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# CANNABIS USE RATES AND MODES OF USE IN KENTUCKY

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# CANNABIS USE RATES AND MODES OF USE IN KENTUCKY, 2020

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## Capstone Project Paper

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A paper submitted in partial fulfillment of the requirements for the degree of Master of Public Health in the University of Kentucky College of Public Health

By

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Lexington, Kentucky
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# ABSTRACT:

## Background and Objectives:

The purpose of this study was to assess cannabis use rates and modes among people who use cannabis (PWUC) in the state of Kentucky in relation to socioeconomic, demographic, and geographic factors. Furthermore, this study compared Kentucky's rates of use to other states and built a multivariable regression model to identify characteristics of individuals who use cannabis in Kentucky.

## Methods:

For this cross-sectional descriptive analysis, we used 2020 data from the Kentucky Behavioral Risk Factor Surveillance System (BRFSS). We tabulated weighted responses to questions asking about frequency of cannabis use over the past 30 days, primary mode of cannabis use, and reasons for cannabis use by demographic and socioeconomic factors.

## Results:

The prevalence of cannabis use was slightly higher in males (12.1%) than females (8.7%). Age groups saw use rates consistent with national trends with those aged 18 to 34 most likely to use cannabis (16.9%), and those 55+ (5.1%) least likely. Education was marginally related to cannabis use rates, which ranged only from 8.9% (college degree or more) to 10.8% (high school or less). Those without healthcare coverage reported more use (18.4%) than those with healthcare coverage (9.6%). Those who made less than $25,000 (14.4%) and less than $50,000 (11.2%) had higher rates of use than those who made $50,000 or more (9.8%). Marital status was consistent among all groups except for Never Married reporting the most use (17.2%). Cannabis use rates were lowest in whites (9.1%) and highest in blacks (21.6%). Residents of Kentucky's Appalachian region were slightly less likely to use cannabis compared to elsewhere in the state (8.8% vs. 11.8%),

## Conclusion:

Cannabis use in Kentucky matches national trends and trends in states where cannabis is legal. Despite the illegal status of cannabis, its use remains relatively common across socioeconomic and demographic groups. It is likely that use of cannabis and preferred modes of use—especially non-smoking modes—will continue to follow national trends, regardless of its status in Kentucky

# ACKNOWLEDGEMENTS

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## ABBREVIATIONS:

| | |
|---|---|
| BRFSS | Behavioral Risk Factor Surveillance System |
| CDC | Center for Disease Control |
| DHSS | Missouri Department of Health and Senior Services |
| MC | Medical Cannabis Use |
| ML | Medical Cannabis Legalization |
| NSDUH | National Survey on Drug Use and Health |
| PWUC | People Who Use Cannabis |
| RL | Recreational Cannabis Legalization |
| THC | delta-9-tetrahydrocannabinol |

# INTRODUCTION:

## Overview of Cannabis Legalization:

The history of the legality of cannabis in the U.S. is complicated and winding. During the late nineteenth Century to the early twentieth, cannabis use was primarily confined to medicinal applications (Patton, 2020). Notably, military physicians used cannabis to help treat injuries throughout the Civil War; and in 1891, American physician J.B. Mattison published his research on the effectiveness of cannabis in treating cocaine and opiate addiction, as well as migraines (Patton, 2020). Despite the increasing evidence of medicinal benefits and support from the medical community, the first quarter of the twentieth century saw numerous laws and acts passed to restrict or prohibit both the sale and use of cannabis. Eventually in 1937, cannabis was essentially made illegal with the Marihuana Tax Act (Patton, 2020). This Act made possession and transfer of cannabis a federal crime which halted almost all medicinal research (Patton, 2020). The Marihuana Tax Act was eventually deemed unconstitutional in 1969 for violating the Fifth Amendment (Patton, 2020). However, in 1970, the Controlled Substances Act was passed, which prohibited the use of cannabis for any purpose (Patton, 2020). It wasn't until the early 1990's that the legalization status of cannabis began to shift. This began in 1993 Surgeon General Elder proposed to study cannabis legalization, and continued with the first statewide medical cannabis legislation (ML), Proposition 215, which was passed in California in 1996 (Yu, Chen, Chen, & Yan, 2020). Since then, as of May 7th 2022, 37 additional states and the District of Columbia have passed ML, and 18 states and the District of Columbia have enacted recreational cannabis legislation (RL) (Legislation, 2021; Yu et al., 2020). Colorado and the state of Washington were the first to enact RL in the Autumn of 2012 (Patton, 2020). Despite the increasing number of ML and RL in the United States, Kentucky is one of 14 states where cannabis remains illegal for any purpose (Legislation, 2021).

Public polls also demonstrate that support among Americans for cannabis legalization has changed dramatically since 1969; with a marked increase in public support since 2000 (Daniller, 2020). Additionally, in a survey conducted in April of 2021, fewer than 10% of adults in the United States felt that cannabis should not be legal at all (Green, 2021). This same survey observed that 31% of adults support only ML ,

while 60% support RL (Green, 2021). Support for legalization varies by age group and political affiliation, yet a majority of each age group, except for those 75+, supports legalization (Daniller, 2020).

This shift in views towards legalization has undoubtedly been influenced by the various purported health benefits of cannabis use (Yu et al., 2020). There has been increasing evidence detailing the efficacy of cannabis for some therapeutic purposes, including pain management, improved appetite and nausea relief among chemotherapy and AIDS patients, easing anxiety and/or depression, limiting use/misuse of other medications, and treating symptoms of epilepsy and multiple sclerosis (Keyhani et al., 2018). Some studies have found an association between ML or RL and a reduction in opioid drug misuse compared to states with no legalization (Shi, 2017). The relationship between opioid misuse and cannabis legalization are not conclusive, but Shi (2017) observed that states that had passed either RL or ML saw reductions in opioid prescriptions for pain relief, hospitalizations and deaths related to opioid overdose, and overall opioid abuse (Shi, 2017).

