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Soda intake and tobacco use among young adult bar patrons: A cross-sectional study in seven cities

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ABSTRACT

Young adults are among the greatest consumers of sugar sweetened beverages, and they also have high smoking rates. However, few studies address the relationship between these risk behaviors; this study examined the relationship between soda consumption and smoking among young adult bar patrons, a high-risk understudied population. A cross-sectional survey of young adult bar patrons (between January 2014 and October 2015) was conducted using randomized time location sampling (N = 8712) in Albuquerque, NM, Los Angeles, CA Nashville, TN, Oklahoma City, OK, San Diego, CA, San Francisco, CA, and Tucson, AZ. The survey found the prevalences of daily regular soda intake ranged from 32% in San Diego to 51% in Oklahoma City and current smoking ranged from 36% in Los Angeles, CA to 49% in Albuquerque, NM. In multinomial multivariate models with no soda consumption as the reference group and controlling for demographics and location, non-daily (OR = 1.24, 95% CI = 1.05, 1.47) and daily smokers (OR = 1.34, 95% CI = 1.08, 1.66) were both more likely to drink regular soda compared to not drinking any soda. No effects were found for diet soda consumption. These linked risks suggest that comprehensive health promotion efforts to decrease sugar sweetened beverage consumption and tobacco use, among other risky behaviors, may be effective in this population.

1. Introduction

To reduce risk for nutrient inadequacy, unhealthy body weight, and chronic disease, the 2015–2020 Dietary Guidelines for Americans recommend a shift to healthier eating patterns that limit daily consumption of added sugars to < 10% of daily calories (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2016). Young adults consume 50–60% more added sugars than these recommendations (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2016). Average daily added sugars intake as a percent of calories in young adult males aged 19 to 30 is 15%, and in young adult females aged 19–30 it is 16% (U.S. Department of Health and Human Services and U.S. Department of Agriculture). Young adults are also among the greatest consumers of sugar-sweetened beverages (SSB) (Dietary Guidelines Advisory Committee, 2015), which account for almost half of all added sugars consumed by the U.S. population (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2016). High SSB intake in young adults is strongly associated with race, education, and economic factors (Han and Powell, 2013; Park et al., 2016a, 2016b), has been shown to vary by geographic location (Park et al., 2016a, 2016b), and to be associated with other high-risk behaviors such as low physical activity (Kristal et al., 2015; Park et al., 2016a, 2016b), smoking (Kristal et al., 2015; Park et al., 2016a, 2016b), and alcohol intake (Park et al., 2016a, 2016b). Soda is the most heavily consumed SSB by young adults (Han and Powell, 2013).

Young adulthood is a period between adolescence and adulthood that includes many transitions during which healthy behaviors may be encouraged or disrupted (Arnett, 2000). Health behavior change programs for young adults have primarily targeted college campuses; however, young adults not attending college display risky behaviors at similar or higher levels than college students (Oesterle, 2013). Bars and nightclubs attract young adults who did not attend or dropped out of college, in addition to college students and college graduates, and interventions in these venues are an efficient way to reach high risk individuals (Fallin et al., 2015). Risky behaviors in young adults often co-occur (Hair et al., 2009). No study, to our knowledge, has examined SSB intake in young adult bar patrons.

Abbreviations: SSB, sugar-sweetened beverage; MCAR, missing completely at random; FIML, full information maximum likelihood; BRFSS, Behavioral Risk Factor Surveillance System

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Smoking is a marker for other unhealthy behavior patterns. For example, among those with illicit substance use disorders, smokers are more likely to choose riskier routes of drug administration (Harrell et al., 2012). Among those with chronic health conditions, those who are smokers are more likely to be non-compliant with medical recommendations (Sherman and Lynch, 2014). In the present study, we compared the association between soda consumption and smoking among young adult bar patrons in seven different regions of the US: Nashville, TN, Oklahoma City, OK, Albuquerque, NM, Tucson, AZ, San Diego, CA, Los Angeles, CA, and San Francisco, CA.

