Original Article

Cannabis Use Among Cancer Survivors in the United States: Analysis of a Nationally Representative Sample

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BACKGROUND: Research on cannabis use among those with a history of cancer is limited. **METHODS:** Prevalence of past-year cannabis use among individuals with and without a cancer history and predictors of use within these 2 groups were determined using data from the Population Assessment of Tobacco and Health study, a nationally representative, longitudinal survey conducted in the United States (waves 1-4; 2013-2018). Discrete time survival analyses were used to estimate baseline (wave 1) predictors (physical health status, mental health status, pain, and demographic variables) on past-year engagement with cannabis within individuals who reported a cancer diagnosis at wave 1 (n = 1022) and individuals who reported never having cancer at any wave (n = 19,702). **RESULTS:** At the most recent survey, 8% of cancer survivors reported past-year cannabis use, compared with 15% of those without a cancer history. Across 4 time points, an estimated 3.8% of cancer survivors engaged with cannabis, as compared to 6.5% of those without a cancer history. Across both groups, older age and having health insurance were associated with lower likelihood of engaging in cannabis use, whereas greater levels of pain were associated with higher likelihood of engaging in cannabis use. Among those without a cancer history, being female, White, and having better mental health status were associated with lower likelihood of engaging in cannabis use. **CONCLUSIONS:** Although cannabis use prevalence is lower among cancer survivors, the reasons for use are not markedly different from those without a cancer history. Continued monitoring of use, reasons for use, and harms or benefits is warranted. ***Cancer* 2021;127:4040-4049**. © *2021 American Cancer Society*.

LAY SUMMARY:

- Results from this study, which uses data from the Population Assessment of Tobacco and Health Study, indicate that cannabis use is generally increasing across cancer survivors and those without a history of cancer.
- Cancer survivors are using cannabis at slightly lower rates than those without a history of cancer.
- Factors related to pain seem to be more prevalent in cancer populations relative to the general population, and could be contributing to cannabis use within cancer survivor populations.

KEYWORDS: cancer, cannabis, Population Assessment of Tobacco and Health (PATH).

INTRODUCTION

Cancer survivors, or those who have been diagnosed with cancer and still living, are a rapidly growing population. It is estimated that there will be 26 million cancer survivors in the United States (US) by 2040.[1] Advances in cancer screening and early detection, as well as improvements in treatment and supportive care have contributed to decreasing cancer-related mortality and increasing cancer survivorship.[2] With the increasing number of cancer survivors, there is a critical need to address cancer-related symptoms, such as chronic pain, fatigue, anxiety, and depression.[3]

To alleviate these symptoms, some cancer patients have looked toward alternative medicine, either in addition to conventional cancer therapies or as a substitute for adjuvant therapies.[4] Qualitative data suggest that cancer patients generally have favorable attitudes toward use of medical cannabis (or marijuana) for cancer symptom and side-effect management.[5,6] Cannabis has been shown to demonstrate varying levels of benefit in symptom relief[7,8] among cancer patients actively undergoing treatment, including that from nausea and vomiting,[9,10] insomnia, anxiety, and depression,[6] and loss of appetite,[11] and cachexia.[12] Cannabis may also help to enhance relaxation, decrease stress, and improve quality of life, though existing evidence is mixed.[13-15] Although research is increasing in this area, there remains many unanswered questions ranging from the prevalence of cannabis use among cancer survivors to questions about the reasons for use and when it is being used during the cancer journey. The focus of this article is on the prevalence of cannabis use and general

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sociodemographic and health-related factors that may be related to cannabis use.

There is increasing public support for medical cannabis use. Approximately 60% of the current US population resides in states with legalized use of medicinal cannabis.[16] Added to this, a recent report from Pew Research Center suggests that two-thirds of Americans support cannabis legalization.[17] The estimated prevalence of past-year cannabis in the United States varies depending on the data source. For example, national prevalence estimates, such as those reported by the National Survey on Drug Use and Health (NSDUH), suggests that cannabis use increased from 10.5% in 2002 to 12.5% in 2013.[18]

These estimates are higher than those reported from the National Epidemiologic Survey of Alcohol and Related Conditions (NESARC), which were 4.1% in 2001-2002 and 9.5% in 2011-2012. Differences between these estimates may be caused by differences in sampling methods and survey procedures: The NSDUH used audio-computer–administered self-interview that enhances privacy, whereas participants in the NESARC were interviewed face-to-face.[19]

