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Long-Term Effects of Minimum Legal Drinking Age Laws on Marijuana and Other Illicit Drug Use in Adulthood*

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Abstract

Background—Exposure to permissive minimum legal drinking age (MLDA) laws (ability to purchase alcohol <21 years) during adolescence can have long-term effects, including heavy alcohol use or alcohol use disorders as adults. We examined whether exposure to permissive MLDA laws during adolescence has long-term effects on illicit drug use and disorders in adulthood.

Methods—Participants from the 2004-2012 National Survey of Drug Use and Health (NSDUH) were linked with historical state MLDA laws. Participants born in 1949-1972 (age 31-63 years at observation, n=110,300) were analyzed because they came of legal age for alcohol purchase when changes occurred in state MLDA laws. Logistic regression was used to model drug use measures as a function of exposure to permissive MLDA during adolescence, adjusting for state and birth-year fixed effects, demographics, and salient state characteristics.

Results—Rates of past month use, past year use, and abuse/dependence of marijuana were 4.7%, 7.8%, and 1.2% respectively. Rates of past month use, past year use, and abuse/dependence of illicit drugs other than marijuana were 2.9%, 6.2%, and 0.7%, respectively. Among the full sample, exposure to permissive MLDA laws was not significantly associated with drug use or

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Contributors

Ms. Krauss led the analyses and manuscript writing. Dr. Grucza provided mentoring on all aspects of the project, including the analytic design, analyses, and revisions to the manuscript. Drs. Cavazos-Rehg, Agrawal, and Bierut contributed to interpretation of results and critical revisions to the manuscript. All authors have read this manuscript and approved its submission to *Drug and Alcohol Dependence*.

Conflict of interest

Dr. Bierut is listed as an inventor on Issued U.S. Patent 8,080,371,"Markers for Addiction," covering the use of certain SNPs in determining the diagnosis, prognosis, and treatment of addiction. All other authors declare they have no conflicts of interest.

abuse/dependence in adulthood. Men exposed to permissive MLDA laws were at 20% increased odds of past year illicit drug use (aOR 1.20, 95% CI 1.09-1.32).

Conclusions—Restricting alcohol access during adolescence did not increase long-term drug use. Allowing the purchase of alcohol among those less than 21 years of age could increase the risk of drug use later in life.

Keywords

Minimum Legal Drinking Age; alcohol policy; marijuana; illicit drugs

1. INTRODUCTION

Prior to the 1970s, while a few states already had a minimum legal drinking age (MLDA) of less than 21 years (generally 18-20 years), most states had a MLDA of 21 years. In the 1970s many of these states lowered the MLDA to less than 21 as minimum age limits for voting were also being lowered (Wechsler and Sands, 1980). After evidence began to show that motor vehicle accidents were increasing among 18-20 year olds, states began raising the MLDA back to 21 in the late 1970s and early 1980s. This process was completed with passage of the 1984 National Minimum Legal Drinking Act stipulating that all states set the MLDA to 21 by 1986 or lose federal highway funds (Toomey et al., 2009). Research since then has confirmed that higher MLDA (age 21) is associated with reductions in alcohol consumption and alcohol-related motor vehicle crashes and fatalities (DeJong and Blanchette, 2014; Lovenheim and Slemrod, 2010; McCartt et al., 2010; Subbaraman and Kerr, 2013; Wagenaar and Toomey, 2002; Wechsler and Nelson, 2010). Furthermore, studies have found that exposure to permissive MLDA laws (ability to purchase alcohol <21 years of age) during adolescence can have long-term effects, including increasing the likelihood of heavy drinking (Kaestner and Yarnoff, 2011; Plunk et al., 2013) and alcohol use disorder (Norberg et al., 2009) in adulthood. In addition, women who were legally permitted to drink prior to age 21 were at elevated risk for death by suicide and homicide (Grucza et al., 2012), while similarly exposed men were at elevated risk for fatal accidents as adults (Kaestner and Yarnoff, 2011).

Our objective was to examine whether MLDA laws could also impact marijuana and other illicit drug use and abuse over the long term. If policies that discourage alcohol use tend to decrease drug use during adolescence, these habits may persist into adulthood, given the importance of this age in the development of substance use disorders (Chen et al., 2012; Sher et al., 2005; Stone et al., 2012). Some prior studies examining short-term effects of alcohol policies on drug use have suggested that alcohol use and illicit drug use are complementary behaviors, i.e., that policies discouraging alcohol use tend to also discourage drug use. For example, higher beer prices have been associated with reduced marijuana use (Farrelly et al., 1999; Pacula, 1998). Likewise, increasing costs of marijuana decreased both marijuana and alcohol use among college students and policies that reduced access to alcohol were associated with reductions in both alcohol and marijuana use (Williams et al., 2004).

