



## Cigarette, electronic cigarette, and marijuana use among young adults under policy changes in California

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### ABSTRACT

**Introduction:** Since 2016, California has implemented a series of policies, including prohibiting the sale of tobacco products and electronic cigarettes (e-cigarettes) to persons under 21, cigarette tax increase, and recreational marijuana legalization. The study aims to examine the use of cigarettes, e-cigarettes, and marijuana among young adults (ages 18–25) and their associations with other factors in the context of these policy changes.

**Methods:** We used the data from the California Health Interview Survey (CHIS) 2017–2018 to compare the rates of using cigarettes, e-cigarettes, and marijuana separately or any use of the three. Using CHIS 2018 data, weighted logistic regression models were used to examine associations of using cigarettes, e-cigarettes, and marijuana separately or any use of these products/substance with demo-socioeconomic factors, psychological distress, and use of each product/substances.

**Results:** Cigarette smoking remained flat while the use of e-cigarettes and marijuana escalated among young adults from 2017 to 2018. Using tobacco products increased the use of marijuana or vice versa among young adults. Severe psychological distress was significantly associated with cigarette use (adjusted odds ratio [AOR] = 4.06; 95% CI = 1.32, 12.55), marijuana use (AOR = 2.32; 95% CI = 1.10, 4.48), and any use (AOR = 4.11; 95% CI = 1.93, 8.77). Moderate psychological distress was also significantly associated with the use of these products/substance. Underage (ages 18–20) young adults had lower odds of using cigarettes than other young adults (ages 21–25).

**Conclusions:** Our findings highlight the importance of addressing the use of cigarettes, e-cigarettes, and marijuana simultaneously through policies to curtail tobacco and marijuana use among young adults.

### 1. Introduction

The U.S. Cannabis Administration and Opportunity Act introduced in 2021 would decriminalize marijuana federally. California's policy changes related to tobacco and cannabis use would inform these discussions on the short-term and long-term impact of such policies, especially among young people. The state of California has legalized recreational marijuana use for adults who are aged 21 years or older from January 1, 2018, but the state also fortified a policy environment reducing cigarette and vaping use. Individuals under 21 years old were prohibited to purchase tobacco products and e-cigarettes in California since June 9, 2016; and because e-cigarettes have been counted in

California's smoke-free laws, both tobacco products and e-cigarettes are prohibited in workplaces and many public areas. The cigarette tax was raised by \$2 per pack to discourage cigarette smoking in California on April 1, 2017. Thus, all these state-level policies adopted between June 2016 and January 2018 made the state to be a natural experimental ground to investigate young adults' tobacco and marijuana use behaviors and related risk factors in the context of the adoption of the policies (Meng and Ponce, 2020).

Young adults are particularly at risk for harm and addiction, as the use of tobacco products in any form and long-term recreational marijuana use (National Academies of Sciences, Engineering, and Medicine, 2017) can be harmful to their health and well-being (National Center for

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Chronic Disease Prevention, 2014). The use of electronic cigarettes (e-cigarettes) and marijuana among young adults can harm the developing brain, which continues to develop until about age 25 (U.S. Department of Health and Human Services, 2016). Use in early adulthood also increases the risk of future addiction to other drugs (National Center for Chronic Disease Prevention, 2014). Previous studies have also found a strong positive association between cigarette and marijuana use (Ramo et al., 2012; Schauer et al., 2015). The mental health of young adults is especially concerning as smoking and psychological distress are known to co-occur (Nguyen et al., 2019). While there are numerous potential explanations for the co-occurrence, very few studies have looked at the effects of psychological distress and the use of cigarettes, e-cigarettes, and/or marijuana simultaneously.

In this study, we focus on the current use (any use in the past 30 days) of cigarettes, e-cigarettes, and marijuana among Californians ages 18 to 25. We compared the rates in current use between 2017 (the year with the tobacco tax increase) and 2018 (the year with recreational marijuana legalization), then examined detailed data from 2018 on patterns of use by sociodemographic characteristics. We further investigated the relationship between the use of cigarettes, e-cigarettes, or marijuana with each of the two products/substance separately, and the use of these products/substance in relationship with psychological distress. This population-based study on young adults gives us an important insight into cigarette, e-cigarette, and marijuana use behaviors in the context of major policy changes. The findings will enhance the understanding of the use and inform the design of programs aimed at curbing the use of these products/substances simultaneously by young adults.