Prevalence estimates of use among cancer survivors also vary. In a cross-sectional, nonprobabilistic sample of cancer survivors in Washington State (n = 926) who varied with respect to treatment status (n = 926; 5% newly diagnosed, 66% currently undergoing treatment, 21% finished therapy, and 9% not currently receiving treatment), investigators found that 24% of patients surveyed over a 6-week period between 2015 and 2016 reported using cannabis in the past year (termed "active users"). Active users were more likely to be younger and have a lower level of education, and less likely to have received hematopoietic cell transplants, in comparison with prior or never cannabis users. Cancer type was not related to cannabis use.[20] The investigators did not report on difference in cannabis use by cancer treatment status. Notably, the study was conducted in a state where, at the time, both medicinal and recreational cannabis use was legalized.

To date, only 2 studies have estimated the prevalence of cannabis use among cancer survivors using nationally representative population-based samples.[21,22] Using data from the US National Health and Nutrition Examination Survey (NHANES, 2005-2014), Tringale et al[22] found that the past-year cannabis estimate among cancer survivors (40.3%) was not statistically different from past-year cannabis use estimates among those without a cancer history (38.1%).[22] Cousins et al[21] used data from the National Survey of Drug Use and Health (NSDUH, 2015-2019) and reported a much lower prevalence of cannabis use among those with a history of cancer. According to Cousins et al,[21] 8.9% of those who had been diagnosed with cancer but not in the past year and 9.9% of those who had been diagnosed with cancer within the past year had also reported cannabis use in the past year.[21]

To refine population-based estimates of cannabis use among the general population and among cancer survivors, additional studies reporting a representative sample of recent and longitudinal data are needed. The objectives of this study were to (1) determine the prevalence of cannabis use in cancer survivors, (2) describe factors that may be related to cannabis use among cancer survivors, and (3) determine to what degree these factors are unique to cancer survivors, relative to individuals without a history of cancer. We hypothesized that with the increasing availability of cannabis for medical use across many states, cannabis use among cancer survivors would increase over time. We also hypothesized that sociodemographic factors, such as age, sex, race/ethnicity, education, income, insurance status and health-related factors, such as measures of pain, physical health, and mental health status would be associated with cannabis use, and that these factors would be more related to use among cancer survivors than those without a history of cancer.

MATERIALS AND METHODS

Data Source and Study Sample

Data were obtained from the Population Assessment of Tobacco and Health (PATH) study, a household-based, nationally representative, longitudinal cohort study of adults and youth in the United States (N = 32,320) that assesses cancer status and tobacco and other substance use. The methods and conceptual framework for the PATH study are described in more detail elsewhere.[23] Briefly, participants were recruited via an address-based, area-probability sampling approach. Adult tobacco users, young adults (18-24 years), and African Americans were oversampled relative to population proportions. Applied survey weights adjust for nonresponse bias and oversampling and yield representative estimates of the noninstitutionalized, civilian US population. Audio-computer–assisted self-interviews available in English and Spanish were used to collect data. Data were collected in 4 annual waves beginning in 2013 to 2014 and proceeding annually in 2014-2015, 2015-2016, and 2016-2018.[23-25]

There were 26,072 adult individuals with longitudinal weights available for wave 1 to wave 4. This includes

participants that provided responses in each of the 4 waves. (There was 1 exception to how the groups were coded. A new skip logic was introduced at wave 4, such that only individuals who said they had visited a doctor in the past 12 months were asked about new diagnoses of cancer. The introduction of this skip logic pattern created a large number of missing participants [N ~ 6000]. To align with previous waves that did not use this skip logic pattern, we decided to remove those who had indicated that they had been diagnosed with cancer in the past 12 months at wave 4 and coded missing values resulting from the skip logic pattern in wave 4 to be a part of the noncancer group.) As such, the longitudinal weights were calibrated to provide estimates representative of the population. Because there was not a perfect overlap between participants who reported cancer status and individual weights, the final weighted analytic sample included 20,724 participants. This analytic sample was divided into 2 groups of participants: those who indicated that they ever had cancer at the baseline (at wave 1), excluding those who may have developed cancer from baseline through wave 4 and including those who are likely to have already completed treatment by wave 4 (wave 1: n = 1022), and participants who indicated that they never had cancer in any of the 4 waves (n = 19,702). This secondary data analysis of deidentified data was deemed exempt by the Virginia Commonwealth University Institutional Review Board.