**THC and Modes of Use**

Controversy exists about the levels/concentration of tetrahydrocannabinol (THC) that are now currently available in products today (Zvonarev, Fatuki, & Tregubenko, 2019). Generally, the term THC refers to the amount of the primary psychoactive compound, delta-9-tetrahydrocannibnol, in the marijuana flower (Greydanus, Hawver, Greydanus, & Merrick, 2013). While THC is the primary psychoactive compound, it is just one of at least 60 cannabinoids identified in the marijuana plant (Greydanus et al., 2013). Cannabinoids are the compounds that interact with the endocannabinoid system in the body to create an intoxicating effect known as a high (Greydanus et al., 2013). Producers in both RL and ML states have developed products with very high levels THC (Schauer, Njai, & Grant-Lenzy, 2020). These highly concentrated forms of cannabis are preferred by some PWUC to ease serious medical conditions such as Parkinson's, side effects of cancer or AIDS treatment, and schizophrenia (Wilkinson, Yarnell, Radhakrishnan, Ball, & D'Souza, 2016).

The United States Federal government claims that prior to the 1990s THC concentration in the marijuana flower averaged less than 2% by weight, and (Stuyt, 2018) during the 1990s the average THC concentration increased to 4%, and then between 1995 and 2012 there was a 212% increase in THC content (Stuyt, 2018). Today, some products available on the market contain THC levels as high as 28% or more (Stuyt, 2018). Calculating THC concentration in final products and the effects of this concentration in a specific individual is difficult because it varies by mode and many individual factors (Stuyt, 2018). Some individuals may be able to tolerate high levels of THC, while others can only consume small amounts at a time.

Smoking is the most common mode of cannabis use in the United States (Schauer et al., 2020). The dried flowers or leaves are ignited, and the smoke is inhaled by the user (Schauer et al., 2020). This can be accomplished using hand- or machine-rolled cigarettes ("joints"), pipes (typically glass or metal), bongs (i.e., water pipes, where smoke is filtered through water before inhalation), blunts (cigars that have had their tobacco completely or partially removed and refilled with marijuana) and other methods (Streck, Hughes, Klemperer, Howard, & Budney, 2019). The psychoactive effects of smoking dried cannabis flower are almost immediate, with the user typically experiencing a high within minutes (Schauer et al., 2020). The THC concentration of dried cannabis flower varies widely depending on the strain of cannabis and how it is grown and cured (Schauer et al., 2020). Dispensaries often sell "pre-rolled" joints that contain 17% to 28% of THC by weight (Stuyt, 2018).

Vaping is a relatively new mode that has become more common with legalization (Schauer et al., 2020). The oil or concentrate used for vaping is extracted from cannabis plant material using chemical solvents or solventless extraction methods (Lazarjani, Young, Kebede, & Seyfoddin, 2021). Solvent extraction uses chemicals such as butane, propane, and ethanol to separate cannabinoids from the marijuana flower (Lazarjani et al., 2021). The solvents are purged from the solution and an oil is left behind that will solidify (Schauer et al., 2020). This solidified product can then be used for vaping or dabbing (Lazarjani et al., 2021). Solventless extraction utilizes cannabinoids' semi-liquid state (Lazarjani et al., 2021). As such, this method does not use chemicals, but instead relies on physical methods, such as applying pressure or temperature to extract the oil

from cannabis flower, or even using water for extraction (Lazarjani et al., 2021). For vaping, the extracted product is placed into a cartridge that is inserted or threaded onto a "vape pen" rechargeable battery (Schauer et al., 2020). This device uses electricity to vaporize the oil so it can be inhaled by the user. Many prefer vaping to smoking as there is no combustion that produces smoke (Baldassarri, Camenga, Fiellin, & Friedman, 2020). Because of this, vaping is considered by PWUC to be a safer alternative to smoking, though this is disputed by healthcare professionals (Sawtelle & Holle, 2021). In fact, some research has also shown vaping cannabis is the most popular mode for teens and young adults and the most preferred for medical use (Baldassarri et al., 2020). Effects are similar immediacy and duration compared to smoking but can be stronger due to higher amounts of THC concentration in the oil (Schauer et al., 2020).

Dabbing refers to vaporizing highly concentrated products with high heat—generally using a "dab rig", a special type of pipe specifically for dabbing—to experience an immediate and intense high (Raber, Elzinga, & Kaplan, 2015). The dab rig consists of numerous parts. Typically, dab rigs contain small glass pipes or water pipes (Raber et al., 2015). Attached to the pipe is a heating platform, referred to as a "nail" (Raber et al., 2015). This heating platform is typically made of quarts, ceramic, or titanium and often heated with a small blow torch (Raber et al., 2015). Once it is heated, some cannabis concentrate is placed on it, which immediately vaporizes and is inhaled through the water pipe (Raber et al., 2015). Concentrates of varying consistency and potency are sold as products known as hash, hash oil, wax, shatter, budder, diamonds, sauce, and more (Schauer et al., 2020) Most products for dabs on the market weigh between 0.5 to 1 gram and have a THC concentration of at least 70% and can even be as high as 90% (Raber et al., 2015)

Edibles are cannabis-containing products that are eaten like food (Schauer et al., 2020). As legalization has increased around the country, the popularity of edibles has increased dramatically (Streck et al., 2019). Products on the market range from cooking oils to candy to beef jerky. Psychoactive effects take longer to achieve than with most other modes but can be more intense (Schauer et al., 2020). Furthermore, once the effects begin, they can last 3-10 hours, depending on the individual (Streck et al., 2019). First, the body needs to digest and break the food down, which then releases the THC into the

blood (Schauer et al., 2020). This process is dependent upon the food type and dose, and the individual's own metabolism, body weight, and tolerance (Goodman, Wadsworth, Leos-Toro, & Hammond, 2020). THC concentration for edibles on average ranges from 1 mg to 100 mg; with state laws typically dictating a dose or "serving" of 5 or 10 mg (Zipursky, Bogler, & Stall, 2020). A unique characteristic of edibles is that compared to other modes, a single product can contain extremely high levels of THC (Zipursky et al., 2020).