On the other hand, restricting access to alcohol might increase the likelihood that young people would turn to marijuana and other drugs, i.e., other drugs are substitutes for alcohol. A study of 12th grader survey data from 1980-1989 found that higher MLDA laws were associated with increased marijuana use (DiNardo and Lemieux, 2001). A study of Australian survey data from 1988-1995 found that an increase in the price of alcohol increased the probability of marijuana use (Cameron and Williams, 2001). When examining the immediate effects of discontinuity of alcohol availability created by the current MLDA of 21 years on drug use among young adults, as alcohol consumption increased at age 21, there was a sharp decrease in consumption of hard drugs and marijuana (Crost and Guerrero, 2012; Deza, 2014) or no significant changes in marijuana use (Crost and Rees, 2013; Yörük and Yörük, 2013).

Only one study examined the long-term effects of exposure to permissive MLDA laws during adolescence on drug use later in adulthood. Norberg et al. (2009) examined respondents born between 1948 and 1970 from the 1991 National Longitudinal Alcohol Epidemiological Survey and the 2001 National Epidemiological Study of Alcohol and Related Conditions. Adults who had been legally allowed to purchase alcohol before age 21 were significantly more likely to have an illicit drug use disorder other than marijuana. Results also suggested that exposure to permissive MLDA increased the risk for marijuana use disorder, but this did not reach statistical significance.

Given the mixed findings regarding short-term effects of alcohol policies on drug use and the little attention given to long-term effects on drug use, additional research is needed to clarify the effects of MLDA laws during adolescence on illicit drug use in adulthood. Additional information on the effects of MLDA laws can help gain insight into how people engage or select their substances and inform debate about effects of lowering the current drinking age. In this study, we attempt to replicate findings of Norberg et al. (2009) in different survey data, and to extend them to an older cohort of adults to identify effects over a longer period of time. Like Norberg et al. (2009), we focus on a cohort of adults who were adolescents during the time period in which many changes in state MLDA laws occurred, but we use more recent national survey data (2004-2012, thus, the cohort is now older). Furthermore, we examine current drug use in addition to drug use disorders for both marijuana and other illicit drugs.

2. MATERIAL AND METHODS

2.1 Subjects

The sample included participants in the 2004-2012 administrations of the National Survey of Drug Use and Health (NSDUH). The NSDUH is an annual nationwide cross-sectional survey of approximately 70,000 randomly sampled non-institutionalized civilians age 12 and older in the United States, with the primary intent of measuring the prevalence and correlates of drug use. Independent, multistage area probability samples are collected for each of the 50 states and the District of Columbia. The survey is administered by RTI International using a combination of computer-assisted personal interviewing (CAPI) conducted by trained interviewers and audio computer-assisted self-interviewing (ACASI), which provides a more confidential way to respond to questions, thereby increasing honest

reporting of illicit drug use (United States Department of Health and Human Services, 2012; Grucza et al., 2007; Tourangeau and Smith, 1996).

For our study, it was necessary to merge NSDUH participant data with state minimum legal drinking age (MLDA) policy, as well as other state level covariates. Access to NSDUH data containing geographic identifiers was obtained through the Center for Behavioral Health Statistics and Quality (CBHSQ) Data Portal maintained by the University of Michigan (http://www.icpsr.umich.edu/icpsrweb/content/SAMHDA/dataportal.html). The Data Portal is a secure virtual computing environment designed to allow for use of NSDUH data for research and policy analysis while also protecting identifiable data from disclosure.

From the 2004-2012 NSDUH data sets, we selected all participants born between 1949 and 1972 (n=111,600) for inclusion in our study, as these participants came of legal age for alcohol purchase during the time period in which between-state and cross-year differences in minimum legal drinking age policies were present (participants were 18-20 years old in 1967 to 1992). Participants from the District of Columbia (n=1,300) were excluded due to missing data for some state covariates. This resulted in 110,300 total participants for analysis. All reports of unweighted sample sizes are rounded to the nearest 100 to help prevent disclosure.

2.2 Outcome measures

The main outcomes were use of marijuana and use of other illicit drugs. We used variables provided by the NSDUH which flagged whether the participant had used marijuana in the past month, used marijuana in the past year, and met the criteria for Diagnostic and Statistical Manual of Mental Disorders 4th edition (DSM-IV) marijuana abuse or dependence (American Psychiatric Association, 1994). Similarly, we used recoded variables that flagged whether the participant had used illicit drugs other than marijuana in the past month, used illicit drugs other than marijuana in the past year, and met the criteria for abuse or dependence for illicit drugs other than marijuana. Illicit drugs other than marijuana included cocaine, heroin, hallucinogens, inhalants, and the non-medical use of pain relievers, sedatives, stimulants, or tranquilizers.

