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Subgroup trends in alcohol and cannabis co-use and related harms during the rollout of recreational cannabis legalization in Washington state

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Abstract

Background: The US state of Washington legalized recreational cannabis in 2012; how this impacted the co-use of cannabis and alcohol in the population overall and among key subgroups has not been examined. The aim of this study is to investigate changes in patterns of alcohol- and cannabis use and alcohol-related harms during the rollout of retail recreational cannabis stores.

Methods: Data come from six cross-sectional samples recruited between January 2014-October 2016 via Random Digit Dial procedures (N = 5,492). Survey-weighted multivariable regression adjusting for gender, age, race/ethnicity, education, employment, marital status, cannabis use, and survey year were used for statistical analyses.

Results: In the sample overall, no significant changes were observed in any alcohol use measures between 2014-2016, while the prevalence of cannabis use significantly ($P < 0.05$) increased from 25.0% to 31.7%, the prevalence of alcohol-related harms at home significantly decreased from 2.1% to 1.0%, and the prevalence of alcohol-related financial harms decreased from 1.5% to 0.8%. Both women and men significantly increased any cannabis use, while women also experienced significantly fewer alcohol-related harms at home and financial harms over time, and increases in the prevalence of cannabis users/non-drinkers. Those 18-29 years old significantly reduced the number of drinking days and overall volume in the past 30 days, and those 30-49 years old significantly decreased alcohol-related harms at home and financial harms. Those 50+ years old significantly increased any cannabis use and simultaneous use of cannabis and alcohol. Non-cannabis users slightly decreased average number of drinks/day, and cannabis users significantly decreased alcohol-related financial harms.

Conclusions: Between 2014-2016, the years during and immediately following the introduction of legal recreational cannabis stores in Washington state, there were no significant changes in cannabis and alcohol co-use or overall alcohol consumption. The only significant changes in the

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sample overall were an increase in any cannabis use and decreases in alcohol-related harms at home and alcohol-related financial harms.

Keywords

Cannabis; marijuana; alcohol; co-use; trends; cannabis legalization; Washington

INTRODUCTION

In November 2012, Washington voters passed Initiative 502 (I-502), eliminating crimes for licensed cannabis production, distribution, sales, and adult (21+) possession of limited amounts of cannabis. I-502 also imposed a 25% excise tax on wholesale and retail cannabis sales, amended existing laws prohibiting driving under the influence (DUI), and introduced new prohibitions on public cannabis consumption and cannabis consumption in a vehicle. Although legalized possession and amended DUI limits went into effect on December 9, 2012, licensed retail stores did not open until July 2014 (Washington State Liquor and Cannabis Board, 2017).

Washington and Colorado were the first US states to legalize recreational cannabis, and few studies have examined trends in cannabis use in the post-legalization period within each state. Results from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) show that the US national prevalence of past year cannabis use among those 12 years and older more than doubled from 4.1% in 2001-2002 to 9.5% in 2012-2013 (Hasin et al., 2015). Similarly, the National Survey on Drug Use and Health (NSDUH) shows a 35% relative increase in past-year cannabis use between 2008 and 2014, with the biggest increase among those 26 years and older (Azofeifa et al., 2016). Subgroups analyses of the NSDUH also show that the prevalence of cannabis use increased by 4% for men and 2.7% women from 2002 to 2014, with all of the increase occurring between 2007-2014 (Carliner et al., 2017). However, a study comparing retrospective to prospective measures of cannabis use in Washington found that retrospective pre-legalization measures showed a smaller increase in prevalence compared to larger changes found using prospective measures in the NSDUH, perhaps due to increased social acceptability (Kerr, Ye, Subbaraman, Williams, & Greenfield, 2018). Similarly, a study of the 1984-2015 National Alcohol Surveys (NAS) using age-period-cohort models concluded that the increase in cannabis use since 2005 occurred across the whole population and is attributable to general period effects not linked specifically to liberalized cannabis legislation (Kerr, Lui, & Ye, 2018).