## 2. Materials and methods

### 2.1. Data and samples

All procedures described here were approved by the Institutional Review Boards of the Universities of California, Los Angeles. All participants provided informed consent.

The study population was drawn from the 2018 California Health Interview Survey (CHIS) in conjunction with data from the 2017 CHIS annual data file. Starting in 2011, CHIS became a continuous survey, generating an annual household sample of approximately 20,000, enabling the provision of timely population-representative health information for Californians in response to rapidly changing social, economic, public health, and health care environments. CHIS covers dozens of health topics including health and wellbeing, health behaviors, and health insurance coverage. CHIS households were selected through random-digit-dial (RDD), and within each household, an adult (age 18 and over) respondent was randomly selected and interviewed via telephone. To capture the diversity of California populations, CHIS is administered in English, Spanish, Cantonese, Mandarin, Korean, Tagalog, and Vietnamese throughout the state of California. Adjustment factors for the selection mechanisms have been incorporated into the data's sample weights. Please refer to the CHIS methodology report for details of the design, sampling, and data processing (CHIS, 2019; CHIS, 2019; CHIS, 2019).

Our analytical sample was limited to young adults ages 18–25. From the CHIS 2018 adult data file, a total of 3,929 young adults were identified and retained for the main analyses. We also used 2018 CHIS data to compare the rates of current cigarette/e-cigarette/marijuana use with those in 2017.

### 2.2. Outcome measures

We used the responses to several questions to define the outcome variables: current users (any use of cigarettes, e-cigarettes, or marijuana in the past 30 days). Specifically, to define current cigarette smoking, respondents who answered yes to the CHIS question, "Altogether, have you smoked at least 100 or more cigarettes in your entire lifetime?" were

asked, "Do you now smoke cigarettes every day, some days, or not at all?" If the respondents said they were now smoking every day or some days, they were also asked "In the past 30 days, when you smoked, how many cigarettes did you smoke per day?" For the respondents who had positive responses to these questions or had more than one cigarette in the past 30 days, they were defined as current users. For e-cigarette smoking, CHIS asked adult respondents: "Have you ever used any type of e-cigarette, vape pen, or e-hookah, such as Blu, NJOY, or Vuse, or any larger devices for vaping, sometimes called vapes, tanks, or mods?" Among those who responded positively, a follow-up question was asked: "During the past 30 days, on how many days did you use electronic cigarettes?" For marijuana use, the question was: "Have you ever, even once, tried marijuana or hashish in any form?" Then, to determine marijuana's current use, CHIS asked the question: "How long has it been since you last used marijuana or hashish in any form?" For the respondents who reported any use within the past month, they were defined as current users.

### 2.3. Assessment of psychological distress

The Kessler 6 (K6) scale was administered to adult respondents to collect self-reports on non-specific psychological distress. It contains six questions on a 5-point scale (0–4) about the frequency of anxiety and depression symptoms (e.g. hopelessness, worthlessness) in the past 30 days (Kessler et al., 2002). The total score of K6 ranges from 0 to 24, K6 scores of 0–4 were usually defined as having no or mild distress, and K6 scores of 5–12 were defined as having moderate psychological distress, and 13 and above were severe psychological distress (Prochaska et al., 2012). Thus, we categorized psychological distress into 3 categories: (1) no/mild psychological distress, (2) moderate psychological distress, and (3) severe psychological distress for this study, as has been done in other studies (Prochaska et al., 2012; Mitchell & Beals, 2011; Fushimi et al., 2012).