Measures

Cancer status

Cancer status was derived from the following question: "Have you ever been told by a physician or other health professional that you had cancer?" (at baseline or wave 1). Cancer status was categorized into cancer survivors (ie, "ever had cancer" at wave 1) and those without a cancer history (ie, "never had cancer" at any time from wave 1 to wave 4). Descriptive statistics by cancer status are provided in Table 1.

Cannabis use

This outcome variable was measured at each wave and derived from questions measuring past-year use (ie, "In the past 12 months, have you smoked part or all of a traditional cigar, cigarillo, or filtered cigar with marijuana in it?" and "In the past 12 months, have you used marijuana, hash, tetrahydrocannabinol [THC], grass, pot, or weed?"). Past-year use was categorized into "used within past 12 months" (coded as 1), and "not used within the past 12 months" (coded as 0) at each wave.

A set of additional questions were available at wave 4. Those who had indicated past 12-month use of marijuana, hash, THC, grass, pot, or weed, were asked whether they had used the substance(s) weekly or more often. Those answering this question were also asked if they had used marijuana, hash, THC, grass, pot, or weed in the past 30 days. Only those who had reported use of any electronic nicotine products were asked whether they had ever used marijuana concentrates, marijuana waxes, THC, or hash oils in an electronic nicotine product. Those who reported ever using an electronic nicotine product to ingest a marijuana byproduct(s) were asked to indicate the number of puffs taken from the electronic product either today, yesterday, or the day before yesterday. Frequencies and weighted percentages or mean scores and standard errors (SEs) for these variables were calculated and presented (see Table 2).

Predictors

All predictors were measured at the baseline (wave 1). Predictors included demographic variables, such as sex (male, female), age (18-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years, and 65 years and older), highest level of education attained (less than high school, high school graduate/General Educational Development diploma, some college or associate degree, and bachelor's degree or higher), health insurance status (has health insurance, does not have health insurance), and annual household income (<$10,000; $10,000-$24,999; $25,000-$49,9999; $50,000-$99,999; and $100,000 or more annually). Other predictors included self-rated measures of physical and mental health (each rated on a 5-point Likert scale from poor to excellent in response to "How would you rate your [physical/mental] health?") and pain in the past 7 days (rated on a scale from 0 to 10, where 0 is no pain and 10 is the worst pain).

Statistical Methods

First, we computed descriptive statistics to compare baseline characteristics (at wave 1) among the group of cancer survivors and among those without a history of cancer. In addition, we computed the prevalence estimates of past-year cannabis use for each group for each of the 4 waves. Prevalence estimates on the additional cannabis-related questions related to the ways they used cannabis were also computed.

For the main part of the analysis, we used discrete time survival analysis to provide an estimate of time to engagement with cannabis over the period of observation. The outcome in the analysis was defined as a latent variable with 4 dichotomous variables, reflecting past-year cannabis use for wave 1 to wave 4 as its indicators, with

equal loadings (ie, all loadings equal to 1). The predictors in this model included health factors (ie, self-rated physical health, self-rated mental health, and pain) and background variables (ie, age, education, health insurance status, and annual household income) assessed at baseline (wave 1). The model was estimated as a multigroup model with separate estimates for the cancer survivor group and for those without a history of cancer. The results are reported as adjusted odds ratios (ORs), reflecting the probability of engaging in cannabis use over the subsequent 3 waves (waves 2, 3, and 4), following the initial baseline (wave 1). These ORs were adjusted for all health factor and background variables in the model.

To compute proportions and pairwise comparisons, we used longitudinal weights with 100 replicate weights for precisely estimating the SEs. For the discrete time survival analysis, we used longitudinal weights in conjunction with modeling the complex, longitudinal structure of the data using Taylor series linearization for adjusting SEs. All analyses were done in Mplus 8.[26]

RESULTS

Table 1 shows sample characteristics for the full sample and separated by cancer history status in an effort to determine whether sociodemographic characteristics differed between those with and without a history of cancer. Most of the sample was female (52%, n = 10831), White (78%, n = 14834), and had at least some college education (59%, n = 11936). Approximately 17% (n = 1807) of the sample was ≥65 years. Participants in the cancer survivor group were significantly older, more likely to have a health insurance, and more likely to be White, as opposed to other racial/ethnic groups (all *P* values <.05). Cancer survivors also rated their pain levels as significantly higher than those without a history of cancer, and their self-ratings of physical health as significantly lower ($P < .05$). No significant differences were found for self-ratings of mental health.