Drinking cannabis is a relatively new mode with a very small, but growing market (Volpe, 2020). Cannabis oil is soluble in alcohol but mixing any federally controlled substance and alcohol is illegal in the United States (The Controlled Substances Act (CSA), 1971). To create cannabis beverages, the cannabis oil is broken down into microscopic particles and then the oil is dissolved into water by using an emulsifier (Perkins, 2021). The final product is a seltzer like liquid that is then added to teas, sodas, nonalcoholic beers, and tonics (Volpe, 2020). The average THC concentration is low compared to other modes, hovering around 5 mg of THC per 5-ounces, but can range from 1 to even 100 mg (Volpe, 2020). Drinking produces a high within 5 to 15 minutes, and it quickly dissipates (Volpe, 2020).

## Objectives:

Using BRFSS survey responses, this study analyzed cannabis use and mode of use in Kentucky in relation to various socioeconomic, demographic, and geographic factors. Rates of cannabis use, and modes of use were compared to those from states with either ML or RL. Lastly, we created a multivariable regression model to help identify characteristics of individuals most likely to use cannabis in Kentucky.

# LITERATURE REVIEW:

Cannabis is the most used illicit drug in the United States, with nearly 48.2 million individuals, or 18% of all residents, reporting using cannabis at least once in 2019 (CDC, 2019). And while the population of Americans living in states with some form of legalization has increased, the number of studies analyzing state-specific and national use trends has grown very little (Daniulaityte et al., 2018). Regarding use rates, the National

Survey on Drug Use and Health (NSDUH) identified decreases in cannabis use from 1979 through 1992 and from 2001 through 2006, with increases noted during the intervening years (Yu et al., 2020). These increases were clear and substantial among states that adopted ML, but less so among states that passed RL (Yu et al., 2020). From 2006 to 2016, the overall number of people covered by ML saw its greatest increase; yet prevalence of cannabis use, which had increased steadily since 1992, remained stagnant. (Yu et al., 2020). Further, despite the expectations of many opponents to legalization, states who have passed RL or ML have seen cannabis use among those below the age of 18 remain stable or even decrease (Zvonarev et al., 2019).

Therapeutic treatments of cannabis have shown promise and are gaining wider acceptance in the medical field, but there is still little robust clinical evidence for medical use of cannabis (Wilkinson et al., 2016). Research on the health benefits and risks of cannabis is limited by numerous factors, including the Schedule 1 designation of cannabis on a federal level, the different modes of use, and co-use of cannabis and other substances by PWUC (Schauer, 2021) These obstacles have limited scientific study and conclusions regarding cannabis use and its effects on individuals and public health.

Studies exist on cannabis use and its relation to cancer both as a potential cause, especially of lung cancer, and as a therapy or preventive measure. Cannabis has been used to help relieve symptoms associated with cancer and/or cancer treatments, including chemotherapy-induced nausea and vomiting, pain associated some cancers, poor appetite, weight loss, and poor quality of life (Sawtelle & Holle, 2021). But there are also numerous studies analyzing the effects of cannabis on risk for cancers at sites including head and neck, lung, and gastrointestinal system (Sawtelle & Holle, 2021). It has been long speculated that cannabis smoke would have similar effects as tobacco smoke on the respiratory system (Tashkin & Roth, 2019). Yet, it is difficult to form any solid conclusions on the effects of cannabis on pulmonary function and lung cancer susceptibility (Tashkin & Roth, 2019). Some studies have shown that cannabis and tobacco smoke have similar effects on the frequency of chronic cough, sputum and wheeze and the present of airway mucosal inflammation, goblet cell and vascular hyperplasia, and metaplasia and cellular disorganization (Tashkin & Roth, 2019). But these studies are confounded by concurrent tobacco smoking, low availability of

literature, and conflicting outcomes (Tashkin & Roth, 2019). Additionally, the increasing availability and use of both cannabis and non-cannabis vaping concentrates led to an outbreak of vaping-associated lung injury (Baldassarri et al., 2020). As of February 18th, 2020, there were a total of 2,807 cases of this lung injury, with most being related to black market products containing cannabinoids (Baldassarri et al., 2020).  Another possible negative aspect of cannabis use is what some researchers have described as a "reverse gateway drug" effect, where some individuals begin using nicotine products only after initiating smoking or vaping with cannabis products (Uddin et al., 2020).

   While cannabis legalization might be associated with decreases in hospitalizations and deaths related to other illicit drugs (specifically opioids, compared to states with no legalization), hospitalizations related to cannabis use have increased substantially, especially among adolescents (Masonbrink, Richardson, Hall, Catley, & Wilson, 2021). From 2008 to 2019, there were 37,562 adolescent hospitalizations related to cannabis in 18 states and Washington D.C (Masonbrink et al., 2021). Well over half (54%) of these hospitalizations were in states with ML, 23% in states with RL, and 23% in states with no cannabis legalization (Masonbrink et al., 2021). Reasons for these hospitalizations include acute cannabis intoxication (i.e., too much THC), unintentional ingestion of cannabis products by children, and cannabis intoxication exacerbating the effects of mental disorders like anxiety, panic disorders, and schizophrenia (Wilkinson et al., 2016). Despite these increases in adolescent hospitalizations, experts advocate for better storage and labeling of items that contain cannabis, rather than further restricting access to cannabis or limiting products (Shi, 2017).

   Overall, the availability of survey data regarding cannabis use is lacking for many parts of the United States (Geissler, Kaizer, Johnson, Doonan, & Whitehill, 2020). For instance, as of March 2020, the BRFSS only asks about cannabis use among adults in 24 states (Geissler et al., 2020). Another survey, the Youth Risk Behavior Surveillance System (YRBSS) asks at least one cannabis use and frequency question of children in 36 states (Geissler et al., 2020). Overall, the number of surveys available implies that only about half of the adult population in the United States is accounted for when it comes to studying national trends of cannabis use (Geissler et al., 2020). As of 2020, the BRFSS survey in Kentucky included cannabis-related questions for the first time.  These

questions included: "During the past 30 days, on how many days did you use marijuana or hashish?", "During the past 30 days, how did you primarily use marijuana?", and "What was the reason you used marijuana?".