### 2.4. Relevant covariates

Covariates that CHIS 2017 represent potential confounding were included if they were known to be related to cigarette or marijuana use behaviors (Ramo et al., 2013; Deasy et al., 2015). The fully adjusted model contained individual/household level socio-demographic characteristics collected during CHIS interviews (CHIS, 2017; CHIS, 2018), including age (18–20, 21–25), race/ethnicity (Latino, Asian, Black, White, American Indian/Alaska Native, other single or multiple races), sex (male, female), household income standardized by federal poverty level (FPL: 0–199% FPL, 200% FPL or above), psychological distress, residence in urban/rural area which is assigned using the Claritas urbanicity model ([https://nhts.ornl.gov/assets/Assessing\\_the\\_Role\\_of\\_Urbanicity.pdf](https://nhts.ornl.gov/assets/Assessing_the_Role_of_Urbanicity.pdf)), and seven regions by grouping 58 counties in California according to their geographic locations, such as Greater Bay Area, Sacramento Area, San Joaquin Valley, Los Angeles, other Southern California, and North/Sierra Counties. The Asian, African American, and White race categories were tabulated as non-Latino ethnicity. The "Others" category aggregates non-Latino Native Hawaiians/Pacific Islanders, American Indians/Alaska Natives, and multi-racial individuals.

### 2.5. Statistical analyses

The bivariate analysis chi-squared tests were used to determine if there were significant changes in the rates of using cigarettes, e-cigarettes, and marijuana, separately or any use of the three between 2017 and 2018. We also did the same analyses to examine the differences in the use across the subgroups by socio-demographic and other characteristics using CHIS 2018 data. Logistic models regressing the odds of using cigarettes, e-cigarettes, and marijuana, separately or any use of the three while accounting for sampling weights were conducted. These models have adjusted for covariates, which include age, race/ethnicity,

sex, FPL, urban/rural status, region of residence, and psychological distress using CHIS 2018 data. We also adjusted for the current use of each of these products/substances to address the potential confounding in all the models except for any use of the three. For example, we co-adjusted for the use of e-cigarettes and marijuana in the model regressing the odds of using cigarettes. A jackknife method based on design-based replicate weights was used to estimate variances and significance values of regression coefficients. The same types of analyses were conducted separately for use of different types of products/substances. All analyses were implemented using SAS 9.4 (SAS Institute Inc., Cary, NC).

### 3. Results

#### 3.1. Trends in tobacco and marijuana use

In 2018, 1.66 million California young adults, ages 18 to 25, were currently using at least one form of cigarette, e-cigarette, or marijuana: 314,000 smoked cigarettes, 682,000 used (vaped) e-cigarettes, and 1.3 million used marijuana. There was no statistically significant change in cigarette use between 2017 and 2018 (Fig. 1). In contrast, there was escalating use of e-cigarettes and marijuana. Between 2017 and 2018, current e-cigarette use (vaping) climbed by 4.8% and current marijuana use rose by 4.6% among young adults. The proportion of young adults currently using any of these products/substance increased by 5.5% between 2017 and 2018 (Fig. 1).

#### 3.2. Descriptive analyses

Table 1 presents descriptive analyses of the current use of cigarettes, e-cigarettes, marijuana, and any use of the three by age, gender, race/ethnicity, income (federal poverty level), psychological distress, urban/rural residence, and region of residence. Young adults aged 18–20 were smoking cigarettes at significantly lower rates (4.6%) than other young adults aged 21–25 (8.6%). Underage use (i.e., use among those aged 18–20) was substantial for e-cigarettes and marijuana. About 17% of underage young adults were current e-cigarette users. About 27% of underage young adults were current marijuana users.

A wide and significant male–female difference was seen in e-cigarette use (9.3 percentage points), with male e-cigarette use nearly doubled female e-cigarette use. Any use of cigarettes, e-cigarettes, or marijuana was also significantly higher for males than females. Young adults who were white have higher rates of cigarette and e-cigarette use than those who were Latino. Approximately 27% of young adult Latino,

whites, and Asians used marijuana. Only e-cigarette rates differed significantly by income: young adults with incomes at or below 200% FPL- used e-cigarettes at lower rates than young adults with incomes greater than 200% FPL. Young adults with psychological distress had higher rates of use of cigarettes, e-cigarettes, marijuana, or any use of the three.

#### 3.3. Logistic regression results

After controlling for covariates in multivariable logistic regression, psychological distress, age, use of the other substances, sex, race/ethnicity, and income levels were significantly associated with the use of cigarettes, e-cigarettes, marijuana, or any use of the three (Table 2).

