cig-only (N = 162)	Alternative users (N = 308)
Age (Mean, SD)[**]	49.9 (11.6)	53.0 (11.1)	48.2 (11.5)
Gender, no. (%)			
Female	145 (31.1)	60 (37.3)	85 (27.8)
Male	309 (66.2)	97 (60.3)	212 (69.3)
Transgender	13 (2.8)	4 (2.5)	9 (2.9)
Race/ethnicity, no. (%)			
African American[*]	209 (46.3)	72 (46.5)	137 (46.3)
White	135 (29.9)	50 (32.3)	85 (28.7)
Hispanic/Latinx	42 (9.3)	12 (7.7)	30 (10.1)
Asian/Pacific Islander	11 (2.4)	3 (1.9)	8 (2.7)
American Indian/Alaskan Native	14 (3.1)	10 (6.5)	4 (1.4)
More than one race	39 (8.7)	8 (5.2)	31 (10.5)
Monthly income – Median (IQR)	900 (881)	932.5 (700)	800 (923)
Place of stay, no. (%)			
Sheltered	430 (91.9)	151 (93.2)	279 (91.2)
Unsheltered	38 (8.1)	11 (6.8)	27 (8.8)
CESD score, Mean (SD)[a**]	21.7 (7.5)	20.5 (6.9)	22.4 (7.7)
PTSD symptoms, no. (%)[b***]	229 (48.7)	62 (38.3)	167 (54.2)
GAD7 score, Mean (SD)[c]	9.0 (6.7)	8.2 (6.6)	9.4 (6.8)
Mild anxiety (0–5), no. (%)	175 (37.2)	70 (43.2)	105 (34.1)
Moderate anxiety (5–10), no. (%)	109 (23.2)	36 (22.2)	73 (23.7)
Severe anxiety (> 10), no. (%)	186 (39.6)	56 (34.6)	130 (42.2)
Diagnosis – Bipolar Disorder	106 (22.6)	29 (17.9)	77 (25.1)
Diagnosis - Schizophrenia	60 (12.9)	18 (11.3)	42 (13.7)
Diagnosis – Schizoaffective Disorder	56 (11.9)	17 (10.5)	39 (12.7)
Hazardous alcohol use, no. (%) [d]	171 (39.6)	53 (34.4)	118 (42.5)
Substance use in the past 30 days [e]			
Cannabis[***]	309 (71.2)	63 (45.7)	246 (83.1)
Cocaine	87 (27.8)	32 (29.6)	55 (26.8)
Amphetamines	142 (52.6)	33 (46.5)	109 (54.8)
Opioids	78 (42.9)	26 (47.3)	52 (40.9)
Medical marijuana card[***]	93 (19.9)	17 (10.6)	76 (24.8)
Smoking behaviors, no. (%)			
Frequency of smoking			
Daily smoker	361 (76.8)	118 (72.8)	243 (78.9)
Non-daily smoker	109 (23.2)	44 (27.2)	65 (21.1)
Average daily cigarette consumption, Mean (SD)	11.3 (10.5)	10.7 (10.8)	11.6 (10.3)
Current use of menthol cigarettes[**]	224 (47.7)	62 (38.3)	162 (52.6)
First cigarette after waking			
< = 30 min	269 (57.3)	85 (52.8)	184 (59.7)
> 30 min	200 (42.6)	76 (47.2)	124 (40.3)
Past year intentional quit attempt lasting 1 day or more, no. (%)	208 (44.6)	79 (49.7)	129 (42.0)
Consider health consequences of smoking	277 (59.1)	100 (61.7)	177 (57.7)
Chance of developing a smoking-related disease if quit smoking [f] **(Mean, SD)**	5.2 (3.1)	5.3 (3.2)	5.1 (3.1)
Chance of developing a smoking-related disease if do not quit smoking [c] **(Mean, SD)**	7.7 (3.3)	7.9 (3.3)	7.6 (3.3)

[a] Depressive symptoms assessed using the Center for Epidemiological Studies (CES-D) score, with depressive symptoms defined as score ≥ 10.