At the time of this writing, we are not aware of any publications reporting population-based rates of cannabis use among adults in the state of Kentucky. One of our main objectives in this study was to compare cannabis use in Kentucky with states with various legalization statuses for cannabis, especially states directly adjacent to Kentucky. States adjacent to Kentucky that have enacted any cannabis legalization as of May 2022 include Illinois, Missouri, Ohio, Virginia, and West Virginia. When the 2020 BRFSS survey was conducted, Illinois was the only RL state bordering Kentucky. Illinois passed "The Cannabis Regulation and Tax Act" in June 2019 and recreational sales began on January 1st, 2020 (705/1-999). 2019). It is worth noting that Virginia became a RL state in 2021 with the passing of HB2312, "Marijuana; legalization of simple possession etc.", but is not currently scheduled to begin legal sales until 2024 (V. C. Program, 2021).

ML states bordering Kentucky include Ohio, West Virginia, and Missouri.  Each of these three ML states differ regarding product availability and individual eligibility to obtain cannabis products. Ohio's House Bill 523 was passed in June 2016, which legalized medical use of cannabis in Ohio (O. M. M. C. Program, 2022). This bill set up various rules to create a dispensary system within the state; including the creation of state-run or state-licensed system of growing facilities, testing labs, physician certifications, patient registration, processors, and retail dispensaries (O. M. M. C. Program, 2022). This system was required to be fully operational by September 2018, with the first licensed sale occurring on January 16, 2019 (O. M. M. C. Program, 2022). The use of cannabis by smoking is prohibited, and individuals cannot grow their own cannabis plants under this law (O. M. M. C. Program, 2022). The only modes that are permitted in OH are oils, tinctures/liquids, plant material, edibles, lotions, creams, and patches (O. M. M. C. Program, 2022). Patients may have up to a 90-day supply, which is determined with the aid of their licensed physician (O. M. M. C. Program, 2022).

West Virginia's Medical Cannabis Act, SB 386, was signed into law on April 19th, 2017 with further amendments being added in 2019 and 2020 (Project, 2022b). The first dispensary opened in November 2021, with many more planning to open in 2022

(Alliance, 2022). The system of state-run or -licensed facilities is like Ohio's. Modes of use available in West Virginia include dry leaf/plant form, pills, oils, gels, creams and ointments, extracts for vaping, tinctures and other liquids, and dermal patches (Project, 2022b). Legislation was introduced in 2020 to allow edibles (Alliance, 2022). Smoking is prohibited, meaning that dry leaf/plant mode can be mixed into food or drinks by patients, but not actually smoked (Alliance, 2022). Home cultivation is not allowed, and patients can only acquire a 30-day supply (Project, 2022b).

Missouri legalized the use of CBD oil to treat seizures and partially decriminalized recreational use in 2014, which reduced penalties for certain cannabis offenses via 2 separate bills (Project, 2022a). In 2018, Amendment 2 was introduced and passed (Project, 2022a), which legalized medicinal cannabis and allowed qualified patients to grow up to 6 cannabis plants and purchase at least four ounces per month (Services, 2022). The first licensed sale occurred on October 17, 2020 (Services, 2022). No modes are prohibited in Missouri (Services, 2022).

Due to the previously mentioned lack of survey data regarding cannabis use for the nation, our comparisons are limited by lack of data. Our comparisons rely heavily on a study by Schauer (2020) utilizing BRFSS survey data from 2016 in 12 states (AK, CA, CO, FL, ID, MN, MS, NE, OH, OK, TN, WY). This study looked at many of the demographics we were interested in and prevalence of mode by users in each state. Another study, Jeffers (2021), combined BRFSS survey data from the years 2016 – 2019 in 21 states and two US territories (AK, CA, CO, FL, GA, GU, ID, IL, MD, MN, MS, MT, NE, NH, ND, OH, OK, PR, SC, TN, UT, WV, WY). This study did not focus on modes of use but looked at status of use and frequency of use amongst various socioeconomic and demographic characteristics.

Despite the mounting successes of cannabis legal activists throughout the country, many still oppose any form of legalization citing lack of robust evidence for therapeutic benefits, moral implications of taxing sick people for cannabis, the risk of worsening mental health (specifically for those with schizophrenia), the potential for more automobile accidents, and the potential for youth to begin using cannabis at a younger age or more frequently (Wilkinson, 2013). These views are not without merit yet are often misplaced and ingrained in longstanding misunderstandings of cannabis and its

effects. Further, it is worth noting that studies have been published, such as Zvonarev (2019) and Schauer (2021), downplaying many of these fears. While the two aforementioned studies don't absolve cannabis of the potential harms listed above, they do provide evidence suggesting that cannabis has not exacerbated any of them.

## METHODS:

### Data Source and Sample:

The BRFSS is maintained by the Centers for Disease Control and Prevention (CDC) and is the largest individual health behavior surveillance system in the United States. For the 2020 survey, BRFSS collected data from more than 400,000 adult respondents in all 50 states, the District of Columbia, and 3 U.S. territories. For the state of Kentucky, there were 3,934 respondents in 2020 and this was the first year that the BRFSS asked questions related to cannabis use.

### Measures

Participants were asked about past 30-day cannabis use: *During the past 30 days, on how many days did you use marijuana or cannabis?* Those indicating any use in the past 30 days were then asked: *During the past 30 days, which one of the following ways did you use marijuana the most often? Did you usually… smoke it, eat it, drink it, vaporize it, dab it, was it used in some other way? Don't know/refused.* The final cannabis related question asked was related to reasons for cannabis use: *When you used marijuana or cannabis during the past 30 days, was it usually… For medical reasons, For non-medical reasons (recreational), For both medical and non-medical reasons.* The responses for "During the past 30 days, on how many days did you use cannabis or hashish?" were used to create a new variable classifying individuals as either being a yes or no for cannabis use. Respondents who reported any number of days greater than 0 and less than or equal to 30 were marked as yes for cannabis use. All others were marked as no. This new variable was used explicitly for creating Table 1. The responses for "During the past 30 days, how did you primarily use cannabis?" were combined into four different groups. Smoking and Other remained on their own, edibles and drinking were combined into group "Ingesting," and dabbing and vaping were combined into group

"Concentrate". This was due to low sample sizes for various modes which left many characteristics empty for table 2.

