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Cannabis use disorders are comparatively prevalent among nonwhite racial/ethnic groups and adolescents: A national study

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ABSTRACT

The racial/ethnic composition of the US population is shifting, with the nonwhite population growing faster than whites. We examined cannabis use disorder (CUD) prevalences and correlates in seven racial/ethnic groups. We included cannabis use (CU) prevalence as a comparison. Data were from the 2005–2011 National Surveys on Drug Use and Health ($N = 394{,}400$). Substance use among respondents aged ≥12 years was assessed by computer-assisted, self-interviewing methods. The following were included as control variables: age, sex, family income, government assistance, county type, residential stability, major depressive episode history, arrest history, nicotine dependence, alcohol disorder, and survey year. Past-year CU prevalence increased significantly from 10.45% in 2005 to 11.41–11.54% during 2009–2011. Compared with whites, mixed-race individuals had higher odds of CU; Asian Americans and Hispanics had lower odds of CU. There were no significant yearly changes in CUD prevalence in the sample during 2005–2011 (1.58–1.73%). Compared with whites, individuals who were mixed-race, black, and Native American had higher odds of CUD; Asian Americans had lower odds. In aggregate, 15.35% of past-year cannabis users met criteria for a CUD in the 12-month period. Past-year cannabis users who were black, Native American, Hispanic, or Asian American had higher odds of CUD than white users. In each racial/ethnic group, adolescent cannabis users generally showed greater odds of CUD than adult users. Behavioral health indicators (major depressive episode, arrest history, nicotine dependence, alcohol disorder) were associated with CU and CUD. In conclusion, CUD disproportionally affects nonwhite groups and youth.

1. Introduction

Globally, an estimated 2.6–5.0% of the population aged 15–64 years used cannabis in the past year (United Nations Office on Drugs and Crime, 2012). In the United States, survey data estimate that approximately 18.1 million people are current cannabis users (7.0% of the general population aged ≥12 years). This far exceeds prescription opioids, which are the second most commonly used drug class with 4.5 million current nonmedical users or 1.7% of the general population aged ≥12 years (Substance Abuse and Mental Health Services Administration [SAMHSA], 2012a). In 2011, there were an estimated 3.1 million first-time users of any illicit drug; of them, 2.6 million used cannabis (SAMHSA, 2012a). The majority of illicit drug use disorders result from cannabis use (CU). Of the estimated 6.5 million general US population aged ≥12 years who have an illicit drug use disorder in a year, 65% of them (representing 1.6% of the general population aged ≥12 years) have a cannabis use disorder (CUD) (SAMHSA, 2012a).

There are a number of potential health risks of CU. CU may impair driving and is an important contributing factor for serious or fatal injury crashes (Institute for Behavior and Health, 2013). Repeated CU is associated with a broad range of psychiatric conditions (addiction; mood, anxiety, or personality disorders; and psychotic symptoms) (Hurd et al., 2013; Lev-Ran et al., 2012; Rubino et al., 2012; Ruiz-Veguilla et al., 2013; Stone et al., 2013). Data from a national survey show that adults (aged ≥18 years) with a past-year mental disorder represent 72% of all cannabis users

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in the sample (Lev-Ran et al., 2012). The identified associations between CU and health conditions tend to show a dose-related pattern, indicating greater severity among frequent cannabis users (Lev-Ran et al., 2012; Rubino et al., 2012; Ruiz-Veguilla et al., 2013; Stone et al., 2013). Additionally, there are age-related effects from cannabis exposure. Repeated CU in adolescence confers a particularly elevated risk for experiencing psychiatric disorders, including psychotic conditions (Rubino et al., 2012; Ruiz-Veguilla et al., 2013; Schubart et al., 2011). Adolescence is a critical phase for brain development in areas associated with impulsivity, judgment, and executive function. Maturation and development of the endocannabinoid systems, which are involved in the regulation of many emotional and appetitive behaviors, could be impacted by chronic CU. Frequent CU might be associated with subtle but lasting neurobiological changes that may impact neural circuitry (emotion, cognition, learning) and behaviors to enhance the vulnerability to the development of a variety of psychiatric conditions (http://www.ncbi.nlm.nih.gov/pubmed?term=Realini%20N%5BAuthor%5D&cauthor=true&cauthor_uid=19559364; Realini et al., 2009; Schneider, 2008).

During the past decade, state-specific policies related to cannabis (medical use, legalization) have contributed to changes in the availability of cannabis (increase in supply, access) and perhaps changes in perceived norms or harm of CU (more tolerant of use, lower perceived risk of harm) (Friese and Grube, 2013; Levy, 2013). There are continuous concerns about the impact of medical cannabis and legalizing recreational use on increasing cannabis problems (Joffe, 2004; Levy, 2013). To date, 20 states and Washington, DC, have medical cannabis, two have legalized recreational use and four states have legislation pending. Cerdá et al. (2012) found that states with medical cannabis had a higher prevalence of CU than states without. Data from the Drug Abuse Warning Network (DAWN) indicate an increase in cannabis-related emergency department visits (SAMHSA, 2012b). Additional studies have suggested a pattern of common medical cannabis diversion and CU by adolescents in substance abuse treatment (Salomonsen-Sautel et al., 2012; Thurstone et al., 2011). Together, these data demonstrate the need to investigate the extent of cannabis problems in adolescents and adults.

Additionally, there have been notable shifts in racial/ethnic compositions of the US population with major nonwhite groups growing faster than the white group (US Census Bureau, 2011). Asian Americans, Hispanics, Native Hawaiians/Pacific Islanders (NHs/PIs), and mixed-race individuals (>1 race) are among the fastest-growing groups, followed by Native Americans (American Indians/Alaska Natives) and blacks. These changing demographics require research to gage their extent of CUD in demographic subgroups to inform research and prevention efforts. No studies have specifically examined and compared prevalences and correlates of CUD in demographic subgroups. Because of smaller population sizes of Asian American, Native American, NH/PI, and mixed-race people, illicit drug use studies typically focus on whites, blacks, and Hispanics, and include small numbers of members from these nonwhite groups. Asian American, Native American, NH/PI, and mixed-race people are often pooled as "others" or omitted from the reports (Johnston et al., 2012).