Related to the increase in cannabis use in the post-legalization period is the question of how trends in the co-use of cannabis and alcohol might change. Literature reviews of cannabis and alcohol substitution and complementarity, which do not include studies of cannabis legalization due to its relative recency, conclude that the relationship between cannabis and alcohol use is complex, and that more lenient cannabis policies are linked to both less (substitution) and more (complementarity) alcohol use (Guttmannova et al., 2016; Meenakshi Sabina Subbaraman, 2016). For example, states that decriminalized cannabis use and/or introduced medical marijuana laws saw declines in alcohol use and related traffic fatalities among young adults in some studies (Anderson, Hansen, & Rees, 2013; Chaloupka

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& Laixuthai, 1997; Thies & Register, 1993), but increases in the frequency of drinking in other studies (Simons-Morton, Pickett, Boyce, ter Bogt, & Vollebergh, 2010; Williams & Mahmoudi, 2004). Furthermore, general population studies show that the effects of liberalized cannabis laws can vary across race/ethnicities (Saffer & Chaloupka, 1999; Meenakshi Sabina Subbaraman, 2016; Wen, Hockenberry, & Cummings, 2014; Williams, Pacula, Chaloupka, & Wechsler, 2004), e.g., state-level cannabis decriminalization was shown to increase alcohol use among African Americans and White males, but decrease alcohol use among Native Americans and Hispanics (Saffer & Chaloupka, 1999).

From a public health standpoint, prior work has shown that among those who co-use cannabis and alcohol, most use the substances simultaneously such that their effects overlap (Meenakshi S. Subbaraman & Kerr, 2015). Furthermore, simultaneous use carries higher risks of social consequences and alcohol-related harms than the use of either substance alone (Midanik, Tam, & Weisner, 2007; Meenakshi S. Subbaraman & Kerr, 2015). Direct comparisons between co-user subgroups also show that those who use cannabis and alcohol simultaneously have more drinks/day, more 5+ drink occasions, higher maximum drinks in an occasion, and are more likely to drive drunk than those who use the substances separately (Meenakshi S. Subbaraman & Kerr, 2015, 2018). Thus, we would expect that any changes in the prevalence of simultaneous cannabis and alcohol co-use in the general population would be accompanied by changes in the prevalence of alcohol-related harms.

Current study

The aim of this study is to investigate changes in patterns of alcohol- and cannabis use and alcohol-related harms during the rollout of retail recreational cannabis stores. Here we examine trends in cannabis and alcohol use and co-use, as well as alcohol-related harms in the Washington state general population and among subgroups defined by gender, age, and cannabis use status. Importantly, our dataset spans 2014-2016 and includes surveys from both pre- and post-opening of retail recreational cannabis stores, allowing us to assess differences between these periods.

METHODS

Data sources

Data were collected in six separate cross-sectional samples across six time-points (every six months) between January 2014 and October 2016. Participants, who were all Washington residents aged 18+ at the time of data collection, were recruited via list-assisted dual-frame Random Digit Dial procedures, with > 40% from cell phones (N = 5,492). The American Association for Public Opinion Research (AAPOR2) cooperation rates were 50.8% (landline) and 59.5% (cell phone) for T1 (N = 1,202); 45.8% (landline) and 62.4% (cell) for T2 (N = 804); 43.7% (landline) and 61.5% (cell) for T3 (N = 823); 41.7% (landline) and 59.6% (cell) for T4 (N = 662); 49.4% (landline) and 60.9% (cell) for T5 (N = 610); and 45.3% (landline) and 63.0% (cell) for T6 (N = 1,391); AAPOR has detailed formulas for cooperation rates that can be found on their website (The American Association for Public Opinion Research, 2000). Previous analyses have shown that the sample is geographically representative of Washington state (Meenakshi S. Subbaraman & Kerr, 2017). The Public

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Health Institute's Institutional Review Board approved this study, and informed consent was obtained from all participants.

Participants were considered current cannabis users if they reported any cannabis use in the past 12 months and current drinkers if they reported any drinking in the past 12 months. Co-use of alcohol and cannabis was assessed among current cannabis and alcohol users using the question, "In the past year, how often did you use alcohol and marijuana or marijuana products at the same time? Was it usually, sometimes, or never?" As done in our previous studies, those who answered "never" were classified as concurrent cannabis/alcohol co-users, while those who answered "usually" or "sometimes" were classified as simultaneous cannabis/alcohol co-users. The other three categories were non-cannabis user/non-drinker, non-cannabis user/drinker, and cannabis user/non-drinker, making five groups. Those who did not answer the questions on current cannabis and alcohol use or co-use were excluded (~1% of total sample). This question and method of categorization have been used before in both national and Washington state-specific studies (Karriker-Jaffe, Subbaraman, Greenfield, & Kerr, 2018; Meenakshi S. Subbaraman & Kerr, 2015, 2018).