Overall, 15% (n = 4511) of the full sample had reported past-year cannabis use at wave 1. Table 2 shows how patterns of cannabis use differed between cancer survivors and those without a history of cancer. Group comparisons showed that past-year cannabis use was much higher among those without a cancer history at baseline as compared with the cancer survivor group (wave 1: 15% or n = 4364 vs 8% or n = 147) and at subsequent waves (wave 2: 13% or n = 4586 vs 5% or n = 119; wave 3: 14% or n = 4632 vs 6% or n = 134; wave 4: 15% or n = 4805 vs 8% or n = 153; all *P* values <.001).

There was a higher proportion of participants with no cancer history having had ever experienced smoking marijuana from a hookah (10% or n = 2883 vs 7% or n = 124, $P = .011$). Regarding past-year cannabis use, a lower percentage of cancer survivors reported smoking cigars with marijuana (2% or n = 46 vs 7% or n = 2547, $P < .001$) and using marijuana, hash, THC, grass, pot, or weed (6% or n = 107 vs 8% or n = 2258, $P = .009$). A lower percentage of cancer survivors reported weekly cannabis use relative to those without a cancer history (18% or n = 114 vs 27% or n = 3207, $P < .001$). However, among ever cannabis users who reported past-year use, no differences were found between cancer survivors and those without a cancer history for past 30-day cannabis use (72% or n = 117 vs 74% or n = 3647, $P = .666$). Among participants that indicated having used cannabis, cancer survivors reported a lower prevalence of ever using cannabis from an electronic nicotine product (26% or n = 83 vs 34% or n = 2702, $P = .026$) when compared with those without a cancer history. No group difference was found for the number of puffs of marijuana taken by participants who said they used an electronic nicotine product (cancer survivors: n = 16, mean = 9.20, SE = 5.06; no cancer history: n = 430, mean = 8.93, SE = 1.11; $P = .955$).

Discrete time survival analysis was used to determine risk factors for cannabis engagement among those with and without a history of cancer. Results showed that across the 4 time points, an estimated 6.5% of those without a cancer history started using cannabis as compared with 3.8% of cancer survivors. Figure 1 shows the survival curves for both groups. As shown in Table 3, for both groups, having health insurance (those without a cancer history: OR, 0.75; 95% CI, 0.68-0.83; cancer survivors: OR, 0.50; 95% CI, 0.28-0.89) and older age (those without a cancer history: OR, 0.65; 95% CI, 0.63-0.68; cancer survivors: OR, 0.55; 95% CI, 0.49-0.60) were associated with lower likelihood of engaging in cannabis use. Specifically, compared with those without health insurance, those with health insurance had a 50% decrease in the odds of engaging in cannabis use among cancer survivors and a 25% decrease in the odds among individuals without cancer. For every 1-year age increase at baseline (wave 1), there was a 45% decrease in the odds of engaging in cannabis use over the subsequent waves for cancer survivors and 35% decrease in the odds of engaging in cannabis use for individuals without cancer history. Higher self-reported levels of perceived pain at baseline was associated with a higher likelihood of engaging in cannabis use for both those without a cancer history (OR,

TABLE 1. Descriptive Statistics of the Study Variables

	Full Sample		No Cancer History		Cancer Survivors		
	N	Weighted %	n	Weighted %	n	Weighted %	χ^2/*P*
Age (years)							
18-24	5659	13	5625	14	34	1	<.001
25-34	4095	18	4029	19	66	4	
35-44	3271	17	3158	18	113	6	
45-54	3250	18	3052	18	198	17	
55-64	2638	17	2382	16	256	21	
65 or older	1807	17	1452	14	355	51	
Education							
Less than high school	2636	11	2520	11	116	10	.182
GED/high school graduate	6072	29	5812	29	260	27	
Some college or associates degree	7332	31	6974	31	358	31	
Bachelor's degree/advanced degree	4604	28	4317	28	287	32	
Income							
<$10,000	3666	14	3535	14	131	9	.021
$10,000-$24,999	4398	20	4197	20	201	19	
$25,000-$49,999	4351	23	4129	23	222	26	
$50,000-$99,999	4068	26	3857	26	211	27	
≥$100,000	2505	18	2352	18	153	19	
Insurance							
No health insurance	3790	15	3714	15	76	4	<.001
Has health insurance	16,753	85	15,812	85	941	96	
Race/Ethnicity							
White	14,834	78	13,960	77	874	91	<.001
Black	3335	12	3255	13	80	5	
Other race/ethnicity	2027	10	1970	10	57	4	
Sex							
Male	9873	48	9485	48	388	41	<.001
Female	10,831	52	10,199	52	632	59	
	M	*SE*	*M*	*SE*	*M*	*SE*	
Pain rating over past 7 days (Range, 0 = no pain to 10 = worst pain)	1.91	0.03	1.86	0.03	2.63	0.12	<.001
Mental health (Range, 0 = poor to 5 = excellent)	3.67	0.01	3.66	0.01	3.70	0.04	.336
Physical health (Range, 0 = poor to 5 = excellent)	3.52	0.01	3.54	0.01	3.26	0.04	<.001

