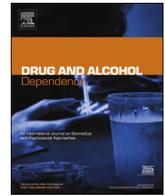




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Full length article

## Roll-your-own cigarette smoking among youth experiencing homelessness

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## ARTICLE INFO

## Keywords:

Roll-your-own  
Cigarettes  
Homeless  
Youth  
Correlates

## ABSTRACT

**Introduction:** Roll-your-own (RYO) cigarette smoking is uncommon among young smokers in the U.S. but may be more widespread among those experiencing homelessness as it is a less expensive source of cigarettes. This study examines the prevalence and correlates of RYO use among young cigarette smokers experiencing homelessness. **Methods:** The analytic sample consisted of 433 unaccompanied homeless youth who reported past month use of factory-manufactured cigarettes. Participants were sampled from 25 street and service sites in Los Angeles County, and completed a survey on their tobacco-related behaviors and cognitions.

**Results:** RYO use was reported by 43% of cigarette smokers. Among those who filled RYOs with tobacco, 87% rolled them with used tobacco (typically mixed with new tobacco). Most RYO smokers reported engaging in high-risk smoking practices, such as smoking discarded cigarettes. Although RYO smokers were more likely than other smokers to perceive RYOs as less risky in general, these groups did not differ in the perceived relative harm, expense, and ease of access of RYOs compared to regular cigarettes. Multivariable analyses indicated that RYO use was associated with older age, less perceived riskiness of RYOs, greater exposure to RYO smokers, and stronger future intentions to smoke.

**Conclusion:** RYOs may encourage continued tobacco use among youth experiencing homelessness and pose additional health risks despite users' beliefs to the contrary. Future research is needed to obtain more detailed information on RYO practices and motivations for use, as well as how to address RYOs in efforts to reduce tobacco use in this population.

### 1. Introduction

Use of roll-your-own cigarettes (RYOs) is less common in the U.S. than in other countries (Minardi et al., 2019; Partos et al., 2018). Nonetheless, studies have found that 25% of U.S. adults report lifetime RYO use (Pericot-Valverde et al., 2017), with exclusive use of RYOs reported by 3.5% of current adult smokers (Branston et al., 2018). RYOs are a less expensive option than factory-manufactured cigarettes, and the lower cost of RYOs has been cited as the most common reason for their use (Joseph et al., 2018). In addition, although most adults believe that RYOs are addictive (Donaldson et al., 2017), some smokers perceive them to be a more natural (Hoek et al., 2017) and less harmful (Joseph et al., 2018; O'Connor et al., 2007) alternative to factory-manufactured cigarettes. Contrary to this view, studies have found that RYO smokers have similar or greater levels of exposure to carcinogens and toxins (Kocyyigit et al., 2011; Lewis et al., 2012; Shahab et al., 2009), and potentially greater risk of developing lung cancer (Rolke et al., 2009) and cancers of the mouth and throat (De Stefani et al., 1992), compared to smokers of factory-manufactured cigarettes. In

addition to the health risks posed by RYOs, studies of smokers have found that RYO smokers tend to be longer-term and heavier smokers (Healey et al., 2016), and they are also less motivated to quit smoking (Andrews et al., 2018).

Given the lower cost of RYOs, it is perhaps not surprising that their use is more common among low-income smokers (Joseph et al., 2018; Young et al., 2006). For the most disenfranchised smokers, those experiencing homelessness, there is some evidence that RYO behavior is distinct in terms of both its prevalence and in the composition of RYO cigarettes. While RYOs are typically made from purchased pouched tobacco, smokers experiencing homelessness often make RYOs from tobacco previously used by others. For example, studies of adult smokers residing in homeless shelters have found that between 37–71% report smoking cigarettes remade from discarded butts and filters (Aloot et al., 1993; Chen et al., 2016). A third study of 292 younger homeless smokers found that 73% smoked discarded cigarette butts in the past month (known as 'sniping'), with the sniped tobacco sometimes reused to make RYOs (Tucker et al., 2015a, 2015b). As one participant in the Tucker et al. (2015) study explained, "Like if there's half a

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E-mail address: [jtucker@rand.org](mailto:jtucker@rand.org) (J.S. Tucker).<https://doi.org/10.1016/j.drugalcdep.2019.107632>

Received 19 April 2019; Received in revised form 16 July 2019; Accepted 19 August 2019

Available online 18 October 2019

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cigarette, I'm going to smoke it; but if there's just like a bunch of little ones, you roll."