The increased concern about the potential impact of increased cannabis availability on cannabis problems, coupled with changing demographic profiles of the US population, point to the need for research to evaluate population-based estimates of CUD and their correlates for racial/ethnic groups. The nationally representative samples of the National Survey on Drug Use and Health (NSDUH) include individuals aged ≥12 years from all major racial/ethnic groups, allowing for comparisons of CUD between adolescents and adults. To include adequate numbers of understudied groups (Asian American, Native American, NH/PI, and mixed-race people) to generate reliable estimates of prevalences and correlates of CUD, multiple years of public-use data files were used. The independent and cross-sectional 2005–2011 NSDUHs use similar designs and permit analysis of the same variables from the pooled sample.

We examined 1) recent national trends in past-year prevalence of CUD to gage the extent of CUD in the general population, and 2) conditional prevalences of CUD among past-year cannabis users to identify demographic differences in the likelihood of CUD. The latter provides empirical information to inform prevention and etiological research. We also determined correlates of CUD for each racial/ethnic group to examine similarities and differences across groups. To facilitate interpretation of findings, we included trends in past-year CU prevalence as a comparison.

2. Methods

2.1. Data source

Public-use data files from the 2005–2011 NSDUHs were analyzed to characterize recent national trends in CUD. All respondents aged ≥12 years were included to provide a comprehensive description of age-related patterns in CUD. The NSDUH is the only national survey designed to provide ongoing estimates of drug use and disorders in the United States (SAMHSA, 2006, 2012a). The 2005–2011 surveys used multistage area probability sampling methods to select a representative sample of the civilian, noninstitutionalized population aged ≥12 years. Residents of households from the 50 states (including shelters, rooming houses, and group homes) as well as civilians residing on military bases were included. The design oversampled people aged 12–25 years. Due to a large sample size, there was no need to oversample racial/ethnic groups, as was done before 1999. The NSDUH's annual sample of respondents was considered representative of the US general population aged ≥12 years.

Respondents were interviewed at their home for about an hour. They were assured that their names would not be recorded and their responses would be kept strictly confidential, and all study procedures and protections were carefully explained. Respondents' sociodemographics were assessed by computer-assisted personal interviews; substance use questions of a sensitive nature were assessed using an audio computer-assisted self-interviewing (ACASI) method to increase respondents' reports of substance use and sensitive behaviors (Turner et al., 1998). The latter was designed to increase honest reports of substance use by allowing respondents to either read the questions on a computer screen or listen to the questions read aloud by the computer through headphones, and then enter their responses directly into the computer.

To include adequate numbers for racial/ethnic groups with smaller population sizes (Native American, Asian American, NH/PI, and mixed race) for detecting meaningful racial/ethnic differences in CUD, we pooled public-use data files from 2005 to 2011 (n = 55,279–58,379/year). These years used similar designs, allowing pooled analyses of the same variables (SAMHSA, 2006, 2012a). Weighted response rates of household screening and interviewing for these years were 87–91% and 73–76%, respectively.

2.2. Study variables

2.2.1. Demographics

Self-reported race and ethnicity were assessed separately. The NSDUH defined seven mutually exclusive groups: non-Hispanic whites, non-Hispanic blacks, non-Hispanic Native Americans (American Indians/Alaska Natives), non-Hispanic NHs/PIs, non-Hispanic Asian Americans, mixed-race individuals (>1 race), and

Hispanics. The data did not distinguish between specific racial groups of mixed-race individuals. In the 2010 census, 83% of mixed-race individuals were white in combination with ≥1 other race (black, Asian American, NH/PI, Native American, or other) (US Census Bureau, 2011). Age, sex, family income, government assistance status, county type (large, small, nonmetropolitan areas), and residential stability (e.g., "How many times in the past 12 months have you moved?") were included in the logistic regression analysis to account for race/ethnicity-related differences in socioeconomic and residential factors (Duncan et al., 2002; Wilson and Donnermeyer, 2006). Government assistance included participation in any government assistance programs (e.g., supplemental security income, food stamps, or cash assistance).

2.2.2. CU and CUD

NSDUH assessments of substance use and substance-specific DSM-IV (Diagnostic and Statistical Manual of Mental Disorders [Fourth Edition]) disorders (abuse or dependence) included a detailed description of each substance class and lists of substances belonging to that class (American Psychiatric Association, 2000). Each substance class was assessed separately via the ACASI method. CU was defined as any self-reported illicit (nonmedical) use of marijuana and hashish. Respondents were read the following: "Marijuana is also called pot or grass. Marijuana is usually smoked—either in cigarettes called joints or in a pipe. It is sometimes cooked in food. Hashish is a form of marijuana that is also called hash. It is usually smoked in a pipe. Another form of hashish is hash oil." The survey then employed discrete questions to assess respondents' past-year use status and frequency of use. Past-year frequency of CU was categorized into three mutually exclusive groups: 1–11 days, 12–51 days, and ≥52 days (weekly or more) (Wu et al., 2012). Standardized assessments for cannabis-specific abuse and dependence symptoms as well as alcohol-specific abuse and dependence symptoms were based on DSM-IV criteria and administered through the ACASI method. CUD included past-year cannabis abuse or dependence; likewise, alcohol use disorder included past-year alcohol abuse or dependence. Lifetime disorders were not assessed.

2.2.3. Other behavioral health

Respondents' past-year alcohol use disorder, past-month nicotine dependence, arrest history (e.g., "Not counting minor traffic violations, have you ever been arrested and booked for breaking the law?"), and any lifetime major depressive episodes (MDEs) were included as control variables due to their associations with substance use (Wu et al., 2008). Specifically, arrest history has been found to a consistent correlate of drug use and is associated with a problematic pattern of illicit drug use behaviors (Bennett et al., 2008; Office of National Drug Control Policy, 2010). Past-month nicotine dependence was defined as specified by the Nicotine Dependence Syndrome Scale (NDSS) (Shiffman et al., 2004) and the Fagerström Test for Nicotine Dependence (FTND) (Heatherton et al., 1991). NDSS assessed dependence similar to the concepts specified by DSM-IV. FTND focuses on discriminating between dependent smokers and nondependent smokers by assessing how soon after waking each smoker has his or her first cigarette. To optimize the number of respondents who can be classified as having current nicotine dependence, NSDUH classifies respondents as having dependence in the past month if they meet criteria as specified by NDSS or FTND. Past-year nicotine dependence was not assessed. Questions assessing past-year MDE were based on DSM-IV criteria (American Psychiatric Association, 2000) and were adapted from the National Comorbidity Survey Replication (for adults) and the National Comorbidity Survey-Adolescent (for adolescents) (Kessler et al., 2005). In NSDUH, a person was defined as having had a lifetime MDE if he/she had five or more of nine symptoms for MDE in the same 2-week period in his/her lifetime, in which at least one of the symptoms was a depressed mood or loss of interest or pleasure in daily activities. We used updated public-use data released in 2013 as they permitted pooled analyses of MDE variables from 2005 to 2011. Pre-2005 data do not include comparable MDE variables.