The number of drinking days in the past 30 days was measured with the question, "Still considering all types of alcoholic beverages, on how many days during the past month, that is the past 30 days, did you have at least one drink of any alcoholic beverage?" The number of drinks/drinking day was measured with the question, "On the days that you drank in the past 30 days, how many drinks did you drink on average?" Overall alcohol volume was calculated by multiplying the number of drinking days by the number of drinks/drinking day. Frequency of 5+ drinks was measured with the question, "Considering all types of alcoholic beverages, on how many days during the past month, that is the past 30 days, did you have 5 or more drinks on an occasion?" Experiences of four different kinds of alcohol-related harms related to 1) home, 2) health, 3) financial position, and 4) work were assessed with the questions, "Was there a time in the past 12 months when you felt your drinking had a harmful effect on your {1) home life; 2) health; 3) financial position; 4) work}?" These questions have also been used in previous studies using the National Alcohol Survey (Greenfield et al., 2009).

Statistical analyses

First, we performed bivariate analyses to obtain the yearly prevalence (dichotomous) and mean (count and continuous) for all outcomes, both for the sample overall and within subgroups defined by gender, age, and cannabis use (yes/no). Because there are seasonal differences in drinking (Goel & Saunoris, 2017), surveys were combined within years for a total of three time-points, 2014, 2015, and 2016. We then used multivariable logistic (dichotomous outcomes: current drinking, harms), negative binomial (count outcomes: number of drinking days, drinks/drinking day, volume, frequency 5+), and multinomial (categorical outcome: co-use of alcohol and cannabis) regression controlling for year to test for trends while adjusting for covariates. Consistent with previous analyses of co-use in this sample (Subbaraman & Kerr, 2018), covariates were gender, age, race/ethnicity, education, employment, marital status, and cannabis use. We report *P*-values from multivariable models. All analyses adjusted for probability of selection due to the sampling design through

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survey weights, and were performed in Stata V.15.1, StataCorp, College Station, TX, USA. Sampling weights account for differential probability of response between landline and cell phone samples, and incorporated post-stratification weights for age, gender, race/ethnicity and educational attainment based on the Washington 2010 Census.

RESULTS

Sample overall

Table 1 describes sample characteristics by survey year. Table 2 shows trends for the sample overall. The prevalence of any cannabis use significantly increased from 25.0% in 2014 to 31.7% in 2016 ($P < 0.003$), the prevalence of alcohol-related harms at home significantly decreased from 2.1% in 2014 to 1.0% in 2016 ($P < 0.013$), and the prevalence of alcohol-related financial harms significantly decreased from 1.5% in 2014 to 0.8% in 2016 ($P < 0.029$). All of these changes were significant in bivariate tests and remained significant in multivariable regression after adjustment for covariates. No significant changes were seen in any alcohol use or cannabis and alcohol co-use measures.

Gender subgroups

Table 3 displays trends among women and men. As in the sample overall, the prevalence of cannabis use significantly increased by approximately six percentage points or more for both genders. Women experienced a significant increase in the prevalence of cannabis users/non-drinkers specifically, which rose significantly from 2.9% to 4.8% ($P < 0.048$). Women also appeared to have significant decreases in alcohol-related harms at home and financial harms. Men slightly decreased the number of drinks/drinking day from 2.5 to 2.2, and had no other significant changes in drinking or alcohol-related problems over time. All of these changes remained significant after adjusting for other covariates.

Age subgroups

Table 4 displays trends within age subgroups. The youngest subgroup, 18-29 years old, significantly decreased the number of drinking days from 7.9 to 6.3 ($P < 0.038$) and average volume from 24.1 to 14.1 drinks ($P < 0.006$) in the past 30 days. The middle age subgroup, 30-49 years old, had significantly fewer alcohol-related harms at home and financial harms over time. Last, the oldest age subgroup, 50+ years old, had significant increases in the prevalence of any cannabis use and the prevalence of simultaneous use of cannabis and alcohol specifically. Again, all of these trends were significant in bivariate tests and remained significant in multivariable regression after adjustment for covariates.