Specifically, among current cigarette users, using e-cigarettes (AOR = 5.25, 95% CI = 2.21, 12.50) was associated with higher odds of smoking cigarettes. Both severe (AOR = 4.06, 95% CI = 1.32, 12.55) and moderate (AOR = 2.59, 95% CI = 1.23, 5.40) psychological distress were also associated with increased cigarette smoking. The underage young adults (age 18 to 20) had lower odds of smoking cigarettes than older young adults (AOR = 0.42, 95% CI = 0.21, 0.82).

For current e-cigarette use, those who were currently using cigarettes (AOR = 5.32, 95% CI = 2.15, 13.16) or marijuana (AOR = 5.63, 95% CI = 3.13, 10.15) had higher odds of smoking e-cigarettes. Males had higher odds than females to use e-cigarettes (AOR = 2.00, 95% CI = 1.04, 3.84). Young adults with incomes greater than 200% FPL had higher odds of using e-cigarettes than those with incomes at or below 200% FPL (AOR = 2.19, 95% CI = 1.18, 4.06).

The odds of current marijuana use were 5 times higher for those who were currently smoking e-cigarettes than those not using them (AOR = 5.43; 95% CI = 3.03, 9.77). Those with severe psychological distress had nearly twice the odds of marijuana use than those with mild or no psychological distress (AOR = 2.32, 95% CI = 1.10, 4.88). Those with moderate psychological distress were also associated with increased marijuana use (AOR = 1.58, 95% CI = 1.01, 2.50) than those with mild or no psychological distress. Native Hawaiians/Pacific Islanders, other races, and multi-racial individuals also had increased odds of using marijuana than white (AOR = 2.43, 95% CI = 1.16, 5.12).

Among young adults with any use of the three products/substance, those with severe psychological distress had 4 times the odds of using any of the three products/substance than those with mild or no psychological distress (AOR = 4.11; 95% CI = 1.93, 8.77). Those with moderate psychological distress were also associated with increased use of any of the three products/substance (AOR = 1.87, 95% CI = 1.19, 2.93) than those with mild or no psychological distress. Males had

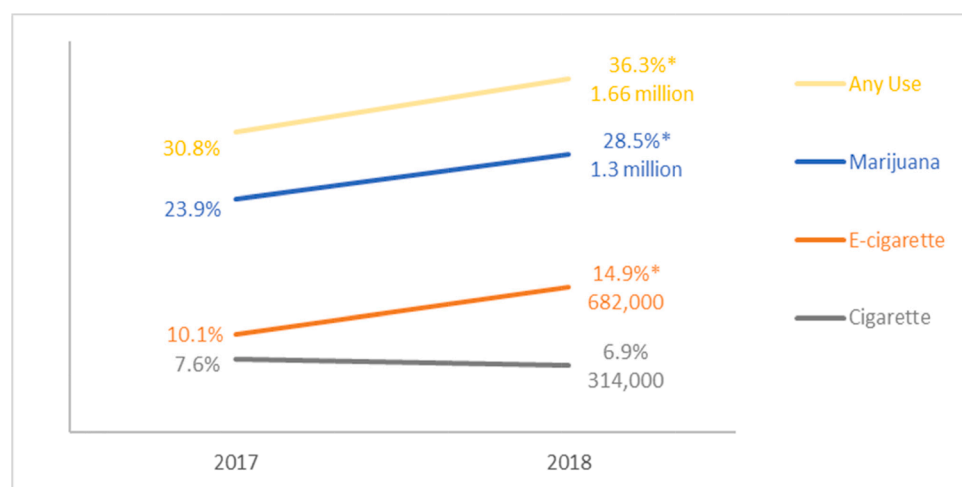


Fig. 1. Trends in Current Use of Cigarettes, E-Cigarettes, or Marijuana, Adults Ages 18–25, California, 2017 and 2018. Source: 2017 and 2018 California Health Interview Surveys Note: \*Differences between 2017 and 2018 were statistically significant at  $p \leq 0.05$ .

**Table 1**

Sociodemographic Patterns of Current Use of Cigarettes, E-Cigarettes, and Marijuana, Adults Ages 18–25, California, 2018.

