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ORIGINAL ARTICLE

Cannabis use among cancer survivors in 22 states: Results from the Behavioral Risk Factor Surveillance System, 2020

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Abstract

Background: This study identified factors associated with recent cannabis use and cannabis use for medical purposes among cancer survivors relative to individuals without a history of cancer.

Methods: Data from the Behavioral Risk Factor Surveillance System were analyzed for the 22 states completing the optional cannabis module in 2020. Weighted multiple logistic regression was performed to explore variables associated with past 30-day cannabis use and cannabis use for medical purposes, stratified by history of cancer. Covariates included state-level cannabis policy, sociodemographic characteristics, health status indicators, and substance use.

Results: Cannabis use was lower among cancer survivors compared to individuals with no history of cancer (7.57% vs. 10.83%). However, a higher proportion of cancer survivors reported use for medical purposes (82.23% vs. 62.58%). After adjusting for state-level policy, biological sex, age, educational attainment, self-reported race/ethnicity, home ownership, mental health status and physical health status, current smoking (odds ratio [OR], 5.14 vs. 3.74) and binge drinking (OR, 2.71 vs. 2.69) were associated with cannabis use in both groups. Characteristics associated with medical cannabis use varied for the two groups; however, daily use (20–30 days; OR, 1.72 vs. 2.43) was associated with cannabis use for medical purposes in both groups after adjusting for other variables in the model.

Conclusions: A high proportion of individuals report cannabis use for medical purposes with higher rates among cancer survivors. Findings support the urgent need for ongoing cannabis research to better understand and inform its use for medical purposes, as well as the development of high-quality standardized education materials and clinical practice guidelines.

KEYWORDS
Behavioral Risk Factor Surveillance System, cancer survivor, cannabis, medical marijuana, smoking

BACKGROUND

The number of individuals diagnosed with cancer and still living (i.e., cancer survivors) is at an all-time high, with an estimated 16.9 million cancer survivors in the United States as of 2019, 68% of which were diagnosed 5 or more years ago.[1] The number of cancer survivors is projected to continue to rise to more than 22.1 million by 2030.[1] This is due to two key factors: a growing number of new cancer diagnoses as a result of the aging population and increases in cancer survivorship because of advances in early detection and treatment.[1] With more cancer survivors than ever, there is a critical need to maximize survivors' quality of life and address cancer-related symptoms, such as chronic pain, fatigue, anxiety, and depression.[1–4] Cannabis (marijuanaand its cannabinoid constituents), may have positive utility to alleviate cancer-related symptoms and side effects.[5–8]

The societal and legal landscape of cannabis has been rapidly evolving since the early 2000s. Despite the lack of strong clinical evidence for its effectiveness, as of mid-2020, 35 states have approved medical cannabis, with almost every one of those states identifying cancer as a qualifying condition.[9] Cancer survivors in particular are likely exposed to various messaging regarding the potential benefits of cannabis, either for treatment of cancer or management of symptoms and side effects, and inconsistent clinician support.[10]

Quantifying the current patterns of cannabis use is imperative as the sociocultural context of cannabis rapidly evolves, as well as the availability and variety of cannabis products increase. Estimates of cannabis use among cancer survivors based on nationally representative population-based samples have varied from 5% to 12% among cancer survivors, and 7% to 16% among individuals without a history of cancer.[11–16] Although useful, these studies obtained a wide range of estimates for both groups, which may be related to differences in the time periods, data sources, and the methods used. Recent literature has demonstrated strengthened evidence among the general population regarding the relationship between cannabis use and sociodemographic characteristics, adverse health behaviors, and state-level cannabis policy.[17,18] However, there are inconsistent findings regarding characteristics related to cannabis use for cancer survivors compared with those without a history of cancer, and the primary reason for use. Strengthening epidemiologic evidence regarding these associations is crucial for understanding specific groups to target for in-depth evaluation and discussions regarding cannabis use as well as identifying specific directions of future research.

This study aims to refine and strengthen current literature by using Behavioral Risk Factor Surveillance System (BRFSS) data, one of the largest annual random digit dial surveys in the United States. The purpose of this study is to identify factors associated with recent cannabis use and cannabis use for medical purposes among cancer survivors relative to individuals without a history of cancer in the United States in 2020.

METHODS

Data source and study sample

BRFSS is an annual nationally representative telephone-based survey, designed by the Centers for Disease Control and Prevention, which collects state-level data on residents regarding their health-related risk behaviors, chronic health conditions, and use of preventive services.[19] The specific methods of data collection are publicly available.[19] The median survey response rate for all states, territories, and Washington, DC, in 2020 was 47.9% and ranged from 24.5% to 67.2%. Response rates for states included in this study had a median of 48.6% and ranged from 38.5% (Delaware) to 67.2% (Mississippi).

The cannabis use (CU) module became an optional module to the BRFSS in 2016. In 2020, 22 continental states administered the CU module, covering approximately 25.17% of the US adult population (Figure 1). Although Guam also deployed the CU module, respondents from the territory were excluded from this study because of concerns regarding differences in external factors influencing the outcome and exposure. Nebraska and Oklahoma only included the optional CU module for version 2 (of two versions) of their BRFSS.

We restricted our analyses to individuals who had responses for the exposure (history of cancer) and primary outcome of interest (cannabis use) (Figure 2). Because the study involves secondary data analysis of publicly available deidentified data with no direct involvement of the human subjects, ethical approval for the study was not sought.

Measures

The CU module measures cannabis use by asking participants the following question, "During the past 30 days, on how many days did you use marijuana or cannabis?"[20] For individuals that reported 1 or more days of cannabis use, they were then asked two additional questions inquiring about the primary method of administration and the reason for use. For this study, responses for cannabis use were dichotomized as (1) yes, 1 or more days and (2) no, zero days. Among individuals who use cannabis, we classified participants into three main categories based on their primary method of administration: (1) inhalation (smoking, vaporization/vaping, dabbing); (2) oral (eat, drink); and (3) other. We also classified participants into three groups based on their reason for use, as asked in the survey: (1) medical reasons; (2) nonmedical reasons; and (3) both medical and nonmedical reasons. To explore frequency of cannabis use, responses were grouped into three categories: (1) 1 to 19 days, (2) 20 to 30 days, and (3) zero days, based on categorization schemes from previous studies.[21–24]

Cancer history was assessed by asking participants whether they were ever told by a physician, nurse, or other health professional they had cancer (excluding skin cancer). Those who responded "yes"

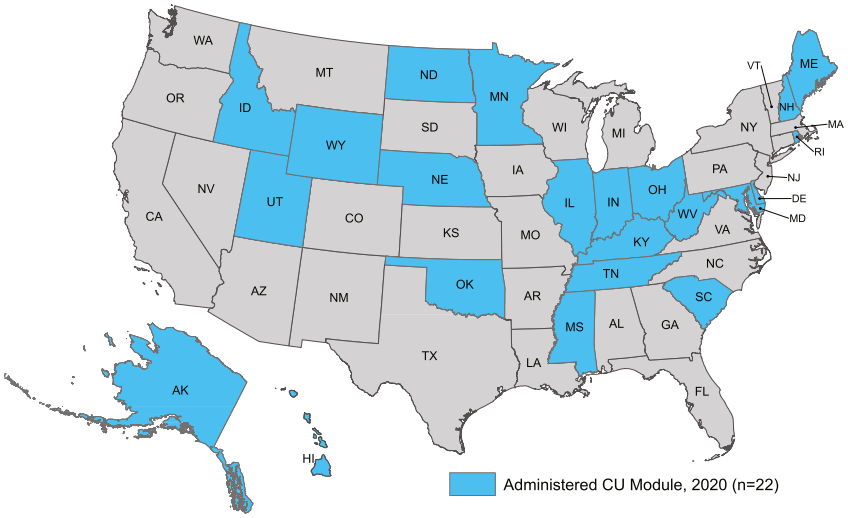

FIGURE 1 US states administering BRFSS 2020 cannabis use (CU) module. BRFSS indicates Behavioral Risk Factor Surveillance System.