2.3. Data quality

NSDUH incorporates consistency checks in assessments and data management, statistical computation, and analysis weights to minimize response inconsistency and adjust for nonresponse bias (Gfroerer et al., 2002; Harrison et al., 2007; SAMHSA, 2012a). A large reliability study found substantial (for abuse/dependence questions) to nearly perfect (for cigarette, alcohol, and CU questions) response agreement for NSDUH measures (SAMHSA, 2010); an NSDUH validity study indicated high agreement between self-reported use and urine drug test results (marijuana, 90%) (Harrison et al., 2007). NSDUH-defined past-year prevalence of alcohol/drug use disorders among adults in 2000 (6.7%) resembled the prevalence of alcohol/drug use disorders (7.4%) among adults in the National Longitudinal Alcohol Epidemiologic Survey (Epstein, 2002).

2.4. Data analysis

Chi-square analysis was used to examine racial/ethnic differences in sociodemographics. We calculated CU and CUD in the sample and CUD in the subsample of past-year cannabis users (conditional probability of CUD given use). We examined conditional prevalences of CUD by race/ethnicity. We conducted adjusted logistic regression analyses to estimate associations between race/ethnicity and CUD among cannabis users, while adjusting for age, sex, family income, government assistance, county type, residential stability, MDE, arrest history, nicotine dependence, alcohol disorder, and survey year, to lessen for their confounding effects. Finally, we examined correlates of CUD for each racial/ethnic group. All analyses took into account the NSDUH's complex designs, such as weighting and clustering (RTI International, 2006). All results are weighted except for sample sizes.

3. Results

3.1. Sociodemographics by race/ethnicity (Table 1)

Compared with whites, nonwhite groups (except for NHs/PIs aged 12–17 years) had higher proportions of people aged <26 years (whites included more adults aged ≥50 years), blacks included more females, and Hispanics had more males. Compared with whites, nonwhite groups (except for Asian Americans) included more individuals residing in low-income households (<$20,000/year) or receiving government assistance.

3.2. Prevalence of past-year CU and CUD (Table 2)

3.2.1. CU in the sample

The CU prevalence in the sample increased slightly from 10.45% in 2005 to 11.41–11.54% in 2009–2011 ($P < 0.05$). Overall (annual average), mixed-race individuals (17.62%), Native Americans (14.97%), and blacks (12.84%) had a higher CU prevalence than whites (11.03%). Adults aged 18–25 years had the highest CU prevalence (29.13%).

3.2.2. CUD in the sample

There were no significant yearly changes in CUD prevalence during 2005–2011 (1.58–1.73%). Overall (annual average), Native

Table 1
Selective demographic characteristics of persons aged 12 years or older ($N = 394,400$).

Race/ethnicity	White		Black		Native American		Native Hawaiian/ Pacific Islander		Asian American		Mixed race		Hispanic	
Sample size	$N = 248,027$		$N = 50,146$		$N = 5939$		$N = 1826$		$N = 13,623$		$N = 12,209$		$N = 62,630$	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Age in years														
12–17	8.68	8.57–8.79	**12.66**	**12.39–12.93**	**11.50**	**10.23–12.90**	10.13	8.73–11.72	**9.62**	**9.05–10.22**	**16.33**	**15.53–17.16**	**13.56**	**13.17–13.95**
18–25	11.92	11.72–12.13	**15.67**	**15.21–16.15**	**15.92**	**14.35–17.63**	**16.77**	**14.39–19.45**	**14.02**	**13.18–14.90**	**15.50**	**14.57–16.47**	**17.37**	**16.89–17.87**
26–34	12.52	12.28–12.76	**15.35**	**14.73–15.99**	14.51	12.26–17.10	**18.08**	**15.37–21.16**	**18.83**	**17.56–20.17**	13.96	12.36–15.72	**20.39**	**19.70–21.11**
35–49	25.00	24.67–25.34	26.10	25.31–26.92	24.17	21.78–26.72	**32.86**	**27.93–38.19**	**29.51**	**27.79–31.28**	**19.60**	**18.07–21.23**	**27.28**	**26.68–27.88**
50–64	24.14	23.69–24.60	**19.54**	**18.62–20.50**	22.55	19.29–26.17	18.11	13.40–24.00	**18.01**	**16.52–19.62**	**20.85**	**18.57–23.33**	**14.17**	**13.47–14.90**
65+	17.73	17.33–18.14	**10.67**	**10.00–11.38**	**11.35**	**8.22–15.48**	**4.06**	**2.02–7.96**	**10.01**	**8.40–11.88**	**13.77**	**11.91–15.86**	**7.23**	**6.62–7.90**
Sex														
Male	48.60	48.24–48.96	**45.44**	**44.57–46.32**	46.92	44.11–49.75	49.46	43.49–55.44	47.54	45.68–49.41	47.27	44.39–50.18	**51.19**	**50.40–51.98**
Female	51.40	51.04–51.76	**54.56**	**53.68–55.43**	53.08	50.25–55.89	50.54	44.56–56.51	52.46	50.59–54.32	52.73	49.82–55.61	**48.81**	**48.02–49.60**
Total family income per year														
<$20,000	14.04	13.69–14.40	**32.54**	**31.66–33.42**	**36.60**	**33.61–39.71**	**18.33**	**14.78–22.51**	14.72	13.27–16.29	**23.96**	**22.11–25.92**	**26.85**	**25.99–27.73**
$20,000–$49,999	30.92	30.52–31.33	**37.24**	**36.36–38.12**	**37.13**	**34.04–40.34**	**38.28**	**33.83–42.95**	**25.87**	**24.21–27.61**	**34.89**	**32.55–37.30**	**42.77**	**41.95–43.59**
$50,000–$74,999	19.21	18.92–19.49	**14.15**	**13.48–14.84**	**12.41**	**10.37–14.79**	15.51	12.22–19.50	18.20	16.86–19.63	**15.79**	**14.27–17.44**	**13.66**	**13.12–14.22**
$75,000+	35.84	35.31–36.37	**16.08**	**15.36–16.83**	**13.85**	**12.10–15.81**	**27.87**	**22.67–33.74**	**41.21**	**39.31–43.13**	**25.36**	**23.33–27.50**	**16.72**	**16.04–17.42**
Government assistance														
Yes	11.74	11.49–11.98	**34.07**	**33.26–34.88**	**37.92**	**34.82–41.12**	**21.18**	**17.49–25.41**	**8.95**	**7.96–10.05**	**22.95**	**20.91–25.12**	**24.06**	**23.27–24.86**
No	88.26	88.02–88.51	**65.93**	**65.12–66.74**	**62.08**	**58.88–65.18**	**78.82**	**74.59–82.51**	**91.05**	**89.95–92.04**	**77.05**	**74.88–79.09**	**75.94**	**75.14–76.73**