Abbreviations: GED, General Educational Development diploma; M, mean; SE, standard error.

1.07; 95% CI, 1.06-1.09) and for cancer survivors (OR, 1.14; 95% CI, 1.06-1.23). Compared with males, females were less likely to engage in cannabis use, but only in the group with no cancer history (OR, 0.66; 95% CI, 0.61-0.72). Among those without a cancer history, Black participants were more likely to engage in cannabis use relative to White participants (OR, 1.27; 95% CI, 1.13-1.43). A similar pattern was observed among those with a history of cancer, though this was not statistically significant, likely because of the lower numbers of Black participants in this group. Lower income was associated with higher likelihood of engaging in cannabis use for those without a cancer history (OR, 0.89; 95% CI, 0.86-0.93). A similar pattern was observed for those with a cancer history, but this was not statistically significant. Better self-rated mental health was associated with lower likelihood of engaging in cannabis use in those without a cancer history (OR, 0.82; 95% CI, 0.79-0.85). Similar, though not statistically significant, trends were found among those with a cancer history. Higher self-rated pain at baseline for both groups was related to a higher likelihood of engaging in cannabis use over the subsequent follow-up assessments (OR, 1.05; 95% CI, 1.06-1.09 among those without a history of cancer; OR, 1.14; 95% CI, 1.06-1.23 among cancer survivors).

DISCUSSION

The overall prevalence of cannabis use in the general population within PATH is within the range provided by other prevalence estimates at the national level (ie, between 13% and 15% in PATH vs 2.8%-12.9% in other studies).[18,27] However, unlike other studies of cancer survivors, a much lower prevalence of cannabis use was reported among cancer survivors in the PATH survey (6%-8% across waves

TABLE 2. Cannabis-Related Measures

	Full Sample		No Cancer History		Cancer Survivors		
	N	Weighted	n	Weighted	n	Weighted	*P*
Past-year cannabis use							
Wave 1 (N = 18,516)	4511	15	4364	15	147	8	<.001
Wave 2 (N = 20,719)	4705	13	4586	13	119	5	<.001
Wave 3 (N = 20,720)	4766	13	4632	14	134	6	<.001
Wave 4 (N = 20,720)	4958	14	4805	15	153	8	<.001
Cannabis use measures at wave IV							
Ever smoked marijuana from a hookah (N = 20,702)[a]	3007	9	2883	10	124	7	.011
In past 12 months, smoked part or all of a traditional cigar, cigarillo, or filtered cigar with marijuana (N = 20,705)[a]	2593	6	2547	7	46	2	<.001
In past 12 months, used marijuana, hash, THC, grass, pot, or weed (N = 18,089)[b]	2365	8	2258	8	107	6	0.009
Marijuana, hash, THC, grass, pot, or weed used weekly or more often (N = 9427)[c]	3321	27	3207	27	114	18	<.001
Ever used marijuana concentrates, marijuana waxes, THC, or hash oils in electronic nicotine product (N = 6803)[d]	2702	34	2619	34	83	26	.026
In past 30 days, used marijuana, hash, THC, grass, pot, or weed (N = 4940)[e]	3764	74	3647	74	117	72	.666
	M	*SE*	*M*	*SE*	*M*	*SE*	
	n = ***446***		n = ***430***		n = ***16***		
Number of puffs of marijuana taken from an electronic nicotine product today/yesterday/day before yesterday (N = 446)[f]	8.94	1.13	8.93	1.11	9.20	5.06	.955

