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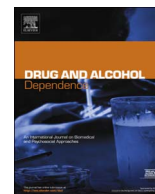
Publication Date

2018-04-01

DOI

10.1016/j.drugalcdep.2017.12.012

Peer reviewed



Full length article

Concurrent nicotine and tobacco product use among homeless smokers and associations with cigarette dependence and other factors related to quitting

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ARTICLE INFO

Keywords:

Smoking
Tobacco use
Concurrent use
Addiction
Homeless
Disadvantaged population

ABSTRACT

Background: Cigarette smoking rates among homeless adults are exceptionally high, contributing to health disparities experienced by this disadvantaged population. Concurrent nicotine and tobacco product use have been shown to result in greater health problems than cigarette smoking alone, and little is known about the rates, motives, and perceived impacts of concurrent use in this group. The purpose of this study is to explore concurrent use rates and constructs of interest among homeless adult daily smokers and to examine differences between concurrent users and non-concurrent users on cigarette dependence, perceived risk of smoking, readiness to quit, and the receipt of recent cessation intervention.

Methods: Participants (N = 396) were recruited from six homeless-serving agencies and/or shelters in Oklahoma City. Enrolled participants completed self-report questionnaires.

Results: The rate of concurrent use was high – 67.2%. Participants most frequently endorsed lower cost and a desire to cut down on cigarette smoking as motives for concurrent product use. Concurrent users indicated both a greater likelihood of developing a smoking-related disease if they did not quit for good and a greater number of past year quit attempts relative to non-concurrent users. There was no significant difference between concurrent users and non-concurrent users on readiness to quit or having received recent smoking cessation intervention.

Conclusion: The need for cessation efforts that account for concurrent use for homeless adult smokers is great. Study findings indicate that concurrent users are commonly pursuing the reduction or elimination of cigarette usage and should be specifically targeted for cessation intervention.

1. Introduction

Smoking prevalence among homeless adults in the United States is high: 75% in some samples, nearly five times the national average and nearly three times the rate of those living below the poverty line (Baggett and Rigotti, 2010; Centers for Disease Control and Prevention, 2016; Kish et al., 2015). Consequently, smoking-related deaths make up a considerable portion of the premature mortality experienced by this group, mainly due to increased rates of cancer and circulatory and respiratory diseases (Baggett et al., 2015a; Baggett et al., 2015b; Baggett et al., 2013; Snyder and Eisner, 2004). Despite this disparity in tobacco-related mortality, tobacco use is not uniformly addressed by healthcare providers who serve homeless adults (Baggett and Rigotti, 2010). Thus, quit rates are low despite the desire to quit (Arnsten et al., 2004; Connor et al., 2002), and are significantly lower than those of domiciled

individuals, who may have greater access to pharmacotherapy and behavioral interventions (Baggett and Rigotti, 2010; Stead and Lancaster, 2012).

To date, few studies have examined the rate of concurrent use (CU) of tobacco products, including electronic nicotine-delivery systems (ENDS), among conventional cigarette smokers who are homeless. While domiciled smokers in the US demonstrate CU rates between 7.9–10.6% (Backinger et al., 2008; Lee et al., 2014), the CU rates of homeless smokers may be as high as 68% (Baggett et al., 2016). This is important because CU may result in greater health problems than cigarette-only smoking; for example, the use of snuff and oral tobacco products synergistically increases the risk of oral/pharyngeal cancers beyond that already conferred through cigarette smoking (Torre et al., 2015; Wyss et al., 2016). In some cases, CU products might be utilized by cigarette smokers as a mechanism to cut down or quit smoking

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cigarettes (Etter and Bullen, 2011; Farsalinos and Polosa, 2014; Goniewicz et al., 2013; Kralikova et al., 2013; Siegel et al., 2011). Although this approach may be effective (e.g., Malas et al., 2016; McNeill et al., 2015), it may also compromise quit attempts (e.g., Al-Delaimy et al., 2015; Frost-Pineda et al., 2010; Grana et al., 2014; Tomar et al., 2010; Walsh et al., 2010; Young et al., 2006). For example, CU may lead to greater dependence on nicotine or result in non-optimal pharmacotherapy dosage recommendations during a cigarette smoking quit attempt (Foulds et al., 2006). Furthermore, some CU among homeless smokers may be related to financial limitations and opportunistic product acquisition (Kish et al., 2015) as opposed to readiness to quit conventional cigarette smoking. Therefore, CU may alternatively reflect an attempt to satisfy a high dependence on nicotine in a context where access to conventional cigarettes is limited. More research is needed to understand motives for CU, the perceived risks of CU, and perceptions of the effectiveness of CU as a mechanism to quit conventional cigarette use among homeless smokers.