It is important to better understand RYO practices among smokers experiencing homelessness, an extremely vulnerable, marginalized and understudied population that is among the most likely to engage in RYO smoking in the U.S. Because it provides a less expensive form of tobacco, RYO use may perpetuate smoking and hinder cessation efforts among smokers experiencing homelessness. As part of a larger study on tobacco use, we collected information on RYO use and cognitions to provide an initial understanding of RYO use among young tobacco users experiencing homelessness. The first goal of the study was to examine the prevalence of RYO use among current cigarette smokers. The second goal was to better understand the types of substances typically used in rolling or remaking cigarettes (e.g., new and/or used tobacco; non-tobacco products such as marijuana). The third goal was to examine the correlates of RYO behavior (e.g., demographic characteristics, RYO-related cognitions, nicotine withdrawal and dependence) to identify risk factors for RYO smoking that might be targeted in efforts to reduce tobacco use among young smokers experiencing homelessness.

**2. Methods**

**2.1. Participants**

Individuals were sampled from 25 service and street sites in Los Angeles County, and were eligible for the study if they (a) were between the ages of 13–25; (b) were not currently living with a parent or guardian; (c) were not getting most of their support for food and housing from family or a guardian; (d) spent the previous night in a shelter, outdoor or public place, hotel or motel room rented with friends (because of no place else to go), or other place not intended as a domicile; and e) had used any type of cigarette, e-cigarette, or other tobacco product or electronic nicotine delivery system (ENDS) in the past 30 days (note that only 6% of youth were ineligible solely for this reason). The analytic sample is restricted to participants who reported past month cigarette smoking. Demographic characteristics of the analytic sample, by RYO status, are presented in Table 1. This research was approved by RAND's institutional review board.

**2.2. Study design**

A probability sample of unaccompanied youth experiencing homelessness was recruited from service sites and street venues in Los Angeles County. Data collection occurred between August 2017 and April 2018. Recruitment sites were selected by developing two sampling frames. One sample frame was for service sites (using local directories of services for homeless persons that listed shelters and drop-in centers) and the other was for street venues (developed with the help of service providers and outreach agencies, as well as informed by our previous studies of this population and knowledge of local hotspots). Service sites were considered eligible if they were in the study area and the majority of their clientele was ages 13 to 25 and English speaking. The research team identified 12 such sites (2 overnight shelters, 10 drop-in centers) that were eligible and agreed to participate, with four agencies (representing 6 sites) refusing participation. In addition, 13 street sites (e.g., sidewalks, parks, alleys, beaches) in the study area were identified where homeless youth congregate. We investigated all sites multiple times and at various times of day to obtain an estimate of the average number of youths served daily by the service sites and the average number of youth that "hang out" at the street venues in a given day. Based on the information collected through these site investigations, a quota was assigned for the number of completed interviews to be achieved at each site (which was approximately proportional to the size of a site, such that more interviews were completed at sites with larger number of youth). A probability sample of homeless youth was then drawn from the 25 study sites. Strategies that were specified a

**Table 1**  
Background characteristics, RYO social factors and cognitions, and smoking heaviness and future intentions among past month cigarette users, by roll-your-own (RYO) status.

Variable	Smoke RYO cigarettes		t-test or chi-squared test
	No (n = 234)	Yes (n = 199)	
<b>Background characteristics</b>			
Mean age	21.7 (2.3)	22.2 (2.1)	p = 0.01
Cisgender/transgender male	162 (69.8%)	140 (75.5%)	p = 0.20
<b>Sexual orientation</b>			
Straight/heterosexual	130 (70.3%)	106 (73.3%)	p = 0.53
Bisexual	55 (14.4%)	55 (16.2%)	
Gay/lesbian	32 (9.2%)	23 (6.8%)	
Questioning/Asexual	17 (6.1%)	15 (3.8%)	
<b>Race/ethnicity</b>			
White	69 (26.1%)	67 (35.4%)	p = 0.004
Black	90 (35.9%)	44 (23.1%)	
Hispanic	48 (25.8%)	47 (21.7%)	
Multiracial/other	27 (12.2%)	41 (19.8%)	
Mean income (in dollars)	280.4 (340.5)	254.4 (314.4)	p = 0.42
Slept outdoors in past month	173 (71.3%)	162 (80.7%)	p = 0.03
<b>RYO cognitions and social factors</b>			
Riskiness of using RYO cigarettes <sup>a</sup>	3.0 (1.0)	2.8 (1.0)	p = 0.04
<b>Harm of RYOs relative to cigarettes</b>			
Less	60 (24.8%)	63 (33.4%)	p = 0.15
Same	132 (57.0%)	108 (51.2%)	
More	42 (18.1%)	28 (15.4%)	
<b>Expense of RYOs relative to cigarettes</b>			
Less	144 (59.7%)	133 (63.4%)	p = 0.51
Same	68 (30.5%)	51 (29.9%)	
More	22 (9.8%)	15 (6.8%)	
<b>Ease of getting RYOs relative to cigarettes</b>			
Less	63 (27.0%)	40 (23.2%)	p = 0.62
Same	112 (49.6%)	94 (50.5%)	
More	59 (23.4%)	65 (26.3%)	
How often around people who RYOs <sup>b</sup>	2.8 (1.2)	3.3 (0.9)	p < .0001
Perceived prevalence of RYO use	5.0 (2.9)	5.6 (2.8)	p = 0.04
<b>Smoking heaviness and future intentions</b>			
Number of cigarettes smoked per day	11.0 (14.1)	12.7 (12.6)	p = 0.22
Latency to 1 <sup>st</sup> cigarette of day ≤ 30 minutes <sup>c</sup>	125 (59.0%)	113 (60.5%)	p = 0.78
Withdrawal symptoms	2.0 (0.9)	2.2 (0.8)	p = 0.02
Intentions to smoke cigarettes, next 6 months <sup>d</sup>	2.6 (1.0)	3.1 (0.9)	p < .0001