2.3 Independent variable of interest: Minimum legal drinking age (MLDA) exposure

We defined permissive MLDA exposure as the ability to legally purchase alcohol before the age of 21. MLDA policy data were coded as described in our previous studies (Grucza et al., 2012; Norberg et al., 2009). State of residence at the time of survey administration was used as a proxy for state of residence at the age of potential exposure, as this data was not available. To assess exposure precisely, we would need to know the state of residence of individuals when they were between the ages of 18 and 21. We used the Panel Study of Income Dynamics (PSID) to examine the expected level of cross-state migration between state of residence at age 20 and state of residence at survey administration in our cohort of interest as well as rates of potential misclassification. These analyses are detailed in Supplementary Material 1[1]. In sum, we estimate that the proxy MLDA exposure (based on

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state of residence at survey administration) would match the true MLDA exposure at age 20 for 89% of respondents. Among the 11% that were misclassified, 47% were towards a permissive MLDA policy and 54% were towards a MLDA of 21. Thus, using state of residence at the time of survey administration is expected to have relatively low misclassification and to introduce only random error into our parameter estimates, biasing the estimates of the association (log-odds ratio) toward zero. Similarly, we have previously demonstrated that migration–induced error is unlikely to bias estimates toward a type I error (Grucza et al., 2012; Norberg et al., 2009).

2.4 Covariates

We accounted for participant demographic covariates, including sex, race/ethnicity, age (divided into quartiles), and education. We also controlled for selected time-varying state economic and demographic variables, including state annual average unemployment rate (from the Bureau of Labor Statistics), per capita income (adjusted for inflation to reflect 2012 dollars; from the Bureau of Economic Analysis), and a measure of citizen political ideology (Berry et al., 1998). Citizen political ideology was not available for 2011 and 2012; data from 2010 was used for these years. Other state covariates were considered (e.g., state alcohol taxes, percent of the state population that were affiliated with primarily Judeo-Christian denominations) but were collinear with state fixed effects, as determined by variance inflation factors, and thus were not included in the models.

2.5 Statistical analysis

To examine our hypothesis that exposure to permissive state MLDA policies during adolescence would be associated with increased likelihood of drug use as an adult, we used a regression extension of a classical “differences-in-differences” quasi-experimental method, expanding the canonical comparison of 2 groups at 2 different time points to multiple time points (Angrist and Pischke, 2008). We used logistic regression to model drug use as a function of exposure to permissive MLDA during adolescence. Below is the basic structure of our logistic regression models.

$$ln\left[\mathrm{P}\left(\mathrm{Y}_{itsk}\right)/\left(1-\mathrm{P}\left(\mathrm{Y}_{itsk}\right)\right)\right]=\alpha+\beta_1 MLDA_{sk}+\beta_2 \mathrm{X}_{1ist}+\beta_3 \mathrm{X}_{2st}+\delta_{st}+\gamma_{\mathrm{k}}+\varepsilon_{itsk}$$

$\mathrm{Y}_{\mathrm{itsk}}$ represents our dichotomous outcomes of interest (e.g., past-month marijuana use) for individual *i* in year *t* living in state *s* and born in year *k*. MLDA is the policy indicator for the ability to purchase alcohol before age 21 for an individual born in year *k* and living in state *s* (0=not legal to purchase before 21, 1=legal to purchase before 21). $\mathrm{X}_{1\mathrm{ist}}$ represents the full vector of individual covariates at year *t*, including sex, race, age, and education. $\mathrm{X}_{2\mathrm{st}}$ represents the full vector of state covariates at year *t* including unemployment rate, citizen political ideology, and income per capita. Fixed effects for unordered categorical indicators of state of residence at year *t* (δ_{st}) and birth year (γ_{k}) and were also included in all models. Including state and birth year fixed effects (which determines MLDA exposure) results in estimates of the effect of the MLDA policy adjusted for stable state characteristics and state-invariant characteristics of each birth year (Angrist and Pischke, 2008).

We also ran models dividing the cohort in half (year of birth 1949-1960, and year of birth 1961-1972). Stratifying by birth cohort allowed us to examine whether effects of MLDA were similar among those who were adolescents when states were primarily lowering the MLDA and those who were adolescents when states were increasing the MLDA. Models were also stratified by sex. Parameter estimates and standard errors were calculated using the SAS (Version 9.2, SAS Institute, Cary, NC) procedure "surveylogistic", employing state as the clustering unit to account for correlation of residuals within states in estimating standard errors (Angrist and Pischke, 2008; Arellano, 1987; Bertrand et al., 2004). Sample weights were applied in all analyses.

3. RESULTS

3.1 Description of sample

Demographic characteristics and prevalence of drug use for NSDUH participants born between 1949 and 1972 are shown in Table 1. All percentages reported are weighted. Approximately 51.2% were women and 69.0% were White (non-Hispanic). Marijuana use was more common than use of other drugs. Past month and past year use of marijuana was 4.7% and 7.8%, respectively, while past month and past year use of illicit drugs other than marijuana was 2.9% and 6.2%, respectively. Among users of illicit drugs other than marijuana, the most common type of drugs used were opioid pain relievers, used non-medically (53.4% for past month use, 57.6% for past year use). Prevalence of abuse or dependence of drugs was low, but slightly higher for drugs other than marijuana (1.2%) than marijuana (0.7%).