Boldface: The estimate in a group differed from the estimates among whites.

Table 2
Past-year CU and CUD in the sample (prevalence) and past-year CUD among past-year cannabis users (conditional prevalence).

Race/ethnicity	CU in sample		CUD in sample		CUD among cannabis users	
Sample size	$N = 394,400$		$N = 394,400$		$n = 68,292$	
	%	95% CI	%	95% CI	%	95% CI
Overall prevalence						
Total	10.82	10.66–10.99	1.66	1.61–1.72	15.35	14.84–15.86
Year						
2005	10.45	10.05–10.88	1.60	1.48–1.73	15.32	14.21–16.50
2006	10.28	9.91–10.67	1.70	1.57–1.84	16.54	15.36–17.79
2007	10.15	9.73–10.59	1.58	1.46–1.71	15.58	14.38–16.86
2008	10.27	9.81–10.76	1.68	1.56–1.81	16.34	15.17–17.59
2009	11.41	11.02–11.80	1.73	1.59–1.88	15.16	14.05–16.34
2010	11.60	11.19–12.04	1.73	1.56–1.92	14.93	13.54–16.43
2011	11.54	11.09–12.01	1.60	1.48–1.74	13.89	12.70–15.17
Race/ethnicity						
White	11.03	10.81–11.26	1.51	1.45–1.57	13.70	13.16–14.24
Black	12.84	12.29–13.41	2.45	2.26–2.66	19.11	17.82–20.48
Native American	14.97	13.13–17.03	3.69	2.96–4.58	24.63	20.20–29.68
Native Hawaiian/ Pacific Islander	10.64	8.05–13.95	1.34	0.91–1.97	12.62	7.74–19.90
Asian American	4.59	3.98–5.29	0.78	0.61–1.00	17.03	13.79–20.86
Mixed race	17.62	16.08–19.27	2.79	2.33–3.32	15.81	13.15–18.88
Hispanic	9.37	9.05–9.70	1.83	1.70–1.97	19.55	18.13–21.07
Age in years						
12–17	13.43	13.21–13.66	3.43	3.29–3.59	25.57	24.68–26.47
18–25	29.13	28.77–29.50	5.65	5.46–5.85	19.39	18.83–19.97
26–34	15.45	14.88–16.04	1.93	1.75–2.14	12.51	11.36–13.75
35–49	8.51	8.23–8.79	0.82	0.73–0.91	9.59	8.63–10.66
50–64	5.08	4.71–5.48	0.35	0.27–0.45	6.86	5.36–8.73
65+	0.73	0.52–1.01	0.03	0.02–0.10	4.77	1.67–12.87
Sex						
Male	13.53	13.29–13.78	2.30	2.22–2.38	16.97	16.35–17.61
Female	8.27	8.10–8.45	1.06	1.01–1.11	12.85	12.28–13.44

Prevalence rates are weighted figures; sample sizes are unweighted numbers.

Americans (3.69%), mixed-race individuals (2.79%), blacks (2.45%), and Hispanics (1.83%) had higher CUD prevalences than whites (1.51%). Adults aged 18–25 years had the highest CUD prevalence (5.65%).

3.2.3. *CUD among past-year cannabis users*

In 2011, 13.89% of past-year cannabis users met criteria for having a CUD, which was lower than the prevalence in 2006 (16.54%) ($P < 0.05$); there were no significant differences in CUD prevalence in other years. Overall, cannabis users who were Native American (24.63%), Hispanic (19.55%), or black (19.11%) had higher CUD prevalences than white cannabis users (13.70%) ($P < 0.05$ for each comparison).

3.3. *Prevalence of CUD among cannabis users, by race/ethnicity (Table 3)*

We stratified the analysis by race/ethnicity to explore yearly variations in CUD among past-year cannabis users. White cannabis users showed a lower CUD prevalence in 2011 compared with white users in 2008 (11.85% vs. 15.14%, $P < 0.05$). There were no significant yearly changes in the CUD prevalence for nonwhite groups.

3.4. *Adjusted analysis of racial/ethnic differences in CU and CUD (Table 4)*

To adjust for the potentially confounding influences (age, sex, family income, government assistance, county type, residential stability, MDE, arrest history, nicotine dependence, alcohol

Table 3
Past-year CUD among past-year cannabis users (conditional prevalence): results are stratified by race/ethnicity ($N = 68,292$).