To the authors' knowledge, only two studies have sought to explore the rate of CU among homeless adult cigarette smokers and the differences between CUs and conventional cigarette-only smokers (hereafter referred to as non-CUs) on factors related to quitting. The first study, conducted in 2013 with a convenience sample of 178 homeless adult smokers from Dallas, Texas, found that rates of recent CU were 51.1% (Kish et al., 2015). Within that sample, little cigars/cigarillos/bidis were the most common CU product, with daily use endorsed by about a quarter of users. The majority (66.7%) endorsed financial motives for CU of cigars/cigarillos/bidis. About 12% of that sample endorsed e-cig dual use, primarily (81.8%) in an attempt to cut down or quit smoking. In that sample, there were no differences between CU and non-CUs in cigarettes smoked per day, years of smoking, time to first cigarette of the day after waking, readiness to quit, or previous past-year intentional quit attempts (Kish et al., 2015). However, this study was limited by its recruitment from only a single shelter (that excluded families and pregnant women), inclusion of both daily and non-daily smokers (who might differ from one another in important ways), and exclusion of individuals who slept rough (i.e., did not sleep in any type of shelter, typically outdoors). In addition, this study did not examine CU as related to comorbid non-nicotine substance abuse, which might affect readiness to quit smoking or compromise a quit attempt. It also failed to examine perceptions of the effectiveness of CU as a mechanism to cut down or quit smoking.

The second study was a multi-site investigation conducted in 2014 in Boston, MA of 306 homeless adult smokers, also including both daily and non-daily smokers (Baggett et al., 2016). There was a 68% CU rate in this sample, and CU was significantly related to sleeping rough, greater subsistence difficulties, and greater drug use, among other things. Similar to the Dallas study, CU was not associated with dependence, readiness to quit, or past-year quit attempts. Large and little cigars were common CU products (56%), and 24% of the sample reported recent e-cig CU. Participants' greatest unique motivation for using e-cigs was curiosity (85% of users), followed by to help quit smoking (69% of users) (Baggett et al., 2016). Although this study benefitted from multiple site recruitment, its sole focus on clinical/healthcare settings limits generalizability to the broader homeless population. Additionally, the association of CU with the receipt of cessation treatment was not examined. Thus, more research in other cities using diverse recruitment sites is needed to further develop an understanding of CU and its correlates among homeless smokers.

The current study aimed to describe CU among homeless adult daily smokers from multiple, non-clinical sites, and to explore differences between CU and non-CU conventional cigarette smokers on several key constructs, including cigarette dependence, perceived risks of smoking, readiness to quit, and the receipt of recent cessation intervention to expand the literature in this area and contribute to a better understanding of characteristics that might affect cessation intervention programming for this vulnerable group.

2. Material and methods

2.1. Participants

Participants were recruited from six homeless-serving shelters in July–August 2016. These individuals were recruited via study fliers posted at these locations. Inclusion criteria were: adults aged 18 years or older, currently receiving services (e.g., shelter, counseling, food) at one of the targeted shelters, and a 7th grade English literacy level as indicated by a score of ≥ 4 on the Rapid Estimate of Adult Literacy in Medicine-Short Form (Arozullah et al., 2007).

Overall, 648 individuals were screened, 38 of whom were ineligible due to an insufficient literacy. Of the 610 enrolled participants, 29 were deemed as not homeless based on responses to the questions: “Where did you sleep last night” (i.e., selecting “My personal apartment or house”), “Are you currently homeless” (i.e., selecting “No”), current months homeless (selecting 0 months), and/or endorsing “I am not currently homeless” in response to the question “What are the reasons for your current homelessness.” Of the remaining 581 participants, 504 participants (87.6%) reported smoking at least 100 cigarettes in their lifetime (Centers for Disease Control and Prevention, 2002). When asked how often they smoked cigarettes, 396 participants (68.2%) self-identified as everyday (vs. some days) smokers, and thus comprised the analytic sample.

2.2. Procedures

The Institutional Review Boards at the University of Oklahoma Health Sciences Center and the University of Houston approved this study. Participants were enrolled following an informed consent process. Data collection occurred at each of the six homeless-serving shelters. Enrolled participants completed questionnaires on a tablet computer as items were read aloud to the participants via headphones. Each participant received a \$20 department store gift card.

2.3. Measures

2.3.1. Participant characteristics

Participant characteristics included age, sex, race, lifetime number of months homeless, and history of comorbid substance use disorder, which was assessed via self-report of ever having been diagnosed with an alcohol or substance use (other than nicotine) disorder.