Approximately 49.3% of the sample was born between 1949 and 1960, and 50.7% was born between 1961 and 1972. Use of marijuana was higher among the younger cohort than the older cohort (past month use 5.1% vs 4.2%, Rao-Scott $\chi^2(1)=33.6$, $p<.001$; past year use 8.8% vs 6.7%, Rao-Scott $\chi^2(1)=91.4$, $p<.001$; abuse/dependence 0.9% vs 0.5%, Rao-Scott $\chi^2(1)=23.9$, $p<.001$). Similarly, use of illicit drugs other than marijuana was higher among the younger cohort than the older cohort (past month use 3.4% vs 2.4%, Rao-Scott $\chi^2(1)=52.8$, $p<.001$; past year use 7.5% vs 4.9%, Rao-Scott $\chi^2(1)=160.4$, $p<.001$; abuse/dependence 1.5% vs 0.8%, Rao-Scott $\chi^2(1)=60.0$, $p<.001$).

3.2 MLDA laws over time

During the time period in which our sample of participants was 18-20 years old (1967 to 1992), many changes occurred in state MLDA laws (Figure 1). The number of states that allowed the purchase of alcohol under the age of 21 increased from 14 in 1968 to a maximum of 39 in 1976-1978, and then decreased over time to only one state (Louisiana) in 1988-1992.

3.3 Associations between permissive MLDA laws and drug use

In multivariable logistic regression models, exposure to permissive MLDA laws (ability to purchase under the age of 21) was not significantly associated with past month marijuana use, past year marijuana use, or marijuana abuse/dependence (Table 2). In similar models focusing on illicit drug use other than marijuana (Table 3), no significant associations

between permissive MLDA laws and past month drug use, past year drug use, or drug abuse/dependence were found.

The analyses were then stratified by cohort (years of birth 1949-1960, and years of birth 1961-1972) and separately by sex (Table 4). No significant associations were found between permissive MLDA laws and marijuana use or abuse/dependence for either cohort or either sex. Among women, there was a trend for exposure to permissive MLDA to be protective of marijuana use, but these estimates did not reach statistical significance. Those in the younger cohort and men who were exposed to permissive MLDA laws during adolescence appeared to have increased odds of past year marijuana use, but these also did not reach statistical significance. However, men exposed to permissive MLDA laws were at 20% increased odds of past year illicit drug use other than marijuana (adjusted odds ratio [aOR] 1.20, 95% confidence interval [CI] 1.09-1.32, p=.023). An alternative specification in which we used a continuous measure of MLDA exposure rather than a dichotomous indicator yielded similar results (see Supplementary Material 2 and Table S1).

3.4 Addressing using state of residence at survey administration as a proxy for state of residence during adolescence

A limitation of our study is that we used state of residence at the time of the survey as a proxy for state of residence as an adolescent. Although we expect misclassification rates to be low and to only introduce random error (see Supplementary Material 1[2]), we also restricted our analyses to participants with a high school education or less because these participants would be less likely to move (Molloy et al., 2011). There were still no significant associations between exposure to permissive MLDA and any marijuana outcomes (Table 5). However, those exposed to permissive MLDA had 15% greater odds of past year use of illicit drugs other than marijuana (aOR 1.15, 95% CI 1.01-1.30). This effect appeared to be strongest among males (aOR 1.26, 95% CI 1.07-1.49) and those born in 1949-1960 (aOR 1.56, 95% CI 1.09-2.22).

4. DISCUSSION

Among individuals who were adolescents/young adults when many changes were occurring in MLDA, we found that being able to purchase alcohol before 21 was not associated with increased odds of marijuana use or marijuana use disorder as an adult. Exposure to permissive MLDA (<21 years) as an adolescent did not in general increase the odds of drug use other than marijuana in adulthood; however, it did increase the odds of past-year use of drugs other than marijuana among men (20% greater odds compared to those not able to purchase alcohol before age 21). Among those that used illicit drugs other than marijuana in our sample, the most commonly used were opioid pain relievers. When restricting analyses to those with lower educational attainment (because they are less likely to migrate across state lines), permissive MLDA was significantly associated with increased odds of past-year use of drugs other than marijuana, with stronger effects among men and those in the older cohort. These stronger results may be due to lower migration rates, but could also reflect the

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fact that minors on college campuses may have easier access to alcohol through their legal-age peers than those off-campus (Grucza et al., 2009).

It is debated whether or not alcohol and drugs are substitutes (one substance is used instead of the other) or complements (both substances are used), though most studies have focused on marijuana. Several studies suggest that, over the short term, alcohol and marijuana are substitutes (Cameron and Williams, 2001; Crost and Guerrero, 2012b; DiNardo and Lemieux, 2001) and others suggest that they are complements (Farrelly et al., 1999; Pacula, 1998; Pape et al., 2009; Williams et al., 2004). Our study shows no long-term elevation or reduction of marijuana use when alcohol access is restricted in adolescence. Even if there is a short-term substitution effect, our results suggest that such behavior does not persist into adulthood to any measureable degree.