	Percent of Population, Ages 18–25	Cigarette	E-Cigarette	Marijuana	Any Use of Cigarettes or E-Cigarettes or Marijuana
<b>Total</b>	<b>100%</b>	<b>6.9%</b>	<b>14.9%</b>	<b>28.5%</b>	<b>36.3%</b>
Age group					
18–20 years old	43.0%	4.6 % <sup>a</sup>	16.7%	27.0%	35.9%
21–25 years old	57.0%	8.6%	13.6%	29.6%	36.6%
Gender					
Male	51.0%	7.8%	19.5%	31.8%	40.9%
Female	49.0%	5.9%	10.2 % <sup>b</sup>	25.1%	31.6 % <sup>b</sup>
Race/Ethnicity*					
Latino	30.0%	4.9 % <sup>c</sup>	10.4 % <sup>c</sup>	27.1%	32.1%
White	27.0%	10.5%	19.0%	27.6%	38.4%
Asian	17.0%	NR	16.0%	27.1%	35.4%
African American	5.0%	NR	NR	38.1%	43.6%
Other Single Race/Multiracial	21.0%	NR	16.4%	30.8%	38.9%
Income as % of Federal Poverty Level (FPL)					
0–200% FPL	43.0%	8.0%	10.1 % <sup>d</sup>	27.1%	33.0%
>200% FPL	57.0%	6.0%	18.5%	29.5%	38.8%
Psychological Distress					
Severe Distress (K6-score: ≥ 13)	8.0%	17.0%	20.0%	41.6%	54.5%
Moderate Distress (K6-score: 5–12)	44.0%	8.6%	12.9%	30.0%	38.0%
No or Mild Distress (K6-score: 0–4)	48.3%	4.3%	10.9%	20.1%	25.9%
Urban and Rural Residence					
Urban	91.0%	7.0%	12.8%	26.5%	33.9%
Rural	9.0%	NR	9.2%	23.2%	30.2%
Region					
North/Sierra Counties	4.0%	14.3%	15.1%	31.7%	40.2%
Greater Bay Area	16.0%	NR	15.1%	30.9%	40.3%
Sacramento Area	6.0%	NR	NR	26.2%	32.4%
San Joaquin Valley	11.0%	7.5%	7.3%	20.5%	25.5%
Central Coast	6.0%	NR	13.4%	28.6%	35.7%
Los Angeles	27.0%	6.3%	12.2%	26.8%	33.4%
Other Southern Cal	30.0%	7.4%	13.3%	24.1%	32.1%

Note: NR: Not reported due to instability of estimate. Data source: 2018 California Health Interview Survey.

\*Race tabulation is based on the UCLA Center for Health Policy Research tabulation, “racehp2\_p1”, which classifies multiracial individuals and Latino individuals according to their reported primary race identification. Other Single Race/Multiracial includes individuals who report Other Race, American Indian/Alaska Native, Native Hawaiian/Pacific Islander, or more than one race. Estimates for American Indian/Alaska Native and Native Hawaiian/Pacific Islander were unstable for reporting.

<sup>a</sup> Significantly different from 21 to 25-year-olds at  $p < 0.05$ .

<sup>b</sup> Significantly different from males at  $p < 0.05$ .

<sup>c</sup> Significantly different from whites at  $p < 0.05$ .

<sup>d</sup> Significantly different from income > 200 %FPL at  $p < 0.05$ .

higher odds than females to use any of the three products/substance (AOR = 1.62; 95% CI = 1.08, 2.45). Young adults with incomes greater than 200% FPL had higher odds of using any of the three products/substance than those with incomes at or below 200% FPL. (AOR = 1.43, 95% CI = 1.00, 2.07).

#### 4. Discussion

From 2017 to 2018, California saw an increase in e-cigarette and marijuana use among young adults, while cigarette smoking remained flat. Psychological distress was observed to be associated with cigarette, e-cigarette, marijuana use, or any use of the three. Using cigarettes, e-cigarettes and marijuana were also found mutually correlated. California’s trends in cigarette and e-cigarette smoking are parallel to those observed nationwide (U.S. Department of Health and Human Services, 2016). What stands out in our findings are several aspects. One is that the percentage of California young adults using marijuana increased to 28.5% from 2017 to 2018 while the national rate remained to be 22% for both years (Substance Abuse and Mental Health Services Administration, 2019) Another finding is that in 2018, those young adults who were using each of these products/substance also significantly increased the odds of using cigarettes, e-cigarettes, or marijuana than their counterparts. Importantly, we found that severe psychological distress was significantly associated with the use of cigarettes and marijuana. Although many tobaccos and recreational cannabis use policies restrict

sales to young adults under age 21, underage use is considerable—about half of the young adults were current e-cigarette users and more than half a million or 40% of current marijuana users were underage.