Abbreviations: M, mean; SE, standard error; THC, tetrahydrocannabinol.
[a]This item was asked of all participants who reported ever using marijuana (ie, as a part of a traditional cigar, cigarillo, or filtered cigar; as marijuana, hash, THC, grass, pot, or weed).
[b]This item was asked of participants who had not reported smoking cigars as blunts in the past 12 months.
[c]This item was asked of participants who reported ever using 2 or more substances (ie, alcohol, other drugs) and who reported using alcohol or other drugs weekly or more often in the past month, 2-12 months ago, or over a year ago.
[d]This item was asked of participants who reported using an electronic nicotine product.
[e]This item was asked of participants who reported using marijuana in the past 12 months.
[f]This item was asked of participants who reported ever using marijuana in an electronic nicotine product and who reported last used marijuana in an electronic nicotine product in the past hour or sometime today, yesterday, or the day before yesterday.

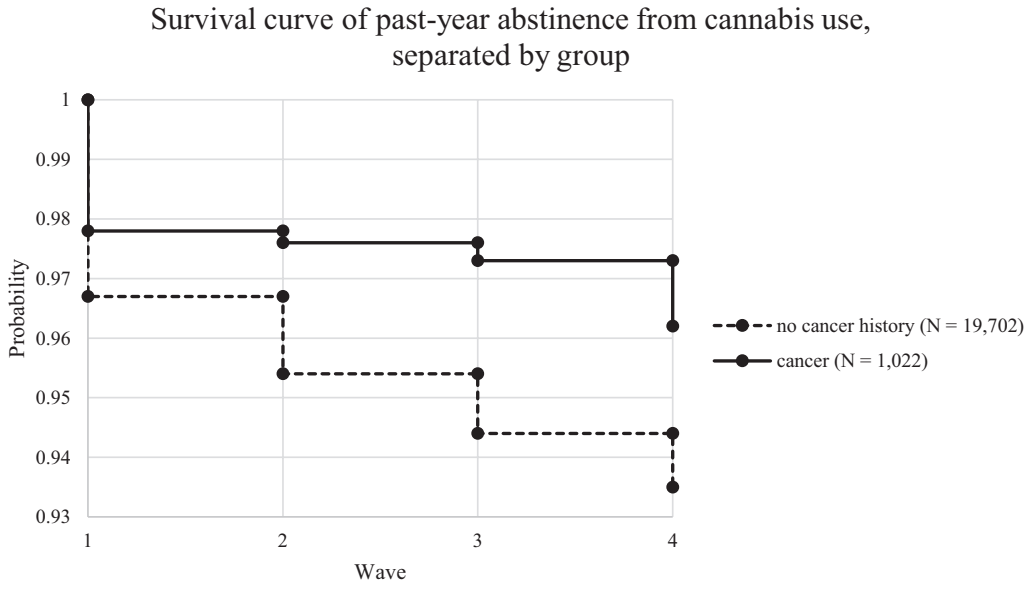

Figure 1. Survival curves for past-year abstinence from cannabis use for cancer survivors and those without a history of cancer. [Correction added on 2 September 2021, after first online publication: Figure 1 has been updated to include all data points.]

TABLE 3. Results From Discrete Time Survival Analysis Predicting Cannabis Engagement

	No Cancer History				Cancer Survivors		
	OR	Lower 95% CI	Upper 95% CI		OR	Lower 95% CI	Upper 95% CI
Female[a]	**0.66**	**0.61**	**0.72**	Female[a]	0.70	0.47	1.05
Age	**0.65**	**0.63**	**0.68**	**Age**	**0.55**	**0.49**	**0.60**
Black[b]	**1.27**	**1.13**	**1.43**	Black[b]	1.48	0.76	2.88
Other race/ethnicity[b]	0.93	0.80	1.08	Other race/ethnicity[b]	0.81	0.41	1.60
Education W1	1.05	0.99	1.11	Education W1	0.92	0.73	1.17
Income W1	**0.89**	**0.86**	**0.93**	Income W1	0.85	0.71	1.01
Has insurance W1[c]	**0.75**	**0.68**	**0.83**	**Has insurance W1**[c]	**0.50**	**0.28**	**0.89**
Pain past 7 days W1	**1.07**	**1.06**	**1.09**	**Pain past 7 days W1**	**1.14**	**1.06**	**1.23**
Physical health status W1	1.03	0.98	1.08	Physical health W1	1.03	0.83	1.29
Mental health status W1	**0.82**	**0.79**	**0.85**	Mental health W1	0.84	0.70	1.01

Abbreviations: OR, odds ratio; W1 = answered at wave 1.
Parameters in bold face are statistically significant at $P < .05$.
[a]Reference group is male.
[b]Reference group is White.
[c]Reference group does not have insurance.