Our results do, however, indicate the possibility of increased risk for use of drugs other than marijuana over the long term when alcohol access is permitted during adolescence, suggesting there may be some long-term complementarity, especially for men and those with lower educational attainment. Others have found that drug use tends to decline once youth reach the legal drinking age, suggesting short-term substitution (Deza, 2014). Although we did not examine short-term substitution or complementarity during adolescence or young adulthood, our results suggest long-term complementarity and support the argument that allowing access to alcohol during adolescence could lead to more drug use problems in adulthood. One possible mechanism for such an effect could involve the contribution of alcohol problems to psychopathology such as mood or anxiety disorders (Cairns et al., 2014; Fergusson et al., 2009; Moreno-Peral et al., 2014; Wang and Patten, 2002). This could lead to misuse of prescription drugs, which we found to be the most commonly used drugs among this cohort (after marijuana).

Similar to our current study, Norberg et al. (2009) studied the long-term effects of exposure to permissive MLDA on alcohol and drug use disorders in adulthood. Regarding marijuana, Norberg et al. found non-significant increased odds of marijuana use disorder in adulthood among those exposed to permissive MLDA during adolescence (odds ratio was 1.55, $p<0.10$). We also found no significant increased odds for marijuana use disorder or for current marijuana use, and most effect sizes were quite small. Regarding drugs other than marijuana, findings of Norberg et al. indicated that exposure to permissive MLDA increased the odds of drug use disorder other than marijuana in adulthood, with an odds ratio of 2.60. Although we did not find a significant effect of permissive MLDA on drug use disorder other than marijuana in adulthood, we did find significant positive effects of permissive MLDA on past-year drug *use* among men.

Our findings for drugs other than marijuana may differ somewhat from Norberg et al.'s due to the differences in surveys used in these studies. For example, differences in survey interviewing methods could affect disclosure of substance use. It is also possible that the longer surveys used by Norberg et al. (National Longitudinal Alcohol Epidemiological Survey and National Epidemiological Study of Alcohol and Related Conditions) could better identify true cases of drug use disorders among users than the NSDUH. In addition, the NSDUH survey data we used was more current (2004-2012), resulting in the cohort of

interest being older when reporting drug use and drug use disorder in adulthood (i.e., age range in Norberg's study 20-54 years, age range in our study 31-63 years); rates of substance use are highest among young adults and lowest among older adults (Substance Abuse and Mental Health Services Administration, 2012). Although the magnitude of the odds ratios are not as large as those of Norberg et al., both studies suggest that restricting access to alcohol during adolescence does not increase drug use in the long-term, but rather allowing the purchase of alcohol among those less than 21 years of age could increase the risk of drug use later in life.

Several limitations should be considered when interpreting our findings. Survey data on illicit drug use is subject to a certain amount of bias due to self-report and social desirability. Current state of residence was used as a proxy for state of residence during the time of adolescence in order to determine exposure to permissive MLDA, which is not ideal. However, based on our analysis of cross-migration rates using PSID data (Supplementary Material 1[3]), we do not expect this to systematically bias results but rather introduce random error into our estimates. We did not account for the potential of crossing state boundaries to access alcohol (cross-state differences in laws) or local drinking ordinances. Our study focused only on *purchasing* age policy, not policies regarding the legality of alcohol *consumption* among minors (e.g., under parental supervision, for religious purposes). However, legal purchasing age is known to affect alcohol consumption over the short term (DeJong and Blanchette, 2014; Subbaraman and Kerr, 2013; Wagenaar and Toomey, 2002; Wechsler and Nelson, 2010), and thus is a valid tool for examining the long-term effects of environments that promote youth alcohol consumption.

The move toward lower legal drinking ages occurred during a period when age-of-majority laws were being liberalized, such as age of birth control access (Guldi, 2008). Thus, MLDA associations may be confounded with these other policy changes, which may also have influenced drinking and drug use behaviors. However, the increases in MLDA that occurred between 1977 and 1988 were in response to public health concerns and occurred after the move toward lower age-of-majority laws. Stratifying our sample into two cohorts (one in which they primarily experienced decreases in MLDA, and one in which participants experienced only increases in MLDA) showed that, in general, effects did not differ substantially between these two cohorts. Thus MLDA associations do not appear to be confounded by other changes in age-of-majority policies.

This study examined the effects of changes in state MLDA laws in the 1970s and 1980s on drug use behaviors later in life. A MLDA of 21 did not appear to increase the risk of marijuana or other illicit drug use in the long-term compared with more permissive MLDAs. In fact, our results suggest that being able to purchase alcohol before the age of 21 could increase the risk of use of illicit drugs other than marijuana in adulthood. Permissive MLDA (<21 years) did not appear to increase the risk of marijuana use in adulthood.