We also used responses to a variety of other questions routinely included in the BRFSS survey to determine participant characteristics. These included: six-level imputed age category, imputed race and ethnicity, computed income categories, computed level of education completed, health plan coverage, marital status, calculated sex variable, and county code. Response categories for some questions were collapsed for analysis due to low response rates. The six-level imputed age variable was reduced to three categories: "18 to 24" and "25 to 34" were combined into "18 to 34". "35 to 44" and "45 to 54" were combined into "35 to 54". "55 to 64" and "65 or older" were combined into "55+". Values for imputed race and ethnicity were combined due to low response rates for American Indiana/Alaskan Native, Hispanic, and other race. They were all combined into the value, "Hispanic/Other". Values for computed level of education were combined. "Did not graduate High School" and "Graduated High School" were combined into one category, "High School Graduate or Below." Income responses were combined into three different variables. "Less than $15,000" and "$15,000 to less than $25,000" were combined into "Less than $25,000". "25,000 to 35,000" and "35,000 to less than $50,000" were combined into "Less than $50,000". Finally, marital status responses of "Married" and "Member of unmarried couple" were combined into "Married/Cohabitating." "Separated", "Divorced", and "Widowed" were all combined into one value. The county of residence for each respondent was used to create a new variable indicating residence in an Appalachian County, as defined by the Appalachian Regional Commission (Commission, 2022). This new binary variable was used to examine cannabis use in the Appalachian Region of Kentucky.

**Data analysis**

All analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC), and CDC guidelines were followed to ensure proper handling of the complex sampling design and survey weights to produce population-based prevalence estimates (CDC, 2021).

Cross-tabulation was used to assess cannabis use prevalence overall by demographic and socioeconomic factors, and to assess modes of use and reason for use

by the same. Around 1% (n=3) of the 292 PWUC who reporting using cannabis did not report a mode of or reason for use. Lastly, logistic regression was used to examine predictors of cannabis use after adjustment for all other factors examined here.

## RESULTS:

### Demographics of Cannabis use

Overall, the past-month prevalence of cannabis use among Kentucky adults was 10.3%. The prevalence of was slightly higher in males (12.1%) compared to females (8.7%). Those 18 to 34 were most likely to use cannabis (16.9%), and those 55+ (5.1%) were the least likely to use cannabis. Education was only marginally related to cannabis use rates, which ranged only from 8.9% (college degree or more) to 10.8% (high school or less). Those without healthcare coverage reported more use (18.4%) than those with healthcare coverage (9.6%). Use increased somewhat with declining income, but the differences were only marginally significant (p=0.06). Those who made less than $25,000 (14.4%) and less than $50,000 (11.2%) had higher rates of use than those who made $50,000 or more (9.8%). Marital status was consistent among all groups except for Never Married, where the rate of use was highest (17.2%). Cannabis use was least common in whites (9.1%) and highest for blacks (21.6%). Residents of Kentucky's Appalachian region were slightly less likely to use cannabis (8.8% vs. 11.8%), but this difference was only marginally significant (p=0.0786).

**Table 1. Cannabis use in Kentucky by demographic, socioeconomic factors, BRFSS 2020**

| Characteristic | Total BRFSS Respondents | Cannabis Use Respondents N (Weighted %) | Chi-Square p value |
|---|---|---|---|
| **Gender** | | | |
| Male | 1,565 | 158 (12.1) | 0.0204 |
| Female | 1,819 | 134 (8.7) | |
| Total | 3,384 | 292 (10.3) | |
| **Age** | | | |
| 18 to 34 | 576 | 101 (16.9) | <.0001 |
| 35 to 54 | 960 | 103 (11.4) | |
| 55+ | 1,848 | 88 (5.1) | |
| Total | 3,384 | 292 (10.3) | |
| **Education** | | | |
| High School Graduate or Below | 1,340 | 116 (10.8) | 0.5245 |
| Some College or Technical School | 969 | 96 (10.7) | |
| College or Technical Graduate | 1,066 | 80 (8.9) | |
| Total | 3,375 | 292 (10.4) | |
| **Healthcare Coverage** | | | |
| Yes | 3,198 | 263 (9.6) | 0.0068 |
| No | 175 | 27 (18.4) | |
| Total | 3,373 | 290 (10.3) | |
| **Income** | | | |
| Less than $25,000 | 845 | 97 (14.4) | <.0001 |
| Less than $50,000 | 660 | 66 (11.2) | |
| $50,000 + | 1,298 | 106 (9.8) | |
| Refused | 581 | 23 (4.4) | |
| Total | 3,384 | 292 (10.3) | |
| **Marital** | | | |
| Married/Cohabitating | 1,794 | 122 (8.1) | <.0001 |
| Separated/Divorced/Widowed | 1,016 | 90 (9.9) | |
| Never Married | 555 | 79 (17.2) | |
| Total | 3,365 | 291 (10.4) | |
| **Race/Ethnicity** | | | |
| White | 3,015 | 241 (9.1) | 0.0003 |
| Black | 189 | 28 (21.6) | |
| Hispanic/Other | 180 | 5 (14.6) | |
| Total | 3,384 | 292 (10.3) | |
| **Appalachia Resident** | | | |
| Yes | 872 | 67 (8.8) | 0.0786 |
| No | 2,233 | 214 (11.8) | |
| Total | 3,105 | 281 (11) | |

## Mode Preferences

Smoking was the most preferred mode for all demographic and socioeconomic groups (67.3%-94.7%). Ingesting was the second most reported (1%-23%) and concentrate was third most (0.7%-14.7%) for all respondents. Other mode was preferred by very few PWUC, except for a noticeably high weighted percentage of use by those aged 55+ (7.8%).