Cannabis user subgroups

Finally, Table 5 shows trends within cannabis user subgroups. Among individuals who did not use cannabis in the past 12 months, only the number of drinks/drinking day significantly changed over time; while significant, the change appears small, going from 1.9 drinks/drinking day in 2014 to 1.8 drinks/drinking day in 2016. Among those who had used cannabis in the past 12 months, there were no significant changes in co-use or drinking over time, though the prevalence of alcohol-related financial harms significantly decreased from 3.7% in 2014 to 1.2% in 2016 ($P < 0.007$).

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DISCUSSION

Summary

Here we found that between 2014-2016, the years during and immediately following the introduction of legal recreational cannabis stores in Washington state, there were no significant changes in cannabis and alcohol co-use or overall alcohol consumption. The only significant changes in the sample overall were an increase in any cannabis use and decreases in alcohol-related harms at home and financial harms. The reductions in alcohol-related harms are notable, and are in line with studies that have found cannabis decriminalization policies related to decreases in harms such as alcohol-related accidents and hospital admissions (Anderson et al., 2013; Anderson & Rees, 2011; Kelly & Rasul, 2014). Furthermore, alcohol-related harms at home and alcohol-related financial harms both went down by about half (i.e., from 2.1% to 1.0% and 1.5% to 0.8%, respectively). If we extrapolate these general population estimates to the entire state (which had population size ~7 million in 2015), this means that ~77,000 fewer residents experienced alcohol-related problems at home and ~49,000 fewer people experienced alcohol-related financial harms between 2014-2016. However, the mechanisms of these reductions are unclear, as there were no concomitant reductions in alcohol use and an increase in overall cannabis use. One plausible explanation is that individuals might be shifting their attribution of harms from alcohol to cannabis, though we did not ask about harms related to cannabis use and are unable to examine this further. Ongoing studies are collecting data on cannabis-related harms.

While the prevalence of any cannabis use significantly increased, the types of cannabis users (e.g., cannabis user/non-drinker, uses simultaneously with alcohol) did not change proportionately in the sample overall or within most subgroups. This suggests that other states or regions considering cannabis legalization might expect to see increases in all types of cannabis users. A growing body of literature is developing cannabis use typologies to identify distinct groups of users and assess differential risks for use in prevention and intervention approaches. Distinguishing factors include, for example, age of onset, frequency of use, medical vs. recreational use, and co-use with alcohol, all of which are related to varying levels of risk (Fischer et al., 2010; Korf, Benschop, & Wouters, 2007; Meenakshi S. Subbaraman & Kerr, 2018). As the literature continues to expand, identifying additional dimensions for cannabis and alcohol co-use typologies and agreeing on terminology, (e.g., “simultaneous use” refers to using both substances in one occasion and “concurrent” use refers to using both over a period of time but not in the same occasion) will be crucial.

Subgroup results

Both women and men significantly increased any cannabis use, though men increased slightly more, similarly to what was found in the NSDUH (Carliner et al., 2017). The increase found here is not likely due to increases in social acceptability of recreational cannabis use because recreational cannabis was legal for the entire study period. Instead, it is more likely that the increase in cannabis use is due to the increase in the number of legal retail cannabis stores, which rose from zero to 60 in 2014, and was more than 250 by the end

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of 2016. Women experienced significantly fewer alcohol-related harms at home and financial harms over time, as well as increases in the prevalence of cannabis users/non-drinkers, while men experienced neither of these. The magnitude of the reduction in the prevalence of harms among women was large, with both the prevalence of harms at home and financial harms falling by more than three-quarters. Although there were no reductions in average quantity or frequency of drinking among women, it could be that some women have shifted into cannabis user/non-drinker status, and are therefore experiencing fewer alcohol-related harms.