[3]Supplementary material can be found by accessing the online version of this paper at http://dx.doi.org and by entering doi:…

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- We studied whether ability to purchase alcohol <21 years affects adult drug use.
- Participants were from the 2004-2012 National Survey of Drug Use and Health.
- No significant associations were found with marijuana use in adulthood.
- Ability to buy alcohol <21 increased drug use other than marijuana among subgroups.

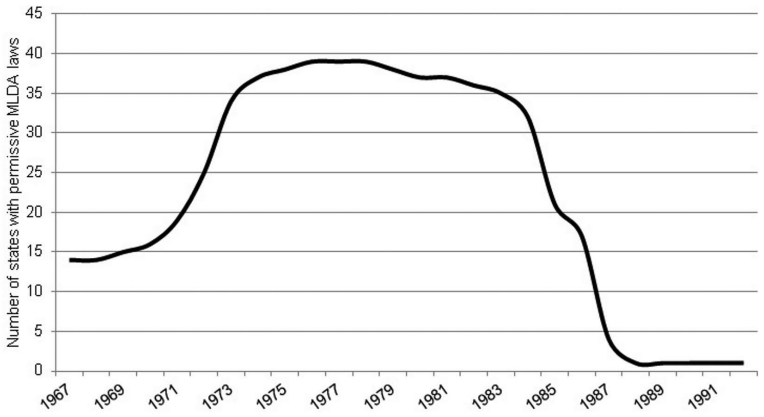

Figure 1.

Number of states with permissive MLDA laws from 1967-1992.

Many states adopted permissive MLDA laws (ability to purchase alcohol <21 years of age) during the 1970s. States began raising the MLDA back to 21 years in the late 1970s and 1980s.

Table 1

Participants from the 2004-2012 National Survey Drug Use and Health (NSDUH) who were born between 1949 and 1972, Sample characteristics

	Full sample		Cohort 1: Year of birth 1949-1960		Cohort 2: Year of birth 1961-1972	
	Unweighted n[a]	Weighted %	Unweighted n[a]	Weighted %	Unweighted n[a]	Weighted %
Total n[a]	110,300	100	41,800	100	68,500	100
Sex						
Men	50,400	48.8	19,100	48.5	31,300	49.1
Women	59,900	51.2	22,700	51.5	37,200	50.9
Race						
White (non-Hispanic)	78,700	69.0	31,500	72.9	47,200	65.2
African American (non-Hispanic)	11,300	11.7	4,200	11.3	7,200	12.0
Hispanic	12,900	12.9	3,700	10.1	9,100	15.5
Other (non-Hispanic)	7,400	6.4	2,500	5.6	5,000	7.3
Age						
31-40 years	31,700	22.8	0	0.0	31,700	45.0
41-46 years	34,800	26.0	5,600	8.5	29,200	43.0
47-52 years	26,900	26.3	19,300	41.1	7,600	11.9
53-63 years	16,900	24.9	16,900	50.4	0	0.0
Education						
Less than high school	13,700	12.7	4,900	12.0	8,700	13.4
High school graduate	34,000	29.7	13,700	30.9	20,400	28.5
Some college	29,200	25.7	10,900	25.4	18,300	25.9
College graduate	33,400	31.9	12,300	31.6	21,200	32.1
Marijuana use						
Past month	5,500	4.7	1,800	4.2	3,700	5.1
Past year	9,200	7.8	3,000	6.7	6,200	8.8
Abuse/Dependence	900	0.7	200	0.5	600	0.9
Use of drugs other than marijuana						
Past month	3,300	2.9	1,000	2.4	2,300	3.4
Past year	7,200	6.2	2,100	4.9	5,100	7.5

	Full sample		Cohort 1: Year of birth 1949-1960		Cohort 2: Year of birth 1961-1972	
	Unweighted n[a]	Weighted %	Unweighted n[a]	Weighted %	Unweighted n[a]	Weighted %
Abuse/Dependence	1,400	1.2	400	0.8	1,000	1.5

[a] All unweighted sample sizes are rounded to the nearest 100 to help avoid disclosure.

Table 2

Association between under 21 MLDA exposure and marijuana use[a]