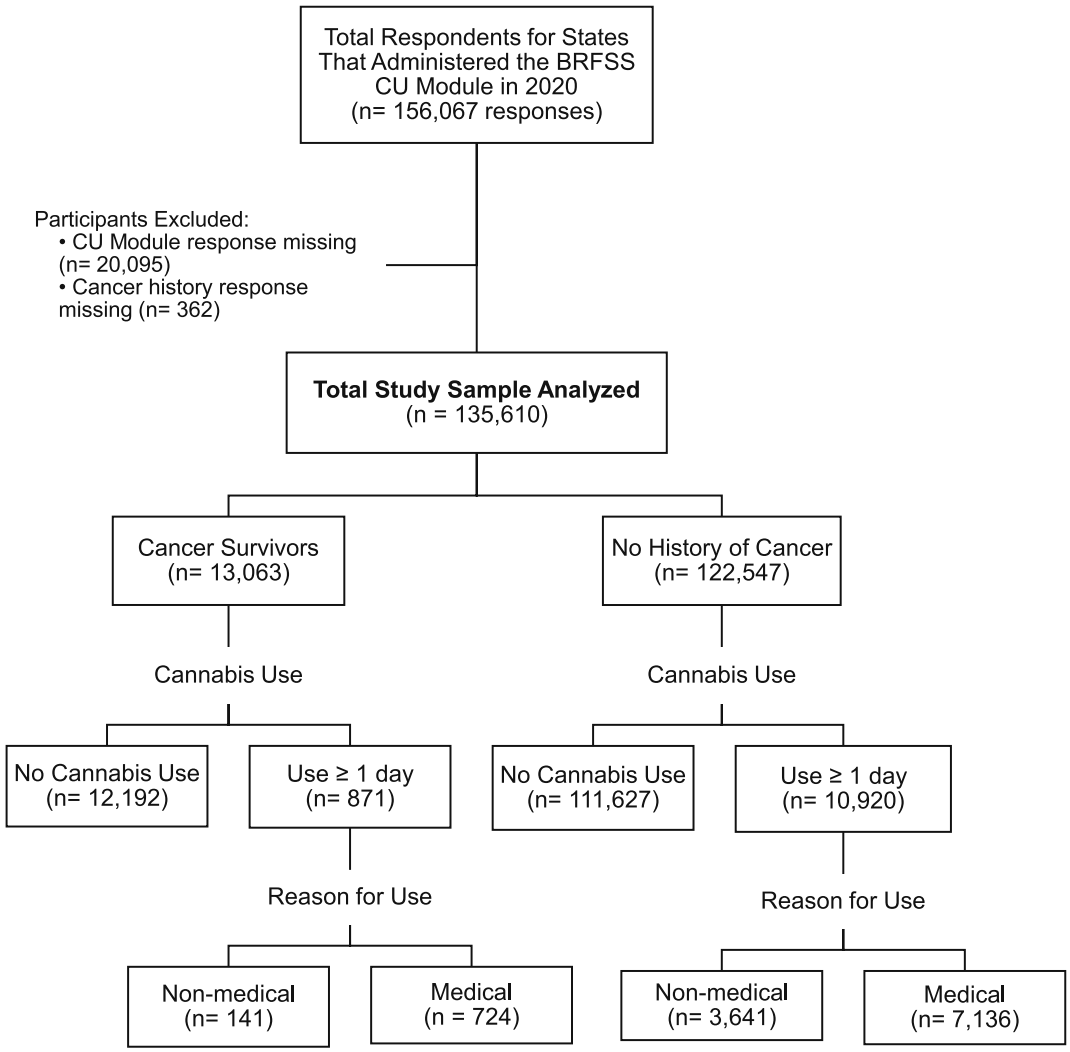

FIGURE 2 Sample selection flow diagram.

were defined as cancer survivors. This operationalization aligns with previous literature and has been shown to be a reasonable method for identifying cancer survivors.[22,23,25,26]

Based on core component questions, several covariates were included in the analysis based on existing literature. These covariates included: sociodemographic characteristics, health indicators, and substance use. The state-level cannabis law (i.e., state-regulated cannabis programs) variable was created based the presence of enacted cannabis laws as of 2020 and was classified into: (1) no comprehensive state-regulated cannabis program: (1a) no public cannabis access program and (1b) high cannabidiol [CBD]/low tetrahydrocannabinol program); (2) comprehensive medical use program (i.e., "medical marijuana laws"); and (3) recreational use program (i.e., "recreational marijuana laws"). All states that had legalized recreational cannabis also had legalized medical cannabis. Categorization is in alignment with the National Conference of State Legislatures, which uses criteria similar to other organizations tracking this issue to determine if a program is comprehensive. Current epidemiologic evidence supports that if age is not considered, then findings regarding both cancer history status and cannabis use are biased by age; therefore, the variable age group was considered in the final models regardless of statistical significance.[13,28–30]

Statistical analysis

SAS version 9.4 (SAS Institute Inc, Cary, North Carolina) was used to create a final data set and analyze data. The BRFSS sampling weight was taken into account according to Centers for Disease Control and Prevention guidelines using the following variables: _STSTR for strata, _PSU for primary sampling units, and _LLCPWT, _LCPWTV2 for sample weights for overall cell phone and landline data, and version 2 data, respectively.[31]

Descriptive statistics were generated to examine the extent of differences between the cancer survivors and individuals with no cancer history. Frequencies, weighted percentages, and corresponding 95% CIs were calculated and reported. If there was a high proportion (≥15%) of participants with missing data, the variable was not included in the following modeling procedures. This was the case for the variable annual household income (15.06% missing), similar to prior studies using the BRFSS. Therefore, homeownership was used as a proxy.[32] To assess the factors associated with the dichotomous primary outcome (cannabis use), we used weighted multivariable logistic regression models stratified by cancer history status. Variables considered for the final model included state-level cannabis law, sociodemographic characteristics, health indicators, and substance use as shown in Table 1. The final model was determined using a combination of the significance criteria using a manual stepwise variable selection (forward and backward) approach, change-in-estimate criterion (examining changes in the point estimates),[27] and background knowledge. Statistical interaction on the multiplicative scale was investigated by adding two-way interaction terms between variables included in the final model.

To explore factors associated with the secondary outcome (cannabis consumption for medical purposes), we restricted our analyses to individuals who reported using cannabis at least 1 day in the past 30 days. We then examined weighted prevalence estimates and 95% CIs. The outcome variable was dichotomized (medical or "both" vs. nonmedical). Weighted multivariable logistic regression models, stratified on cancer history status, were conducted using similar methods described previously. Adjusted prevalence odds ratios and corresponding 95% CIs were calculated to estimate associations. A two-sided p value <.05 was considered statistically significant.

RESULTS

Descriptive statistics

In our study population, 7.05% (N = 3,794,283) reported ever being told that they had any type of cancer (excluding skin cancer). There are notable differences in the study population by cancer history status, which are illustrated in Table 1. Cancer survivors were predominantly female (59.65%), aged 65 years and older (57.00%), married (56.26%), non-Hispanic White (83.93%), and owned a home (83.16%), and more than half either had some college education (30.01%) or a college degree or above (27.63%). The majority of cancer survivors reported having good or better general health (68.14%), ≤13 days in which their mental health was not good (84.67%), and ≤13 days in which their physical health was not good (78.12%). Compared with individuals with no history of cancer, a greater proportion of cancer survivors were former smokers (36.05% vs. 23.81%). Cancer survivors were also less likely to report binge drinking (6.87% vs. 13.52%). Further details are available in Table S1 (available online).

Cannabis use by cancer history status

Among all adults, 10.60% reported being a current cannabis user and almost half of individuals (46.02%) resided in a state where medical cannabis is legal. The proportion of current cannabis users varied by state, ranging from 6.89% (Nebraska) to 19.04% (Maine) (data not shown). This was reflective of state-level cannabis policies where the prevalence of current cannabis use was 7.81% (95% CI, 6.98–8.63) where there was no public access, 9.48% (95% CI, 8.91–10.06) where only CBD/low tetrahydrocannabinol is legal, 11.13% (95% CI, 10.73–11.53) where medical use is legalized, and 12.03% (95% CI, 10.72–13.34) where recreational use is legalized. Only 7.57% (95% CI, 6.69–8.45) of cancer survivors reported any cannabis use in the past 30 days, whereas 10.83% (95% CI, 10.47–11.20) of individuals with no history of cancer reported cannabis use. The majority of individuals in both groups reported primary consumption of cannabis through inhalation (70.42% and 84.16%).