Differences were also seen across age subgroups, with the youngest reporting reductions in drinking quantity and frequency, the middle reporting fewer alcohol-related harms, and the oldest reporting increased prevalence of cannabis use and simultaneous use of cannabis and alcohol. The reductions in drinking frequency and volume in the youngest, 18-29 year old age group are in line with prior studies showing reductions in total consumption among young adults in states with medical marijuana laws (Anderson et al., 2013; Pacula, Powell, Heaton, & Sevigny, 2013). Furthermore, the reduction in past 30 day volume was quite drastic among the youngest subgroup (i.e., from 24.1 to 14.1 drinks), which is consistent with both US and international studies showing reductions in drinking among younger cohorts (Jang, Patrick, Keyes, Hamilton, & Schulenberg, 2017; Ng Fat, Shelton, & Cable, 2018). Although we did not examine substance substitution here, a literature review of cannabis and alcohol substitution and complementarity concluded that younger adults might use less alcohol in environments with more liberal cannabis policies (Meenakshi Sabina Subbaraman, 2016). For example, two large studies using Monitoring the Future data found that frequency of heavy alcohol use and heavy drinking went down among youth and young adults in states that decriminalized cannabis use (Chaloupka & Laixuthai, 1997; DiNardo & Lemieux, 2001). On the other hand, a study comparing international drug policies found that alcohol use was higher among young adults in countries with less restrictive cannabis policies (Simons-Morton et al., 2010). Ongoing studies are collecting detailed co-use data to better understand substitution/complementarity in this group.

The observed increase in cannabis use among older adults is not surprising given recent findings from an epidemiologic literature review which concluded that adults 50 years or older have increased cannabis use the most of any age group since 2000, with those 65 years or older having the greatest increase among the older adult population (Lloyd & Striley, 2018 29451). The increased prevalence of simultaneous cannabis and alcohol use among those 50+ is particularly important to note as our prior work has shown that simultaneous use is related to more alcohol consumption and alcohol-related problems than both alcohol-only or concurrent use of cannabis and alcohol (Meenakshi S. Subbaraman & Kerr, 2015). Although there were no changes in alcohol-related harms for the oldest group here, future studies should continue monitoring this group closely. Interestingly, cannabis users experienced fewer alcohol-related financial harms over time, although there were again no significant changes in alcohol consumption. This is surprising, as it is unclear what mechanisms could explain the association between increased cannabis use and decreased alcohol-related harms besides reduced drinking. Again, it could be that older adults are shifting their attribution of harms from alcohol to cannabis, which we will assess in future studies.

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Strengths and limitations

The primary strength of this study is the repeated cross-section design that spans periods both pre- and post-opening of the legal recreation cannabis stores; there were zero stores open during our first wave of data collection and more than 250 open by the last wave. The design and timing allows us to examine how changes in cannabis and alcohol co-use and alcohol-related harms over time are correlated with the rollout of legal cannabis stores. We know of no other study or dataset that includes individual-level cannabis and alcohol consumption co-use measures from both before and after stores opened.

Limitations include that Washington state's population may have unique characteristics that limit generalizability to other states and countries. The prevalence of cannabis and alcohol use in Washington are among the highest in the country (Center for Behavioral Health Statistics and Quality, 2017), though similar to states that have recently legalized or are considering legalizing cannabis, e.g., New Mexico and the New England states. Other potential limitations are that responses may be affected by reporting biases, such as the social acceptability of cannabis use, alcohol use and/or alcohol-related problems, or by changes in the characteristics of non-response. Data regarding non-responders are not available, and it is possible that clinically important subpopulations are under-represented (e.g., those with severe alcohol problems and/or alcohol use disorder). Finally, our surveys did not include measures of cannabis-related harms, which should be a priority area for future studies.

Conclusion

Washington has paved the way for several US states' legalization of recreational cannabis, though cannabis legalization still carries questions regarding changes in substance use and problems over time. Key issues include whether drinking, co-use of cannabis and alcohol, and alcohol-related harms will increase. Here we find that in the immediate post-legalization period, there was a significant increase in the prevalence of cannabis use, no significant changes in overall alcohol consumption, and a significant decrease in alcohol-related harms at home. These findings have immediate public health and policy relevance given concerns regarding spillover effects of recreational cannabis legalization.

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Table 1.