Marijuana use:	Past month use		Past year use		Abuse or Dependence	
	aOR (95% CI)	p	aOR (95% CI)	p	aOR (95% CI)	p
Under 21 MLDA exposure	0.97 (0.87, 1.08)	.586	1.04 (0.95, 1.14)	.360	0.99 (0.77, 1.27)	.904
Sex						
Men	2.14 (1.98, 2.32)	<.001	1.92 (1.80, 2.04)	<.001	2.64 (2.25, 3.10)	<.001
Women	Ref.		Ref.		Ref.	
Race						
White (non-Hispanic)	Ref.		Ref.		Ref.	
African American (non-Hispanic)	1.02 (0.86, 1.21)	.808	1.05 (0.91, 1.21)	.526	1.65 (1.18, 2.30)	.003
Hispanic	0.27 (0.19, 0.39)	<.001	0.30 (0.23, 0.40)	<.001	0.31 (0.20, 0.47)	<.001
Other (non-Hispanic)	0.44 (0.28, 0.69)	<.001	0.44 (0.30, 0.65)	<.001	0.53 (0.39, 0.72)	<.001
Age						
31-40 years	0.91 (0.65, 1.28)	.579	1.01 (0.76, 1.36)	.924	1.45 (0.71, 2.97)	.313
41-46 years	0.86 (0.66, 1.12)	.269	0.98 (0.77, 1.25)	.897	1.38 (0.72, 2.65)	.334
47-52 years	0.91 (0.77, 1.08)	.280	0.98 (0.81, 1.18)	.806	1.35 (0.73, 2.49)	.336
53-63 years	Ref.		Ref.		Ref.	
Education						
Less than high school	2.56 (2.08, 3.16)	<.001	2.09 (1.69, 2.58)	<.001	3.36 (2.41, 4.67)	<.001
High school graduate	1.77 (1.57, 2.00)	<.001	1.52 (1.38, 1.67)	<.001	1.55 (1.23, 1.94)	<.001
Some college	1.62 (1.48, 1.77)	<.001	1.45 (1.37, 1.54)	<.001	1.63 (1.32, 2.01)	<.001
College graduate	Ref.		Ref.		Ref.	
Year	1.00 (0.96, 1.04)	.968	1.00 (0.97, 1.03)	.991	0.92 (0.85, 0.98)	.015
Unemployment rate (%)	0.98 (0.94, 1.02)	.244	0.98 (0.95, 1.01)	.159	1.04 (0.95, 1.15)	.378
Citizen political ideology	1.00 (0.99, 1.00)	.208	1.00 (0.99, 1.00)	.098	0.99 (0.97, 1.00)	.076
Per capita income, per dollar	0.96 (0.91, 1.01)	.085	0.97 (0.93, 0.999)	.046	1.06 (0.97, 1.15)	.185

[a] All models also include fixed effects for state and year of birth.

Table 3

Association between under 21 MLDA exposure and use of illicit drugs other than marijuana[a]

Use of illicit drugs other than marijuana	Past month use		Past year use		Abuse or Dependence	
	aOR (95% CI)	p	aOR (95% CI)	p	aOR (95% CI)	p
Under 21 MLDA exposure	1.05 (0.89, 1.23)	.588	1.08 (0.97, 1.20)	.177	1.13 (0.88, 1.45)	.324
Sex						
Men	1.36 (1.23, 1.49)	<.001	1.28 (1.20, 1.37)	<.001	1.81 (1.58, 2.08)	<.001
Women	Ref.		Ref.		Ref.	
Race						
White (non-Hispanic)	Ref.		Ref.		Ref.	
African American (non-Hispanic)	0.91 (0.74, 1.11)	.336	0.78 (0.65, 0.93)	.006	1.62 (1.31, 2.01)	<.001
Hispanic	0.52 (0.40, 0.68)	<.001	0.51 (0.41, 0.63)	<.001	0.65 (0.47, 0.89)	.006
Other (non-Hispanic)	0.66 (0.53, 0.82)	<.001	0.58 (0.51, 0.67)	<.001	1.06 (0.76, 1.46)	.748
Age						
31-40 years	0.70 (0.45, 1.11)	.131	0.72 (0.52, 1.00)	.050	0.46 (0.20, 1.05)	.065
41-46 years	0.75 (0.52, 1.08)	.116	0.78 (0.57, 1.05)	.100	0.62 (0.34, 1.16)	.136
47-52 years	0.81 (0.64, 1.01)	.065	0.80 (0.64, 1.01)	.063	0.68 (0.45, 1.03)	.066
53-63 years	Ref.		Ref.		Ref.	
Education						
Less than high school	2.31 (1.80, 2.95)	<.001	1.95 (1.63, 2.32)	<.001	5.52 (4.21, 7.23)	<.001
High school graduate	1.43 (1.26, 1.63)	<.001	1.32 (1.20, 1.45)	<.001	2.85 (2.09, 3.89)	<.001
Some college	1.38 (1.22, 1.57)	<.001	1.34 (1.25, 1.44)	<.001	2.45 (2.02, 2.99)	<.001
College graduate	Ref.		Ref.		Ref.	
Year	0.99 (0.95, 1.04)	.726	0.98 (0.95, 1.01)	.134	0.93 (0.88, 0.99)	.013
Unemployment rate (%)	0.96 (0.91, 1.00)	.057	0.97 (0.94, 0.99)	.015	0.99 (0.92, 1.06)	.719
Citizen political ideology	1.00 (0.996, 1.01)	.381	1.00 (0.99, 1.01)	.819	1.00 (0.99, 1.02)	.567
Per capita income, per dollar	0.98 (0.94, 1.02)	.339	0.98 (0.94, 1.01)	.216	0.97 (0.90, 1.05)	.493

[a] All models also include fixed effects for state and year of birth.