Note. <sup>a</sup> Scale: 1 = not at all, 2 = a little, 3 = somewhat, 4 = very; <sup>b</sup> scale: 1 = never, 2 = hardly ever, 3 = sometimes, 4 = often; <sup>c</sup> Results based on n = 208 non-RYO smokers and n = 188 RYO smokers who did not endorse the "I do not use this product" response option for the latency item. <sup>d</sup> scale: 1 = definitely no, 2 = probably no, 3 = probably yes, 4 = definitely yes.

priori and tailored to the type of site were used to select the youths to be approached, screened and surveyed. For example, at drop-in centers survey staff obtained a copy of the drop-in center sign-in sheet and then used random number tables to determine the order in which they would approach youth for eligibility screening. For street sites, survey staff walked clockwise along the block (randomly selecting which end of the block was the starting point), approaching all potentially eligible youth for screening in the order in which they were encountered.

### 2.3. Procedures

Two data collection efforts were used to obtain the sample: one for the main sample and another for a supplemental sample that focused on sexual minority youth. For the main sample, 613 youth were approached for eligibility screening (19 refused, 224 screened ineligible, and 370 screened eligible). For those who screened ineligible, 82 were outside the age range only, 50 were not homeless only, 40 were not a tobacco user only, 4 were currently living with or getting most of their support for food and housing from family or a guardian only; and 48 were ineligible for multiple reasons (note that eligibility criteria for the main sample did not include sexual or gender minority status, although this information was collected on the survey). Of the 370 youth that screened eligible, 357 completed the survey. Three of the 357 completers were subsequently dropped from the dataset due to poor quality data, resulting in a final sample size of 354 for the main sample. Near the end of the main data collection we conducted supplemental data collection to increase the number of sexual and gender minority youth in our sample and thus provide adequate statistical power to test for differences in tobacco use by sexual and gender minority status. We focused our efforts on 10 of the original 25 sites that yielded the highest recruitment of sexual and gender minority participants during the main data collection. An item was added to the eligibility screening form that asked which term best described their sexual orientation and gender identity: straight/heterosexual or LGBTQ (lesbian, gay, bisexual, transgender, questioning). Youth who identified as LGBTQ, and met all other eligibility criteria, were invited to participate. This supplemental data collection involved approaching 420 youth for eligibility screening (19 refused, 280 screened ineligible, and 121 screened eligible). For those who screened ineligible, 125 did not identify as LGBTQ only, 20 were outside the age range only, 5 were not homeless only, 20 were not a tobacco user only, 4 were repeaters (i.e., had already participated in the survey), and 106 were ineligible for multiple reasons. Of the 121 LGBTQ youth that screened eligible, 115 completed the survey. The survey was self-administered, with field staff available to provide assistance if needed. Youth received \$3 cash for participating in the eligibility screening and \$20 cash for participating in the survey.

### 2.4. Measures

#### 2.4.1. Background characteristics

These included whether they identified as cisgender/transgender male or cisgender/transgender female, race/ethnicity [non-Hispanic white (reference) vs. Hispanic, non-Hispanic black, and non-Hispanic multiracial/other], age, sexual orientation (straight/heterosexual vs. lesbian, gay, bisexual, questioning or asexual), past month income, and whether they had slept outdoors in the past 30 days (as an indicator of homelessness severity; 0 = *no*, 1 = *yes*).

#### 2.4.2. Roll-your-own cigarette use

Participants were asked separate questions about how many days they used “cigarettes (e.g., Marlboro, Camel, Newport, not including natural cigarettes)” and “natural cigarettes (e.g., American Spirit)” in the past 30 days (0 = 0 days to 7 = all 30 days). They were subsequently asked: “Out of every 10 cigarettes that you smoke, how many are regular cigarettes, natural cigarettes, or roll-your-own cigarettes.” Participants were classified as a past month cigarette smoker if they reported either using cigarettes or natural cigarettes in the past 30 days, and a RYO user if they additionally indicated that any of their cigarettes are RYO (otherwise, they were classified as a non-RYO user). Note that four respondents were excluded from the analyses because they indicated that they used RYOs, but had not smoked cigarettes in the past 30 days. For those who indicated RYO use, they completed four items asking how often they fill them with: “only tobacco that has not been previously used (‘new’ tobacco),” “only tobacco you got from a discarded cigarette butt (‘used’ tobacco),” “a mix of ‘new’ and ‘used’

tobacco,” and “tobacco mixed with marijuana.” Each item was rated on a scale from 0 = *never* to 5 = *always*. From this information we derived indicators of whether they had ever filled RYOs with each type of product. In addition, we created mutually exclusive categories of whether they had only filled RYOs with new tobacco, had only filled RYOs with used tobacco, or had filled RYOs with both new and used tobacco.