[b] PTSD symptoms assessed using the Primary Care PTSD Screen for DSM-5 (PC-PTSD-5) scale and reports the proportion of participants with PTSD symptoms.

[c] Anxiety symptoms assessed using the GAD7, and categorizes scores as mild (scores = 0–5), moderate (scores = 5–10) and severe anxiety (scores ≥ 10).

[d] Hazardous alcohol use defined as AUDIT-C score > 3 for women and > 4 for men.

[e] Only among persons who reported ever-using substances.

[f] Smoking-related disease risk, Score range 1–11 where 1 = 0%, 2 = 10%, 3 = 20%, 4 = 30%, 5 = 40%, 6 = 50%, 7 = 60%, 8 = 70%, 9 = 80%, 10 = 90%, 11 = 100%.

[*] = < 0.05.

[**] = < 0.01.

[***] = < 0.001.

For participants who reported current use of e-cigarettes, i.e., use in the past 30 days, we asked about the number of times per day that they usually used their e-cigarette (assuming that one 'time' consisted of around 15 puffs or lasted around 10 min) (Gorukanti, Delucchi, Ling, Fisher-Travis, & Halpern-Felsher, 2016). We asked participants to report the total time that they had used their e-cigarette on a given day during the past 30 days (just a few puffs, less than 1-min total; 1–5 min total; 6–15 min total; 16–60 min total; more than one hour of total use). We asked about the manner in which they smoked their e-cigarette/ vapor pen (continuously throughout the day; distinct smoking bouts that are shorter than smoking a traditional cigarette; distinct smoking bouts similar to smoking a traditional cigarette, or other). We also asked participants to report the concentration of nicotine usually used in their e-cigarette (don't know; 0 mg; 1–6 mg; 7–12 mg; 13–18 mg;

19–24 mg; 25+ mg).

2.5. Perceptions of risk, addictiveness and harmfulness of cigarettes and ATPs

We relied on previously validated instruments to assess risk, addictiveness and harm. Participants rated their chances of developing a smoking-related disease if they quit smoking today and their chance of developing a smoking-related disease if they never quit smoking, on a scale of 0% (definitely will not develop a smoking-related disease) to 100% (definitely will develop a smoking-related disease) (Dillard, McCaul, & Klein, 2006; Nelson et al., 2004). Participants reported their perceptions of addictiveness and harmfulness (*"How addictive/harmful do you think these products are?"*) of cigarettes, e-cigarettes, smokeless

Table 2
Patterns and frequency of use of alternative tobacco products (N = 470).

	Alternative users N = 308 No. (%)
E-cigarette use	
E-cigarette past 30 day use	65 (29.8)
No. of days used in the last 30 days, Mean (SD)	6.7 (8.1)
Flavored e-cigarette past 30 day use	63 (20.5)
Use of e-cig flavors in the past 30 days	
Mint	3 (1.0)
Wintergreen	0 (0.0)
Menthol	6 (2.0)
Fruit	35 (11.4)
Coffee	2 (0.7)
Dessert	11 (3.6)
Spice	1 (0.3)
Alcohol	1 (0.3)
Smokeless tobacco use	
Smokeless tobacco use past 30 day use	13 (12.5)
No. of days used in the last 30 days, Mean (SD)	9.2 (10.0)
Cigar use	
Cigar use past 30 day use	191 (74.0)
No. of days used in the last 30 days, Mean (SD)	8.9 (9.6)
Flavored cigar past 30 day use	130 (67.0)
Mint	3 (1.0)
Wintergreen	2 (0.7)
Menthol	16 (5.2)
Fruit	83 (27.0)
Coffee	5 (1.6)
Dessert	22 (7.1)
Spice	2 (0.7)
Alcohol	15 (4.9)
Tobacco pipe use	
Tobacco pipe use past 30 day use	27 (19.0)
No. of days used in the last 30 days, Mean (SD)	6.8 (8.8)
Hookah use	
Hookah use past 30 day use	9 (7.8)
No. of days used in the last 30 days, Mean (SD)	5.8 (7.0)
Blunt use	
Blunt use past 30 day use	208 (77.9)
No. of days used in the last 30 days, Mean (SD)	13.3 (11.1)
Cannabis use	
Cannabis use past 30 day use	238 (80.1)
No. of days used in the last 30 days, Mean (SD)	17.4 (11.5)