Table 4

Association between under 21 MLDA exposure and drug use, stratified by cohort[a] and sex

	Past month use		Past year use		Abuse or Dependence	
	aOR (95% CI)	**p**	**aOR (95% CI)**	**p**	**aOR (95% CI)**	**p**
Marijuana use						
Cohort						
Year of birth 1949-1960[b]	0.95 (0.70, 1.28)	.726	0.98 (0.74, 1.31)	.898	0.93 (0.42, 2.04)	.852
Year of birth 1961-1972[c]	1.09 (0.92, 1.28)	.326	1.11 (0.99, 1.25)	.079	1.03 (0.73, 1.45)	.870
Sex						
Men	1.04 (0.86, 1.26)	.691	1.14 (0.98, 1.32)	.081	1.04 (0.75, 1.45)	.800
Women	0.86 (0.73, 1.004)	.056	0.90 (0.81, 1.003)	.057	0.83 (0.56, 1.24)	.360
Use of illicit drugs other than marijuana						
Cohort						
Year of birth 1949-1960[b]	1.11 (0.74, 1.67)	.621	1.18 (0.88, 1.57)	.275	1.16 (0.53, 2.55)	.714
Year of birth 1961-1972[c]	1.03 (0.83, 1.27)	.796	1.11 (0.98, 1.27)	.103	1.09 (0.83, 1.45)	.532
Sex						
Men	1.09 (0.91, 1.30)	.354	**1.20 (1.09, 1.32)**	**<.001**	1.22 (0.89, 1.68)	.223
Women	1.00 (0.78, 1.28)	.994	0.94 (0.79, 1.12)	.485	1.00 (0.66, 1.51)	.986

[a] All models also include fixed effects for state and year of birth, as well as sex, race, age category, education, year, state unemployment rate, state citizen ideology, and state per capita income. Models stratified by sex do not include sex as a predictor.

[b] Year of birth 1949-1960, unweighted N=41,800 (rounded to the nearest 100)

[c] Year of birth 1961-1972, unweighted N=68,500 (rounded to the nearest 100)

Table 5

Association between under 21 MLDA exposure and drug use among participants with high school education or less[a]

	Past month use		Past year use		Abuse or Dependence	
	aOR (95% CI)	**p**	**aOR (95% CI)**	**p**	**aOR (95% CI)**	**p**
Marijuana use						
Overall[b]						
Under 21 MLDA exposure	1.00 (0.84, 1.20)	.976	1.05 (0.91, 1.20)	.503	1.13 (0.72, 1.78)	.595
By Cohort						
Year of birth 1949-1960[c]	1.05 (0.65, 1.70)	.839	1.00 (0.69, 1.45)	.995	1.68 (0.37, 7.58)	.501
Year of birth 1961-1972[d]	1.24 (0.98, 1.55)	.069	1.16 (0.97, 1.38)	.108	1.25 (0.76, 2.04)	.378
By Sex						
Men[e]	0.98 (0.76, 1.26)	.886	1.05 (0.86, 1.27)	.630	1.07 (0.64, 1.81)	.796
Women[f]	1.05 (0.80, 1.36)	.737	1.03 (0.86, 1.24)	.727	1.26 (0.66, 2.38)	.486
Use of illicit drugs other than marijuana						
Overall[b]						
Under 21 MLDA exposure	1.00 (0.83, 1.19)	.961	**1.15 (1.01, 1.30)**	**.034**	1.24 (0.94, 1.65)	.127
By Cohort						
Year of birth 1949-1960[c]	1.24 (0.76, 2.02)	.393	**1.56 (1.09, 2.22)**	**.014**	1.58 (0.68, 3.71)	.291
Year of birth 1961-1972[d]	1.02 (0.79, 1.31)	.893	1.16 (0.99, 1.38)	.074	1.20 (0.86, 1.68)	.281
By Sex						
Men[e]	1.08 (0.86, 1.37)	.499	**1.26 (1.07, 1.49)**	**.005**	1.29 (0.88, 1.89)	.191
Women[f]	0.89 (0.61, 1.29)	.539	1.00 (0.81, 1.23)	.988	1.16 (0.69, 1.96)	.578

[a] All models also include fixed effects for state and year of birth, as well as sex, race, age category, education (less than high school vs high school), year, state unemployment rate, state citizen ideology, and state per capita income. Models stratified by sex do not include sex as a predictor.

[b] Overall unweighted N=47,700 (rounded to the nearest 100)

[c] Year of birth 1949-1960, unweighted N=18,600 (rounded to the nearest 100)

[d] Year of birth 1961-1972, unweighted N=29,100 (rounded to the nearest 100)

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[e] Men, unweighted N=23,000 (rounded to the nearest 100)

[f] Women, unweighted N=24,700 (rounded to the nearest 100)