#### 2.4.3. High-risk smoking practices

These were assessed with items used in previous studies of high-risk smoking practices among individuals experiencing homelessness (Aloot et al., 1993; Tucker et al., 2015a, 2015b). Participants were asked the number of days they had done each of the following during the past 30 days: (a) smoked a discarded cigarette butt or filter, (b) smoked a cigarette remade from a discarded cigarette butt; and (c) smoked a cigarette remade from things other than tobacco, such as cigarette filters or drugs. Items were rated on a scale from 0 = 0 days to 6 = all 30 days; however, for the purposes of analysis, we created dichotomous indicators of whether they had engaged in each of these behaviors in the past 30 days (0 = *no*, 1 = *yes*).

#### 2.4.4. Smoking heaviness and future intentions

Participants were asked, on the days they smoked cigarettes in the past 30 days, about how many cigarettes they smoked per day. As an indicator of nicotine dependence, we asked how soon after waking they usually smoke their first cigarette (regular, natural, or roll-your-own): within 5 min; 6–30 minutes; 31–60 minutes; after 60 min. Those who smoked their first cigarette within 30 min were classified as nicotine dependent (Baker et al., 2007). Withdrawal symptoms were assessed generally with the 8-item Minnesota Nicotine Withdrawal Scale ( $\alpha = 0.91$ ; Hughes, 1992; Toll et al., 2007). Finally, participants were asked whether they intended to use “regular cigarettes” and “natural cigarettes” any time in the next 6 months (1 = *definitely no* to 4 = *definitely yes*); if respondents used both types of cigarettes, their responses were averaged.

#### 2.4.5. RYO-related social factors and perceptions of risk, cost, and access

We assessed exposure to users of RYOs by asking how often they are around or with people who use RYOs, which was rated on a 4-point scale (1 = *never* to 4 = *often*). We also asked about perceived peer descriptive norms by asking, “In general, out of every 10 people your age, how many do you think use RYOs?” Perception of the health risks of using RYOs was assessed on a 4-point scale (1 = *not at all risky* to 4 = *very risky*; Romer and Jamieson, 2001). Finally, separate items assessed the perceived harm (Smith et al., 2007), availability (Johnston et al., 2018) and cost (Shadel et al., 2019) of RYOs relative to “regular cigarettes” (response options: less, same as, or more).

### 2.5. Analyses

Departures from proportionate-to-size random sampling due to changes in the sampling rates during the fielding period, differential non-response rates across sites, and differential rates of visits to service sites and street venues among homeless youth require the use of weights to adjust estimates and correct for potential bias due to respondents’ differential inclusion probabilities. All analyses incorporate these weights and account for the modest design effect that they induce, using the linearization of standard errors (Skinner, 1989). Missing data ranged from 0 to 4% of cases and was imputed using the mean/mode of all non-missing responses.

T-tests and chi-square tests were used to compare past month cigarette smokers who did and did not report using RYOs on background characteristics, RYO-related social factors and cognitions, and nicotine withdrawal symptoms, nicotine dependence, and intentions to continue smoking cigarettes in the future. We then conducted a multivariable logistic regression model, with the outcome being any reported use of

**Table 2**  
Cigarette smoking characteristics among past month RYO cigarette smokers (N = 199).

Variable	N (%) / Mean (SD)
Mean # cigarettes (out of every 10) that are RYO	3.23 (2.32)
% who fill RYOs with new tobacco	159 (80.0%)
% who fill RYOs with used tobacco	137 (74.3%)
% who fill RYOs with a mix of new and used tobacco	123 (67.3%)
% who fill RYOs with tobacco mixed with marijuana	163 (80.5%)
% who smoked discarded cigarette butt or filter, past 30 days	122 (65.6%)
% who smoked cigarette remade from discarded butt, past 30 days	117 (61.5%)
% who smoked cigarette remade from things other than tobacco, past 30 days	84 (41.1%)

Note. Unweighted Ns and weighted percentages, means and SDs are reported. Participants could endorse multiple items; as such, percentages do not sum to 100%.

RYOs. The model included only those covariates which showed bivariate differences between these two groups at  $p < .10$  (given our sample size and concerns about multicollinearity of covariates). Finally, we were also interested in exploring whether sexual orientation moderated associations of each variable in the multivariable model with RYO smoking status. We conducted separate logistic regression analyses for each of these variables that included the variable of interest, sexual orientation, and the interaction term.