2.3.2. Cigarette dependence

The number of years smoked, the average number of cigarettes smoked per day (CPD), and expired breath carbon monoxide (CO) readings (via a Vitalograph BreathCO™ monitor) were assessed. Additionally, participants provided the time to first cigarette after waking (TTF): within 5 min, 6–30 min, 31–60 min, and after 60 min (Heatherton et al., 1989).

2.3.3. Concurrent use

Concurrent users were conventional cigarette smokers endorsing the use of a non-cigarette tobacco or nicotine product in the last 30 days. The product options included: (a) snus, such as Camel or Marlboro snus; (b) roll-your-own cigarettes (RYO); (c) tobacco from a hookah or a waterpipe; (d) dissolvable tobacco products like Ariva/Stonewall/Camel/Camel Orbs/Camel sticks; (e) Electronic cigarettes or E-cigarettes (including battery-operated vape pens, e-pipes, e-cigs, personal vaporizers, or e-hookahs), such as Fin, NJOY, Blu, e-Go, and Vuse; (f) cigars; (g) little cigars/cigarillos/bidis; (h) chewing tobacco, dip, or snuff; and/or (i) other tobacco product (besides conventional cigarettes). Visual aids (e.g., pictures of generation 1, 2, and 3 e-cigs) were presented with question text. Frequency of CU in the last 30 days was also assessed (every day, 5–6 days a week, 3–4 days a week, 1–2 days a week, less than 1 day a week, and I don't know). CU items mirror those

Table 1
Sample Descriptives and Differences by Product Use Status (N = 396).

Variable	Overall N = 396	Concurrent Users (n = 266)	Non-Concurrent Users (n = 130)	t or χ^2 Value	P-Value
	M (± SD) or% [n]	M (± SD) or% [n]	M (± SD) or% [n]		
Age	42.9 (± 11.8)	41.8 (± 12.1)	45.2 (± 10.7)	−2.76	0.006
Sex				10.38	0.001
Male	64.9% [257]	70.3% [187]	53.8% [70]		
Female	35.1% [139]	29.7% [79]	46.2% [60]		
Race				0.81	0.367
White	61.6% [244]	63.2% [168]	58.5% [76]		
All Other	38.4% [152]	36.8% [98]	41.5% [54]		
Lifetime Months Homeless	41.0 (± 51.2)	41.1 (± 51.5)	40.9 (± 50.9)	0.026	0.980
Years Smoked	23.5 (± 12.5)	23.2 (± 12.2)	24.0 (± 13.1)	−0.56	0.578
Expired CO	13.5 (± 8.7)	13.3 (± 8.8)	13.9 (± 8.6)	−0.63	0.527
CPD	14.5 (± 7.2)	14.7 (± 7.3)	14.2 (± 6.9)	0.74	0.462
Time to First Cigarette				0.02	0.893
< 5 min	48.0% [190]	47.7% [127]	48.5% [63]		
≥ 5 min	52% [206]	52.3% [139]	51.5% [67]		
Diagnosed with a non-nicotine substance abuse disorder	42.2% [167]	45.9% [122]	34.6% [45]	4.53	0.033
Readiness to Quit (Scale 1–8)	4.7 (± 2.0)	4.6 (± 2.0)	4.7 (± 2.0)	−0.46	0.649
Past Year Quit Attempts	1.8 (± 2.5)	2.0 (± 2.7)	1.3 (± 2.0)	1.72	0.003
Perceived Risk of Smoking	6.3 (± 3.0)	6.5 (± 2.9)	5.8 (± 3.1)	2.09	0.037
Received smoking cessation counseling at local shelters				0.855	0.355
No	96.5% [382]	95.9% [255]	97.7% [127]		
Yes	3.5% [14]	4.1% [11]	2.3% [3]		

Note: Differences between Concurrent Users and Non-Concurrent Users were assessed using independent samples *t* tests and chi-square tests. CO = carbon monoxide. CPD = cigarettes smoked per day.

presented in prior research to increase comparability between studies (Baggett et al., 2016; Kish et al., 2015; Rath et al., 2012).

2.3.4. Concurrent use motives

Participants were asked to endorse the motives for CU. Possible responses included: (a) to help me quit smoking cigarettes; (b) to help me cut down on smoking cigarettes; (c) it is cheaper than smoking cigarettes; (d) it is less harmful to my health than cigarettes; (e) I can use it in places where cigarettes are not allowed; (f) it tastes better or is more pleasurable to use than cigarettes; (g) I use this product for reasons that are not listed; and/or (h) none of the above reasons.

2.3.5. Perceived risk of concurrent use

Participants who endorsed CU were asked to what degree people risk harming their health when using that product on a 5-point scale where 1 = no risk, 2 = little risk, 3 = some risk, 4 = a lot of risk, and 5 = extreme risk.