tobacco, cigars/cigarillos/ little cigars, tobacco pipe, hookah and blunts using a Likert scale (not addictive/harmful at all, slightly addictive/ harmful, moderately addictive/harmful, quite addictive/harmful, extremely addictive/harmful (Gorukanti et al., 2016; Roditis, Lee, & Halpern-Felsher, 2015; Roditis, Delucchi, Cash, & Halpern-Felsher, 2016).

2.6. Mental health disorders

We used the Center for Epidemiologic Studies Depression Scale Revised (CESD-R-10; Björgvinsson, Kertz, Bigda-Peyton, McCoy, & Aderka, 2013; Miller, Anton, & Townson, 2008; Radloff, 1977) to assess depressive symptoms and reported a mean score (score ≥ 10 = depressive symptoms). We used the Generalized Anxiety Disorder (GAD7; Spitzer, Kroenke, Williams, & Lowe, 2006) scale to assess anxiety symptoms. We reported an average score and categorized scores as mild (scores = 0–5), moderate (scores = 5–10) and severe anxiety (scores = > 10). We assessed symptoms of post-traumatic stress disorder (PTSD) using the Primary Care PTSD Screen for DSM-5 (PC-PTSD-5) scale (Prins, Bovin, Kimerling, Kaloupek, Marx, Pless Kaiser, & Schnurr, 2015), and reported the proportion of participants who had PTSD symptoms. We asked participants to self-report whether they had ever been diagnosed with bipolar disorder, schizoaffective disorder, or schizophrenia (1 = yes, 0 = no).

2.7. Alcohol and substance use

We asked participants to report lifetime and past 30-days illicit substance use of cocaine, methamphetamines, and opioids. We asked about cannabis use, number of days used in the past 30 days, and whether participants had a medical cannabis card. We used the AUDIT-C (Bush, Kivlahan, & McDonell, 1998) to assess hazardous alcohol use (score of ≥ 4 for men and ≥ 3 for women) (Bradley et al., 2003).

2.8. Data analysis

We calculated the mean and standard deviations (SD) or median and interquartile range (IQR) for continuous variables. We calculated proportions for categorical variables. We showed differences in demographics, cigarette smoking characteristics, patterns and frequency of use of flavored and unflavored ATPs, and perceptions of risk, addictiveness and harmfulness of ATPs (any perception versus none) between cigarette-only users and ATP users. We summarized e-cigarette patterns of use using means (SD) and proportions among e-cigarette users. We used logistic regression to examine the bivariate and multivariable associations between ATP use and past-year quit attempts, adjusting for covariates shown to be associated with quit attempts in prior studies with homeless adults (Baggett et al., 2013; Vijayaraghavan, Tieu, Ponath, Guzman, & Kushel, 2016) including demographics, substance use disorders, depression, and cigarette use characteristics. We conducted all analyses using Stata, Version 12.1 (StataCorp, 2011).

3. Results

3.1. Sample characteristics

Among the 470 participants, 66.2% were male, 46.3% African American, and 91.9% sheltered (Table 1). The majority (76.8%) were daily cigarette smokers, and more than half (57.3%; N = 269) smoked within 30 min of waking. About half (44.0%) made an intentional quit attempt in the past year, with the median length of quit attempt being 14 days (IQR 3–90). Average CES-D scores were indicative of depressive symptoms; 39.6% reported severe anxiety, and 48.7% reported PTSD symptoms. Other substance use was common, with 52.6% reporting amphetamine use and 71.2% reporting cannabis use in the past 30 days.