2. Method

2.1. Participants and procedure

Data was analyzed from one wave of the National Party Culture Study, a large study of tobacco use among young adult bar patrons collected between January 2014 and October 2015. Methods have been described elsewhere (Lisha et al., 2016; Thrul et al., 2016), and were originally developed as a way to reach under-studied populations in the locations they frequent (Lee et al., 2014; Ling et al., 2014). In brief, time-location sampling was used to generate a sample of young adults from bars in Albuquerque, Los Angeles, Nashville, Oklahoma City, San Diego, San Francisco, and Tucson. Using a well-established methodology (Magnani et al., 2005; Muhib et al., 2001), venues, dates, and times were randomly selected from a list of bars and clubs frequented by young adults in each city. The research team worked with marketing consultants with expertise in young adult nightlife to identify party promoters, DJs, and other entertainers and opinion leaders in each of the cities to create a census of bars and nightclubs popular among young adults. In addition, focus groups with young adult bar patrons were used to identify additional venues and to validate which venues were popular. The process of generating and validating the list of bars was iterated multiple times until saturation was achieved (no new popular venues were named by respondents beyond those already listed). Venues, dates and times for survey administration were randomly selected from the lists in each city. Eligible participants (present in bar at randomly selected time, age 18–26, and not visibly intoxicated) were approached to fill out a paper survey and receive a $5 incentive (response rate 77%). Staff were mainly young adults (under 30 years old) comfortable working in a bar environment, and all received training on survey methods, human subjects research, and completed supervised field trials for data collection. Lastly, “secret shoppers” were used to monitor adherence to data collection protocols. All study procedures were reviewed and approved by the Committee on Human Research (institutional review board) at the University of California San Francisco.

2.2. Measures

In order to minimize survey respondent burden while allowing for a greater number of questions to be asked, the surveys used a planned missing data three-form design - a set of core questions were asked of all participants, while another set of items was asked only to two-thirds of participants (Graham et al., 2006).

2.3. Demographics

Demographic variables were asked of all participants including age (calculated from date of birth), sex (male vs. female), self-reported sexual orientation (dichotomized into “straight” vs. any other sexual orientation), education (in college, college graduate, college dropout/never attended college), and race/ethnicity Race/ethnicity was determined by 2 questions: “Are you of Hispanic/Latino, or Spanish origin?” and “What is your race?” and responses were combined to create 4 categories (non-Hispanic Black, non-Hispanic White, non-Hispanic Other, Hispanic).

2.4. Tobacco

All participants were asked “During the past 30 days, on how many days did you: Smoke at least one cigarette?” Current smokers were those who reported any cigarette use in the last 30 days. Current smokers were divided into daily (smoked on 30 of the past 30 days) and non-daily smokers (smoked on 1–29 of the past 30 days) (Kalkhoran et al., 2016; Lisha et al., 2016).

2.5. Main outcome: soda variables

Two items, “On average how many cans or bottles of SODA do you drink EACH DAY?” and, “Is most of the soda you drink diet or regular?” were combined to create our 3-level outcome variable indicating whether people were soda drinkers, diet soda drinkers or did not drink any soda. Individuals were considered to be soda drinkers if they indicated that they drank at least one soda per day on average. These items were part of the three-form design and therefore were only asked of two-thirds of the participants.

2.6. Analytical plan

First, descriptive statistics were used to characterize the overall sample, and by soda drinking status. Next, univariate analyses examined differences on all the variables between soda consumption category. This portion of the analysis was completed using SAS (SAS Institute, 2008). Lastly, multinomial logistic regression models were fitted using the 3-level soda consumption category as the outcome variable with “no soda” as the reference category. Independent variables included smoking behavior, sociodemographics, and the city where the data was collected. Analysis was completed using M*plus* (Muthén and Muthén, 2007). Missing data was handled using full information maximum likelihood (FIML), which allows all observations to be used. Due to the three-form planned missing design we can assume the data was missing completely at random (MCAR) (Graham et al., 2006). Data from all the variables in the model is used to create estimates so that no observations are dropped. In this method, missing values are not replaced or imputed, but the missing data is handled within the analysis model. The FIML method has been shown to produce more accurate estimates in model estimations by adjusting for the uncertainty caused by missing data (McArdle and Hamagami, 1992).