	CUD among past-year cannabis users													
	White		Black		Native American		Native Hawaiian/ Pacific Islander		Asian American		Mixed race		Hispanic	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Year														
Total	**13.70**	**13.16–14.24**	**19.11**	**17.82–20.48**	**24.63**	**20.20–29.68**	12.62	7.74–19.90	17.03	13.79–20.86	17.27	11.57–24.99	**19.55**	**18.13–21.07**
2005	**14.04**	**12.85–15.32**	**19.72**	**16.14–23.84**	26.51	14.81–42.80	17.15	8.98–30.30	14.64	8.86–23.25	17.27	11.57–24.99	**16.75**	**14.35–19.46**
2006	**14.55**	**13.15–16.07**	**21.34**	**18.35–24.66**	**27.52**	**19.67–37.05**	16.86	6.87–35.79	21.95	12.77–35.08	21.11	13.80–30.90	**21.05**	**17.65–24.90**
2007	14.80	13.39–16.32	17.12	14.37–20.27	24.30	10.13–47.76	19.35	7.50–41.54	19.47	9.28–36.34	15.59	10.76–22.06	17.42	13.35–22.41
2008	**15.14**	**13.91–16.44**	18.25	14.68–22.45	24.78	16.35–35.70	9.23	2.89–25.78	7.84	3.90–15.12	14.71	7.80–26.00	**22.35**	**18.72–26.46**
2009	**13.49**	**12.41–14.64**	**18.92**	**15.32–23.13**	**25.11**	**16.90–35.60**	18.45	7.55–38.53	19.50	11.78–30.53	16.57	10.87–24.43	**18.91**	**15.45–22.94**
2010	**12.44**	**11.21–13.78**	**20.63**	**16.52–25.44**	**26.43**	**18.62–36.07**	8.49	3.68–18.40	14.72	7.89–25.81	17.13	12.27–23.41	**20.48**	**16.45–25.21**
2011	**11.85**	**10.51–13.32**	**17.76**	**15.01–20.89**	18.96	9.50–34.27	8.28	2.30–25.67	20.21	13.02–30.02	12.03	8.07–17.57	**19.58**	**16.51–23.07**

Boldface: The estimate in a group differed from the estimates in whites.
There was no significant yearly variation in CUD among cannabis users in each racial/ethnic group.
Prevalence rates are weighted figures; sample sizes are unweighted numbers.

disorder, and survey year) on the estimates of racial/ethnic differences in CUD, we conducted logistic regression analyses of CU and of CUD.

3.4.1. CU in the sample

Compared with whites, mixed-race people had greater odds of CU (adjusted odds ratio [AOR] 1.41, 95% confidence interval [CI] 1.24–1.60); Asian Americans (AOR 0.39, 95% CI 0.34–0.45) and Hispanics (AOR 0.61, 95% CI 0.58–0.63) had lower odds of CU. Young adults aged 26–34 years had higher odds of CU than adolescents aged 12–17 years; odds of CU declined with older age groups. Male sex, low family income (<$20,000), residence in a large metropolitan area, MDE, arrest history, nicotine dependence, and alcohol disorder were associated with increased odds of CU.

3.4.2. CUD in the sample

Compared with whites, black (AOR 1.45, 95% CI 1.32–1.59), Native American (AOR 1.80, 95% CI 1.38–2.34), and mixed-race people (AOR 1.36, 95% CI 1.10–1.70) had greater odds of CUD; Asian Americans had lower odds of CUD (AOR 0.70, 95% CI 0.54–

Table 4
AORs of past-year CU in the sample and of CUD among past-year cannabis users.

Adjusted logistic regression[a]	CU in the sample $N = 394,400$		CUD in the sample $N = 394,400$		CUD among cannabis users $n = 68,292$	
			AOR	95% CI	AOR	95% CI
Race/ethnicity (vs. white)						
Black	0.94	0.89–1.00	**1.45**	**1.32–1.59**	**1.40**	**1.27–1.54**
Native American	1.04	0.90–1.19	**1.80**	**1.38–2.34**	**1.49**	**1.03–2.14**
Native Hawaiian/Pacific Islander	0.72	0.50–1.04	0.65	0.42–1.01	0.73	0.43–1.25
Asian American	**0.39**	**0.34–0.45**	**0.70**	**0.54–0.91**	**1.88**	**1.39–2.55**
Mixed race	**1.41**	**1.24–1.60**	**1.36**	**1.10–1.70**	1.13	0.89–1.43
Hispanic	**0.61**	**0.58–0.63**	1.01	0.91–1.13	**1.41**	**1.25–1.58**
Age in years (vs. 12–17)						
18–25	**1.70**	**1.65–1.75**	**0.80**	**0.74–0.85**	**0.47**	**0.43–0.51**
26–34	**0.70**	**0.67–0.74**	**0.25**	**0.22–0.28**	**0.27**	**0.23–0.30**
35–49	**0.37**	**0.36–0.39**	**0.12**	**0.11–0.14**	**0.20**	**0.18–0.23**
50–64	**0.24**	**0.22–0.26**	**0.05**	**0.04–0.06**	**0.15**	**0.11–0.20**
65+	**0.05**	**0.03–0.06**	…[b]		**0.11**	**0.04–0.31**
Sex (vs. female)						
Male	**1.41**	**1.37–1.45**	**1.72**	**1.62–1.83**	**1.28**	**1.18–1.38**
Family income per year (vs. <$20,000)						
$20,000–$49,999	**0.87**	**0.83–0.92**	**0.84**	**0.76–0.92**	0.89	0.80–1.00
$50,000–$74,999	**0.79**	**0.75–0.83**	**0.78**	**0.68–0.89**	0.90	0.78–1.05
$75,000+	**0.80**	**0.76–0.85**	**0.85**	**0.76–0.94**	1.03	0.91–1.16
Government assistance (vs. no)	0.99	0.95–1.05	1.11	1.00–1.23	1.05	0.94–1.18
County type (vs. large metropolitan)						
Small metropolitan	**0.76**	**0.74–0.79**	**0.81**	**0.76–0.88**	0.93	0.86–1.01
Nonmetropolitan	**0.53**	**0.48–0.58**	**0.57**	**0.50–0.66**	0.86	0.72–1.02
Residential move (vs. no)	**1.19**	**1.15–1.23**	**1.16**	**1.08–1.26**	1.03	0.95–1.11
Major depressive episode (vs. no)	**1.47**	**1.40–1.54**	**2.08**	**1.92–2.26**	**2.05**	**1.88–2.23**
Arrested/booked (vs. no)	**2.39**	**2.30–2.50**	**2.46**	**2.29–2.64**	**1.27**	**1.18–1.37**
Nicotine dependence (vs. no)	**2.43**	**2.33–2.54**	**2.77**	**2.54–3.03**	**1.16**	**1.07–1.25**
Alcohol use disorder (vs. no)	**3.64**	**3.47–3.81**	**5.13**	**4.71–5.57**	**2.46**	**2.26–2.66**
Frequency of CU, days/year (vs. 1–11 days/year)						
12–51	……		……		**8.95**	**7.89–10.16**
52+	……		……		**24.10**	**21.04–27.61**

Bold faced: $P < 0.05$.
[a] Each adjusted logistic regression included all variables listed in the first column and controlled for survey year.
[b] Adults aged 50+ were categorized as one group due to small sample sizes.