Results from weighted multivariable logistic regression models of factors associated with cannabis use by cancer history status are presented in Table 2. Factors significantly associated with cannabis

TABLE 1 Characteristics of study population, 2020.[a]

	Cancer survivors (n = 13,063; N = 3,794,283 [7.05%])			No history of cancer (n = 122,547; N = 49,997,794 [92.95%])		
	n	*N*	Wt. % (95% CI)	*n*	*N*	Wt. % (95% CI)
State-level cannabis law[b]						
No public access	1083	163,399	4.31 (3.95–4.66)	10,701	2,348,775	4.70 (4.63–4.77)
CBD/low THC	2798	1,283,986	33.84 (32.29, 35.39)	24,967	15,926,279	31.85 (31.56–32.15)
Medical use only	7458	1,725,766	45.48 (43.86–47.11)	72,030	23,028,382	46.06 (45.74–46.38)
Recreational use	1724	621,131	16.37 (14.34–18.40)	14,849	8,694,359	17.39 (16.99–17.79)
Sociodemographic						
Sex						
Male	5049	1,531,068	40.35 (38.65–42.06)	55,856	24,255,236	48.51 (47.96–49.07)
Female	8014	2,263,215	59.65 (57.94–61.35)	66,691	25,742,558	51.49 (50.93–52.04)
Age (years)						
18–44	727	371,407	9.79 (8.67–10.90)	37,930	23,260,032	46.52 (45.97–47.07)
45–54	1085	414,940	10.94 (9.85–12.02)	19,028	7,947,389	15.90 (15.48–16.31)
55–64	2499	845,248	22.28 (20.60–23.96)	24,554	8,379,101	16.76 (16.38–17.14)
65+	8752	2,162,687	57.00 (55.21–58.79)	41,035	10,411,273	20.82 (20.45–21.20)
Education attainment						
Less than HS	777	478,699	12.66 (10.79–14.53)	7146	5399256	10.84 (10.35–11.33)
HS diploma	3530	1,064,563	28.15 (26.67–29.63)	34,267	14991697	30.09 (29.59–30.59)
Some college	3746	1,193,679	31.56 (30.01–33.12)	34,941	15778153	31.67 (31.15–32.19)
College degree or above	4973	1,044,919	27.63 (26.26–29.00)	45,828	13653970	27.40 (26.97–27.84)
Missing	37			365		
Race/ethnicity						
NH White	11,245	3,133,541	83.93 (82.17–85.68)	96,351	35,800,684	72.79 (72.24–73.34)
NH Black	683	330,498	8.85 (7.75–9.95)	8792	6,191,506	12.59 (12.19–12.99)
NH Other[c]	686	158,961	4.26 (3.67–4.85)	9476	3,396,275	6.91 (6.62–7.19)
Hispanic	224	110,735	2.97 (1.47–4.46)	5771	3,794,743	7.72 (7.27–8.16)
Missing	225			2157		
Homeownership						
Own	10,659	3,142,605	83.16 (81.9–84.41)	88,352	35,294,662	71.24 (70.75–71.74)
Rent	1957	525,937	13.92 (12.78–15.05)	26,871	10,932,358	22.07 (21.62–22.52)
Other	403	110,566	2.93 (2.31–3.54)	6555	3,312,997	6.69 (6.40–6.97)
Missing	44			769		
Urban/rural status						
Urban	10,475	3,368,904	88.79 (87.84–89.74)	100,258	45,010,945	90.03 (89.76–90.29)
Rural	2588	425,379	11.21 (10.26–12.16)	22,289	4,986,850	9.97 (9.71–10.24)
Health indicators						
General health						
Good or better	9222	2,578,060	68.14 (66.50–69.77)	105,330	43,028,157	86.24 (85.86–86.62)
Fair or poor	3791	1,205,434	31.86 (30.23–33.50)	16,977	6,865,346	13.76 (13.38–14.14)
Missing	50			240		

(Continues)

TABLE 1 (Continued)

	Cancer survivors (*n* = 13,063; *N* = 3,794,283 [7.05%])			No history of cancer (*n* = 122,547; *N* = 49,997,794 [92.95%])		
	n	*N*	Wt. % (95% CI)	*n*	*N*	Wt. % (95% CI)
Mental health (days not good)						
0–13	11,094	3,145,075	84.67 (83.45–85.89)	106,005	42,353,880	86.38 (86.00–86.76)
14 or more	1702	569,408	15.33 (14.11–16.55)	14,411	6,678,259	13.62 (13.24–14.00)
Missing	267			2131		
Physical health (days not good)						
0–13	10,021	2,865,951	78.12 (76.76–79.48)	108,290	44,343,495	90.44 (90.09–90.78)
14 or more	2659	802705	21.88 (20.52–23.24)	11,944	4,689,123	9.56 (9.22–9.91)
Missing	383			2313		
Substance Use						
Smoking status[d]						
Current smoker	1635	609,614	16.26 (15.02–17.51)	17,274	8,085,004	16.29 (15.89–16.70)
Former smoker	4816	1,351,115	36.05 (34.45–37.64)	31,858	11,545,396	23.27 (22.81–23.72)
Never smoker	6512	1,787,649	47.69 (45.95–49.43)	72,692	29,995,195	60.44 (59.91–60.98)
Missing	100			723		
Binge drinking						
Yes	777	253,801	6.87 (6.05–7.70)	15,299	7,036,387	14.52 (14.13–14.90)
No	12,048	3,439,591	93.13 (92.30–93.95)	104,687	41,440,088	85.48 (85.10–85.87)
Missing	238			2561		
Any cannabis use						
Yes	871	287,247	7.57 (6.69–8.45)	10,920	5,417,059	10.83 (10.47–11.20)
No	12,192	3,507,035	92.43 (91.55–93.31)	111,627	44,580,735	89.17 (88.8–89.53)
Frequency of cannabis use among active users						
1–19 days	433	145,647	50.70 (44.74–56.67)	5722	2,794,425	51.59 (49.79–53.38)
20–30 days	438	141,600	49.30 (43.33–55.26)	5198	2,622,634	48.41 (46.62–50.21)
Reason for cannabis among active users						
Medical	469	156,733	54.85 (48.90–60.80)	3409	1,466,556	27.49 (26.01–28.98)
Nonmedical	141	50,786	17.77 (13.39–22.16)	3641	1,996,088	37.42 (35.69–39.15)
Both	255	78,232	27.38 (21.97–32.78)	3727	1,871,482	35.09 (33.39–36.78)
Missing	6			143		
Primary method of cannabis use among active users						
Inhalation	596	200,051	70.42 (65.05–75.79)	8876	4,496,461	84.16 (82.87–85.44)
Oral	181	61,018	21.48 (16.46–26.50)	1539	705,826	13.21 (12.03–14.39)
Other	86	23,014	8.10 (5.45–10.75)	375	140,740	2.63 (2.05–3.22)
Missing	8			130		

Abbreviations: CBD, cannabidiol; HS, high school; NH, non-Hispanic; THC, tetrahydrocannabinol.

[a]Results among the 22 states that used the BRFSS cannabis module.

[b]Number of states included for: no public access (*n* = 2 states), CBD/low THC (*n* = 6 states), medical use only (*n* = 11 states), and recreational use (*n* = 3 states).

[c]Other races include: American Indian or Alaska Native, Asian (Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian), Pacific Islander (Native Hawaiian, Guamanian or Chamorro, Samoan, Other Pacific Islander), or Other not listed.

[d]Includes smoking cigarettes only.