3. Results

3.1. Sample characteristics

The current study included 8712 participants. Overall the samples were evenly split between males and females and the mean age was approximately 23 years old (Table 1). Race/ethnicity reflected the population in different cities, with more Hispanics in Albuquerque, Los Angeles, San Diego and Tucson and more Asians in Los Angeles and San Francisco. The sample included a range of educational backgrounds, with 22.9% reporting no college, 42.1% reporting that they were currently in college and 35.0% reporting that they were college graduates. The sample was mainly heterosexual (81.9%), though the number of non-heterosexual participants was much higher than the 6.4% national prevalence of 18 to 29-year-olds identifying as LGBT (Gates and Newport, 2012). Overall, approximately 57% of the participants reported daily soda intake; rates of daily diet soda intake ranged between 9% in San Diego to 23% in Oklahoma City and regular soda intake, between 32% in San Diego to 51% in Oklahoma City. Rates of current (past 30 day) smoking ranged from 36% in Los Angeles to 49% in Albuquerque. Among smokers, 30% were daily smokers, ranging from 24% in San Diego to 44% in Oklahoma City.

Table 1
Smoking status, sociodemographics and location for overall sample and soda group. Data was collected between 2014 and 2015 in in Albuquerque, NM, Los Angeles, CA Nashville, TN, Oklahoma City, OK, San Diego, CA, San Francisco, CA, and Tucson, AZ.

	Overall (N = 8212)	Diet (N = 630, 16.1%)	Regular (N = 1590, 43.4%)	No soda (N = 1706, 43.5%)
Smoking status[a,b]				
Non-daily (N, %)	2217 (28.5%)	183 (30.1%)	442 (29.3%)	417 (25.9%)
Daily (N, %)	963 (12.4%)	74 (12.1%)	239 (15.8%)	166 (10.3%)
Non-smoker (N, %)	4602 (59.1%)	352 (57.8%)	829 (54.9%)	1029 (63.8%)
Sociodemographics				
Age (M, SD)	23.88 (1.8)	23.88 (1.8)	23.67 (1.9)	23.85 (1.8)
Females (N, %)[b,c]	3883 (47.7%)	337 (54.1%)	602 (38.0%)	883 (52.1%)
Straight sexual orientation (N, %)[a,b,c]	6614(81.9%)	471 (75.9%)	1253 (80.6%)	1411 (84.3%)
Education[a,b]				
Graduated from college (N, %)	2844 (35.0%)	239 (38.5%)	415 (26.5%)	662 (39.2%)
In college (N, %)	3418 (42.1%)	234 (37.7%)	668 (42.7%)	708 (41.9%)
Drop out of college/HS/GED (N, %)	1858 (22.9%)	148 (23.8%)	482 (30.8%)	318 (18.8%)
Race/ethnicity				
Black (N, %)	582 (7.2%)	38 (6.1%)	151 (9.6%)	107 (6.4%)
API (N, %)	685 (8.5%)	50 (8.0%)	122 (7.8%)	145 (8.6%)
Other (N, %)	840 (10.4%)	69 (11.1%)	162 (10.4%)	170 (10.1%)
Hispanic (N, %)	2592 (32.2%)	202 (32.5%)	523 (33.4%)	543 (32.3%)
White (N, %)	3352 (41.6%)	263 (42.3%)	607 (38.8%)	714 (42.5%)
Location[b,c]				
Albuquerque	1171 (14.3%)	54 (8.6%)	230 (14.5%)	297 (17.4%)
Los Angeles	1163 (14.2%0	97 (15.4%)	217 (13.6%)	257 (15.1%)
Nashville	1135 (13.8%)	103 (16.4%)	284 (17.9%)	195 (11.4%)
Oklahoma City	1263 (15.4%)	144 (22.9%)	316 (19.9%)	163 (9.6%)
San Diego	1223 (14.9%)	53 (8.4%)	188 (11.8%)	343 (20.1%)
San Francisco	1107 (13.5%)	98 (15.6%)	178 (11.2%)	219 (12.8%)
Tucson	1150 (14.0%)	81 (12.9%)	177 (1.1%)	232 (13.6%)