Our findings that cigarette smoking rates remained flat between 2017 and 2018, but e-cigarette smoking and marijuana increased could be possibly explained by the current policy changes related to the cigarette tax increase and recreational marijuana legalization in California. The finding that the smoking rates would remain flat is expected since the CHIS 2017 data were collected after the cigarette tax increase in April 2017. Studies have found that marijuana policy could inadvertently affect cigarette and marijuana use and this spillover effect poses challenges to tobacco cessation (Wang et al., 2016; Reboussin et al., 2021). Similar to our findings, other studies have also shown that cannabis and e-cigarettes uses have increased among youth, and these trends will likely continue as e-cigarettes remain to gain popularity and cannabis legalization policies proliferate (Skinner et al., 2021).

Our findings that the use of tobacco is positively associated with the use of marijuana or vice versa among young adults are consistent with other studies (Ramo and Prochaska, 2012). There are several explanations for this association. One is that tobacco and marijuana use support and reinforce the use of each other (Ramo et al., 2012) Research has shown that tobacco use is associated with initiation and dependence on other substances, such as marijuana (Schauer & Peters, 2018). Longitudinal studies that examined tobacco use before marijuana use generally supported a gateway sequence and progression, in that case, people



**Table 2**  
Factors Associated with Current Use of Cigarettes, E-Cigarettes, and Marijuana, Adults Ages 18–25, California, 2018.

	Cigarette	E-Cigarette	Marijuana	Any Use
Effect	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Moderate Psychological Distress vs. No Distress	2.59 (1.23 to 5.40) **	1.06 (0.54 to 2.04)	1.58 (1.01 to 2.50) **	1.87 (1.19 to 2.93) **
Severe Psychological Distress vs. No Distress	4.06 (1.32 to 12.55) *	1.39 (0.50 to 3.86)	2.32 (1.10 to 4.88) **	4.11 (1.93 to 8.77) **
Age 18–20 vs 21–25	0.42 (0.21 to 0.82) **	1.62 (0.88 to 2.96)	0.78 (0.53 to 1.16)	0.93 (0.65 to 1.33)
Male vs Female	1.20 (0.58 to 2.47)	2.00 (1.04 to 3.84) **	1.26 (0.81 to 1.97)	1.62 (1.08 to 2.45) **
Latino vs. White	0.45 (0.18 to 1.16)	0.58 (0.28 to 1.18)	1.40 (0.80 to 2.44)	0.92 (0.62 to 1.96)
African American vs. White	0.54 (0.21 to 1.44)	0.91 (0.48 to 1.73)	1.33 (0.74 to 2.40)	1.10 (0.54 to 1.39)
American Indian/ Alaska Native vs. White	0.64 (0.01 to 5.67)	0.64 (<0.001 to 750)	1.70 (0.27 to 10.72)	0.97 (0.13 to 7.47)
Asian vs White	0.46 (0.10 to 2.25)	0.84 (0.36 to 1.97)	0.99 (0.49 to 2.01)	0.79 (0.39 to 1.62)
Others Single/ Multiple Race vs White	0.66 (0.13 to 3.26)	0.43 (0.12 to 1.56)	2.43 (1.16 to 5.12) **	1.55 (0.77 to 3.10)
FPL 200%+ vs Under 200%	0.55 (0.23 to 1.34)	2.19 (1.18 to 4.06) **	1.10 (0.70 to 1.72)	1.43 (1.00 to 2.07) *
Cigarette Use vs No		5.32 (2.15 to 13.16) **	1.35 (0.63 to 2.92)	
E-Cigarette Use vs No	5.25 (2.21 to 12.50) **		5.43 (3.03 to 9.77) **	
Marijuana Use vs No	1.35 (0.64 to 2.87)	5.63 (3.13 to 10.15) **		
Urban vs Rural	1.02 (0.32 to 3.29)	1.78 (0.72 to 4.41)	1.26 (0.51 to 3.11)	1.50 (0.71 to 3.18)
North./Sierra Counties vs San Joaquin Valley	0.85 (0.25 to 2.87)	1.64 (0.35 to 7.71)	1.42 (0.57 to 3.50)	1.63 (0.73 to 3.68)
Greater Bay Area vs San Joaquin Valley	0.42 (0.06 to 3.05)	1.84 (0.43 to 7.82)	1.39 (0.55 to 3.57)	1.69 (0.72 to 3.96)
Sacramento Area vs San Joaquin Valley	0.88 (0.11 to 7.09)	0.95 (0.16 to 5.57)	1.09 (0.36 to 3.33)	1.16 (0.43 to 3.14)
Central Coast vs San Joaquin Valley	0.30 (0.06 to 1.57)	2.82 (0.67 to 11.92)	1.00 (0.40 to 2.51)	1.45 (0.57 to 3.68)
Los Angeles vs San Joaquin Valley	0.65 (0.21 to 2.03)	2.09 (0.65 to 6.69)	0.87 (0.35 to 2.14)	1.24 (0.57 to 2.67)
Other Southern Cal vs San Joaquin Valley	0.79 (0.26 to 2.35)	2.22 (0.77 to 6.45)	0.66 (0.29 to 1.49)	0.95 (0.44 to 2.03)