TABLE 2 Factors associated with cannabis use, by cancer history status 2020.[a]

	Cancer survivors (*N* = 3,336,246)		No history of cancer (*N* = 44,147,152)	
	aPOR (95% CI)	*p*	aPOR (95% CI)	*p*
State-level law		.0003[b]		<.0001[b]
No state-regulated program	2.06 (1.24–3.41)		1.88 (1.60–2.21)	
Medical use only	Ref.		Ref.	
Recreational	1.73 (1.31–2.30)		1.36 (1.25–1.48)	
Sex		.023[b]		<.0001[b]
Male	1.38 (1.05–1.81)		1.54 (1.40–1.68)	
Female	Ref.		Ref.	
Age (years)		<.0001[b]		<.0001[b]
18–44	4.25 (2.81–6.44)		4.00 (3.45–4.63)	
45–54	2.22 (1.45–3.39)		1.91 (1.62–2.26)	
55–64	2.00 (1.44–2.79)		2.04 (1.73–2.40)	
65+	Ref.		Ref.	
Education attainment		.131		.004[b]
Less than HS	0.81 (0.49–1.36)		1.19 (0.98–1.43)	
HS diploma	0.71 (0.49–1.02)		1.14 (1.02–1.27)	
Some college	1.02 (0.73–1.44)		1.22 (1.10–1.36)	
College degree or above	Ref.		Ref.	
Race/ethnicity		.005[b]		<.0001[b]
NH White	Ref.		Ref.	
NH Black	2.21 (1.41–3.45)		1.61 (1.41–1.84)	
NH Other	1.32 (0.83–2.11)		0.96 (0.84–1.10)	
Hispanic	0.97 (0.42–2.25)		0.98 (0.79–1.21)	
Homeownership		.003[b]		<.0001[b]
Own	Ref.		Ref.	
Do not own	1.58 (1.16–2.14)		1.60 (1.46–1.77)	
Poor mental health		.004[b]		<.0001[b]
0–13 days	Ref.		Ref.	
14 or more days	1.64 (1.17–2.31)		2.15 (1.92–2.40)	
Poor physical health		.049[b]		<.0001[b]
0–13 days	Ref.		Ref.	
14 or more days	1.38 (1.00–1.90)		1.34 (1.16–1.55)	
Smoking status		<.0001[b]		<.0001[b]
Current smoker	5.14 (3.54–7.48)		3.74 (3.37–4.15)	
Former smoker	2.94 (2.08–4.15)		2.21 (1.98–2.46)	
Never smoker	Ref.		Ref.	
Binge drinking		<.0001[b]		<.0001[b]
Yes	2.71 (1.90–3.85)		2.69 (2.43–2.98)	
No	Ref.		Ref.	

Abbreviations: aPOR, adjusted prevalence odds ratio; HS, high school; NH, non-Hispanic.

[a]Adjusted for state-level cannabis policy (2020), sex, age group, education attainment, self-reported race/ethnicity, home ownership, mental health status, physical health status, smoking status, and binge drinking.

[b]indicates statistically significant at $p < .05$.

use are similar for both groups including state-level policy, age, biological sex, self-reported race/ethnicity, home ownership, mental health status, and physical health status. Educational attainment was associated with cannabis use for individuals without a history of cancer ($p = .004$), but not for cancer survivors ($p = .131$). For both cancer survivors (adjusted prevalence odds ratio [aPOR], 2.71; 95% CI, 1.90–3.85) and those without a history of cancer (aPOR, 2.69; 95% CI, 2.43–2.98), binge drinking was similarly associated with cannabis use. Being a current smoker was associated with a 3.5- to 5-fold increase in the odds of cannabis use among cancer survivors and those without a history of cancer.

Reason for use among cannabis users by cancer history status

Overall, 63.58% ($N = 3{,}573{,}004$) of cannabis users reported using cannabis for medical purposes. Table 3 presents the frequency of different characteristics within primary reason for use and is stratified by cancer status. Regardless of the primary reason for use, among both groups, the majority of individuals primarily consumed cannabis through inhalation methods. Compared with individuals without a history of cancer, a higher proportion of cancer survivors reported using cannabis for medical purposes (82.23% vs. 62.58%). Regardless of reason for use, a higher proportion of participants with a history of cancer who consumed cannabis were older (aged 55–64 years and older than 65 years), whereas the highest proportion for participants without a history of cancer were in the youngest age category (18–44 years). For both groups, individuals who reported using cannabis for medical purposes were more likely to report daily use (20–30 days), be non-Hispanic White, have arthritis, report fair or poor general health status, report ≥14 bad physical health days, and report ≥14 poor mental health days. Further details are available in Table S2.

Factors associated with cannabis consumption for medical purposes by cancer history status are presented in Table 4. Number of poor mental health days, frequency of use, and method of use were the only significant variables for those with a history of cancer. Consuming cannabis frequently (20–30 days/month) was associated with a higher odds of cannabis use for medical purposes among both cancer survivors (aPOR, 1.72; 95% CI, 1.02–2.90) and those without a history of cancer (aPOR, 2.43; 95% CI, 2.03–2.91). Oral consumption of cannabis was associated with a higher odds of cannabis use for medical purposes among both cancer survivors (aPOR, 2.52; 95% CI, 1.46–4.36) and those without a history of cancer (aPOR, 1.46; 95% CI, 1.16–1.83).

DISCUSSION

This cross-sectional study identified factors associated with the prevalence of cannabis use and cannabis use for medical purposes among cancer survivors compared with individuals without a history of cancer using 2020 BRFSS data for 22 states. We found that the overall prevalence of current cannabis use was 10.60%, with a lower prevalence of cannabis use among cancer survivors compared with individuals with no history of cancer (7.57% vs. 10.83%). A high proportion of individuals report cannabis use for medical purposes, with higher rates among cancer survivors (82.23% vs. 62.58%). The estimates observed in our study are within the range provided by other prevalence estimates; however, there are slight differences observed when comparing studies using the same data source for previous years (higher overall prevalence of cannabis use and lower prevalence of use among cancer survivors observed).[14–17] Differences could simply be a reflection of the states included in the sample or could indicate changes in the prevalence of cannabis use, thus underscoring the need for continued surveillance with consistent reporting. To our surprise, findings also suggest similarities for both groups (cancer survivors and individuals without a history of cancer) regarding individual characteristics associated with cannabis use and strengthens previous literature regarding the importance of age, biological sex, and race/ethnicity in regards to adult cannabis use.[11,14,15,17] However, we observed differences in characteristics associated with medical cannabis use for the two groups. It is becoming apparent that individuals are interested in the therapeutic potential of medical cannabis despite the lack of an evidence-based approach to using cannabis compared with other pharmacotherapies.[33]

Findings reiterate the need for increased efforts to address modifiable health risk behaviors, including substance use, in survivorship care in oncology and primary care settings.[34,35] A particularly concerning finding, consistent with previous studies, is the relationship between cigarette smoking and binge drinking with cannabis use among both cancer survivors and those without a history of cancer, even after adjusting for confounding.[15,36,37] This may be due to established contributing factors (related to an individual's environment and genetics) that could predispose individuals to substance misuse, abuse, and/or dependence, which we could not control for in our study.[38–40] Evidence shows that tobacco use in particular can interfere with cancer treatment and recovery, increase the risk of recurrence, and lead to the development of secondary cancers. Despite clear recommendations regarding evidence-based approaches for tobacco cessation among cancer survivors, there remains a gap in the translation from research to practice.[41–44] Subsequently, there are opportunities for investigation on how best to implement strategies that promote behavior change throughout the cancer continuum.

When considering the impacts of cannabis exposure, it is important to consider the dose (i.e., potency of cannabis), frequency of use, the route of administration/consumption, and active ingredients (i.e., cannabinoids). This study offers insight into frequency and route of administration. Although frequency of cannabis use did not vary by cancer history status, route of administration did. Among all current cannabis users, the primary method of consumption was through inhalation, which is potentially the fastest method of delivery. This is in line with multiple other studies.[14–16,45] We observed

TABLE 3 Distribution of covariates among active cannabis users, stratified by reason for use and history of cancer.