3.2. Patterns and frequency of use of flavored and unflavored ATPs

Overall, past 30 day use of ATPs was high: 74.0% for cigars, 77.9% for blunts, 29.8% for e-cigarettes, and 19.0% for tobacco pipes (Table 2). While 13.6% reported use of flavored e-cigarettes in the past 30-days, over half (55%) reported use of flavored cigars in the past 30-days. Among ATP users who reported current use of e-cigarettes and cigars, use of fruit-flavored products was the most common (see Table 2).

3.3. E-cigarette use

Among current users of e-cigarettes (n = 65), 60% were male, and most were either African American or White (Table 4). E-cigarette users used their devices an average of 5.6 times per day, and generally used them for less than a minute total (37.5%, n = 24) or 1–5 min total (20.3%, n = 13). Half (50.0%, n = 32) of the participants usually smoked their e-cigarettes in distinct smoking bouts that are shorter than smoking a traditional cigarette (shorter length of time and fewer number of puffs), and 29.7% (n = 19) smoked their e-cigarette continuously throughout the day (only a few puffs each time). More than half (57.8%, n = 37) did not know the concentration of nicotine in their e-cigarettes.

Table 3

Summary of Logistic Regression Analysis Predicting Quit Attempts in the Past Year.

	Quit attempts in past year			
	Bivariate OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Alternative tobacco product use (cigarette-only user, referent)				
Alternative tobacco product user	0.73 (0.50–1.08)	0.12	0.62 (0.30–1.27)	0.19
Gender (female referent)				
Male	0.98 (0.72–1.33)	0.90	0.70 (0.36–1.37)	0.31
Age	1.01 (0.99–1.02)	0.52	0.99 (0.96–1.02)	0.58
Hazardous alcohol use [a] (non-hazardous alcohol use, referent)				
Hazardous alcohol use	**1.48 (1.00–2.18)**	**0.05**	**2.07 (1.07–4.02)**	**0.03**
CES-D score [b]	1.01 (0.99–1.03)	0.45	0.98 (0.94–1.03)	0.47
Cocaine use in the last 30 days (no use, referent)				
Yes	1.45 (0.88–2.39)	0.15	1.95 (0.89–4.28)	0.09
Amphetamine use in last 30 days (no use, referent)				
Yes	**0.57 (0.35–0.93)**	**0.03**	**0.50 (0.26–0.98)**	**0.04**
Cannabis use in the last 30 days (no use, referent)				
Yes	0.89 (0.59–1.36)	0.59	1.05 (0.49–2.25)	0.91
Average daily cigarette consumption	**0.96 (0.94–0.99)**	**0.00**	0.99 (0.96–1.02)	0.43
First cigarette after waking (within 5 min referent)				
6–30 min	1.05 (0.62–1.75)	0.87	0.81 (0.35–1.88)	0.63
31–60 min	**1.74 (1.00–3.03)**	**0.05**	0.96 (0.37–2.49)	0.93
After 60 min	**2.34 (1.48–3.80)**	**0.00**	1.74 (0.76–3.99)	0.19

[a] Hazardous alcohol use defined as AUDIT-C score > 3 for women and > 4 for men.

[b] Depressive symptoms assessed using the Center for Epidemiological Studies (CES-D) score, with depressive symptoms defined as score ≥ 10.

3.4. Risk, harm and addiction perceptions of cigarettes and ATPs

Almost all participants perceived cigarettes to be addictive or harmful, and among ATPs, most participants also perceived cigars, smokeless tobacco, tobacco pipe, blunts and e-cigarettes to be harmful or addictive (Figs. 1 and 2).