For those 55+, ingesting was the 2nd highest preferred mode (17.7%), and females (19.6%) reported ingesting more than males (9.3%). Concentrate use was highest for the 18 to 34 age group (9.2%) with the other age groups reporting very little use. Those who reported earning $50,000+ were more likely to use edibles or drinks than any other income group (21.2%). Married/cohabitating adults reported higher rates of ingesting (22.8%) than those of other marital statuses. Ingesting was most common among white Kentuckians (17.1%), and black Kentuckians reported the highest preference for smoking (94.7%). Mode of use did not vary significantly by Appalachian residence.

**Table 2. Cannabis use preferred mode in Kentucky by demographic, socioeconomic factors, BRFSS 2020**

| Characteristic | Cannabis Users | Smoking Respondents N (Weighted %) | Ingesting Respondents N (Weighted %) | Concentrate Respondents N (Weighted %) | Other Respondents N (Weighted %) | Chi-Square p value |
|---|---|---|---|---|---|---|
| **Gender** | | | | | | |
| Male | 156 | 125 (82.5) | 17 (9.3) | 12 (7.9) | 2 (0.3) | 0.0063 |
| Female | 133 | 97 (72.8) | 19 (19.6) | 6 (4.1) | 11 (3.5) | |
| Total | 289 | 222 (78.2) | 36 (13.8) | 18 (6.2) | 13 (1.7) | |
| **Age** | | | | | | |
| 18 to 34 | 101 | 78 (73.6) | 12 (17.3) | 11 (9.2) | . | - |
| 35 to 54 | 102 | 87 (88.2) | 10 (7.5) | 4 (3.8) | 1 (0.6) | |
| 55+ | 86 | 57 (70.7) | 14 (17.7) | 3 (3.8) | 12 (7.8) | |
| Total | 289 | 222 (78.2) | 36 (13.8) | 18 (6.2) | 13 (1.7) | |
| **Education** | | | | | | |
| High School Graduate or Below | 114 | 97 (84.9) | 11 (9.9) | 5 (5) | 1 (.2) | 0.1714 |
| Some College or Technical School | 96 | 70 (72.6) | 14 (18) | 6 (6.8) | 6 (2.6) | |
| College or Technical Graduate | 79 | 55 (70.3) | 11 (17) | 7 (8.5) | 6 (4.2) | |
| Total | 289 | 222 (78.2) | 36 (13.8) | 18 (6.2) | 13 (1.7) | |
| **Healthcare Coverage** | | | | | | |
| Yes | 260 | 199 (78.6) | 32 (12.5) | 16 (6.9) | 13 (2) | - |
| No | 27 | 21 (75) | 4 (23) | 2 (2) | . | |
| Total | 287 | 220 (78.1) | 36 (13.9) | 18 (6.3) | 13 (1.7) | |
| **Income** | | | | | | |
| Less than $25,000 | 96 | 75 (82.9) | 12 (13.3) | 3 (2) | 6 (1.7) | 0.0139 |
| Less than $50,000 | 65 | 56 (90.3) | 3 (4.3) | 3 (3.8) | 3 (1.6) | |
| $50,000 + | 105 | 73 (67.3) | 19 (21.2) | 10 (9.8) | 3 (1.6) | |
| Refused | 23 | 18 (77.7) | 2 (5.2) | 2 (14.7) | 1 (2.4) | |
| Total | 289 | 222 (78.2) | 36 (13.8) | 18 (6.2) | 13 (1.7) | |
| **Marital** | | | | | | |
| Married/Cohabitating | 120 | 85 (69.6) | 23 (22.8) | 9 (6.5) | 3 (1.2) | 0.0003 |
| Separated/Divorced/Widowed | 89 | 73 (88.5) | 6 (6.2) | 1 (0.7) | 9 (4.6) | |
| Never Married | 79 | 64 (82.6) | 7 (7.9) | 7 (9) | 1 (0.5) | |
| Total | 288 | 222 (78.4) | 36 (13.9) | 17 (6) | 13 (1.7) | |
| **Race/Ethnicity** | | | | | | |
| White | 238 | 178 (73.7) | 33 (17.1) | 17 (7.2) | 10 (2.1) | 0.0003 |
| Black | 28 | 25 (94.7) | 2 (5.2) | . | 1 (0.1) | |
| Hispanic/Other | 23 | 19 (88.8) | 1 (1) | 1 (8.9) | 2 (1.3) | |
| Total | 289 | 222 (78.2) | 36 (13.8) | 18 (6.2) | 13 (1.7) | |
| **Appalachia Resident** | | | | | | |
| Yes | 67 | 55 (84) | 9 (12.1) | 2 (2.7) | 1 (1.1) | 0.5203 |
| No | 211 | 159 (76.5) | 27 (14.9) | 15 (7) | 10 (1.6) | |
| Total | 278 | 214 (78.2) | 36 (14.3) | 17 (6) | 11 (1.5) | |

# Reasons For Cannabis Use Distribution

More PWUC across all demographic and socioeconomic characteristics reported using cannabis for both recreational and medicinal reasons than for either reason alone. Females reported medicinal use only (30.9%) more than males (21.5%). Those 55+ more frequently reported medicinal use (52.6%) compared to the other age groups. Those with some college or technical school reported higher medicinal (39.1%) and recreational use (39%). College or Technical school graduates were most likely to report they used cannabis for both purposes (50.3%), followed by High school graduate or below (46.9%). Those reporting having healthcare coverage and those with no coverage both used cannabis for recreational and medical purposes more frequently than either alone (38.6% and 64.9%, respectively). Those who refused to disclose their income more frequently cited medicinal reasoning (42.3%) than stated income groups. Hispanic/Other reported combined medicinal and recreational reasoning much more than any other race (81.8%).