Note: Pairwise comparisons were done between soda categories using Bonferroni adjustment at $p < .05$.
[a] Difference between diet and no soda groups.
[b] Difference between regular and no soda groups.
[c] Difference between regular and diet groups.

3.2. Univariate comparisons by pattern of soda consumption

Univariate analyses determined that soda drinking behavior was related to smoking behavior, sociodemographics, and location ($p < .05$). Those who did not drink soda had the highest proportion of non-smokers compared to diet drinkers and regular soda drinkers. Among young adult bar patrons that were regular soda drinkers (data not shown in tables), current smoking rate was 37.4% in San Francisco, Los Angeles 38.7%, Tucson, 39.3%, Nashville 43.5%, San Diego, 48%, Albuquerque 49.3%, and Oklahoma City, 53.6%. Diet soda drinkers and non-soda drinkers had a higher proportion of females than regular soda drinkers. Differences in educational status were found between diet or regular soda drinkers compared to non-soda drinkers. No differences in soda consumption were found between groups by race/ethnicity or by sexual orientation. Differences were also found based on location (Table 1).

3.3. Multinomial logistic regression analysis

It was found that both being non-daily (OR = 1.32, 95% CI = 1.12, 1.55) and daily (OR = 1.60, 95% CI = 1.32, 1.94) smokers compared to non-smokers were associated with increased odds of drinking regular soda compared to not drinking any soda.

In a second multivariate adjusted model, all the sociodemographic and location variables were added as independent variables, still using "did not drink soda" as the referent (Table 2). The relationship with smoking remained significant: non-daily (OR = 1.24, 95% CI = 1.05, 1.47) and daily smokers (OR = 1.34, 95% CI = 1.08, 1.66) compared to non-smokers were more likely to drink regular soda. Males compared to females were less likely to drink diet soda (OR = 0.73, 95% CI = 0.61, 0.86) but more likely to drink regular soda (OR = 1.82, 95% CI = 1.58, 2.06) compared to not drinking any soda. Those who graduated from college (OR = 0.53, 95% CI = 0.44, 0.64) or were in college (OR = 0.78, 95% CI = 0.66, 0.93) versus those who dropped out of college or who did not have a college education were less likely to drink regular soda compared to no soda. Significant differences by location were seen in the adjusted model: compared to respondents in San Diego (the referent), those in Los Angeles, Nashville, and Oklahoma City were all more likely to drink both diet and regular soda compared to no soda. Respondents in San Francisco and Tucson were more likely to drink diet soda compared to no soda, but no difference was found for regular soda consumption.

4. Discussion

Young adult bar patrons who smoke were significantly more likely to drink regular soda than nonsmokers. Overall, compared to non-smokers, both non-daily and daily smokers were 1.24 to 1.34 times more likely to consume regular soda than no soda. These findings are consistent with previous findings demonstrating that adults consuming > 1 SSB daily were more likely to be current smokers versus never smoking (Kristal et al., 2015). Clustering of smoking and other high-risk behaviors has been recognized among both adolescents and young adults, and may reflect an overall higher propensity for risk taking (Colby et al., 2017; Hair et al., 2009; Jessor, 1991). However, young adults have also been observed to "trade-off" unhealthy alcohol or dietary intake patterns by increasing exercise (Giles and Brennan, 2014), which could be examined in future studies of young adult bar patrons.