3.5. Differences between cigarette only and ATP users

Among participants, 34.5% were cigarette-only users and 65.5% were ATP users (Table 1). Compared to ATP users, cigarette-only users were more likely to be older, White and American Indian/Alaska Native; ATP users were more likely to self-identify as Hispanic/Latinx. ATP users were more likely to report depressive symptoms, PTSD and past 30-days use of other substances compared to cigarette-only users. Compared to cigarette-only users, ATP users were more likely to report use of menthol cigarettes. ATP users reported high rates of use of cigars (74.0%) and blunts (77.9%) in the past 30 days. In comparison, rates of use of e-cigarettes (29.8%), smokeless tobacco (12.5%), or tobacco pipe (19.0%) were low (Table 2). ATP users were more likely to perceive cigars and blunts as addictive compared to cigarette-only users (*p* < 0.02, respectively; Fig. 1), and were more likely to perceive cigars (*p* = 0.004) and tobacco pipes (*p* = 0.008) as harmful compared to cigarette-only users (Fig. 2). Cigarette-only and ATP users did not differ in their perception of risk of developing a smoking-related illness (Table 1).

3.6. Factors associated with quit attempts

ATP use was not associated with a past-year quit attempt. In multivariable analysis, hazardous alcohol use (adjusted odds ratio (AOR) = 2.07; CI 1.07–4.02) was associated with higher odds and amphetamine use (AOR = 0.50; CI 0.26–0.98) was associated with lower odds of past-year attempts (Table 3).

4. Discussion

In this study of current smokers who experienced homelessness, we found that 65.5% concurrently used an ATP. This estimate is similar to that reported in studies of adult homeless daily smokers in Oklahoma City, OK (67.2%, Neisler et al., 2018) and Boston, MA (68%, Baggett

et al., 2016), but higher than that reported among homeless adult smokers in Dallas, TX (51.1%, Kish et al., 2015). Consistent with prior studies, we found that cigars, e-cigarettes, and blunts were the most commonly used ATP (Baggett et al., 2016; Kish et al., 2015; Neisler et al., 2018). Cigar use is common among individuals experiencing homelessness, perhaps due to their lower cost relative to cigarettes (Baggett, Tobey, & Rigotti, 2013). Hispanic/Latinx participants were slightly more likely to report ATP use, in contrast to the general population where Hispanic/Latinx individuals have reported lower rates of use (Sung, Wang, Yao, Lightwood, & Max, 2016; Sung, Wang, Yao, Lightwood, & Max, 2018). ATP use is common among cigarette smokers experiencing homelessness, highlighting a need for providers to be aware of and screen for ATP use in this population.

Contrary to our hypothesis and findings from a previous study (Neisler et al., 2018), the use of ATP in the past 30 days was not associated with a past-year quit attempt. We did not observe an association between ATP use and number of cigarettes smoked or time to first cigarette after waking, which are other metrics of nicotine dependence and predictors of quit attempts. These findings suggest that the frequency of ATP use or motivations of use (i.e., use specifically to aid with cessation) may be more significant predictors of cigarette quit attempts than use of an ATP in the past 30-days. The type of ATP may also make a difference. Compared to other non-combustible tobacco products like cigars, which may carry equivalent risk to cigarettes, e-cigarettes may be considered less risky and more likely to be used for cigarette quit attempts (Glantz & Bareham, 2018). However, we found no independent association between e-cigarettes and quit attempts in bivariate and multivariable analysis.

Amphetamine use in the past 30-days was associated with a lower odds of making a quit attempt after adjusting for other covariates. Our findings highlight a specific group of individuals who may have high levels of nicotine and co-occurring substance use dependence that might pose challenges for cigarette smoking cessation. In contrast, hazardous alcohol use was associated with higher odds of past-year quitting. Our results are in contrast to previous studies that indicated that smoking cessation was significantly associated with fewer drinking days, fewer drinks consumed on drinking days, and lower odds of heavy drinking among individuals experiencing homelessness (Reitzel, Nguyen, Eischen, Thomas, & Okuyemi, 2014). Integrated efforts in treating tobacco and substance use might benefit this population.

Consistent with previous studies (Baggett et al., 2016; Kish et al.,

Table 4
E-cigarette patterns of use (N = 65, those who used in the past 30 days).