### 3. Results

In our analytic sample of  $N = 433$  past month cigarette smokers,  $n = 199$  (weighted percentage: 43.2%) reported that they smoked RYO cigarettes. Among youth who smoked RYOs, an average of 3 out of every 10 cigarettes they smoked were RYOs (see Table 2). Most youth who smoked RYOs reported that they filled them with new tobacco (80%), used tobacco (74%), and a mix of new and used tobacco (67%). However, when those who filled RYOs with tobacco were categorized into mutually exclusive groups, it was rare for youth to report filling them with new tobacco only (13%) or used tobacco only (4%); rather, filling them with a mix of new and used tobacco was by far the most common method (83%). In addition, use of spliffs were commonly reported, with 81% of RYO users reporting that they filled their cigarettes with a mix of tobacco and marijuana.

Table 1 compares past month cigarettes smokers who reported that they used RYOs to those who reported that they did not. In terms of demographics, RYO smokers were significantly more likely than non-RYO smokers to be older, non-Hispanic white or multiracial/other, and to have slept outdoors in the past 30 days; however, the two groups did not significantly differ in terms of gender, sexual orientation, or past month income. Compared to non-RYO smokers, RYO smokers also tended to report more exposure to other RYO smokers, that more of their same-aged peers smoked RYOs, and that RYOs posed less of a health risk in general; however, the two groups did not differ in terms of their perceptions of the health risks, expense, or ease of access to RYOs compared to regular cigarettes. Finally, RYO smokers tended to report greater withdrawal symptoms and stronger intentions to continue smoking cigarettes in the next 6 months than did non-RYO smokers; however, the two groups did not significantly differ on the number of cigarettes typically smoked per day or on the indicator of nicotine dependence.

We ran a multivariable logistic regression model that included all variables in Table 1 that were associated with RYO status at  $p < .10$ : age, race/ethnicity, slept outdoors, riskiness of using RYOs, exposure to RYO users, perceived prevalence of RYO use, withdrawal symptoms, and intentions to continue smoking cigarettes in the next 6 months. As shown in Table 3, results indicated that four of these variables remained

**Table 3**  
Results from multivariable logistic regression model of the correlates of RYO use among past month cigarette smokers.

Variable	Used roll-your-own cigarettes OR (95% CI)	p =
Mean age	<b>1.14 (1.01, 1.29)</b>	<b>0.03</b>
Race/ethnicity		
White (ref)	–	–
Black	0.67 (0.32, 1.40)	0.29
Hispanic	0.83 (0.40, 1.75)	0.62
Multiracial/other	1.58 (0.72, 3.49)	0.25
Slept outdoors in past month	1.07 (0.56, 2.02)	0.84
Riskiness of using RYO cigarettes	<b>0.73 (0.55, 0.97)</b>	<b>0.03</b>
How often around people who RYOs	<b>1.41 (1.07, 1.88)</b>	<b>0.02</b>
Perceived prevalence of RYO use	1.02 (0.92, 1.12)	0.77
Withdrawal symptoms	1.08 (0.77, 1.52)	0.66
Intentions to smoke cigarettes in next 6 months	<b>1.42 (1.02, 1.97)</b>	<b>0.04</b>

significantly associated with RYO use. Older youth were more likely to smoke RYOs, with a 14% increase in the likelihood of using RYOs for each additional year of age. Youth who reported greater exposure to RYO smokers, and stronger future intentions to continue smoking, were also more likely to smoke RYOs; in both cases, a one point increase in the variable was associated with about a 40% increase in the likelihood of using RYOs. Finally, youth were less likely to smoke RYOs if they perceived them as posing greater health risks, with a one point increase in perceived riskiness associated with a 27% decrease in the likelihood of using RYOs. We explored whether sexual orientation moderated the association of each of these variables with RYO smoking; none of the four interaction terms was statistically significant.

### 4. Discussion

Results from this study indicate that the use of RYOs is commonplace among young smokers experiencing homelessness, with about 4 in 10 reporting this form of tobacco use. Further, the use of RYOs did not significantly differ by gender, sexual orientation, or race/ethnicity (although RYO smokers tended to be older). Nearly all of the RYO smokers in our sample at least sometimes rolled these cigarettes with used tobacco, albeit typically mixed with new tobacco. Further, our results suggest that they may be obtaining this used tobacco by sniping discarded cigarette butts (Tucker et al., 2015a, 2015b); among youth who reported RYO smoking, 66% had smoked discarded cigarettes and 62% had smoked cigarettes remade from discarded butts in the past 30 days. Smoking discarded cigarettes previously used by other people is concerning to the extent that it may increase youth's exposure to toxins and/or susceptibility to infectious diseases (Dhillon et al., 2009; Linch and Prahlow, 2008), in addition to the other well-known health risks associated with tobacco use (USDHHS, 2014). Although few programs are available to help homeless youth quit smoking (Shadel et al., 2014), there is widespread interest among service providers working with this population in offering cessation services (Shadel et al., 2014). Further, most homeless youth smokers have tried to quit on their own and are interested in using formal cessation services (Tucker et al., 2015a, 2015b), despite the myriad of other challenges that they face. Results from this study suggest that RYO smoking among young smokers experiencing homelessness is an important issue that deserves attention in any future efforts to reduce tobacco use in this population.