	Cancer survivors		No history of cancer	
	Medical[a] N = 234,966 Wt % (95% CI)	Non-Medical N = 50,786 Wt % (95% CI)	Medical[a] N = 3,338,038 Wt % (95% CI)	Non-Medical N = 1,996,088 Wt % (95% CI)
Total	82.23 (77.84–86.61)	17.77 (13.39–22.16)	62.58 (60.85–64.31)	37.42 (35.69–39.15)
State-level law				
No state-regulated program	33.08 (27.13–39.03)	29.71 (17.19–42.22)	31.60 (30.46–32.74)	33.17 (31.56–34.78)
Medical use only	51.94 (45.55–58.33)	52.16 (38.99–65.32)	52.49 (51.18–53.81)	40.44 (38.88–42.01)
Recreational	14.98 (8.87–21.10)	18.14 (5.58–30.70)	15.91 (14.49–17.33)	26.38 (24.43–28.34)
Sociodemographic				
Sex				
Male	38.94 (32.54–45.34)	61.20 (49.09–73.31)	55.83 (53.66–58.00)	65.27 (62.29–68.26)
Female	61.06 (54.66–67.46)	38.80 (26.69–50.91)	44.17 (42.00–46.34)	34.73 (31.74–37.71)
Age (years)				
18–44	30.24 (23.39–37.09)	24.53 (12.81–36.24)	66.58 (64.67–68.49)	73.58 (71.12–76.03)
45–54	14.96 (10.32–19.59)	9.99 (1.86–18.13)	12.60 (11.23–13.98)	10.10 (8.60–11.61)
55–64	27.36 (21.75–32.97)	21.70 (12.37–31.03)	13.75 (12.41–15.08)	10.90 (8.93–12.88)
65+	27.44 (22.39–32.48)	43.78 (30.75–56.80)	7.07 (6.20–7.93)	5.41 (4.33–6.49)
Education				
Less than HS	17.73 (11.01–24.45)	14.80 (5.00–24.60)	16.02 (13.91–18.13)	11.19 (8.75–13.63)
HS diploma	26.57 (21.03–32.11)	19.84 (10.11–29.57)	33.81 (31.82–35.79)	32.83 (29.96–35.71)
Some college	35.30 (29.22–41.38)	34.93 (23.13–46.74)	34.37 (32.37–36.37)	32.78 (29.78–35.79)
College degree or above	20.39 (15.96–24.82)	30.42 (17.27–43.57)	15.81 (14.54–17.09)	23.19 (20.96–25.42)
Employment				
Employed	30.00 (23.67–36.32)	37.61 (24.86–50.37)	56.69 (54.56–58.82)	66.20 (63.16–69.23)
Unemployed	16.97 (11.55–22.4)	6.78 (2.16–11.41)	22.31 (20.55–24.07)	23.85 (20.98–26.72)
Retired	23.33 (18.71–27.96)	44.22 (31.06–57.37)	8.14 (7.00–9.28)	5.97 (4.86–7.09)
Unable to work	29.70 (24.05–35.34)	11.38 (3.16–19.61)	12.86 (11.51–14.21)	3.98 (2.81–5.15)
Race/ethnicity				
NH White	77.44 (71.69–83.18)	66.01 (54.18–77.83)	69.27 (67.12–71.42)	64.11 (61.05–67.17)
NH Black	12.58 (7.31–17.86)	22.20 (11.35–33.05)	14.87 (13.22–16.52)	20.39 (17.72–23.06)
NH Other	7.26 (4.53–9.98)	5.22 (1.10–9.34)	7.99 (7.00–8.99)	5.81 (4.69–6.92)
Hispanic	2.72 (0.99–4.46)	6.57 (1.95–11.19)	7.87 (6.18–9.56)	9.69 (7.20–12.19)
Homeownership				
Own	61.98 (55.26–68.71)	71.94 (61.06–82.82)	51.59 (49.45–53.73)	52.07 (48.98–55.16)
Do not own	38.02 (31.29–44.74)	28.06 (17.18–38.94)	48.41 (46.27–50.55)	47.93 (44.84–51.02)
Veteran				
Yes	16.67 (12.48–20.86)	14.92 (6.27–23.56)	8.46 (7.21–9.72)	6.08 (4.63–7.54)
No	83.33 (79.14–87.52)	85.08 (76.44–93.73)	91.54 (90.29–92.79)	93.92 (92.46–95.37)
Urban/rural				
Urban	87.31 (82.54–92.07)	94.54 (90.85–98.23)	91.62 (90.73–92.52)	93.57 (92.58–94.57)
Rural	12.69 (7.93–17.46)	5.46 (1.77–9.15)	8.38 (7.49–9.27)	6.43 (5.43–7.42)

(Continues)

TABLE 3 (Continued)

	Cancer survivors		No history of cancer	
	Medical[a] N = 234,966 Wt % (95% CI)	Non-Medical N = 50,786 Wt % (95% CI)	Medical[a] N = 3,338,038 Wt % (95% CI)	Non-Medical N = 1,996,088 Wt % (95% CI)
Health indicators				
Having a provider				
Yes	84.48 (79.97–88.99)	79.82 (69.24–90.40)	69.10 (67.13–71.08)	62.92 (60.00–65.84)
No	15.52 (11.01–20.03)	20.18 (9.60–30.76)	30.90 (28.92–32.87)	37.08 (34.16–40.00)
Health plan				
Yes	88.10 (82.76–93.44)	90.02 (82.46–97.57)	81.71 (80.08–83.33)	83.72 (81.50–85.93)
No	11.90 (6.56–17.24)	9.98 (2.43–17.54)	18.29 (16.67–19.92)	16.29 (14.07–18.50)
Diagnosed arthritis				
Yes	58.02 (51.31–64.74)	30.05 (18.8–41.3)	30.12 (28.14–32.09)	12.12 (10.21–14.03)
No	41.98 (35.26–48.69)	69.95 (58.7–81.2)	69.88 (67.91–71.86)	87.88 (85.97–89.79)
General health				
Excellent or better	52.93 (46.44–59.42)	81.23 (71.58–90.88)	75.65 (73.87–77.44)	90.28 (88.47–92.08)
Fair or poor	47.07 (40.58–53.56)	18.77 (9.12–28.42)	24.35 (22.56–26.13)	9.72 (7.92–11.53)
Physical health				
0–13 days	60.40 (54.16–66.65)	85.14 (75.61–94.67)	81.13 (79.45–82.8)	95.32 (94.19–96.44)
14 or more	39.60 (33.35–45.84)	14.86 (5.33–24.39)	18.87 (17.2–20.55)	4.68 (3.56–5.81)
Mental health				
0–13 days	63.43 (57.22–69.64)	83.12 (74.66–91.57)	67.01 (64.96–69.05)	79.55 (76.67–82.42)
14 or more	36.57 (30.36–42.78)	16.88 (8.43–25.34)	32.99 (30.95–35.04)	20.45 (17.58–23.33)
Substance use				
Smoking status				
Current smoker	46.46 (39.81–53.12)	27.44 (16.5–38.37)	40.95 (38.86–43.04)	32.85 (29.89–35.82)
Former smoker	34.17 (28.21–40.13)	45.27 (32.2–58.34)	28.32 (26.28–30.36)	19.96 (17.66–22.26)
Never smoker	19.37 (15.06–23.68)	27.3 (14.94–39.65)	30.73 (28.75–32.71)	47.19 (44.12–50.26)
Binge drinking				
Yes	20.74 (14.64–26.84)	26.31 (15.35–37.26)	30.16 (28.03–32.29)	42.49 (39.48–45.50)
No	79.26 (73.16–85.36)	73.69 (62.74–84.65)	69.84 (67.71–71.97)	57.51 (54.50–60.52)
Method of cannabis use				
Inhalation	68.63 (62.81–74.46)	78.52 (66.11–90.94)	83.49 (81.98–85.00)	85.56 (83.28–87.84)
Oral or other	31.37 (25.54–37.19)	21.48 (9.06–33.89)	16.51 (15.00–18.02)	14.44 (12.16–16.72)
Frequency of cannabis use				
1–19 days	47.42 (40.81–54.03)	65.40 (53.10–77.69)	43.13 (40.99–45.26)	64.96 (61.93–68.00)
20–30 days	52.58 (45.97–59.19)	34.60 (22.31–46.90)	56.87 (54.74–59.01)	35.04 (32.00–38.07)

Abbreviations: HS, high school; NH, non-Hispanice.