Age, Mean (SD)	45.8 (10.6)
Gender, no. (%)	
Female	24 (36.9)
Male	39 (60.0)
Transgender	2 (3.1)
Race/ethnicity, no. (%)	
African American	21 (33.3)
White	20 (31.8)
Hispanic/Latinx	9 (14.3)
Asian/Pacific Islander	2 (3.2)
American Indian/Alaskan Native	0 (0.0)
More than one race	11 (17.5)
CESD score, Mean (SD)[a]	22.5 (7.2)
PTSD symptoms, no. (%)[b]	40 (61.5)
GAD7 score, Mean (SD)[c]	8.3 (6.2)
Mild anxiety (0–5), no. (%)	24 (36.9)
Moderate anxiety (5–10), no. (%)	19 (29.2)
Severe anxiety (> 10), no. (%)	22 (33.9)
Hazardous alcohol use, no. (%)[d]	23 (37.1)
No. of times smoked per day in the past 30 days, Mean (SD)	5.6 (6.9)
Amount of time user per day in the past 30 days	
Just a few puffs; < 1 min total	24 (37.5)
1–5 min total	13 (20.3)
6–15 min total	11 (17.2)
16–60 min total	9 (14.1)
> 1 h of total use	7 (10.9)
Manner of smoking	
Continuously throughout the day (only a few puffs each time)	19 (29.7)
Distinct smoking bouts that are shorter than smoking a traditional cigarette (shorter length of time and fewer number of puffs)	32 (50.0)
Distinct smoking bouts similar to smoking a traditional cigarette (similar length of time and number of puffs)	10 (15.6)
Other	3 (4.7)
Concentration of nicotine in the e-cigarette product	
Don't know	37 (57.8)
0 mg	0 (0.0)
1–6 mg	9 (14.1)
7–12 mg	5 (7.8)
13–18 mg	5 (7.8)
19–24 mg	1 (1.6)
25 + mg	7 (10.9)

[a] Depressive symptoms assessed using the Center for Epidemiological Studies (CES-D) score, with depressive symptoms defined as score ≥ 10.

[b] PTSD symptoms assessed using the Primary Care PTSD Screen for DSM-5 (PC-PTSD-5) scale and reports the proportion of participants with PTSD symptoms.

[c] Anxiety symptoms assessed using the GAD7, and categorizes scores as mild (scores = 0–5), moderate (scores = 5–10) and severe anxiety (scores ≥ 10).

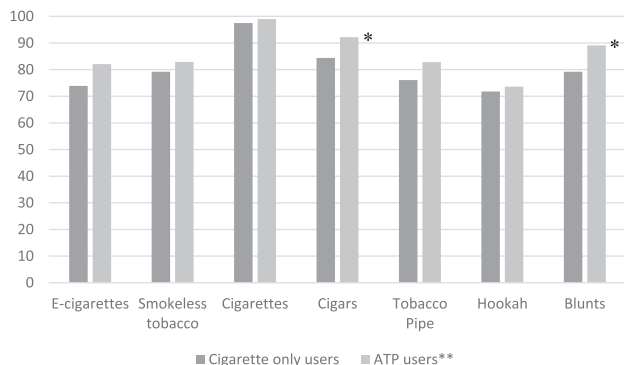[d] Hazardous alcohol use defined as AUDIT-C score > 3 for women and > 4 for men.

Fig. 1. Any perception of addictiveness (versus none) of cigarette and alternative tobacco products by tobacco use status (N = 470). * = p < 0.05. ** = We classified ATP users as those who reported use of one or more forms of non-cigarette tobacco or nicotine products in the past 30 days in addition to cigarettes.
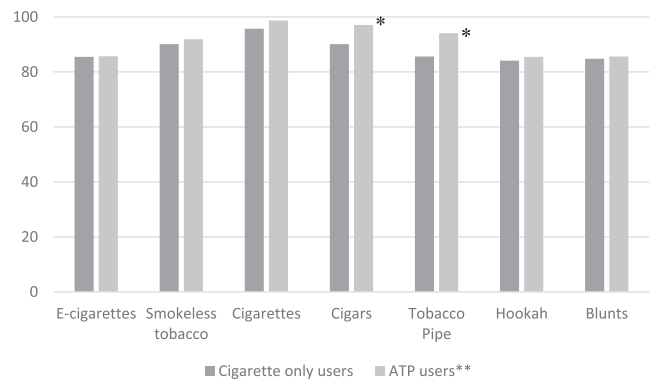