2.3.6. Perceived effectiveness of concurrent use on cigarette smoking

The degree to which CU helped smokers to cut down or quit smoking was assessed by self-report, with questions specific to the product used. Possible responses included: (a) yes, definitely, (b) yes, somewhat, (c) not sure, (d) not really, and (e) not at all.

2.3.7. Perceived risk of smoking

Participants were asked to report a percentage likelihood of developing at least one smoking-related disease if they did NOT quit for good, in increments of 10 percentage points ranging from “0% – I will DEFINITELY NOT develop”, with a “50% – I have a 50/50 chance”, to “100% I will DEFINITELY develop”. Similar questions have been used in prior research to assess the perceived risk of developing cancer from smoking (Dillard et al., 2006; Nelson et al., 2004).

2.3.8. Smoking cessation-related variables

An adapted Readiness to Quit Ladder (RTQ) was used to assess motivation to quit smoking (Abrams et al., 2003). Responses ranged from 1 = “I enjoy smoking and have decided not to quit smoking for my lifetime. I have no interest in quitting.” to 8 = “I still smoke, but I have begun to change, like cutting back on the number of cigarettes I smoke.

I am ready to set a quit date.” Quit attempts were measured by asking participants to self-report how many times they successfully quit smoking for at least 24 h in the last past year, excluding times when they wanted to smoke but did not have money to buy cigarettes. The receipt of cessation services over the past 3 months was assessed by self-report.

2.4. Data analysis

Descriptive statistics were used to describe the sample. Differences between CUs and non-CUs were examined using Chi-Square and *t*-tests. Of the analyzable sample of 396 persons, missing data on any variable ranged from 0% to 4.9% with no patterns related to missingness. SPSS version 23 was used for data analyses and $p \leq 0.05$ was considered statistically significant. Requests for data, analytic methods, and study materials can be made to the corresponding author.

3. Results

3.1. Sample descriptives

Participants (N = 396; 64.9% male) were 42.9 (± 11.8) years old on average and largely white (64.6%). The average lifetime number of months homeless was 41.0 (± 51.2). Participants had been smoking for an average of 23.5 (± 12.5) years, had an average expired CO of 13.5 ppm (± 8.68), smoked an average of 14.5 (± 7.2) CPD, and 48.0% smoked within 5 min of waking. Participants reported an average of 1.8 (± 2.5) quit attempts in the past year. Overall, 42.2% of participants had been diagnosed with an alcohol or non-nicotine substance use disorder (See Table 1).

3.2. Concurrent use rates, motives, risks, & effectiveness

Over half of the sample (67.2%) reported CU over the past 30 days. CU varied by product with RYO (59.8%), ENDS (40.2%), and cigars (30.5%) most commonly endorsed. Among CUs, 54.9% reported the use of two or more products in addition to conventional cigarettes. More than half of RYO users endorsed use at least 3–4 days a week. More than half of ENDS users and cigar users endorsed use at least 1–2 days a week

Table 2
Frequency of Endorsed Concurrent Nicotine and Tobacco Product Use (n = 266).

	Snus	RY O	Tobacco from a hookah or waterpipe	Dissolvable tobacco products	ENDS	Cigars	Little cigars/cigarillos/bidis	Chewing tobacco, dip, or snuff	Other tobacco products
	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]
Less than 1 day a Week	31.8% [7]	27.4% [43]	83.3% [5]	50.0% [2]	34.3% [36]	32.5% [26]	43.3% [26]	27.7% [13]	40.0% [6]
1 to 2 days a Week	18.2% [4]	20.4% [32]	0% [0]	25.0% [1]	19.0% [20]	31.3% [25]	30.0% [18]	19.1% [9]	20.0% [3]
3 to 4 days a Week	22.7% [5]	12.1% [19]	0% [0]	25.0% [1]	9.5% [10]	16.3% [13]	18.3% [11]	14.9% [7]	26.7% [4]
5 to 6 days a Week	0% [0]	8.9% [14]	16.7% [1]	0% [0]	15.2% [16]	12.5% [10]	3.3% [2]	14.9% [7]	0% [0]
Every Day	27.3% [6]	31.2% [49]	0% [0]	0% [0]	21.9% [23]	7.5% [6]	5.0% [3]	23.4% [11]	13.3% [2]
Missing	4	2	1	1	2	1	1	1	1
Total Number of Users	26	159	7	5	107	81	61	48	16

Note: RYO = Roll Your Own. ENDS = Electronic Nicotine Delivery System. A total of 3endorsements for “I do not know” were not included (2 Snus, 1 ENDS). Participants could endorse > 1 product.