[a]Primary reason for cannabis use includes medical purposes (e.g., medical purposes only, or both medical and recreational).

a greater proportion of individuals without a history of cancer reporting inhalation methods compared to cancer survivors. This is potentially worrisome because of increasing concern of adverse effects on the respiratory system associated with inhalation of cannabis, as well as some studies suggesting that cannabis smoke may contain toxic components similar to tobacco smoke.[46–50]

TABLE 4 Factors associated with cannabis use for medical purposes compared with nonmedical purposes, by cancer history status.

	Cancer survivors (*N* = 285,752 [5.08%])		No cancer history (*N* = 5,334,126 [94.92%])	
	aPOR (95% CI)[a]	*p*	aPOR (95% CI)[a]	*p*
State-level law		.988		<.0001[b]
No state-regulated program	Ref.		Ref.	
Medical use only	1.07 (0.41–2.80)		1.74 (1.31–2.31)	
Recreational	1.00 (0.54–1.86)		2.24 (1.73–2.90)	
Sex		.036[b]		<.0001[b]
Male	Ref.		Ref.	
Female	1.86 (1.04–3.33)		1.46 (1.22–1.75)	
Age (years)		.486		.053
18–44	2.00 (0.84–4.79)		0.89 (0.67–1.19)	
45–54	1.15 (0.45–2.91)		1.14 (0.81–1.60)	
55–64	1.13 (0.57–2.26)		1.21 (0.84–1.74)	
65+	Ref.			
Education attainment		.476		.020[b]
Less than HS	Ref.		Ref.	
HS diploma	1.32 (0.42–4.22)		1.46 (1.00–2.14)	
Some college	1.80 (0.86–3.78)		1.30 (1.05–1.62)	
College degree or above	1.23 (0.64–2.37)		1.35 (1.10–1.66)	
Race/ethnicity		.088		.0002[b]
NH White	Ref.		Ref.	
NH Black	1.00 (0.44–2.28)		0.81 (0.62–1.05)	
NH Other	0.25 (0.07–0.86)		0.84 (0.53–1.33)	
Hispanic	0.71 (0.20–2.55)		0.51 (0.37–0.71)	
Poor mental health		.262		<.0001[b]
0–13 days	Ref.		Ref.	
14 or more	1.52 (0.73–3.17)		1.53 (1.24–1.88)	
Poor physical health		.007[b]		<.0001[b]
0–13 days	Ref.		Ref.	
14 or more days	3.43 (1.41–8.38)		3.59 (2.63–4.90)	
Smoking status		.077		<.0001[b]
Current smoker	2.30 (1.09–4.83)		1.49 (1.22–1.82)	
Former smoker	1.10 (0.55–2.19)		1.81 (1.45–2.25)	
Never smoker	Ref.		Ref.	
Binge drinking		.275		<.0001*
Yes	0.65 (0.29–1.42)		0.63 (0.52–0.75)	
No	Ref.		Ref.	
Frequency of use		.040[b]		<.0001[b]
1–19 days	Ref.		Ref.	
20–30 days	1.72 (1.02–2.90)		2.43 (2.03–2.91)	

(Continues)

TABLE 4 (Continued)

	Cancer survivors (*N* = 285,752 [5.08%])		No cancer history (*N* = 5,334,126 [94.92%])	
	aPOR (95% CI)[a]	*p*	aPOR (95% CI)[a]	*p*
Method of use		.001[b]		.001[b]
Inhalation	Ref.		Ref.	
Oral/other	2.52 (1.46–4.36)		1.46 (1.16–1.83)	

Abbreviations: aPOR, adjusted prevalence odds ratio; HS, high school; NH, non-Hispanic; Ref., reference.

[a]Adjusted for state-level cannabis policy (2020), sex, age group, education attainment, self-reported race/ethnicity, mental health status, physical health status, smoking status, binge drinking status, frequency of use, method of use.

[b]indicates statistically significant at $p < .05$.

Conversely, our findings suggest that individuals consuming cannabis for medical purposes had higher odds of using oral consumption, as well as more frequent use. This contradicts a 2018 study that found high prevalence of inhalation methods, even among medical cannabis use, but did not adjust for potential confounding.[15] This may reflect geographic differences, inadequate adjustment, or may be due to market or social transitions. There has been a surge in the number and variety of available cannabis products in the past 5 years alone, especially among edibles, which have had an increase in the development of products with more precise dosing (which may enable safer use) and varying levels and presence of active cannabinoids. However, we were unable to assess these components because of limitations in available data. It is important to acknowledge that it may be difficult to ascertain an individual's true exposure because of the lack of regulatory oversight (e.g., product screening programs, accurate labeling) of cannabis in many states.[10,51–53]

Clinicians are becoming increasingly more accepting of patients using cannabis for medical purposes; however, most report not feeling equipped to make clinical recommendations.[10,54,55] Evidence shows that patients are using medical cannabis with minimal medical oversight including obtaining medical cannabis authorization from a provider who is unfamiliar with their medical history and relying on unregulated sources for information regarding cannabis.[56–59] Specifically, most patients report obtaining information regarding strains, ratios of active ingredients, routes of administration, and dosages from cannabis dispensaries. However, dispensary personnel are unevenly trained, with dispensaries often prioritizing sales skills over cannabis pharmacotherapeutic knowledge.[60–63] To address this issue, several modifications to practice, policy, research, and education are warranted, as outlined by Braun and Tulsky in 2018.[64] At a minimum, health systems and national professional societies need to produce high-quality standardized education materials and clinical practice guidelines.

Limitations

There are several key limitations that should be considered when interpreting the results of the current study, primarily related to the use of secondary data. First, we were limited to the questions asked in BRFSS; thus, we were unable to ascertain more detailed information about cancer survivors such as time since cancer diagnosis, type of cancer, and stage. Second, self-reported survey data may be more susceptible to measurement error (i.e., information bias) than other data collection methods. However, BRFSS data have been found to be reliable and have high levels of validity when compared with other self-reported data. Self-reported past 30-day cannabis use has also been found to be a variable with limited potential sources of measurement error.[65] The categorization of state-level cannabis policy that was used in this study is an improvement from the dichotomization that some literature uses and is contextually meaningful. However, it has been found that there is substantial heterogeneity in state cannabis law variability across several domains, including manufacturing or testing, product labeling, and types of products permissible for sale, as well as limits on the supply or dose that can be dispensed.[66] Third, although observational data are susceptible to selection bias (e.g., selected sample representative of the target population), it is not generally a main concern for BRFSS data because of raking survey methodology, which adjusts for selection into the study. However, it is important that there was a high number of individuals missing outcome data, which can indicate selection bias may be present because of censoring (e.g., a missing data problem). There is a need for further investigation of possible effects of missing data for optional BRFSS modules. Despite limitations, our study has important strengths including the use of a strong sampling design, a large and diverse sample from 22 US states, and access to a large number of covariates that were assessed using validated survey questions. Additionally, our study was strengthened by using a comparison group, which multiple previous studies lacked.

CONCLUSIONS

Overall, this study strengthens the epidemiological evidence of factors associated with the prevalence of cannabis use and cannabis use for medical purposes among cancer survivors compared with individuals without a history of cancer. There are several key findings that call for additional investigation to ensure that patients and

providers are able to make informed evidence-based decisions regarding the use of cannabis. First, despite the lack of strong scientific literature compared with other pharmacotherapies, most individuals in the study report cannabis use for medical purposes. Second, there is a high prevalence of cigarette smoking among cannabis users, including cancer survivors. Third, inhalation methods are preferred for consumption, resulting in potential exposure to combustion-related toxins and irritants. However, individuals reporting cannabis use for medical purposes were more likely to use oral consumption methods. Findings underscore the need for continued surveillance as well as the development of high-quality standardized education materials.

AUTHOR CONTRIBUTIONS

Ami E. Sedani: Conceptualization, methodology, formal analysis, visualization, writing - original draft, and writing - review & editing. **Janis E. Campbell:** Writing - review & editing. **Laura A. Beebe:** Conceptualization, methodology, and writing - review & editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in the Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System at https://www.cdc.gov/brfss/annual_data/annual_2020.html.