Table 5
AORs of past-year CUD among past-year cannabis users: results are stratified by race/ethnicity ($N = 68,292$).

Logistic regression[a]	White		Black		Native American		Native Hawaiian/Pacific Islander		Asian American		Mixed race		Hispanic	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Age in years (vs. 12–17)														
18–25	**0.42**	**0.38–0.46**	**0.60**	**0.49–0.75**	0.69	0.42–1.12	**0.21**	**0.06–0.70**	**0.37**	**0.18–0.74**	**0.54**	**0.34–0.85**	**0.56**	**0.46–0.69**
26–34	**0.23**	**0.20–0.27**	**0.37**	**0.27–0.53**	0.43	0.17–1.13	….[d]		**0.29**	**0.11–0.72**	**0.25**	**0.10–0.62**	**0.32**	**0.23–0.44**
35–49	**0.18**	**0.15–0.21**	**0.28**	**0.20–0.38**	**0.20**	**0.09–0.46**	….[d]		**0.23**	**0.07–0.77**	**0.25**	**0.11–0.58**	**0.14**	**0.09–0.24**
50–64	**0.14**	**0.10–0.20**	**0.19**	**0.11–0.31**	….[c]		….[d]		….[c]		**0.16**	**0.04–0.68**	**0.18**	**0.06–0.54**
65+	….[b]		….[b]		….[c]		….[d]		….[c]		….[b]		….[b]	
Sex (vs. female)														
Male	**1.29**	**1.17–1.42**	**1.42**	**1.16–1.73**	1.06	0.68–1.65	1.50	0.48–4.64	1.09	0.61–1.94	1.30	0.84–2.02	1.18	0.97–1.44
Family income per year (vs. <$20,000)														
$20,000–$49,999	0.93	0.82–1.06	0.72	0.58–0.90	1.32	0.39–4.42	1.32	0.39–4.42	0.88	0.44–1.78	1.21	0.80–1.84	0.91	0.69–1.21
$50,000–$74,999	0.96	0.80–1.16	0.64	0.44–0.92	0.95	0.21–4.28	0.95	0.21–4.28	2.13	1.00–4.54	**2.59**	**1.23–5.44**	0.68	0.53–0.87
$75,000+	1.08	0.93–1.26	0.71	0.47–1.06	2.07	0.45–9.43	2.07	0.45–9.43	1.51	0.75–3.04	1.19	0.62–2.29	0.91	0.65–1.27
Government assistance (vs. no)	1.05	0.90–1.21	0.96	0.75–1.22	1.35	0.83–2.20	2.29	0.75–7.05	1.11	0.38–3.26	1.43	0.81–2.53	1.07	0.84–1.36
County type (vs. large metropolitan)														
Small metropolitan	**0.88**	**0.80–0.97**	0.98	0.80–1.21	0.94	0.43–2.03	1.79	0.58–5.49	0.90	0.47–1.71	**1.64**	**1.04–2.58**	0.99	0.79–1.23
Nonmetropolitan	0.86	0.71–1.05	1.05	0.67–1.63	0.65	0.33–1.28	….[e]		0.01	0.001–0.37	0.79	0.35–1.78	0.91	0.47–1.75
Residential move (vs. no)	1.06	0.95–1.18	1.09	0.89–1.32	1.27	0.80–2.02	**4.03**	**1.68–9.65**	0.70	0.37–1.29	1.18	0.73–1.91	0.89	0.70–1.13
Major depressive episode (vs. no)	**2.03**	**1.85–2.23**	**2.10**	**1.56–2.83**	1.56	0.75–3.24	1.76	0.40–7.84	**2.11**	**1.10–4.05**	**2.41**	**1.38–4.20**	**2.14**	**1.63–2.81**
Arrested/booked (vs. no)	**1.15**	**1.04–1.27**	**1.50**	**1.21–1.85**	1.45	0.86–2.47	0.73	0.21–2.53	0.65	0.33–1.28	1.15	0.76–1.74	**1.71**	**1.39–2.09**
Nicotine dependence (vs. no)	**1.11**	**1.01–1.21**	1.16	0.92–1.47	1.01	0.58–1.76	0.99	0.35–2.82	**2.23**	**1.05–4.74**	1.12	0.72–1.75	1.28	0.97–1.69
Alcohol use disorder (vs. no)	**2.24**	**2.01–2.49**	**3.21**	**2.59–3.98**	1.26	0.77–2.07	2.16	0.87–5.36	2.10	1.00–4.41	**1.93**	**1.35–2.76**	**3.07**	**2.46–3.83**
Cannabis use, days/year (vs. 1–11 days/year)														
12–51	**8.30**	**6.90–9.98**	**10.85**	**7.08–16.63**	**4.19**	**1.18–14.86**	**33.50**	**4.64–241.95**	**15.88**	**6.09 41.38**	**8.92**	**4.36–18.26**	**10.05**	**7.23–13.96**
52+	**25.91**	**21.68–30.96**	**24.48**	**16.91–35.44**	**9.41**	**2.93–30.24**	**70.09**	**11.36–432.26**	**49.66**	**20.34,121.26**	**17.70**	**9.65–32.48**	**19.72**	**14.21–27.37**

Bold faced: $P < 0.05$.

[a] Each adjusted logistic regression included all variables listed in the first column and controlled for survey year.

[b] Adults aged 50+ were categorized as one group due to small sample sizes.

[c] Adults aged 35+ were categorized as one group due to small sample sizes.

[d] Adults aged 18+ were categorized as one group due to small sample sizes.

[e] Small metropolitan and nonmetropolitan areas were categorized as one group due to small sample sizes.

0.91). Different from the patterns of findings for CU, adolescents had higher odds of CUD than adult groups. Adolescents were 20% more likely than adults aged 18–25 to have a CUD. Other significant correlates of CUD resembled correlates of CU; however, alcohol disorder was strongly associated with CUD (AOR 5.13, 95% CI 4.71–5.57).