(See Table 2).

The most frequently endorsed motives for CU were: “It is cheaper than smoking cigarettes” and “To help me cut down on smoking cigarettes.” The least frequently endorsed motive was “It is less harmful to my health than cigarettes.” Motive endorsement varied by product. For example, nearly 50% of chewing tobacco users and nearly 40% of ENDS users endorsed “I can use it in places where cigarettes are not allowed,” a pattern not reflected in other products (See Table 3).

Over 50% of respondents denoted “a lot of risk” or “extreme risk” for RYO, tobacco from a hookah or waterpipe, cigars, little cigars/cigarillos/bidis, chewing tobacco, dip or snuff, and other tobacco products. Cigars and little cigars/cigarillos/bidis were perceived as having the highest average risk to health and dissolvable tobacco products and ENDS were reported as having the lowest average risk (See Table 4).

Among CUs, the perceived effectiveness of cutting down or quitting smoking varied by product. ENDS were viewed as the most effective, with 58.8% of ENDS users citing that “yes, definitely” or “yes, somewhat” that the product was able to help them cut down or quit smoking cigarettes. However, over 50% of snus, RYO, hookah or water pipe, dissolvable tobacco, cigar, and little cigars/cigarillos/bidis users perceived that the product was “not really” or “not at all” effective in helping them cut down or quit smoking cigarettes (See Table 5).

Overall, of the 125 participants whose CU motive was to cut down or quit smoking, 79.3% of chewing tobacco, dip, or snuff users; 68.5% of ENDS users; 63.6% of RYO users reported that the CU product “yes, definitely” or “yes, somewhat” was perceived as effective. For other products, less than 45% of participants endorsed an affirmative response to the perceived effectiveness of the CU for cutting down or quitting smoking.

3.3. Differences between concurrent and non-concurrent users

CUs did not differ from non-CUs on race, lifetime months homeless, years smoked, CPD, or TTF cigarette. CUs were younger (41.8 vs. 45.2, p = .006), more likely to be male (70.3% vs. 53.8%, p = .001), and more likely to be diagnosed with a non-nicotine substance abuse disorder (45.9% vs. 34.6%, p = .037) than non-CUs (See Table 1).

Relative to non-CUs, CUs endorsed greater likelihood of developing at least one smoking-related disease if they did not quit for good (6.5 vs. 5.8, p = .037) and had significantly more past-year quit attempts (2.0 vs. 1.3, p = .003). Groups did on RTQ or receipt of smoking cessation treatment.

4. Discussion

In this sample of adult homeless daily smokers in Oklahoma City, the CU rate was high (67.2%), but similar to that reported in a study of adult homeless smokers in Boston (Baggett et al., 2016). Notably, this CU rate is over 6-times greater than that found in domiciled samples (Backinger et al., 2008; Lee et al., 2014). Given the known contributions of tobacco to mortality (Baggett et al., 2013; Lee et al., 2014; Snyder and Eisner, 2004), the increased health risks of CU beyond conventional cigarette use (Torre et al., 2015; Wyss et al., 2016), and the dearth of available cessation services provided to this disadvantaged population (Baggett and Rigotti, 2010), the need to alter the landscape of how tobacco is addressed in healthcare and homeless-serving settings is clear and emergent. In the current study, only 3.5% of participants received any smoking cessation intervention within the last 3-months, with no differences between CU and non-CU in receipt. The lack of available cessation interventions and health-care provider’s general acceptance of tobacco use among homeless groups has been previously reported (Baggett et al., 2015a), and results reported herein may reflect a similar phenomenon. Thus, not only must tobacco control and treatment resources be directed to homeless smokers at higher rates, but also efforts to dually address high rates of CU are critical to mitigating tobacco-related health disparities in this group. A better understanding of CU and its correlates may inform intervention such efforts.

Like previous studies, the most commonly endorsed CU motives were “It is cheaper than smoking cigarettes” and “To help me cut down on smoking cigarettes.” Although financial restrictions and opportunistic product acquisition may underlie some CU, for some, CU may reflect openness to harm reduction and a desire to end conventional cigarette use. In particular, results suggest that CU of ENDS, as well as chewing tobacco, dip or snuff, may be commonly associated with an enhanced desire to change or stop cigarette use. Moreover, many participants felt like these products were effective at helping them cut down or quit smoking. Although longitudinal analysis and controlled experiments would be necessary to empirically validate beliefs about the effectiveness of CU to affect conventional cigarette smoking, results suggest that active CU may represent a window of opportunity for providers to intervene with empirically-based practices that are known to help facilitate cessation success.