Young adult smokers may be particularly vulnerable to risks associated with high SSB intake. Higher SSB consumption among smokers might be because both tobacco (Ling and Glantz, 2002) and sugar-sweetened beverage industry marketing (Dietary Guidelines Advisory Committee, 2015) heavily target young adults. Other studies suggest that smokers have altered taste perceptions, reflected as a decreased sensitivity to sweeteners leading to overconsumption (Pepino and

Table 2
Multivariate regression results for soda drinking (ref group = do not drink soda). Data was collected between 2014 and 2015 in in Albuquerque, NM, Los Angeles, CA Nashville, TN, Oklahoma City, OK, San Diego, CA, San Francisco, CA, and Tucson, AZ.

	Model 1: No covariates		Model 2: Sociodemographic covariates	
	Diet	Regular	Diet	Regular
Smoking status				
Non-daily	1.15 (0.93, 1.42)	**1.32 (1.12, 1.55)**	1.17 (0.94, 1.46)	**1.24 (1.05, 1.47)**
Daily	0.97 (0.74, 1.27)	**1.60 (1.32, 1.94)**	0.93 (0.70, 1.25)	**1.34 (1.08, 1.66)**
Non-smoker	Ref	Ref	Ref	Ref
Sociodemographics				
Age			1.03 (0.98, 1.09)	0.97 (0.94, 1.01)
Males (ref = females)			**0.73 (0.61, 0.86)**	**1.82 (1.59, 2.01)**
Straight (ref = not straight)			**0.70 (0.56, 0.86)**	0.97 (0.78, 1.17)
Education				
Graduated from college			1.24 (0.97, 1.59)	**0.53 (0.44, 0.64)**
In college			0.99 (0.78, 1.26)	**0.78 (0.66, 0.93)**
Drop out of college/HS/GED			Ref	Ref
Race/ethnicity				
Black			**0.67 (0.45, 0.98)**	**1.35 (1.04, 1.76)**
API			0.92 (0.65, 1.29)	1.21 (0.94, 1.57)
Other			1.00 (0.74, 1.36)	1.09 (0.86, 1.37)
Hispanic			1.10 (0.90, 1.37)	**1.22 (1.03, 1.43)**
White			Ref	Ref
Location				
Albuquerque			1.10 (0.73, 1.64)	1.21 (0.87, 1.54)
Los Angeles			**2.10 (1.47, 3.01)**	**1.33 (1.04, 1.71)**
Nashville			**2.41 (1.68, 3.47)**	**2.05 (1.60, 2.63)**
Oklahoma City			**3.33 (2.36, 4.69)**	**1.95 (1.53, 2.49)**
San Diego			Ref	Ref
San Francisco			**2.50 (1.74, 3.59)**	1.24 (0.96, 1.61)
Tucson			**2.29 (1.58, 3.33)**	1.07 (0.82, 1.39)

Bold face indicates significant differences with the referent group, $p < .05$.

Mennella, 2007; Sato et al., 2002). Additional risks may be that addictions and addictive-like behaviors related to smoking and added sugars have a common biological basis (Mahler and de Wit, 2010; Thorgeirsson et al., 2013), and that both smoking (US Department of Health and Human Services, 2014), and frequent SSB consumption contribute to increased cardiovascular disease risk (Malik et al., 2010).