**Table 3. Reasons for Cannabis Use in Kentucky by demographic, socioeconomic factors, BRFSS 2020**

| Characteristic | Total BRFSS Respondents | Recreational Use N (Weighted %) | Medicinal Use N (Weighted %) | Combined Use N (Weighted %) | Chi-Square p value |
|---|---|---|---|---|---|
| **Gender** | | | | | |
| Male | 155 | 50 (33.6) | 42 (21.5) | 63 (44.9) | 0.3209 |
| Female | 134 | 36 (30) | 52 (30.9) | 46 (39.1) | |
| Total | 289 | 86 (32) | 94 (25.6) | 109 (42.3) | |
| **Age** | | | | | |
| 18 to 34 | 101 | 31 (29.9) | 18 (16) | 52 (54.1) | <.0001 |
| 35 to 54 | 102 | 33 (35) | 29 (23) | 40 (42) | |
| 55+ | 86 | 22 (31.5) | 47 (52.6) | 17 (16) | |
| Total | 289 | 86 (32) | 94 (25.6) | 109 (42.3) | |
| **Education** | | | | | |
| High School Graduate or Below | 120 | 33 (24.8) | 38 (28.3) | 49 (46.9) | 0.0018 |
| Some College or Technical School | 90 | 27 (39) | 41 (39.1) | 22 (22) | |
| College or Technical Graduate | 78 | 25 (36.2) | 15 (13.5) | 38 (50.3) | |
| Total | 288 | 85 (31.9) | 94 (25.7) | 109 (42.4) | |
| **Healthcare Coverage** | | | | | |
| Yes | 260 | 80 (34.6) | 86 (26.8) | 94 (38.6) | 0.0395 |
| No | 27 | 5 (15.6) | 8 (19.5) | 14 (64.9) | |
| Total | 287 | 85 (32) | 94 (25.8) | 108 (42.2) | |
| **Income** | | | | | |
| Less than $25,000 | 97 | 25 (27.9) | 32 (19.8) | 40 (52.2) | 0.2288 |
| Less than $50,000 | 63 | 19 (34.2) | 19 (25.2) | 25 (40.6) | |
| $50,000 + | 106 | 34 (33.4) | 33 (28.2) | 39 (38.4) | |
| Refused | 23 | 8 (39.2) | 10 (42.3) | 5 (18.5) | |
| Total | 289 | 86 (32) | 94 (25.6) | 109 (42.3) | |
| **Marital** | | | | | |
| Married/Cohabitating | 113 | 34 (30.8) | 38 (25.8) | 41 (43.4) | 0.9936 |
| Separated/Divorced/Widowed | 96 | 25 (32.9) | 32 (24.9) | 39 (42.2) | |
| Never Married | 80 | 27 (33.8) | 24 (26.5) | 29 (39.7) | |
| Total | 289 | 86 (32) | 94 (25.6) | 109 (42.3) | |
| **Race/Ethnicity** | | | | | |
| White | 238 | 75 (34.5) | 78 (27.6) | 85 (37.9) | 0.0391 |
| Black | 28 | 10 (33.1) | 10 (24.9) | 8 (41.9) | |
| Hispanic/Other | 23 | 1 (8.4) | 6 (9.8) | 16 (81.8) | |
| Total | 289 | 86 (32) | 94 (25.6) | 109 (42.3) | |
| **Appalachia Resident** | | | | | |
| Yes | 67 | 21 (36.2) | 26 (29.7) | 20 (34.1) | 0.4842 |
| No | 212 | 62 (30.3) | 66 (25.2) | 84 (44.5) | |
| Total | 279 | 83 (31.6) | 92 (26.2) | 104 (42.2) | |

# Regression Analysis Distribution

After adjustment for all socioeconomic and demographic factors, cannabis users had significantly higher odds of being male (aOR=1.43, 95% CI 1.10 – 1.86). Income appeared to have no association with cannabis use, although those refusing to report income appeared to be least likely to use cannabis (aOR=0.33, 95% CI 0.20 - 0.56). Marital status was still associated with cannabis use in the multivariable regression model, with cannabis users having greatest odds of being separated/divorced/widowed (aOR=1.68, 95% CI 1.21 – 2.32). Black Kentuckians were still most likely to use cannabis after adjustment for other facors (1.80 95% CI 1.14 – 2.84) compared to white and Hispanic/other (1.30, 95% CI .8 – 2.13) Kentuckians, though this association was attenuated. Appalachian residents were somewhat less likely to use cannabis than non-Appalachian residents. A major difference in this is that those without healthcare coverage are less likely to use cannabis than those with, yet Table 1 above showed the opposite.

**Table 4. Logistic Regression predicting cannabis use in Kentucky**

| Characteristic | Odds Ratio | (95% Conf. Interval) |
|---|---|---|
| **Gender** | | |
| Female | Ref | ----- |
| Male | 1.43 | (1.10, 1.86) |
| **Age** | | |
| 18 to 34 | Ref | ----- |
| 35 to 54 | 0.56 | (0.40, 0.79) |
| 55+ | 0.21 | (0.14, 0.30) |
| **Education** | | |
| High School Graduate or Below | Ref | ----- |
| Some College or Technical School | 1.20 | (0.88, 1.63) |
| College or Technical Graduate | 0.87 | (0.62, 1.23) |
| **Healthcare Coverage** | | |
| Yes | Ref | ----- |
| No | 0.72 | (0.45, 1.15) |
| **Income** | | |
| Less than $25,000 | Ref | ----- |
| Less than $50,000 | 0.82 | (0.57, 1.18) |
| $50,000 + | 0.70 | (0.49, 1.00) |
| Refused | 0.33 | (0.20, 0.56) |
| **Marital** | | |
| Married/Cohabitating | Ref | ----- |
| Separated/Divorced/Widowed | 1.68 | (1.21, 2.32) |
| Never Married | 1.20 | (0.83, 1.73) |
| **Race/Ethnicity** | | |
| White | Ref | ----- |
| Black | 1.80 | (1.14, 2.84) |
| Hispanic/Other | 1.30 | (0.80, 2.13) |
| **Appalachian Resident** | | |
| No | Ref | ----- |
| Yes | 0.74 | (0.54, 1.0) |

