

Articles

Health Care Use by Frequent Marijuana Smokers Who Do Not Smoke Tobacco

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Even though marijuana smoke contains carcinogens and more tar than tobacco smoke and marijuana intoxication has been implicated as a risk factor for injuries, relatively little epidemiologic evidence has identified marijuana use as a risk factor for ill health. This study is the first to examine the health effects of smoking marijuana by comparing the medical experience of "daily" marijuana smokers who never smoked tobacco ($n = 452$) with a demographically similar group of nonsmokers of either substance ($n = 450$). Marijuana smoking status was determined during multiphasic health checkups at Kaiser Permanente medical centers between July 1979 and December 1985. Medical records were reviewed for as long as 2 years after the checkups. Frequent marijuana smokers had small increased risks of outpatient visits for respiratory illnesses (relative risk [RR] = 1.19; 95% confidence interval [CI] = 1.01, 1.41), injuries (RR = 1.32; CI = 1.10, 1.57), and other types of illnesses (RR = 1.09; CI = 1.02, 1.16) compared with nonsmokers; their risk of being admitted to a hospital was elevated but not statistically significant (RR = 1.51; CI = 0.93, 2.46). Analyses were adjusted for sex, age, race, education, marital status, and alcohol consumption. Daily marijuana smoking, even in the absence of tobacco, appeared to be associated with an elevated risk of health care use for various health problems.

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Marijuana is the most widely used illicit recreational drug in the United States. Marijuana smoke contains carcinogens and more tar than tobacco smoke, and the psychoactive effects of marijuana ingestion have been implicated as a risk factor for injuries. Yet, surprisingly little epidemiologic evidence is available concerning the possible effects of smoking marijuana on respiratory health, injury risk, or other health conditions.*

As a pilot project for a larger study of the health consequences of smoking marijuana, we compared the medical experience of persons who self-reported frequent marijuana smoking but who never smoked tobacco with that of a demographically matched group who reported never smoking tobacco or marijuana. To our knowledge, this study is the first to review the medical records of a large number of non-tobacco smoking marijuana users.

Subjects and Methods

Study Population

Study subjects were selected from members of the Kaiser Permanente Medical Care Program who had at least one multiphasic health checkup (MHC) at the Oakland or San Francisco, California, medical centers be-

tween July 1979 and December 1985. The multiphasic health checkup was completed by about 30,300 persons per year during the study period; the examination was discontinued at San Francisco in 1980. The MHC population has been described previously and has provided the data for numerous studies of smoking and drinking habits.^{1,2} The Kaiser Permanente membership is demographically and socially heterogeneous, reflecting the diversity of the San Francisco Bay Area population, but impoverished and undereducated persons are underrepresented.³ Persons who take the MHC tend to be more health conscious and better educated than Kaiser Permanente members in general.^{4,5}

The MHC examinees were given several questionnaires documenting demographic and social characteristics, medical history, health habits, the use of tobacco and marijuana (questionnaire administered from July 1979 to 1986), and the use of alcohol (questionnaire administered from 1978 to 1985). About 86% of the examinees completed the tobacco or marijuana use questionnaire, and 80% completed the alcohol use questionnaire.

Definitions of Study Groups

About 14,600 respondents to the tobacco-marijuana survey during the study period reported smoking mari-

*See also the editorial by D. P. Tashkin, MD, "Is Frequent Marijuana Smoking Harmful to Health?" on pages 635-637 of this issue.

ABBREVIATIONS USED IN TEXT

CI = confidence interval
 MHC = multiphasic health checkup
 RR = relative risk

juana more than six times in their lifetimes and that they currently smoked marijuana. Among these persons, a group of 746 marijuana smokers reported smoking marijuana almost every day and never smoking tobacco. We defined the first MHC at which the tobacco-marijuana survey was completed as the index MHC for the marijuana smoking group. We selected a comparison group of nonsmokers from respondents who reported never smoking marijuana or tobacco. For each marijuana smoking subject, we attempted to match a nonsmoker by sex, age (birth year), race (Asian, African American, white), and index MHC date (within a month). We initially matched controls with 709 marijuana smokers. To control for varying lengths of Kaiser Permanente membership, we selected for study those pairs in which both members were enrolled in Kaiser for either at least one or at least two years after the index MHC. This process left 486 pairs for whom medical charts were reviewed (65% of the 746 original marijuana smokers). An additional 70 persons were excluded from this report because of the unavailability of an alcohol questionnaire after December 1985. The final sample thus consisted of 452 marijuana smokers and 450 nonsmokers.

Data Sources

The index MHC questionnaire provided information on sex, age, race, education, and marital status; self-reported health status (a checklist of 34 medical conditions); the existence of serious illnesses; hospital admissions in the past year; and the presence of problems with drugs. Data on marijuana and tobacco use, duration of marijuana use, and number of days ill with a cold, flu, or sore throat were obtained from the supplemental tobacco-marijuana survey. We used a drinking status measure derived in previous studies from items regarding quantity and frequency of drinking on the alcohol survey.⁶ Six drinking categories were defined for this study: abstainer, ex-drinker, occasional (<1 drink per month), less than one drink per day but more than one per month, one to two drinks per day, and three or more drinks per day. The small number of ex-drinkers was combined with abstainers in the main analyses.