1-4 vs 8%-40% in other studies).[20-22] Other nationally representative studies[21,22] found that younger individuals are more likely to use cannabis. Comparably, our analysis showed that older individuals at baseline were less likely to use cannabis in subsequent years, regardless of whether they were cancer survivors or those without a cancer history.[20] Across both groups, greater levels of perceived pain were associated with a higher likelihood of engaging in cannabis use. The finding on perceived pain aligns with another study examining cannabis use for the management of pain, which found that average past 7-day pain intensity score was significantly higher among users of cannabis within the past year, relative to controls.[28]

Differences in the reported prevalence of cannabis use and associated factors might be attributed to differences in study design, sampling methods, and population composition. For example, the study by Pergram et al, which found that 24% of surveyed cancer patients currently undergoing treatment reported past-year use, was conducted in Washington State, a state where cannabis is legal.[20] Respondents in PATH were sampled across the United States where legalization laws vary. This is also the case for the studies conducted using NHANES[22] and NSDUH[21] data. Additionally, the time of diagnosis and stage of cancer were unknown among PATH respondents. As such, it is possible that those undergoing treatment may have very different attitudes and willingness to using cannabis to manage symptoms of the treatment or their disease from those who are just completing treatment, or from those who are no longer in treatment. Differences in reported prevalence of cannabis use across national data sets might also be attributed to differences in the age of the sample populations. For example, NHANES respondents were aged 20 to 60 years, whereas PATH data do not have a maximum-age cap. Additionally, NHANES data are collected through a medical examination and biospecimens (ie, urine sample), which, even though participants are told that the urine is not for drug testing, might nevertheless encourage respondents to report more truthfully.

To our knowledge, there are only 2 other studies that have employed a nationally representative sample to examine cannabis use among cancer survivors.[21,22] One is a recent study published by Cousins et al,[21] which found that cannabis use was less common in those with a past (8.9%) or recent (9.9%) cancer diagnosis, relative to those without a history of cancer (15.9%). The other is a study published by Tringale et al,[22] using the US National Health and Nutrition Examination Survey[29] (NHANES, 2005-2014) data. This study reported past-year cannabis use to be 40.3% (n = 826) among cancer survivors and 38% among respondents without cancer.[22] The estimates provided by the NHANES study were more than triple that reported in other national prevalence studies, which range between 2.8% and 12.9%.[18,19,21,27,30] The peculiarly high prevalence estimate of past-year use in the NHANES data is also 130% to 140% higher than the estimate in a very similar national survey (National Survey on Drug Use and Health, NSDUH[31]) conducted over the same period.[21,32] Alshaarawy and Anthony speculated that the health context of the NHANES study, which was conducted similarly to a physical examination where blood and urine were collected, might have promoted more accurate reporting of cannabis use: especially if participants were told that the biospecimen was not being used for drug testing.[32]

If this is the case, the prevalence estimate obtained in our study using PATH data and in the Cousins et al[21]

study using NSDUH data may be underestimating past-year cannabis use. Continued research on the extent of cannabis use among cancer survivors would help more accurately determine the point prevalence. Research on factors related to cannabis use in the subpopulation is also needed.

One of the factors related to use, as suggested by Cousins et al, is age.[21] That study found that differences in recent cannabis use (which includes recent or past use anytime within the past year) between those with and without cancer were not seen in older adults (aged ≥ 50 years) or in the youngest age group (18-34 years), but were found for the middle-age group (35-49 years). Similar to that study, we also found that age was a significant predictor of whether someone engaged in cannabis use. In our study, which modeled the relationship between age at baseline and subsequent likelihood of engaging in cannabis use over 3 annual waves of assessment, we observed that the older the participant was at the initial baseline assessment, the less likely they were to engage with cannabis over the subsequent waves of data collection.

In addition to finding similar relationships between age and cannabis use, our study and that of Cousins et al[21] were highly aligned with respect to the prevalence of cannabis use (ie, 8.9% of those with a history of cancer vs 15.9% of those without a history of cancer in NSDUH, and 8% of those with a history of cancer vs 15% of those without a history of cancer in the most recent wave of PATH). Our study expands the literature in that it capitalizes on the longitudinal design of PATH and complements the cross-sectional study designs of Tringale et al[22] and Cousins et al.[21] Specifically, our study estimates the percentage of respondents within each group who used cannabis over the approximate 4-year observational period and the factors that predicted this likelihood of use over this period.