3.4.3. CUD among past-year cannabis users

Here, the analysis examined odds of CUD among cannabis users; frequency of past-year CU was adjusted in the model to control for race-related variation in CU. Compared with white cannabis users, those who were black (AOR 1.40, 95% CI 1.27–1.54), Native American (AOR 1.49, 95% CI 1.03–2.14), Asian American (AOR 1.88, 95% CI 1.39–2.55), or Hispanic (AOR 1.41, 95% CI 1.25–1.58) had increased odds of CUD. Adolescent cannabis users had higher odds of CUD than adult cannabis users. Male sex, MDE, arrest history, nicotine dependence, and alcohol disorder were associated with increased odds of CUD.

3.5. Adjusted analysis of CUD among cannabis users by race/ethnicity (Table 5)

Finally, we stratified the analysis by race/ethnicity and conducted logistic regression analyses to determine correlates of CUD in cannabis users for each group. Survey year was adjusted in each model.

In each racial/ethnic group (except for Native Americans), adolescent cannabis users showed greater odds of CUD than users in all adult groups. Among cannabis-using Native Americans, adolescents had greater odds of CUD than adults aged ≥35 years, but resembled that of adults aged 18–34. Male sex increased odds of CUD in whites and blacks. Family income $50,000–$74,999 vs. <$20,000 (in mixed-race people), residence in large metropolitan areas vs. small metropolitan areas (whites), residence in small metropolitan areas vs. large metropolitan areas (mixed-race people), and residential move (NHs/PIs) increased odds of CUD. Previous MDE (whites, blacks, Hispanics, Asian Americans, and mixed-race people), arrest history (whites, blacks, and Hispanics), nicotine dependence (whites, Asian Americans), alcohol disorder (whites, blacks, Hispanics, and mixed-race people), and monthly (12–51 days/year) or weekly (≥52 days/year) CU (all racial/ethnic groups) increased odds of CUD.

4. Discussion

In parallel with the changing state policies with regard to cannabis, studies have indicated a rise in illicit CU and cannabis-involved admissions to addiction treatment facilities and emergency departments (Johnston et al., 2012; SAMHSA, 2012b; SAMHSA, 2012c). Capitalizing on the large national samples, we reported new findings on CUD for understudied racial/ethnic populations (Native American, Asian American, NH/PI, and mixed-race). The findings have timely implications for research, prevention, and health policy. *First,* past-year CU prevalence increased significantly from 10.45% in 2005 to 11.41–11.54% in 2009–2011. Mixed-race individuals had greater odds of CU than whites. Asian Americans and Hispanics had lower odds of CU than whites. Backs, Native Americans, and NHs/PIs resembled whites in odds of CU. *Second,* there were no significant yearly variations in CUD prevalence in the sample during 2005–2011 (1.58–1.73%). Compared with whites, mixed-race individuals, blacks, and Native Americans had higher odds of CUD; Asian Americans had lower odds of CUD. *Third,* approximately one in seven past-year cannabis users had a CUD in a year. Compared with cannabis-using whites, cannabis-using blacks, Native Americans, Asian Americans, and Hispanics had greater odds of CUD. *Fourth,* in all racial/ethnic groups, adolescent cannabis users generally showed greater odds of CUD than adult cannabis users. Behavioral health indicators (MDE, arrest history, nicotine dependence, alcohol disorder) were associated with increased odds of CU and CUD.

4.1. Adolescents are more likely than adults to have a CUD that requires intervention

The most noteworthy finding is the consistent pattern of associations showing that adolescents (12–17 years) in general and adolescent cannabis users particularly are more likely than adults to have a recent or active CUD. Adult groups showed age-related decreases in odds of CU and CUD. Although adults aged 18–25 had greater odds than adolescents of using cannabis in the past year, adolescents were 20% more likely than young adults (18–25 years) and 75–95% more likely than older adults (≥26 years) to have a CUD. Adolescent cannabis users were 53% more likely than young adult cannabis users (18–25 years) and 73–89% more likely than older cannabis users (≥26 years) to have a CUD. Even after stratifying analyses by race/ethnicity, adolescent cannabis users in each racial/ethnic group had greater odds of having a CUD than adult cannabis users. These analyses adjusted for respondents' sex, family income, government assistance, county type, residential stability, MDE, arrest history, nicotine dependence, alcohol disorder, and survey year. Analyses of CUD among cannabis users also controlled for the frequency of CU. The overall pattern indicates robustness in the findings suggesting that adolescents are the most vulnerable group to have a CUD. Unfortunately, the adverse effects of cannabis use are likely to be most devastating to adolescent users, including the impact of cannabis on the developing brain (cognition, memory, motivation, emotion) as well as numerous medical and psychosocial correlates of CU or CUD (accidents, educational or employment problems, delinquency, criminal activities, mental and medical conditions, other substance abuse) (Meier et al., 2012; Rubino et al., 2012; Ruiz-Veguilla et al., 2013; Schubart et al., 2011; Svrakic et al., 2012; Werb et al., 2010).

Elevated odds of CUD among adolescents may be related to a possibility that marijuana is the primary drug of abuse in adolescence. The Treatment Episode Data Set (TEDS), which examines substance abuse treatment admissions collected by states in monitoring their treatment systems, shows that in 2010 cannabis-involved treatment represented 87% of all admissions by adolescents (12–17 years) and that opioids and cocaine are more commonly identified as drugs of abuse in adults aged ≥18 years (SAMHSA, 2012c). Data from electronic medical records of patients in the community also found cannabis as the primary drug use disorder disproportionally affecting adolescents (Wu et al., 2011a, 2013a). Additionally, studies have shown a clear association between early drug use (before adulthood) or chronic use and elevated odds of DSM-IV disorders (e.g., substance use, mood, and anxiety disorders) (Brook et al., 2000; Najt et al., 2011; O'Neil et al., 2011). Some adolescents who use cannabis repeatedly may be particularly vulnerable and affected by multiple risk factors (e.g., delinquency, mental health problems, school problems, and other substance use) that interact to enhance propensity to addiction and psychiatric conditions (DuRant et al., 1999; Najt et al., 2011; O'Neil et al., 2011; Rubino et al., 2012).