In addition to making RYOs with used tobacco, another important finding is that 81% of RYO smokers also reported at least sometimes making spliffs by rolling cigarettes that contained both cannabis and tobacco. Given that cannabis use is common among youth experiencing homelessness (Santa Maria et al., 2018; Wenzel et al., 2010), the administration of cannabis and tobacco among the RYO smokers in our

sample is not surprising. However, the practice appears to be much more widespread among youth experiencing homelessness than in the general population, at least based on studies using California samples. For example, a recent study of young adults in California found that among those who used both cannabis and tobacco in the past year, only 12% mixed both products in a cigarette (and 27% mixed both products in a joint; Tucker et al., 2019). The co-administration of cannabis and tobacco is problematic in that cannabis use may hinder efforts to quit cigarette smoking among young people (Amos et al., 2004; Ramo et al., 2013), and is associated with increased symptoms of cannabis dependence (Ream et al., 2008). Taken together, these findings suggest that young RYO smokers experiencing homelessness are not only at heightened risk of health problems from their tobacco use, but their co-administration of cannabis and tobacco via RYO cigarettes may lead to poorer cannabis-related outcomes as well.

Consistent with previous work showing that RYO smokers are less motivated to quit than non-RYO smokers (Andrews et al., 2018), results from the present study indicate that young RYO smokers experiencing homelessness hold stronger intentions to continue smoking in the future. However, while other research has found that RYO smokers tend to be heavier smokers (Healey et al., 2016), one possible reason why they might be less motivated to quit, the present study did not find significant differences between RYO and non-RYO smokers in terms of the number of cigarettes smoked per day, latency to first cigarette of the day (i.e., nicotine dependence), or withdrawal symptoms (when controlling for other factors). Cost considerations also did not appear to distinguish between RYO and non-RYO smokers in that these two groups did not significantly differ in their monthly income, homelessness severity (i.e., being unsheltered), or youth's perceptions of the cost of RYOs compared to factory-manufactured cigarettes. Rather, the two factors that emerged as among the strongest predictors of RYO smoking were perceived health risks of using RYOs and exposure to other people who used RYOs. Although RYO- and non-RYO smokers did not differ in their perceptions of the health risks of RYOs compared to regular cigarettes, RYO smokers tended to rate lower the health risks of RYO smoking in general. RYO smokers also tended to report greater exposure to other RYO smokers; this may not only facilitate their access to RYO tobacco/supplies, but a recent meta-analysis found that peer smoking is associated with nearly twice the odds of continuing to smoke among young people (Liu et al., 2017). These findings suggest that efforts to reduce RYO smoking among youth experiencing homelessness should particularly address health-related beliefs about RYOs and social factors that increase the likelihood of youth engaging in this behavior.

This study provides a first glimpse at RYO smoking among young tobacco users experiencing homelessness. Despite the notable strengths of the study, such as the probability sample of young tobacco smokers experiencing homelessness, there are several limitations worth noting. Results are based on a sample of youth experiencing homelessness in the Los Angeles area and may not generalize to homeless youth in other parts of the U.S. or to young tobacco users not experiencing homelessness. The exclusive reliance on self-report data is another study limitation. In addition, given that this was part of a larger survey on tobacco use, we were not able to collect detailed information on RYOs, such as the relative proportion of used vs. new tobacco that is typical of RYOs, youth's preferences for what they put in their RYOs, or (more generally) the factors that may motivate their use of RYOs over factory-manufactured cigarettes. The study is also lacking information on the mechanisms through which exposure to RYO users may influence youth's own RYO behavior. These are important directions for future research in this area, particularly mixed methods studies that include qualitative data collection.

In conclusion, although regular RYO use is generally quite low in the U.S., RYO smoking is a pervasive problem in young people experiencing homelessness. Their use was not predicted by hypothesized predictors such as nicotine dependence and lower cost, but rather was related to youth's social environment and lower perceived risk

associated with use. Interventions designed to target cigarette smoking in this population need to attend to their high levels of RYO use, and future research needs to understand more about their motivations for using RYO cigarettes.

### Role of funding source

This work was supported by the National Cancer Institute (R01CA204004; PI: Tucker).

### Contributors

Joan Tucker and William Shadel co-led the design of the study, and Joan Tucker wrote the first draft of the manuscript. Daniela Golinelli and Daniel Siconolfi contributed to the design of the study. Rachana Seelam conducted the analyses. All authors contributed to and have approved the final manuscript.