Note: \* P < 0.05, \*\*P < 0.01. Current use is defined as past 30-day use of the specified product/substance.

smoked tobacco first, then marijuana (Lynskey et al., 2003). Additional studies have shown a “reverse gateway effect,” that those who used marijuana were at increased risk of initiating tobacco (D’Amico and McCarthy, 2006). Another explanation for the concurrent use of cigarettes, e-cigarettes and marijuana is that tobacco and marijuana can co-occur via the same devices for both tobacco and marijuana (Schauer et al., 2015). Studies showed that concurrent users were more likely to use e-cigarettes and blunts to administer marijuana. (Reboussin et al.,

2021) Vaporizers (e-cigarettes) are increasingly popular among young people. Many youths replace nicotine with marijuana (THC or hash oil) in battery-powered vaporizers (Budney et al., 2015; Morean et al., 2015). Another way is through the use of “blunts,” or rolling up marijuana in a cigar or cigarillo shell. Research has shown that ‘smoking’ was found to constitute a social construct within which the use of cigarettes, cigars, and blunts was somewhat interchangeable among the youth (Lee et al., 2010). Tobacco and marijuana, taken in combination, potentially raise the likelihood of dependence on these substances and problems associated with their use. For example, one study of University of Florida college students who used both cigarettes and marijuana found that 65% had smoked both substances in the same hour; 31% reported they smoked tobacco to prolong and sustain the effects of marijuana, and 55% had friends who engaged in these behaviors (Tullis et al., 2003).

Our findings that psychological distress was significantly associated with smoking cigarettes or using marijuana were supported by previous studies (Sung et al., 2011; Copeland and Maxwell, 2007). Studies showed that adolescents and young adults with mental health problems were at high risk for tobacco and marijuana use, compared to those without such problems (Ramsey et al., 2005; Choi et al., 2019; Roberts et al., 2007). Studies also showed that affective disorders and psychological distress were more common among those who smoke than those who do not smoke and among cannabis-dependent participants (Mathews et al., 2011). Daily cannabis use was significantly more common among persons with serious psychological distress and was increasing in this group, as well as among those without (Weinberger et al., 2008). Lower quit rates among those with serious psychological distress are one factor that could contribute to the higher prevalence of smoking in this group (Leung et al., 2011). A study using the 2008–2016 National Survey on Drug Use and Health showed that quit rates among individuals with past-month psychological distress were approximately half than quit rates of those without psychological distress and had not increased over the past decade (Streck et al., 2008). Adults with depression or psychological distress had a lower quit ratio overall, but were equally or even more likely to make quit or self-regulation attempts (Shi, 2014). One study’s findings suggest an increase in psychological distress among those who smoke over time may be due to the fact that as smoking has declined, thus those with psychological distress are comprising a greater proportion of those remaining to smoke. (Zvolensky et al., 2018).