Although cannabis may be used for several medical issues, prior literature suggests that cannabis use for pain is common, especially among those who experience chronic pain. Recent studies suggest that between 45% and 80% of individuals who receive medical cannabis do so for pain management.[33,34] Cannabis use has also been attributed to mitigating mental health challenges, such as anxiety or depression.[35,36] Although, we did not find evidence for this among the cancer survivor group in our analyses. Surprisingly, physical health status was also not found to be a significant predictor of cannabis use for either cancer survivors or those without a history of cancer in our study. This finding differs from other studies, which suggests that cannabis is used commonly for the relief of physical symptoms.[20,37,38]

Our study results should also be considered within the context of certain limitations. Cancer diagnosis was self-reported and not confirmed by a medical professional. Furthermore, although the PATH data set has a very large sample of cancer survivors, it is designed to primarily study tobacco use. As a result, some information that is unique to cancer survivors is not available as part of the PATH data set, such as information on specific cancer type/stage, time since diagnosis, cancer reoccurrence, or prescribed cancer treatments. Also, the dearth of information on why cancer survivors use cannabis does not allow for the identification of unique predictors among cancer survivors. Having this information available in future studies would be useful for determining why someone with a history of cancer may use cannabis.

Although the PATH data do provide some information on how cannabis may have been used (ie, in a hookah, as a wax; as THC/hash oil in electronic nicotine products; in a traditional cigar, cigarillo, or filtered cigar; or as hash, pot, or weed) and provide clues for how use might differ between cancer survivors and those without a history of cancer, there is a limited amount of information available on cannabis type, frequency, and reasons for use (ie, recreation vs managing symptoms). Two studies focused on a diverse group of patients seeking certification for medical cannabis in Michigan[39,40] suggest that those with a history of cancer are less likely to endorse daily or almost daily use of cannabis,[40] less frequently endorse smoking cannabis,[39] and more frequently endorse edible use.[39] More studies are needed to validate these findings.

Also missing from the current analyses is information regarding whether participants reside in a state with legal recreational and/or medical cannabis-use laws. The inclusion of this information in future studies would be especially informative for cancer treatment. Results from prior studies suggest that cancer patients seeking medical cannabis are different from those seeking medical cannabis without cancer and that the methods by which cannabis is used may also differ by cancer status.[39,40] In addition, more refined measurement of cancer and marijuana use is needed in future studies to address existing limitations to available survey items.

Despite these limitations, there are several strengths to this study. Our study characterizes cannabis use in cancer survivors and those without a cancer history and describes trends over time within these 2 groups. Furthermore, data obtained for these analyses come from a large national survey conducted in the United States, are weighted to adjust for its complex sampling design, and use statistical models that take advantage of the

longitudinal nature of the data. It represents one of the largest nationally representative studies to date to compare cannabis use among cancer survivors and those without a cancer history. However, for more precise estimates of cannabis use within the general population and among cancer survivors and to determine factors that might be predictive of use over time, more research is needed.

Our results indicate that cancer survivors are using cannabis at slightly lower rates than those without a history of cancer. However, the specific causes for why this trend may be occurring remain unknown. It is possible that cancer survivors who have more frequent follow-up with medical practitioners might not need to self-medicate for cancer-related symptoms. Physicians might also be choosing to not prescribe patients cannabis based on limited evidence for the effectiveness of cannabis alleviating cancer-related symptoms.[41]

Under many state laws, cannabis is becoming increasingly available for medical use. Yet, there is a paucity of evidence to guide the clinical management of cannabis use among patients. Given that patients, regardless of cancer status, may elect to use cannabis for pain, other symptom management, or recreational purposes, clinicians will need to be able to counsel patients on cannabis use in clinical contexts, particularly related to the efficacy and harms of cannabis as a symptom-management tool.[42] Clinicians will also need to work with researchers to consider how best to expand cannabis research to fill the gaps of knowledge regarding the clinical and public health effects of expanded use.

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CONFLICT OF INTEREST DISCLOSURE

The authors made no disclosures.

AUTHOR CONTRIBUTIONS

All authors were involved in the study design, interpretation of results, manuscript writing, and decision to submit.

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