Kaiser Permanente outpatient medical records were reviewed by two trained medical records technicians who were unaware of subjects' marijuana smoking status. The medical records of each pair of subjects were reviewed for the same follow-up period, which was either one or two years after the index MHC date, depending on the length of membership in the Kaiser program. Following a written protocol, records reviewers identified all office visits to a physician or nurse practitioner. Prenatal visits were excluded, as were telephone contacts, letters, and visits for procedures only, such as ultrasonograms. As many as

three illnesses were coded as reasons for the visit, using the International Classification of Diseases, 9th Revision, codes.⁷ Each visit was assigned to one of three categories for this report: respiratory conditions (codes 460 to 519), injuries and poisonings (codes 800 to 999), or other diseases and conditions (all other codes). If more than one, the reason listed first was used. Inpatient data were obtained from Kaiser Permanente computer-based hospital admission files. All hospital admissions were included. Because of the small number of hospital admissions during the follow-up period, we combined all diagnoses in the analysis.

Analysis

Differences in the distribution of baseline characteristics were evaluated with χ^2 tests. Poisson regression was used to estimate the relative risk for the marijuana smoking group versus the nonsmoking group of outpatient visits or hospital admissions. The matched-pairs design was dropped in the analysis, and the variables used for matching were instead controlled statistically to avoid dropping both members of a pair when only one member was missing data on a covariate. Covariates in each regression model included alcohol consumption, age, sex, race, educational level, and marital status. Terms for marijuana exposure interacting with drinking status were introduced to examine possible interaction effects. The SAS statistical analysis package was used for all analyses.⁸

Results

Characteristics of the marijuana smokers and the nonsmokers at the time of the index MHC are compared in Table 1. Marijuana smokers had a lower educational level and were less likely to be married than nonsmoking subjects. Alcohol drinking levels differed dramatically between the two groups, with marijuana smokers being more likely to drink alcohol and (among current drinkers) to drink more heavily. Marijuana smokers reported more days ill with a cold, flu, or sore throat in the past year and were more likely than the nonsmoking group to report having a serious problem with drugs.

A total of 6,088 visits were recorded, including 3,206 among the marijuana smoking group and 2,882 among the nonsmoking group. At least one outpatient visit for respiratory problems was made by 36% of the marijuana smokers versus 33% of the nonsmokers, 39% versus 28% made at least one visit for injury, and 94% versus 93% made at least one visit for other reasons. After adjustment for covariates, the marijuana smoking group showed small but statistically significant increased risks of outpatient visits for all three categories of conditions (Table 2).

Interaction between marijuana smoking and alcohol consumption was significant in relation to visits for injury and for other reasons but not in relation to visits for respiratory problems. The percentage distributions of visits for injury (none versus ≥ 1) by drinking level suggest that the generally higher injury risk for the marijuana smoking group compared with the nonsmoking group was reduced in the heaviest drinking level (Table 3). For other dis-

TABLE 1.—Self-reported Characteristics of Marijuana Smokers (n = 452) and Nonsmokers (n = 450) at Index Multiphasic Health Checkup, July 1979 to 1985 (%)

Characteristic	Marijuana Smokers, %	Nonsmokers, %	Characteristic	Marijuana Smokers, %	Nonsmokers, %
Sex			Current problem with drugs?		
Female	32.7	33.1	Yes	5.8†	0.0†
Male	66.3	66.9	No	92.7	98.2
Age, yr			Missing data	1.6	1.8
<25	35.4	36.2	Number of health conditions (34 possible)		
25-34	48.0	46.2	None	23.0	29.1
≥35	16.6	17.6	1-4	58.6	53.1
Race			≥5	16.8	16.0
Asian	2.0	2.0	Missing data	1.6	1.8
African American	36.9	37.3	Mean (SD)	2.5 (2.5)	2.2 (2.7)
White	61.1	60.7	Days ill with cold, flu, sore throat in past year		
Educational level			None	25.0*	33.1*
High school or less	22.4*	15.6*	1-5	49.3	44.7
Some college or vocational ...	42.5	40.9	≥6	24.1	21.6
College graduate or more	33.0	41.8	Missing data	1.6	0.7
Missing data	2.2	1.8	Serious illness in past year?		
Marital status			Yes	10.8	7.1
Married	29.4†	44.0†	No	86.3	90.9
Separated, divorced, widowed .	11.3	7.3	Missing data	2.9	2.0
Never married	57.3	46.9	Admitted to hospital in past year?		
Missing data	2.0	1.8	Yes	4.9	6.0
Alcohol drinking status			No	92.9	91.6
Never drank	2.4†	20.2†	Missing data	2.2	2.4
Former drinker	0.9	3.1	Duration of marijuana use, yr		
Current drinker			<5	19.0	--
<1 drink/mo	10.6	27.3	5-9	33.6	--
>1 drink/mo, <1/day	42.7	36.7	10-14	36.3	--
1-2 drinks/day	27.4	10.0	≥15	9.5	--
≥3 drinks/day	15.9	2.7	Missing data	1.5	--

* $P < .05$. † $P < .001$.

eases, the difference in risk was higher in the nondrinking and heaviest drinking levels (Table 3).