Concurrent users did not differ from non-CU on race, lifetime months homeless, years smoked, number of cigarettes smoked, or time to first cigarette. However, CUs were younger than non-CUs, more likely to be male, and had higher rates of non-nicotine substance use disorder diagnoses. The younger age of CUs was similar to previous

Table 3
Endorsed Motives for Concurrent Nicotine and Tobacco Product Use (n = 266).

	Snus		RYO		Tobacco from a hookah or waterpipe		Dissolvable tobacco products		ENDS		Cigars		Little cigars/cigarillos/bidis		Chewing tobacco, dip, or snuff		Other tobacco products		Total Number of Endorsements	
	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]
To help me quit smoking cigarettes	29.2% [7]	3.2% [5]	0% [0]	25.0% [1]	42.9% [45]	12.5% [10]	8.3% [5]	44.7% [21]	20.0% [3]	97										
To help me cut down on smoking cigarettes	41.7% [10]	17.8% [28]	16.7% [1]	50.0% [2]	58.1% [61]	27.5% [22]	23.3% [14]	51.1% [24]	13.3% [2]	164										
It is cheaper than smoking cigarettes	20.8% [5]	74.5% [117]	50.0% [3]	75.0% [3]	41.0% [43]	52.5% [42]	61.7% [37]	34.0% [16]	26.7% [4]	270										
It is less harmful to my health than cigarettes	16.7% [4]	5.7% [9]	0% [0]	0% [0]	26.7% [28]	3.8% [3]	3.3% [2]	6.4% [3]	13.3% [2]	51										
I can use it in places where cigarettes are not allowed	29.2% [7]	2.5% [4]	0% [0]	0% [0]	38.1% [40]	2.5% [2]	3.3% [2]	48.9% [23]	6.7% [1]	79										
It tastes better or is more pleasurable to use than cigarettes	25.0% [6]	8.3% [13]	16.7% [1]	0% [0]	37.1% [39]	15.0% [12]	15.0% [9]	17.0% [8]	13.3% [2]	90										
I use this product for reasons that are not listed	8.3% [2]	19.1% [30]	16.7% [1]	25.0% [1]	17.1% [18]	20.0% [16]	31.7% [19]	21.3% [10]	33.3% [5]	102										
None of the above reasons	12.5% [3]	9.6% [15]	33.3% [2]	0% [0]	10.5% [11]	16.3% [13]	10.0% [6]	6.4% [3]	46.7% [7]	60										
Missing	2	2	1	1	2	1	1	1	1	N/A										
Total Number of Users Responding	24	157	6	4	105	80	60	47	15	913										

Note: Percentages are percent of users who indicated that motive for a product divided by total number of non-missing users of that product. RYO = Roll Your Own. ENDS = Electronic Nicotine Delivery System. Participants could endorse > 1 product and > 1 motive.

Table 4
Perceived Risk of Concurrent Nicotine and Tobacco Product Use (n = 266).

	Snus		RYO		Tobacco from a hookah or waterpipe		Dissolvable tobacco products		ENDS		Cigars		Little cigars/cigarillos/bidis		Chewing tobacco, dip, or snuff		Other tobacco products	
	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	
No Risk (1)	4.2% [1]	1.9% [3]	16.7% [1]	25.0% [1]	11.3% [12]	0% [0]	0% [0]	0% [0]	0% [0]	6.7% [1]								
Little Risk (2)	16.7% [4]	3.8% [6]	0% [0]	25.0% [1]	22.6% [24]	2.5% [2]	1.7% [1]	8.5% [4]	0% [0]	0% [0]								
Some Risk (3)	37.5% [9]	28.0% [44]	16.7% [1]	25.0% [1]	50.0% [53]	26.3% [21]	35.0% [21]	31.9% [15]	20.0% [3]	20.0% [3]								
A Lot of Risk (4)	25.0% [6]	43.9% [69]	33.3% [2]	25.0% [1]	9.4% [10]	41.3% [33]	41.7% [25]	38.3% [18]	53.3% [8]	53.3% [8]								
Extreme Risk (5)	16.7% [4]	22.3% [35]	33.3% [2]	0% [0]	6.6% [7]	30.0% [24]	21.7% [13]	21.3% [10]	20.0% [3]	20.0% [3]								
Missing	2	2	1	1	1	1	1	1	1	1								
Total Number of Users	26	159	7	5	107	81	61	48	16	16								
Average Risk M (± SD)	3.33 (± 1.09)	3.81 (± 0.89)	3.67 (± 1.51)	2.50 (± 1.29)	2.77 (± 1.00)	3.99 (± 0.82)	3.83 (± 0.79)	3.72 (± 0.90)	3.80 (± 1.01)	3.80 (± 1.01)								

Note: RYO = Roll Your Own. ENDS = Electronic Nicotine Delivery System. Participants could endorse > 1 product.