### Declaration of Competing Interest

No conflict declared.

### References

- Aloot, C.B., Vredevoe, D.L., Brecht, M.L., 1993. Evaluation of high-risk smoking practices used by the homeless. *Cancer Nurs.* 16, 123–130.
- Amos, A., Wiltshire, S., Bostock, Y., Haw, S., McNeill, A., 2004. 'You can't go without a fag... you need it for your hash'—A qualitative exploration of smoking, cannabis and young people. *Addiction* 99, 77–81.
- Andrews, M.E., Sabado, M., Choi, K., 2018. Prevalence and characteristics of young adult smokers in the U.S. in the precontemplation stage of smoking cessation. *Addict. Behav.* 84, 167–170.
- Baker, T.B., Piper, M.E., McCarthy, D.E., Toll, B.A., 2007. Time to first cigarette in the morning as an index of ability to quit smoking: implications for nicotine dependence. *Nicotine Tob. Res.* 9, S555–S570.
- Branston, J.R., McNeill, A., Gilmore, A.B., Hiscock, R., Partos, T.R., 2018. Keeping smoking affordable in higher tax environments via smoking thinner roll-your-own cigarettes: findings from the International Tobacco Control Four Country Survey 2006–15. *Drug Alcohol Depend.* 193, 110–116.
- Chen, J.S., Nguyen, A.H., Malesker, M.A., Morrow, L.E., 2016. High-risk smoking behaviors and barriers to smoking cessation among homeless individuals. *Resp Care* 61, 640–645.
- De Stefani, E., Oreggia, F., Rivero, S., Fierro, L., 1992. Hand-rolled cigarette smoking and risk of cancer of the mouth, pharynx, and larynx. *Cancer* 70, 679–682.
- Dhillon, R., Bastiampillai, T., Hong, S., 2009. An unusual case of hospital-acquired infection: legionella longbeachae. *Aust. Psychiatry* 17, 337–338.
- Donaldson, E.A., Hoffman, A.C., Zandberg, I., Blake, K.D., 2017. Media exposure and tobacco product addiction belief: findings from the 2015 Health Information National Trends Survey (HINTS-FDA 2015). *Addict. Behav.* 72, 106–113.
- Healey, B., Edwards, R., Hoek, J., 2016. Youth preferences for roll-your-own versus factory-made cigarettes: trends and associations in repeated national surveys (2006–2013) and implications for policy. *Nicotine Tob. Res.* 18, 959–965.
- Hoek, J., Ferguson, S., Court, E., Gallopel-Morvan, K., 2017. Qualitative exploration of young adult RYO smokers' practices. *Tob. Control* 26, 563–568.
- Hughes, J.R., 1992. Tobacco withdrawal in self-quitters. *J. Consult. Clin. Psychol.* 60, 689–697.
- Johnston, L.D., Miech, R.A., O'Malley, P.M., Bachman, J.G., Schulenberg, J.E., Patrick, M.E., 2018. Monitoring the Future National Survey Results on Drug Use: 1975–2017: Overview, Key Findings on Adolescent Drug Use. Institute for Social Research, The University of Michigan, Ann Arbor.
- Joseph, S., Krebs, N.M., Zhu, J., Wert, Y., Goel, R., Reilly, S.M., Sun, D., Richie, J.P., Nikiforov, I., Cheriya, P., Muscat, J.E., 2018. Differences in nicotine dependence, smoke exposure and consumer characteristics between smokers of machine-injected roll-your-own cigarettes and factory-made cigarettes. *Drug Alcohol Depend.* 187, 109–115.
- Kocycigit, A., Selek, S., Celik, H., Dikilitas, M., 2011. Mononuclear leukocyte DNA damage and oxidative stress: the association with smoking of hand-rolled and filter-cigarettes. *Mutat. Res. Toxicol. Environ. Mutagen.* 721, 136–141.
- Lewis, A.J., Truman, P., Hosking, M.R., Miller, J.H., 2012. Monoamine oxidase inhibitory activity in tobacco smoke varies with tobacco type. *Tob. Control* 21, 39–43.
- Linch, C.A., Prahlow, J.A., 2008. Microscopical examination of particles on smoked cigarette filters. *Forensic Sci Med Pathol.* 4, 228–233.
- Liu, J., Zhao, S., Chen, X., Falk, E., Albarracin, D., 2017. The influence of peer behavior as a function of social and cultural closeness: a meta-analysis of normative influence on adolescent smoking initiation and continuation. *Psychol. Bull.* 143, 1082–1115.
- Minardi, V., Ferrante, G., D'Argenio, P., Mascocco, M., Spizzichino, L., Bietta, C., Contoli, B., Gallus, S., 2019. Roll-your-own cigarette use in Italy: sales and consumer profile – data from PASSI surveillance, 2015–2016. *Int. J. Public Health* 64, 423–430.