Sample demographics from Washington surveys by year

	2014		2015		2016	
Fielding Period	**January 2014 - October 2014**		**March 2015 - November 2015**		**March 2016 - December 2016**	
Sample Size	**2006**		**1,485**		**2,001**	
Sex	*Weighted %*	*n*	*Weighted %*	*n*	*Weighted %*	*n*
Male	49.53%	(1,095)	49.60%	(644)	49.59%	(870)
Female	50.47%	(911)	50.40%	(841)	50.41%	(1,131)
Age						
18-29	22.67%	(295)	21.74%	(166)	21.89%	(218)
30-49	33.98%	(530)	34.23%	(377)	33.95%	(470)
50+	43.4%	(1,128)	44.02%	(891)	44.16%	(1,272)
Race/Ethnicity						
White	75.08%	(1,694)	74.98%	(1,273)	73.49%	(1,687)
Black	4.63%	(58)	4.07%	(39)	4.19%	(54)
Hispanic	9.39%	(89)	9.59%	(62)	9.80%	(81)
Other	10.89%	(165)	11.36%	(111)	12.52%	(179)
Education						
≤ High School	35.05%	(502)	33.89%	(350)	34.57%	(407)
≥ Some College	64.95%	(1,494)	66.11%	(1,127)	65.43%	(1,592)
Employment						
Retired/not working	39.29%	(874)	40.66%	(677)	40.79%	(969)
Full- or part-time	60.71%	(1,110)	59.34%	(783)	59.21%	(1,006)
Marital Status						
Not Married	42.16%	(858)	44.07%	(655)	44.38%	(834)
Married/cohabitating	57.84%	(1,138)	55.93%	(820)	55.62%	(1,162)
Drinking Status						
5+ Drinker	10.05%	(144)	8.37%	(88)	9.38%	(124)
Drinker (no 5+)	57.09%	(1,172)	60.78%	(893)	58.96%	(1,198)
Non-Drinker	32.85%	(615)	30.85%	(443)	31.79%	(611)
Marijuana User						
User	25.04%	(381)	26.21%	(317)	31.71%	(479)
Non-User	74.96%	(1,617)	73.79%	(1,158)	68.29%	(1,517)
Cooperation rate						
Cell phone	60.95%		60.55%		61.95%	
Landline	43.3%		42.7%		47.35%	

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Table 2.

Prevalence and trends in overall co-use, drinking, and alcohol-related harms in Washington state, 2014-2016

	SAMPLE OVERALL (N = 5,492)			
	2014	**2015**	**2016**	**Trend *P****
Any cannabis use, past 12 months (%)	**25.0**	**26.2**	**31.7**	**0.003**
Non-cannabis user/non-drinker (%)	27.6	25.2	25.1	(ref)
Non-cannabis user/drinker (%)	47.5	48.7	43.4	ns
Cannabis user/non-drinker (%)	3.7	3.9	5.3	ns
Concurrent cannabis/alcohol user (%)	8.9	9.1	10.6	ns
Simultaneous cannabis/alcohol user (%)	12.2	13.1	15.7	ns
Current drinker (%)	68.9	71.0	70.0	ns
Average # drinking days, past 30 days	8.6 (0.3)	8.7 (0.4)	8.7 (7.9)	ns
Average # drinks/drinking day, past 30 days	2.2 (0.1)	2.1 (0.1)	2.0 (0.1)	ns
Average volume, past 30 days	21.6 (2.1)	21.0 (2.5)	20.5 (1.6)	ns
Frequency 5+, past 30 days	0.9 (0.2)	0.8 (0.1)	0.9 (0.1)	ns
Alcohol-related harms at home, past 12 months (%)	**2.1**	**2.8**	**1.0**	**0.013**
Health harms (%)	3.5	5.5	4.9	ns
Work harms (%)	0.7	1.4	0.6	ns
Financial harms (%)	**1.5**	**2.1**	**0.8**	**0.029**

* From multivariable regression models adjusting for age, gender, race/ethnicity, education, employment, marital status, and cannabis use

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Table 3.