Table 5
Perceived Effectiveness of Concurrent Nicotine/Tobacco Product to Cut Down or Quit Cigarette Smoking (n = 266).

	Snus	RYO	Tobacco from a hookah or waterpipe	Dissolvable tobacco products	ENDS	Cigars	Little cigars/cigarillos/bidis	Chewing tobacco, dip, or snuff	Other tobacco products	Total Endorsements
	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]	n
Yes, definitely	19.0% [4]	9.5% [14]	0% [0]	0% [0]	25.5% [26]	5.9% [4]	1.9% [1]	22.9% [11]	12.5% [1]	61
Yes, somewhat	19.0% [4]	24.3% [36]	14.3% [1]	0% [0]	33.3% [34]	26.5% [18]	18.5% [10]	45.8% [22]	25.0% [2]	127
Not sure	4.8% [1]	6.8% [10]	28.6% [2]	0% [0]	5.9% [6]	5.9% [4]	5.6% [3]	2.1% [1]	25.0% [2]	29
Not really	28.6% [6]	29.7% [44]	28.6% [2]	100% [1]	20.6% [21]	23.5% [16]	31.5% [17]	8.3% [4]	12.5% [1]	112
Not at all	28.6% [6]	29.7% [44]	28.6% [2]	0% [0]	14.7% [15]	38.2% [26]	42.6% [23]	25.0% [10]	25.0% [2]	128
Missing	5	11	0	4	5	13	7	0	8	N/A
Total Number of Users	26	159	7	5	107	81	61	48	16	457

Note: RYO = Roll Your Own Cigarettes. ENDS = Electronic Nicotine-Delivery Systems. Participants could endorse > 1 product.

work, and the sex differences reflected trends reported therein for homeless adults (Kish et al., 2015); this younger age of CU is also mirrored in a study that showed a high frequency of CU among homeless youth (Tucker et al., 2014). The relatively greater representation of women (35.1% vs. 24.7%) may have contributed to the significant differences reported in the current study. The present study expanded the exploration of differences between CUs and non-CUs on relevant participant characteristics, including substance use comorbidities that can be considered when designing CU cessation interventions. However, additional variables not explored herein might also be relevant in treatment planning or targeting, including a history of psychiatric diagnoses, psychiatric symptoms, and trauma, as well as other sociodemographic variables including sexual orientation and identity, and should be included in future studies.

Despite no between-group differences in the number of cigarettes smoked per day, CUs indicated a greater likelihood of developing a smoking-related disease if they did not quit smoking relative to non-CUs. Results may suggest that CUs account for dual or poly-product use in smoking-related health risk estimations; perhaps due to the shared mode of smoke inhalation-based nicotine delivery (e.g., RYO). Moreover, seven of the nine CU products were acknowledged as conferring at least some risk of harm to health. Within CUs, however, risk attribution varied between products. Similar to prior research (Etter and Bullen, 2011; Farsalinos and Polosa, 2014; Goniewicz et al., 2013; Kish et al., 2015; Polosa et al., 2013), ENDS were perceived as less harmful to health, while RYO cigarettes, cigars, and little cigars/cigarillos/bidis were perceived as riskier. However, due to the cross-sectional nature of this work, it is unknown if dual or poly-product use causally contributes to higher risk perception or if it reflects an attempt to mitigate cigarette-specific health risks (e.g., use of ENDS to quit smoking harm-conferring conventional cigarettes). This is particularly the case because RYO cigarettes and ENDS, whose use may reflect distinct motives, were the most frequently endorsed CU products.

Concurrent users reported more past year quit attempts than non-CUs. Despite this, groups did not differ in readiness to quit smoking. The average readiness to quit for both groups fell between “I sometimes think about quitting smoking, but I have no plans to quit” and “I often think about quitting smoking, but I have no plans to quit.” However, it is important to acknowledge that whereas readiness to quit may fluctuate from day to day and possibly even hour to hour depending on contextual factors (e.g., dependence, triggers) (Vidrine et al., 2013), quit attempts represent a behavioral demonstration of this readiness. Thus, results suggest that while many cigarette smokers may be thinking about but not planning to quit, the greater number of quit attempts among CUs coupled with high endorsements of CU motives to cut down or quit smoking may indicate that CUs are particularly apt treatment targets for agencies with limited smoking cessation resources.