4.2. People who self-identify as mixed-race, black, or Native American are disproportionally affected by CU and CUD

Another new finding with implications for research and health policy is the higher prevalence of CU (mixed-race) and CUD (mixed-race, black, Native American) among nonwhite groups compared with whites. As a group, people who self-identified as mixed-race were most likely to use cannabis in the past year; they also had higher odds of CUD than whites. Similarly, an adolescent study found higher prevalences of any drug use disorder among mixed-race and Native American adolescents than in other racial/ethnic groups (Wu et al., 2011b). Between 2000 and 2010, the mixed-race

population grew 3.3 times faster than the total US population (US Census Bureau, 2011). The mixed-race population size (2.9% of the US population) is greater than that of Native Americans (0.9%) and NHs/PIs (0.2%) and is smaller than that of Asian Americans (4.8%). Because mixed-race people are not routinely reported by studies, little is known about substance use intervention needs of this rapidly growing group (SAMHSA, 2012b, 2012c). This result and others suggest that the self-identified mixed-race group is generally younger (including most adolescents) and poorer, and they appear to have more behavioral health concerns (major depression, tobacco smoking) than whites (Wu et al., 2013b). While the heterogeneity in racial/ethnic backgrounds complicate research efforts for disentangling mixed-race people, findings highlight a clear need for research to monitor and elucidate this group's substance use and health indicators (Wu et al., 2013b, 2013c).

The findings concerning Blacks and Native-Americans are also of interest: while they resembled whites in odds of CU, they were more likely than whites to have a CUD in the sample and among cannabis users. Historically, cocaine use has been more prevalent among blacks than whites, but recent data suggest a decline in cocaine use among blacks (SAMHSA, 2012a, 2012c). By comparison, the number of treatment admissions for primary cannabis abuse among persons aged ≥12 years increased from 14.3% in 2000 to 18.4% in the 2010 TEDS database (SAMHSA, 2012c). Among adolescents, cannabis-involved admissions increased from 62% of all adolescent admissions in 2000 to 73% in 2010. Cannabis was the most commonly identified illicit drug problem in 2010 for all admissions by blacks, while opioids were the more commonly identified drug in whites. Hence, research focused on changing patterns of drug use problems for blacks, especially CU among young blacks, is needed. Further, the finding of elevated odds of CUD among Native Americans reaffirms the need to address drug use problems for the most socioeconomically disadvantaged Native American population in the United States (Wu et al., 2011b).

4.3. Cannabis-using Asian Americans and Hispanics show elevated odds of CUD

Asian Americans and Hispanics showed lower odds of CU than whites; however, among cannabis users in particular, both had greater odds of CUD than whites. TEDS findings also showed that cannabis was the key primary drug of abuse for Asian Americans and Hispanics (SAMHSA, 2012c). In 2010, cannabis accounted for greater proportions of all treatment admissions for Asian Americans (20.3%) and Hispanics (23.0%) than for whites (14.2%). Overall, the data tend to be in line with other findings that show higher proportions of transition from CU to cannabis dependence among minorities (Lopez-Quintero et al., 2011).

4.4. Limitations

NSDUH uses cross-section designs to generate national representative samples of the noninstitutionalized population to provide population-based drug use estimates. About 2% of institutionalized or homeless individuals are not covered by the survey's sampling plan. These findings do not apply to them. The cross-sectional data provide estimated prevalences and associations for correlates of CU and CUD, not causality. Like other national studies, NSDUH relies on respondents' self-reports, which may be influenced by memory errors or underreporting. To increase the accuracy of self-reports, NSDUH uses detailed probes to augment assessments for substance use and ACASI to ensure respondents' privacy (SAMHSA, 2012a). NSDUH has conducted methodological studies to guide its designs and has implemented rigorous procedures to ensure data quality (SAMHSA, 2010; SAMHSA, 2012a). This study also reveals the challenge of monitoring drug use problems for minority groups, especially NHs/PIs and Native Americans. Despite use of national samples, the number in both groups is moderate and it limits the analysis for CUD. It is important to note that each racial/ethnic group examined is diverse in racial/ethnic composition and cultural backgrounds. Research is needed to disentangle subgroup differences. Additionally, how symptoms of CUD might be expressed differently and interpreted differently by adolescents vs. adults may influence prevalence estimates, which deserve in-depth research to inform assessments and classification of CUDs (Winters et al., 2011). Overall, these findings are conservative CUD estimates for the broadly defined seven major racial/ethnic groups in the national samples of the general population.

4.5. Conclusions and implications

This study presents new, comprehensive, and national-level CUD estimates for all major racial/ethnic groups identified by the national Healthy People initiative. Younger age, race/ethnicity, and behavioral health indicators (substance disorder, MDE, arrest history) are consistent correlates of CUD. There is a strong and robust association between a greater frequency of CU and odds of CUD, suggesting a gradient relation. These finding suggest that adolescents are most vulnerable to CUD and that nonwhite groups are disproportionally affected by CUD. They reiterate the importance of starting substance use prevention programs in early adolescence and lend support for the need to develop culturally appropriate programs for *all racial/ethnic groups* (Edwards et al., 2010). Given the concerns about potential influences of changing policies on the availability of cannabis, findings from the representative sample can serve as "baseline" data for tracking future trends in CUD. They also provide empirical support for research to investigate the long-term impact of medical cannabis on CU and CUD especially among adolescents and nonwhite groups. Future research should explore the mechanisms that contribute to subgroup differences in CUD given use, such as reasons for use (medical, nonmedical motives), cultural-related norms for CU or normalization of use, perceived risk of harm from use, access to medical sources, and the availability (Friese and Grube, 2013; Levy, 2013; Lopez-Quintero and Neumark, 2010; O'Callaghan and Hannon, 2003; Plancherel et al., 2005; Shih et al., 2010). There is a continuous need to monitor unintended consequences of policy changes and to evaluate the risks and benefits of legalized cannabis. Finally, studies are needed to clarify the long-term effects of cannabis on the developing brain and mental health (e.g., psychosis).

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Contributors

Li-Tzy Wu originated research questions, conducted data analyses, and wrote the drafts of the paper. All authors contributed to critical revisions and interpretations of the findings to result in the final manuscript.

Conflicts of interest

Paolo Mannelli has received support from Alkermes, Inc., Forest Research Institute, Pfizer Inc., and Sunovion Pharmaceuticals. The other authors have no conflicts of interest to disclose.

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