- O'Connor, R.J., McNeill, A., Borland, R., Hammond, D., King, B., Boudreau, C., Cummings, K.M., 2007. Smokers' beliefs about the relative safety of other tobacco products: findings from the ITC Collaboration. *Nicotine Tob. Res.* 9, 1033–1042.
- Partos, T.R., Gilmore, A.B., Hitchman, S.C., Hiscock, R., Branston, J.R., McNeill, A., 2018. Availability and use of cheap tobacco in the United Kingdom 2002–2014: findings from the International Tobacco Control project. *Nicotine Tob. Res.* 20, 714–724.
- Pericot-Valverde, I., Gaalema, D.E., Priest, J.S., Higgins, S.T., 2017. E-cigarette awareness, perceived harmfulness, and ever use among U.S. adults. *Prev. Med.* 104, 92–99.
- Ramo, D.E., Delucchi, K.L., Hall, S.M., Liu, H., Prochaska, J.J., 2013. Marijuana and tobacco co-use in young adults: patterns and thoughts about use. *J. Stud. Alcohol Drugs* 74, 301–310.
- Ream, G.L., Benoit, E., Johnson, B.D., Dunlap, E., 2008. Smoking tobacco along with marijuana increases symptoms of cannabis dependence. *Drug Alcohol Depend.* 95, 199–208.
- Rolke, H.B., Bakke, P.S., Gallefoss, F., 2009. Relationships between hand-rolled cigarettes and primary lung cancer: a Norwegian experience. *Clin. Respir. J.* 3, 152–160.
- Romer, D., Jamieson, P., 2001. Advertising, smoker imagery, and the diffusion of smoking behavior. In: Slovic, P. (Ed.), *Smoking: Risk, Perception, and Policy*. Sage, Thousand Oaks, CA, pp. 127–155.
- Santa Maria, D.M., Narendorf, S.C., Cross, M.B., 2018. Prevalence and correlates of substance use in homeless youth and young adults. *J. Addict. Nurs.* 29, 23–31.
- Shadel, W.G., Tucker, J.S., Abbott, M.M., 2019. Knowledge of alternative tobacco products in unaccompanied homeless youth. *Tob. Regul. Sci.* 5, 65–75.
- Shadel, W.G., Tucker, J.S., Mullins, L., Staplefoote, L., 2014. Providing smoking cessation programs to homeless youth: the perspective of service providers. *J. Subst. Abuse Treat.* 47, 251–257.
- Shahab, L., West, R., McNeill, A., 2009. A comparison of exposure to carcinogens among roll-your-own and factory-made cigarette smokers. *Addict. Biol.* 14, 315–320.
- Skinner, C., 1989. Domain means, regression and multivariate analyses. In: Skinner, C., Holt, D., Smith, T. (Eds.), *Analysis of Complex Surveys*. Wiley, New York, pp. 59–88.
- Smith, S.Y., Curbow, B., Stillman, F.A., 2007. Harm perception of nicotine products in college freshmen. *Nicotine Tob. Res.* 9, 977–982.
- Toll, B.A., O'Malley, S.S., McKee, S.A., Salovey, P., Krishnan-Sarin, S., 2007. Confirmatory factor analysis of the Minnesota nicotine withdrawal scale. *Psychol. Addict. Behav.* 21, 216–225.
- Tucker, J.S., Pedersen, E.R., Seelam, R., Dunbar, M.S., Shih, R.A., D'Amico, E.J., 2019. Types of cannabis and tobacco/nicotine co-use and associated outcomes in young adulthood. *Psychol. Addict. Behav.* 33, 401–411.
- Tucker, J.S., Shadel, W.G., Golinelli, D., Ewing, B., Mullins, L., 2015a. Motivation to quit and interest in cessation treatment among homeless youth smokers. *Nicotine Tob. Res.* 17, 990–995.
- Tucker, J.S., Shadel, W.G., Golinelli, D., Mullins, L., Ewing, B., 2015b. Sniping and other high-risk smoking practices among homeless youth. *Drug Alcohol Depend.* 154, 105–110.
- U.S. Department of Health and Human Services, 2014. *The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, Atlanta, GA.
- Wenzel, S.L., Tucker, J.S., Golinelli, D., Green, H.D.Jr., Zhou, A., 2010. Personal network correlates of alcohol, cigarette, and marijuana use among homeless youth. *Drug Alcohol Depend.* 112, 140–149.
- Young, D., Borland, R., Hammond, D., Cummings, K.M., Devlin, E., Yong, H.-H., O'Connor, R.J., for the ITC Collaboration, 2006. Prevalence and attributes of roll-your-own smokers in the International Tobacco Control (ITC) four Country Survey. *Tob. Control* 15 (Suppl. III), iii76–iii82.