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REFERENCES

1. Miller KD, Nogueira L, Mariotto AB, et al. Cancer treatment and survivorship statistics, 2019. *CA A Cancer J Clin*. 2019;69(5):363-385. doi:10.3322/caac.21565
2. Mitchell AJ, Ferguson DW, Gill J, Paul J, Symonds P. Depression and anxiety in long-term cancer survivors compared with spouses and healthy controls: a systematic review and meta-analysis. *Lancet Oncol*. 2013;14(8):721-732. doi:10.1016/s1470-2045(13)70244-4
3. Shi Q, Smith TG, Michonski JD, Stein KD, Kaw C, Cleeland CS. Symptom burden in cancer survivors 1 year after diagnosis: a report from the American Cancer Society's Studies of Cancer Survivors. *Cancer*. 2011;117(12):2779-2790. doi:10.1002/cncr.26146
4. Dulaney C, Wallace AS, Everett AS, Dover L, McDonald A, Kropp L. Defining health across the cancer continuum. *Cureus*. 2017;9(2). doi:10.7759/cureus.1029
5. Strasser F, Luftner D, Possinger K, et al. Comparison of orally administered cannabis extract and delta-9-tetrahydrocannabinol in treating patients with cancer-related anorexia-cachexia syndrome: a multicenter, phase III, randomized, double-blind, placebo-controlled clinical trial from the Cannabis-In-Cachexia-Study-Group. *J Clin Oncol*. 2006;24(21):3394-3400. doi:10.1200/jco.2005.05.1847
6. Zhang H, Xie M, Archibald SD, Jackson BS, Gupta MK. Association of marijuana use with psychosocial and quality of life outcomes among patients with head and neck cancer. *JAMA Otolaryngol Head Neck Surg*. 2018;144(11):1017-1022. doi:10.1001/jamaoto.2018.0486
7. Mücke M, Phillips T, Radbruch L, Petzke F, Häuser W. Cannabis-based medicines for chronic neuropathic pain in adults. *Cochrane Database Syst Rev*. 2018;3(7). doi:10.1002/14651858.cd012182.pub2
8. Ng JY, Abrams A, Pathak A, Tahir U, Jomy J. What are the experiences of patients using cannabis for pain? A systematic review of qualitative studies. *Eur J Integr Med*. 2022;49:102098. doi:10.1016/j.eujim.2021.102098
9. National Conference of State Legislatures. State medical cannabis laws. Accessed April 3, 2023. https://www.ncsl.org/research/health/state-medical-marijuana-laws.aspx
10. Nugent SM, Meghani SH, Rogal SS, Merlin JS. Medical cannabis use among individuals with cancer: an unresolved and timely issue. *Cancer*. 2020;126(9):1832-1836. doi:10.1002/cncr.32732
11. Do EK, Ksinan AJ, Kim SJ, Del Fabbro EG, Fuemmeler BF. Cannabis use among cancer survivors in the United States: analysis of a nationally representative sample. *Cancer*. 2021;127(21):4040-4049. doi:10.1002/cncr.33794
12. Tringale KR, Huynh-Le MP, Salans M, Marshall DC, Shi Y, Hattangadi-Gluth JA. The role of cancer in marijuana and prescription opioid use in the United States: a population-based analysis from 2005 to 2014. *Cancer*. 2019;125(13):2242-2251. doi:10.1002/cncr.32059
13. Cousins MM, Jannausch ML, Coughlin LN, Jagsi R, Ilgen MA. Prevalence of cannabis use among individuals with a history of cancer in the United States. *Cancer*. 2021;127(18):3437-3444. doi:10.1002/cncr.33646
14. Lee M, Salloum RG, Jenkins W, Hales DB, Sharma A. Marijuana use among US adults with cancer: findings from the 2018–2019 Behavioral Risk Factor Surveillance System. *J Cancer Surviv*. 2022:1-10. doi:10.1007/s11764-021-01138-z
15. Poghosyan H, Poghosyan A. Marijuana use among cancer survivors: quantifying prevalence and identifying predictors. *Addict Behav*. 2021;112:106634. doi:10.1016/j.addbeh.2020.106634
16. Schauer GL, Njai R, Grant-Lenzy AM. Modes of marijuana use–smoking, vaping, eating, and dabbing: results from the 2016 BRFSS in 12 States. *Drug Alcohol Depend*. 2020;209:107900. doi:10.1016/j.drugalcdep.2020.107900
17. Jeffers AM, Glantz S, Byers A, Keyhani S. Sociodemographic characteristics associated with and prevalence and frequency of cannabis use among adults in the US. *JAMA Netw Open*. 2021;4(11):e2136571. doi:10.1001/jamanetworkopen.2021.36571
18. Martins SS, Segura LE, Levy NS, et al. Racial and ethnic differences in cannabis use following legalization in US states with medical cannabis laws. *JAMA Netw Open*. 2021;4(9):e2127002. doi:10.1001/jamanetworkopen.2021.27002
19. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System (BRFSS): about BRFSS. Updated May 16, 2014. Accessed January 1, 2021. https://www.cdc.gov/brfss/about/index.htm
20. Centers for Disease Control and Prevention. BRFSS questionnaires. Updated June 8, 2022. Accessed April 3, 2023. https://www.cdc.gov/brfss/questionnaires/index.htm
21. Azofeifa A, Mattson ME, Schauer G, McAfee T, Grant A, Lyerla R. National estimates of marijuana use and related indicators—National Survey on Drug Use and Health, United States, 2002–2014. *Morb Mortal Wkly Rep - Surveillance Summ*. 2016;65(11):1-25. doi:10.15585/mmwr.ss6511a1
22. Poghosyan H, Noonan EJ, Badri P, Braun I, Young GJ. Association between daily and non-daily cannabis use and depression among