Prevalence and trends in co-use, drinking, and alcohol-related harms by gender

	WOMEN (n = 3,067)				MEN (n = 2,425)			
	2014	**2015**	**2016**	**Trend *P****	**2014**	**2015**	**2016**	**Trend *P***
Any cannabis use, past 12 months (%)	20.9	23.4	26.3	0.040	29.3	29.1	37.2	0.040
Non-cannabis user/non-drinker (%)	30.1	28.6	27.8	(ref)	25.0	21.8	22.2	(ref)
Non-cannabis user/drinker (%)	**49.1**	**48.1**	**45.9**	**ns**	45.9	49.3	40.9	ns
Cannabis user/non-drinker (%)	2.9	2.8	4.8	0.048	4.6	5.1	5.8	ns
Concurrent cannabis/alcohol user (%)	8.4	11.2	9.5	ns	9.5	7.0	11.7	ns
Simultaneous cannabis/alcohol user (%)	9.5	9.3	12.0	ns	15.1	17.0	19.4	ns
Current drinker (%)	67.1	68.8	67.4	ns	70.7	73.2	72.1	ns
Average # drinking days, past 30 days	7.6 (0.4)	6.9 (0.4)	7.7 (0.5)	ns	**9.5 (0.5)**	**10.3 (0.6)**	**9.5 (0.6)**	**ns**
Average # drinks/drinking day, past 30 days	1.8 (0.1)	1.7 (0.1)	1.9 (0.1)	ns	2.5 (0.1)	2.5 (0.2)	2.2 (0.1)	0.037
Average volume, past 30 days	15.4 (1.9)	13.2 (1.3)	16.6 (2.3)	ns	27.4 (3.7)	28.0 (4.4)	23.7 (0.1)	ns
Frequency 5+, past 30 days	0.4 (0.1)	0.4 (0.1)	0.5 (0.1)	ns	1.4 (0.3)	1.1 (0.2)	1.1 (0.2)	ns
Alcohol-related harms at home, past 12 months (%)	2.0	0.5	0.4	0.021	2.3	5.0	1.6	ns
Health harms (%)	3.4	3.8	5.1	ns	3.5	7.3	4.8	ns
Work harms (%)	**0.7**	**1.0**	**0.2**	**ns**	0.8	1.8	0.9	ns
Financial harms (%)	**1.5**	**1.0**	**0.3**	**0.027**	1.6	3.1	1.3	ns

* From multivariable regression models adjusting for age, race/ethnicity, education, employment, marital status, and cannabis use

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Table 4.

Trends in co-use, drinking, and harms by age

	AGE 18-29 (n = 679)				AGE 30-49 (n = 1,377)				AGE 50+ n = 3,291			
	2014	**2015**	**2016**	**Trend *P****	**2014**	**2015**	**2016**	**Trend *P***	**2014**	**2015**	**2016**	**Trend *P***
Any cannabis use, past 12 months (%)	39.7	38.5	49.4	0.061	28.3	26.7	31.0	ns	**15.1**	**20.9**	**23.6**	**0.001**
Non-cannabis user/non-drinker (%)	22.9	23.1	17.5	(ref)	25.0	21.8	24.7	(ref)	32.2	28.5	29.4	(ref)
Non-cannabis user/drinker (%)	37.9	38.4	33.1	ns	46.7	51.7	44.7	ns	52.3	50.7	47.1	ns
Cannabis user/non-drinker (%)	4.0	3.1	4.6	ns	3.5	4.7	4.8	ns	3.8	3.9	6.2	0.056
Concurrent cannabis/alcohol user (%)	13.9	14.3	18.7	ns	10.3	8.0	10.5	ns	5.3	7.8	6.6	ns
Simultaneous cannabis/alcohol user (%)	21.4	21.2	26.1	ns	14.5	13.8	15.2	ns	**6.1**	**9.0**	**10.7**	**0.006**
Current drinker (%)	73.7	73.8	77.8	ns	71.5	73.7	70.6	ns	64.1	67.7	64.5	ns
Average # drinking days, past 30 days	**7.9 (0.6)**	**8.0 (0.9)**	**6.3 (0.8)**	**0.038**	8.2 (0.8)	8.4 (0.8)	8.5 (0.7)	ns	9.6 (0.5)	9.6 (0.5)	10.1 (0.6)	ns
Average # drinks/drinking day, past 30 days	2.6 (0.2)	2.3 (0.1)	2.3 (0.2)	ns	2.3 (0.2)	2.4 (0.2)	2.1 (0.2)	ns	1.7 (0.1)	1.8 (0.2)	1.8 (0.1)	ns
Average volume, past 30 days	**24.1 (4.7)**	**18.7 (2.9)**	**14.1 (1.6)**	**0.006**	23.2 (4.5)	25.2 (6.4)	23.0 (3.5)	ns	19.1 (2.2)	19.4 (1.8)	21.2 (2.2)	ns
Frequency 5+, past 30 days	1.2 (0.2)	1.0 (0.2)	0.9 (0.2)	ns	1.3 (0.4)	0.9 (0.2)	0.9 (0.2)	ns	0.3 (0.1)	0.6 (0.2)	0.6 (0.2)	ns
Alcohol-related harms at home, past 12 months (%)	3.5	3.3	3.1	ns	3.0	3.1	2.7	ns	**1.9**	**2.4**	**2.3**	**0.018**
Health harms (%)	1.2	1.0	0.9	ns	0.9	1.1	0.8	ns	**0.3**	**0.6**	**0.6**	**0.002**
Work harms (%)	7.2	7.3	6.6	ns	5.1	7.2	4.1	ns	1.7	2.8	2.1	ns
Financial harms (%)	6.1	5.2	6.7	ns	4.2	4.8	4.9	ns	1.8	3.4	1.6	ns
Morning drink (%)	3.0	1.8	1.9	ns	1.7	2.6	2.0	ns	2.1	0.4	0.7	ns
Guilt/remorse (%)	12.1	17.5	16.7	ns	9.4	12.7	8.8	ns	3.6	4.6	3.8	ns
Blackout (%)	20.9	18.2	19.9	ns	8.1	7.3	6.8	ns	**1.3**	**2.3**	**3.9**	**0.004**
Injury (%)	2.8	3.2	1.5	0.055	2.3	2.1	0.4	0.065	0.2	0.1	0.0003	ns
Cut down (%)	3.7	3.2	1.8	ns	4.1	3.7	3.1	ns	1.1	3.6	2.0	ns
Alcohol-related harms at home, past 12 months (%)	3.2	4.4	0.9	0.053	**3.5**	**4.4**	**1.2**	**0.010**	0.6	0.9	0.9	ns
Health harms (%)	4.7	11.1	6.2	ns	4.4	7.1	5.3	ns	2.3	2.0	4.2	ns