# DISCUSSION:

This is the first study we are aware of to examine cannabis use among adults in the state of Kentucky. Important findings from this study include smoking being the most common mode of use, with nearly 78% of all respondents reporting it as their preferred mode. And despite the lack of legal retail options for these products in Kentucky, ingesting (edibles and drinking) and concentrates (vaping and dabbing) were also relatively common overall, especially among those with higher incomes and educational attainment. Low income (less than $25,000) reported the highest rates of use (14.4%), but this did not differ much from the other groups. Although, those who refused to report their income had the lowest use rate (4.4%). For our study education seemed to have little, if any, association with rates of cannabis use. Black Kentuckians used cannabis at rates higher (21.6%) than white Kentuckians (9.1%) or those from other races/ethnicities (14.6%). Further studies could reveal whether if there is any sort of relationship between the urban-rural distribution of black Kentuckians, as urban-rural status was not examined here. Appalachia Residents reported very little use (8.8%). Notably, Kentuckians who reported not having healthcare reported higher rates of cannabis use (18.4%). This might suggest that some individuals without access to healthcare are self-medicating with cannabis, though more research is needed to understand this phenomenon. Many of our results match part of the Jeffers (2021) study, which found "that young, male, Black, and Native American individuals and individuals with low educational attainment and income were more likely to engage in higher frequency cannabis use." Yet our study differs slightly from the results observed in the Schauer (2020) study, where male, white, young (age groups 18-20 and 21-25 years) with some college education were found to most likely to use cannabis.

Smoking was the most preferred modality in our study (82.5%) and the Schauer (2020) study showed that for all 12 states, smoking was the preferred modality (90.7%). While our study combined Eating and Drinking and Vaping and Dabbing for our analysis, the Schauer (2020) study kept all modes in the BRFSS separate. We did this due to the low respondent number in our study. Despite this, our results can be compared with the Schauer (2020) study, which shows eating cannabis being the second highest preferred modality (24.7%) and vaping the third (19.5%). Drinking was low for the

Schauer (2020) study (5.3%), but as the data is from 2016 which is well before drinkable cannabis became easier to obtain and was easier to produce.

Finding reliable data for mode preferences for recent years in adjacent states is difficult. Cannabis use questions were asked in Ohio in the 2016 BRFSS, yet medicinal cannabis use was legalized in 2016 and the 2016 BRFSS was completed before its legalization. The Schauer (2020) study analyzed cannabis use data with the 2016 BRFSS and included Ohio and Tennessee. Both of those states at the time did not have RL. Ohio began ML in 2016 and Tennessee did not, and as of May 2022 still does not, have any legalization. Despite this, trends in Ohio are much like Kentucky's, with PWUC preferring smoking as their main modality (95.2%) (Schauer et al., 2020). Eating cannabis was reported as the second highest (14%), while vaping (9.4%) and dabbing (8.8%) were the third reported modality (Schauer et al., 2020). Drinking and Other use preferences were not reported. In Tennessee, smoking was the also the most preferred modality (96.4%), with eating and vaping being second (22.6%) and third (19.4%). Drinking, dabbing, and other were not reported.

Cannabis use rates did not vary greatly across income groups. This is like the Jeffers (2021) study, which didn't show much variance between income groups. Although, our study showed that those with higher incomes reported more variety in modes, suggesting that their income allowed them to either travel to states that sold various modes or maybe even have products shipped to their homes. Lower income respondents also had a somewhat higher rate of ingesting cannabis. This could be explained by edibles sold at dispensaries tend to have more product available for less money. For example, in Missouri an eighth of an ounce (3.5g) of cannabis flower, typically used for smoking, averages between $40 and $60 (Press, 2021). This amount of flower will typically make seven joints. The average price for a pack of edibles is $36 (Holman, 2020). The edible products can be torn apart and consumed in smaller doses, and as noted above, edibles tend to have a stronger high and last longer.

## STRENGTHS AND LIMITATIONS:

One major limitation with the BRFSS is that it is survey data. Interviewees may not be entirely honest, especially with questions related to illicit drug use. A major issue with the BRFSS and our study is that individuals who are jailed or institutionalized are not interviewed. Illicit drug use is a major reason for incarceration, so rates inclusive of incarcerated population would almost certainly be higher than observed in this study. Another major limitation for this study was the low response rate for the BRFSS in Kentucky in 2020. This year had some of the lowest response rates for the BRFSS nationwide (CDC, 2021). The SARS CoV-2 (COVID-19) Pandemic led to a major shift in the work force, starting in March of 2020 (CDC, 2021). Some of the BRFSS data collectors were forced to cease work due to logistical difficulties and could not make calls for some time (CDC, 2021). Kentucky was not able to conduct surveys for each of the 12 months of 2020 and did not begin data collection until May (CDC, 2021). While it did meet the minimum requirements to be included in the 2020 BRFSS public-use data set, there might be differences in estimates and analysis when compared to other years (CDC, 2021). Also, 2020 was the first year that cannabis use questions were asked in the state of Kentucky. This prevents any sort of analysis to establish any sort of trends or comparisons to previous years. The pandemic might also have affected use rates if some PWUC could not access their usual cannabis sources, or they may have changed mode of use due to fears of COVID-19. PWUC may have switched to other easier to obtain illicit drugs, alcohol, or quit use in general. Finally, we did not control for important health behaviors possibly related to cannabis use, such as tobacco use, and this leaves potential for residual confounding that was not accounted for in our analysis.

## CONCLUSION:

Overall, cannabis use in Kentucky resembles national trends and trends in states where cannabis is legal. Despite the illegal status of cannabis, the five most common modes of use were all present in Kentucky. As nearby states legalize cannabis and as the pandemic restrictions disappear, we speculate that use of cannabis and experimentation with non-smoking modes of use may increase. Generally, the low number of respondents in the

BRFSS and the COVID-19 pandemic may have limited this study's findings, but it

remains the first such examination of cannabis use among adults in Kentucky to date.

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