United States adult cancer survivors. *Nurs Outlook*. 2021;69(4):672-685. doi:10.1016/j.outlook.2021.01.012
23. Xu W, Gilmer DO, Starkweather A, Kim K. Associations among marijuana use, health-related quality of life, exercise, depression and sleep in cancer survivors. *J Adv Nurs*. 2021;77(5):2386-2397. doi:10.1111/jan.14780
24. Dai H, Richter KP. A national survey of marijuana use among US adults with medical conditions, 2016-2017. *JAMA Netw Open*. 2019;2(9):e1911936. doi:10.1001/jamanetworkopen.2019.11936
25. Mowls DS, Brame LS, Martinez SA, Beebe LA. Lifestyle behaviors among US cancer survivors. *J Cancer Surviv*. 2016;10(4):692-698. doi:10.1007/s11764-016-0515-x
26. Doose M, Mollica MA, Attai DJ, et al. Identifying and describing cancer survivors: implications for cancer survivorship research and clinical care. *Cancer*. 2021;128(2):383-390. doi:10.1002/cncr.33937
27. Rothman KJ, Greenland S, Lash TL. *Modern Epidemiology*. Vol 3. Wolters Kluwer Health/Lippincott Williams & Wilkins; 2008.
28. Mauro PM, Carliner H, Brown QL, et al. Age differences in daily and nondaily cannabis use in the United States, 2002–2014. *J Stud Alcohol Drugs*. 2018;79(3):423-431. doi:10.15288/jsad.2018.79.423
29. Chawla D, Yang YC, Desrosiers TA, Westreich DJ, Olshan AF, Daniels JL. Past-month cannabis use among US individuals from 2002–2015: an age-period-cohort analysis. *Drug Alcohol Depend*. 2018;193:177-182. doi:10.1016/j.drugalcdep.2018.05.035
30. Siegel RL, Miller KD, Fuchs HE, Jemal A. *Cancer statistics, 2022*. CA Cancer J Clin. 2022;72:7-33.
31. Centers for Disease Control and Prevention. Overview: BRFSS 2019. Accessed January 1, 2021. https://www.cdc.gov/brfss/annual_data/2019/pdf/overview-2019-508.pdf
32. Shaw M. Housing and public health. *Annu Rev Publ Health*. 2004;25(1):397-418. doi:10.1146/annurev.publhealth.25.101802.123036
33. Schlag AK, O'Sullivan SE, Zafar RR, Nutt DJ. Current controversies in medical cannabis: recent developments in human clinical applications and potential therapeutics. *Neuropharmacology*. 2021;191:108586. doi:10.1016/j.neuropharm.2021.108586
34. Gallicchio L, Tonorezos E, de Moor JS, et al. Evidence gaps in cancer survivorship care: a report from the 2019 National Cancer Institute Cancer Survivorship Workshop. *J Natl Cancer Inst*. 2021;113(9):1136-1142. doi:10.1093/jnci/djab049
35. Elmore LW, Greer SF, Daniels EC, et al. Blueprint for cancer research: critical gaps and opportunities. *CA A Cancer J Clin*. 2021;71(2):107-139. doi:10.3322/caac.21652
36. Schauer GL, Berg CJ, Kegler MC, Donovan DM, Windle M. Differences in tobacco product use among past month adult marijuana users and nonusers: findings from the 2003–2012 National Survey on Drug Use and Health. *Nicotine Tob Res*. 2015;18(3):281-288. doi:10.1093/ntr/ntv093
37. Schauer GL, Berg CJ, Kegler MC, Donovan DM, Windle M. Assessing the overlap between tobacco and marijuana: trends in patterns of co-use of tobacco and marijuana in adults from 2003–2012. *Addict Behav*. 2015;49:26-32. doi:10.1016/j.addbeh.2015.05.012
38. Aghaii SSH, Kamaly A, Esfahani M. Meta-analysis of individual and environmental factors that influence people's addiction tendencies. *Int J High Risk Behav Addiction*. 2012;1(3):92.
39. Secades-Villa R, Garcia-Rodríguez O, Jin CJ, Wang S, Blanco C. Probability and predictors of the cannabis gateway effect: a national study. *Int J Drug Pol*. 2015;26(2):135-142. doi:10.1016/j.drugpo.2014.07.011
40. Yuan M, Kanellopoulos T, Kotbi N. Cannabis use and psychiatric illness in the context of medical marijuana legalization: a clinical perspective. *Gen Hosp Psychiatr*. 2019;61:82-83. doi:10.1016/j.genhosppsych.2019.08.003
41. Goldstein AO, Ripley-Moffitt CE, Pathman DE, Patsakham KM. Tobacco use treatment at the US National Cancer Institute's designated cancer centers. *Nicotine Tob Res*. 2012;15(1):52-58. doi:10.1093/ntr/nts083
42. Warren GW, Marshall JR, Cummings KM, et al. Practice patterns and perceptions of thoracic oncology providers on tobacco use and cessation in cancer patients. *J Thorac Oncol*. 2013;8(5):543-548. doi:10.1097/jto.0b013e318288dc96
43. Warren G, Marshall J, Cummings K, et al. IASLC Tobacco Control and Smoking Cessation Committee. Practice patterns and perceptions of thoracic oncology providers on tobacco use and cessation in cancer patients. *J Thorac Oncol*. 2013;8(5):543-548. doi:10.1097/jto.0b013e318288dc96
44. Rojewski AM, Bailey SR, Bernstein SL, et al. Considering systemic barriers to treating tobacco use in clinical settings in the United States. *Nicotine Tob Res*. 2019;21(11):1453-1461. doi:10.1093/ntr/nty123
45. Knapp AA, Lee DC, Borodovsky JT, Auty SG, Gabrielli J, Budney AJ. Emerging trends in cannabis administration among adolescent cannabis users. *J Adolesc Health*. 2019;64(4):487-493. doi:10.1016/j.jadohealth.2018.07.012
46. Moir D, Rickert WS, Levasseur G, et al. A comparison of mainstream and sidestream marijuana and tobacco cigarette smoke produced under two machine smoking conditions. *Chem Res Toxicol*. 2008;21(2):494-502. doi:10.1021/tx700275p
47. Sheehan TJ, Hamnett HJ, Beasley R, Fitzmaurice PS. Chemical and physical variations of cannabis smoke from a variety of cannabis samples in New Zealand. *Forensic Sci Res*. 2019;4(2):168-178. doi:10.1080/20961790.2018.1445937
48. Graves BM, Johnson TJ, Nishida RT, et al. Comprehensive characterization of mainstream marijuana and tobacco smoke. *Sci Rep*. 2020;10(1):1-12. doi:10.1038/s41598-020-63120-6
49. Martinasek MP, McGrogan JB, Maysonet A. A systematic review of the respiratory effects of inhalational marijuana. *Respir Care*. 2016;61(11):1543-1551. doi:10.4187/respcare.04846
50. Hooper RW, Garfield JL. An emerging crisis: vaping-associated pulmonary injury. *Am Coll Phys*. 2020;172(1):57-58. doi:10.7326/m19-2908
51. Finn K. Why marijuana will not fix the opioid epidemic. *Mo Med*. 2018;115(3):191.
52. Bonn-Miller MO, Loflin MJ, Thomas BF, Marcu JP, Hyke T, Vandrey R. Labeling accuracy of cannabidiol extracts sold online. *JAMA*. 2017;318(17):1708-1709. doi:10.1001/jama.2017.11909
53. Mudan A, DeRoos F, Perrone J. Medical marijuana miscalculation. *N Engl J Med*. 2019;381(11):1086-1087. doi:10.1056/nejmc1907013
54. Braun IM, Wright A, Peteet J, et al. Medical oncologists' beliefs, practices, and knowledge regarding marijuana used therapeutically: a nationally representative survey study. *J Clin Oncol*. 2018;36(19):1957-1962. doi:10.1200/jco.2017.76.1221
55. Gardiner KM, Singleton JA, Sheridan J, Kyle GJ, Nissen LM. Health professional beliefs, knowledge, and concerns surrounding medicinal cannabis–a systematic review. *PLoS One*. 2019;14(5):e0216556. doi:10.1371/journal.pone.0216556
56. Victorson D, McMahon M, Horowitz B, Glickson S, Parker B, Mendoza-Temple L. Exploring cancer survivors' attitudes, perceptions, and concerns about using medical cannabis for symptom and side effect management: a qualitative focus group study. *Complement Ther Med*. 2019;47:102204. doi:10.1016/j.ctim.2019.102204
57. Braun IM, Nayak MM, Revette A, et al. Cancer patients' experiences with medicinal cannabis–related care. *Cancer*. 2021;127(1):67-73. doi:10.1002/cncr.33202
58. Weiss MC, Hibbs JE, Buckley ME, et al. A Coala-T-Cannabis Survey Study of breast cancer patients' use of cannabis before, during, and after treatment. *Cancer*. 2022;128(1):160-168. doi:10.1002/cncr.33906
59. Pergam SA, Woodfield MC, Lee CM, et al. Cannabis use among patients at a comprehensive cancer center in a state with legalized

medicinal and recreational use. *Cancer*. 2017;123(22):4488-4497. doi:10.1002/cncr.30879
60. Braun IM, Nayak MM, Roberts JE, et al. Backgrounds and trainings in cannabis therapeutics of dispensary personnel. *JCO Oncol Pract*. 2022;18(11):e1787-e1795. doi:10.1200/op.22.00129
61. Haug NA, Kieschnick D, Sottile JE, Babson KA, Vandrey R, Bonn-Miller MO. Training and practices of cannabis dispensary staff. *Cannabis Cannabinoid Res*. 2016;1(1):244-251. doi:10.1089/can.2016.0024
62. Merlin JS, Althouse A, Feldman R, et al. Analysis of state cannabis laws and dispensary staff recommendations to adults purchasing medical cannabis. *JAMA Netw Open*. 2021;4(9):e2124511. doi:10.1001/jamanetworkopen.2021.24511
63. Calcaterra SL, Cunningham CO, Hopfer CJ. The void in clinician counseling of cannabis use. *J Gen Intern Med*. 2020;35(6):1875-1878. doi:10.1007/s11606-019-05612-4
64. Braun I, Tulsky J. Reconciling the discrepancies in medicine's relationship to medical marijuana. *Am Coll Phys*. 2018:646-647.
65. Watkins SL, Karliner-Li P, Lee YO, Koester KA, Ling PM. A mixed-methods study to inform the clarity and accuracy of cannabis-use and cannabis-tobacco co-use survey measures. *Drug Alcohol Depend*. 2021;224:108697. doi:10.1016/j.drugalcdep.2021.108697
66. Richard EL, Althouse AD, Arnsten JH, et al. How medical are states' medical cannabis policies? Proposing a standardized scale. *Int J Drug Pol*. 2021;94:103202. doi:10.1016/j.drugpo.2021.103202

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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