Soda intake among young adult bar patrons was similar to rates found in national studies. Forty percent of the young adults surveyed reported drinking at least one regular soda per day on average. Overall, in the seven study sites, young adult bar patrons aged 18–26 reported a daily regular soda intake of 40.5%, which was higher than the adult daily SSB intake rate of 30.1% and roughly equivalent to the overall young adult SSB consumption among 18–24 year olds (43.3%) and 25–34 year olds (38.2%) reported by the 2013 Behavior Risk Factor Surveillance System (BRFSS), survey which included questions on SSB consumption in 23 states (Park et al., 2016a, 2016b). Because the young adult bar patron survey measured only regular soda intake compared to the BRFSS data which defined SSBs as regular soda, sugar-sweetened fruit drink, sweet tea, and sports or energy drinks, it is likely that soda consumption reported by young adult bar patrons in this study is an underestimate of SSB consumption. These findings suggest that young adults attending bars and nightclubs may be at slightly higher risk for daily regular soda intake than the young adult population overall.

Frequency of both regular and diet soda intake among young adult bar patrons displayed parallel patterns seen in other studies. Similar to the 2013 BRFSS data (Park et al., 2016a, 2016b), daily intake of at least one regular soda in young adult bar patrons was most frequently reported among men, Blacks and persons with less than a college education. In addition, regular soda intake frequency among young adult bar patrons was higher in southern locations, consistent with data from the National Health Interview Study (Park et al., 2015) and BRFSS (Kumar et al., 2014), which showed that SSB intake was higher in southern states. Higher SSB consumption in southern states has been attributed to varying factors including beverage retail environments (Martin-Biggers et al., 2013), cultural norms (McCabe-Sellers et al., 2007), and advertising (Hillier et al., 2009). Young adult bar patrons reported a diet soda intake rate similar to that reported by adults aged 20 years and older reported in the National Health and Nutrition Examination Survey, 1999–2010: 16.1% and 15%, respectively (Bleich et al., 2014).

There are promising interventions for young adult bar patrons to address smoking using commercial marketing tactics that directly counter tobacco industry promotional strategies (Fallin et al., 2015; Ling et al., 2014). These interventions also found significant decreases in binge drinking, suggesting that the links between health-related risk behaviors might facilitate translation of anti-tobacco bar interventions to address SSB consumption in this high risk population. A combined approach to in bar interventions is further supported by emerging evidence demonstrating that integrated prevention programs are feasible and effective and may be more efficient than discrete prevention strategies (Hale et al., 2014). There is increasing recognition that tobacco cessation enhances rather than undermines treatment for substance abuse, suggesting that interventions may successfully address these two risk behaviors (Prochaska, 2010). However, we are not aware of smoking cessation interventions that attempt to address both tobacco and SSB consumption. Tobacco and SSB use are both heavily promoted in retail environments, and healthy retail initiatives have potential to affect consumption of both products, a strategy that is being explored in San Francisco (San Francisco Tobacco Free Project website, 2016). This study suggests that healthy retail initiatives in locations with close proximity to bars and nightclubs might be a promising strategy to reach high risk young adults.

5. Limitations

Findings are cross-sectional and do not provide evidence for changes in soda consumption among young adults over time. We cannot determine whether the independent variables explored in this study

cause soda consumption, and findings reported here are subject to reverse causality. This study of bar patrons could not feasibly include an extensive assessment of a wide array of risk behaviors; future studies should address this context. In addition, the conclusions of this study may not generalize to geographic locations beyond the seven cities represented here, to other age groups (e.g. youth, older adults with more established smoking patterns), or to young adults who do not frequent bars. Because highly intoxicated individuals could not provide informed consent and participate in the study, our results do not include this very high risk subgroup and thus may underestimate the frequency of risk behavior. Finally, the category of "Non-Daily Smoker" could range from 1 to 29 days per month so it has a lot of variability. The fact that effects were found in both Daily and Non-Daily smokers indicates that the results are robust.

6. Conclusion

This study contributes to an emerging body of literature focused on the high SSB intake rates among young adults. This innovative survey of hard-to-reach and under-studied young adult bar patrons found that young adults attending bars and nightclubs are at high risk for regular soda intake and smoking, and that current smokers are more likely to drink at least one regular soda per day than non-smokers. These findings suggest there is potential to combine SSB cessation interventions with tobacco control programs for young adult bar patrons.

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