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	AGE 18-29 (n = 679)				AGE 30-49 (n = 1,377)				AGE 50+ n = 3,291			
	2014	**2015**	**2016**	**Trend *P****	**2014**	**2015**	**2016**	**Trend *P***	**2014**	**2015**	**2016**	**Trend *P***
Work harms (%)	2.0	3.5	1.3	ns	0.9	2.0	0.6	ns	0.2	0.2	0.1	ns
Financial harms (%)	2.2	5.3	1.7	ns	**2.2**	**1.7**	**0.5**	**0.024**	0.8	0.5	0.6	ns

* From multivariable regression models adjusting for gender, race/ethnicity, education, employment, marital status, and cannabis use

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Table 5.

Prevalence and trends in co-use, drinking, and alcohol-related harms by cannabis use group

	NON-CANNABIS USERS (n = 4,292)				CANNABIS USERS (n = 1,200)			
	2014	**2015**	**2016**	**Trend *P*** *	**2014**	**2015**	**2016**	**Trend *P***
Cannabis user/non-drinker (%)	--	--	--	--	15.0	15.0	16.8	(ref)
Concurrent cannabis/alcohol user (%)	--	--	--	--	35.8	34.9	33.5	ns
Simultaneous cannabis/alcohol user (%)	--	--	--	--	49.2	50.1	49.7	ns
Current drinker (%)	63.2	65.9	63.4	ns	85.2	85.1	83.3	ns
Average # drinking days, past 30 days	8.5 (0.4)	8.4 (0.4)	8.3 (0.5)	ns	8.9 (0.7)	9.4 (0.8)	9.1 (0.7)	ns
Average # drinks/drinking day, past 30 days	**1.9 (0.1)**	**1.8 (0.1)**	**1.8 (0.1)**	**0.035**	2.7 (0.2)	2.7 (0.2)	2.5 (0.2)	ns
Average volume, past 30 days	18.9 (2.7)	17.0 (1.5)	16.0 (1.3)	ns	27.7 (3.7)	28.7 (6.5)	27.1 (3.5)	ns
Frequency 5+, past 30 days	0.6 (0.2)	0.6 (0.1)	0.5 (0.1)	ns	1.5 (0.2)	1.1 (0.2)	1.3 (0.2)	ns
Alcohol-related harms at home, past 12 months (%)	1.3	1.2	0.6	ns	4.3	6.7	1.8	0.053
Health harms (%)	2.3	3.0	2.9	ns	6.5	12.1	8.7	ns
Work harms (%)	0.4	0.4	0.4	ns	1.4	4.0	0.9	ns
Financial harms (%)	0.7	0.8	0.6	ns	**3.7**	**5.4**	**1.2**	**0.007**

* From multivariable regression models adjusting for gender, age, race/ethnicity, education, employment, and marital status