Given that our study is cross-sectional, the direction of the association between substance use and mental health could not be established. If substance use is an antecedent to psychological distress, our estimated effects of psychological distress on smoking cigarettes and marijuana use may be biased upward. A few longitudinal studies provide causal evidence that smoking or marijuana use increased with psychological distress. For instance, a study using longitudinal data showed that smoking uptake was associated with an increase in psychological distress (Carter et al., 2014). Another birth cohort study that tracks youth longitudinally from before marijuana onset also reinforced that early-onset and chronic marijuana use was associated with a greater risk of psychiatric disorders (McLaren et al., 2010). Data from a cohort study (the Stockholm Public Health Cohort) with an 8-year follow-up in the general population in Stockholm County also showed cannabis use was associated with an increased risk of psychological distress eight years later in Sweden women (Danielsson et al., 2016). Regardless of the causal direction, to protect the health and well-being of young adults, decision-makers need to consider both the mental health and substance use behavior implications of less restrictive substance use policies.

California laws (T21) banned sales of cigarettes, e-cigarettes in 2016, and marijuana to young adults under 21 years old. Though underage young adults (age 18 to 20) had lower odds of smoking cigarettes than older young adults, the underage use was substantial for e-cigarettes and marijuana. Studies on the effectiveness of these laws were limited but showed some promising results. The studies did show that California law reduced illegal sales to youth under 18 (Zhang et al., 2018; Ali et al., 2020; Dove et al., 2021). Researchers from UC Davis used data from the

2012–2019 Behavioral Risk Factor Surveillance System (n = 15,863) and observed that although the trends of ever and current smoking did not change significantly before and after California's T21 policy, while there was an 8% annual decrease of daily smoking before the policy and a 26% annual decrease after the policy among underage in California (Dove et al., 2021). Our study and others showed that underage use could still be an issue due to limited knowledge of such laws and other influencing factors (e.g. perceived support for such a law). A study found that the knowledge of the minimum legal age (MLA) was inversely associated with the intention to use tobacco among youth. Educational campaigns to raise awareness and support for MLA among youth may improve the impact of MLA policies (Dai et al., 2021).

The strength of this study is that it is based on CHIS data, which is the largest state health survey in the nation, and it collects extensive information for assessing the health and health behaviors of adults, adolescents, and children in California. Each year, CHIS surveys over 20,000 households. Also, from 2016 to January 2018, California implemented a series of policies, including prohibiting the sale of tobacco products and e-cigarettes to persons under 21, a cigarette tax increase, and recreational marijuana legalization. All these state-level policy changes make California a natural experimental ground for studies on tobacco and marijuana use behaviors and risk factors associated with smoking behaviors among young adults. It is worth noting that the findings in this study are subject to some limitations. First, data were self-reported, which might have resulted in recall and social desirability biases. Specifically, we were unable to examine whether decriminalization and legalization of adult marijuana use affected self-reporting bias; that is, respondents might have felt more comfortable reporting marijuana use as it became legal in California. Second, the survey does not include institutionalized populations and persons in the military in its sample, so the results might not be generalizable to those populations. Lastly, as noted, it is based on cross-sectional data, it is difficult to determine the direction of the relationships we estimated, for instance, if cigarette use caused marijuana use or vice versa.

## 5. Conclusions

In this changing smoking environment where young adults are experimenting with tobacco, e-cigarettes, and marijuana, policies that affect the access and social environments of all three products/substances should be considered together. Policies need to ensure that young adults do not choose one product over the other because of differential prices, access, and availability across products/substances (Saffer et al., 2019). Targeted tobacco and cannabis prevention strategies are needed for youth, especially in states that have implemented a policy with more access to recreational use of cannabis. Given the nationwide adoption of minimum legal age policies for tobacco sales, educational campaigns to promote knowledge of the policy may improve its impact. In tandem with these policies and education and outreach activities, a holistic strategy is imperative in addressing psychological distress and the use of other substances to effectively curtail tobacco and marijuana use among young adult users.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

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