Fig. 2. Any perception of harmfulness (versus none) of cigarette and alternative tobacco products by tobacco use status (N = 470). * = p < 0.05. ** = We classified ATP users as those who reported use of one or more forms of non-cigarette tobacco or nicotine products in the past 30 days in addition to cigarettes.

2015; Neisler et al., 2018), we found that ATP users had higher rates of mental health disorders and substance use in the past 30-days compared to cigarette-only users. Given high rates of smoking among individuals with mental health and substance use disorders (SAMSHA, 2013; Ziedonis et al., 2008), the use of ATP among this population may signal a need for higher levels of nicotine to allay symptoms from mental health and substance use conditions (Stanton et al., 2016). Alternatively, ATP users may use other substances such as cannabis to reduce cravings to smoke, and may be more likely to attempt to quit smoking. While exploring these associations was beyond the scope of this study, our results highlight the need for studies to examine the underlying role of ATP use to curb substance use cravings and/or alleviate mental health symptoms or reduce the urge to smoke cigarettes among cigarette smokers experiencing homelessness.

Among both e-cigarette and cigar users and the general population, fruit flavored products had the highest appeal. This is consistent with a recent study that some adult e-cigarette users initiate use of these products because of their flavors (Landry et al., 2019). Studies are needed to examine whether flavored tobacco contributes to the initiation of ATP and/or smoking cessation among populations experiencing homelessness, especially in light of recent momentum to restrict these products.

Almost all participants perceived cigarettes to be addictive and harmful, and cigarette only and ATP users did not differ in their perception of risk of developing a smoking-related illness. Most participants perceived cigars and e-cigarettes to be harmful or addictive. These findings have particular salience to the Food and Drug Administration's regulatory authority, and suggest that efforts to inform the public of the harms associated with ATPs, specifically flavored e-cigarettes, are reaching this population.

Although ATP users perceived higher levels of addiction and harm from some tobacco products, including cigars and tobacco pipes, they also reported high rates of use of some of these products. These findings are consistent with those from a previous study where knowledge of risk was not associated with reduction in product use (Neisler et al. 2018).

Our study has several limitations. Our findings, which are intended to be representative of homeless adults seeking emergency shelter services in San Francisco, may not be generalizable to the general homeless population. The cross-sectional nature precludes us from evaluating a causal association between risk, harm, and addiction perceptions and smoking cessation behaviors. Longitudinal studies are needed to further explore these associations. Measurement error is possible given that tobacco use behaviors were self-reported and not biochemically verified. Residual confounders such as affects toward e-cigarettes and motivations for use of these products were not explored in this study

and warrant further exploration.

4.1. Conclusion

Flavored and unflavored ATP use is common among currently smoking adults experiencing homelessness, highlighting a need for studies that explore the bidirectional role of ATP in curbing mental health and substance use symptoms and its impact on smoking cessation. Service providers could be trained to screen for ATP use among homeless clientele to gauge levels of nicotine dependence to tailor nicotine replacement therapy.

CRediT authorship contribution statement

Natalie M. Alizaga: Conceptualization, Formal analysis, Investigation, Writing - original draft. **Marlena Hartman-Filson:** Writing - review & editing, Investigation. **Holly Elser:** Writing - review & editing. **Bonnie Halpern-Felsher:** Writing - review & editing. **Maya Vijayaraghavan:** Conceptualization, Writing - review & editing, Supervision, Funding acquisition.

Declaration of Competing Interest

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