Extant literature provides some direction regarding tobacco control and cessation interventions that are likely to be effective for homeless

cigarette smokers. For example, restricting tobacco use in and around settings that serve homeless adults can lead to reduced environmental smoke exposure (Businelle et al., 2015) and engender quit attempts (Hopkins et al., 2010). On an individual level, Nicotine Replacement Therapy (NRT) is an effective smoking cessation tool, and has been shown to be successful in disadvantaged populations for individuals who have greater adherence to patch use early in their quit attempt (Ma et al., 2016), when combined with motivational interviewing (Okuyemi et al., 2013), or when addressing both depression and motivation to quit (Ojo-Fati et al., 2016), though evidence about addressing depression in treatment has been mixed, see Robinson et al., 2016. Additionally, the provision of small financial incentives for cessation milestones may improve abstinence rates, as supported by other studies conducted among socioeconomically disadvantaged participants (Businelle et al., 2014; Kendzor et al., 2015). At a basic level, tobacco control interventions need to be implemented, and cessation resources provided by homeless-serving agencies as evidence suggests there is much room to improve on both counts. However, additional considerations need to account for how to address CU among smokers trying to quit. In particular, due to the potential for higher rates of non-nicotine substance abuse as was the case in the present study, interventions addressing CU may need to account for this and other comorbidities to improve outcomes. Additionally, CU should be considered in NRT dosing to enhance effectiveness. Finally, interventions addressing cigarette use among homeless adults should attend to the potential for concurrent alterations in CU, and address dual and poly-product use wherever possible to have the greatest impact on health.

Limitations of this study include the use of an adult homeless sample from one city, which may limit the generalizability of results to other cities or states, particularly with different tobacco product pricing/taxation and access to various CU products that might affect use patterns and motives (Wrighting et al., 2016). A report from the Oklahoma City Planning Department indicates that in January 2016, there were approximately 1511 homeless adults in Oklahoma City (Oklahoma City Planning Department, 2016). This suggests that roughly 40% of the homeless population in Oklahoma City participated in this study, but given the study criteria, the sample was likely more stable/sheltered, literate, and English-speaking than those who did not participate. In this study, CU was defined as use over the last 30 days and thus might not represent regular use; however, this delineation is common in prior studies regarding CU (Baggett et al., 2016; Kish et al., 2015). Finally, a small subset of non-daily smokers (n = 59) was excluded from analysis to understand better the constructs among the more sizable group homeless smokers (daily smokers), who may differ from non-daily smokers in significant ways (e.g., dependence). Although this was a strength of our approach relative to past studies among homeless smokers, future studies should seek to understand better how investigated constructs operate among non-daily smokers.

Study limitations are balanced by strengths, including recruitment

from multiple sites; and including a broad range of CU products, an extensive list of possible motives for CU use, and perceptions of the effectiveness of CU as a means to reduce or eliminate smoking. Future work in this area should examine the longitudinal impact of CU on smoking behaviors. In particular, the effectiveness of CU (e.g., ENDS) as a means to reduce or eliminate cigarette smoking should be studied, as it appears to be an acceptable quit method and one that is perceived as effective by this population. However, perceptions should be considered in light of the potential dearth of other cessation services and methods made readily available to this group. Further improvements to the study design should be considered, including participant elaboration on what products comprise the “other” tobacco product category through direct inquiry. Finally, future studies might delineate finer subgroups (non-CU vs. tobacco using CU vs. ENDS using CUs) to understand better relations with risk perceptions, readiness to quit, and other factors related to cessation.

5. Conclusions

Concurrent use of other nicotine-based products is common among conventional cigarette smokers who are homeless. The need for cessation efforts that include consideration of CU is crucial, both to mitigate risk to health as well as to heighten the likelihood of successful smoking cessation. In some cases, CU appears to reduce or eliminate cigarette usage and thus suggesting a window of opportunity for the implementation of more evidence-based cessation interventions. Future research in this area should include attention to factors that can increase responsiveness to smoking cessation treatments among individuals who are homeless and who may have several comorbid conditions (e.g., behavioral health issues, non-nicotine addictions), including dual and poly-tobacco product use.

Contributors

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Role of funding source

This work was supported by the Oklahoma Tobacco Research Center at the University of Oklahoma Health Sciences Center (to MSB), with additional support from the University of Houston (to LRR). This work was also supported by funding from the American Cancer Society grant MRSMT-12-114-01-CPPB (to MSB) and the National Institute of Drug Abuse (1F31DA043390; to LG). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the sponsoring organizations.

Conflict of interests

The authors declare that they have no conflicts of interest.

Acknowledgements

Additional acknowledgements are made to candidacy committee members Lorraine R. Reitzel, Ph.D., Sascha Hein, Ph.D., and Margit Wiesner, Ph.D. at the University of Houston for supporting this work.

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