The duration of marijuana smoking was associated in different ways with the three categories of visits (Table 4). The risk of respiratory visits was significantly elevated for persons who had smoked marijuana for less than ten years, but not for those who had smoked for ten years or more. Among marijuana smokers, there was a negative association between duration of smoking and risk of visits for respiratory problems ($P = .0002$). For injury visits, however, a longer duration of marijuana smoking was associated with a greater risk. Compared with the nonsmoker group, persons who had smoked marijuana for 15

years or more had twice the risk of visits for injury. A test for linear trend was significant ($P = .0001$). For other types of visits, only those who had smoked marijuana for five to nine years had a significantly increased risk compared with the nonsmoker group, and the other duration categories did not follow a consistent pattern.

There were 86 hospital admissions in the two study groups. The relative risk for the marijuana smoking group compared with the nonsmoker group was elevated but not statistically significant (relative risk [RR] = 1.51; 95% confidence interval [CI] = 0.93, 2.46; $P = .10$). A duration of marijuana use of less than five years was of borderline significance (RR = 2.02; 95% CI = 0.98, 4.15; $P = .06$).

TABLE 2.—Relative Risk (RR) of Outpatient Medical Visits for Respiratory, Injury, and Other Conditions by Marijuana Smokers (n = 452) Versus Nonsmokers (n = 450)*

Marijuana Exposure	Type of Visit					
	Respiratory		Injury		Other	
	RR	95% CI	RR	95% CI	RR	95% CI
Nonsmokers (reference)	1.00	--	1.00	--	1.00	--
Marijuana smokers	1.19	1.01, 1.41	1.32	1.10, 1.57	1.09	1.02, 1.16

CI = confidence interval

*Adjusted for sex, age, race, educational level, marital status, and alcohol consumption.

TABLE 3.—Percentage Making 1 or More Outpatient Visits for Injury and Other (Nonrespiratory) Causes by Marijuana and Alcohol Use

Alcohol Use	No.	Outpatient Visits					
		Marijuana Smokers			Nonsmokers		
		Injury, %	Other, %	(n)	Injury, %	Other, %	(n)
Never or former	120	40.0	100.0	(15)	27.6	93.3	(105)
Occasional	171	25.0	95.8	(48)	28.5	98.4	(123)
<1 drink/day	358	40.9	95.3	(193)	28.5	90.9	(165)
1-2 drinks/day	169	37.9	94.3	(124)	24.4	91.1	(45)
≥3 drinks/day	84	47.2	90.3	(72)	41.7	83.3	(12)

There was no significant interaction between marijuana smoking and alcohol use.

Discussion

Although epidemiologic studies concerning the health consequences of smoking marijuana are relatively few, a long-term use of marijuana has been implicated as a possible hazard to mental, pulmonary, immune, and reproductive functioning,⁹ and marijuana intoxication has been implicated as a risk factor for accidents and injuries.¹⁰ Because marijuana is usually ingested by smoking, possible respiratory effects have naturally been the most frequently investigated.

Compared with tobacco smokers, marijuana smokers typically smoke fewer cigarettes per day but consume more of the cigarette, inhale longer and more deeply, and retain the smoke longer in the lungs.¹¹ This probably explains why the respiratory deposition of tar and adsorption of carbon monoxide in experimental subjects were four and five times higher, respectively, after smoking marijuana than after smoking tobacco.¹² Because of the high prevalence of cigarette smoking among marijuana smokers, however, it has been difficult to assess the independent association between marijuana smoking and respiratory disease, including lung cancer.¹³ Marijuana use has been linked to respiratory problems.¹⁴⁻¹⁷ In one study, heavy smokers of marijuana, whether or not they also smoked tobacco, reported more chronic bronchitis symptoms and more acute bronchitis episodes than nonsmokers of either marijuana or tobacco.¹⁵ Heavy marijuana smoking, with or without concomitant tobacco smoking, appears to affect large (but not small) airway function adversely and to produce histologic lesions in the air-

ways.^{15,16,18} A positive association between smoking “nontobacco cigarettes” (presumed to be marijuana) and respiratory symptoms in smokers and nonsmokers of tobacco was reported in a population survey in Tucson, Arizona. Lung function was decreased among male—but not female—smokers of nontobacco cigarettes more than among tobacco smokers.¹⁹

Marijuana has repeatedly been found to be the second most common drug, after alcohol, present in the blood of nonfatally and fatally injured persons,^{20,21} although the role marijuana may play in injury-producing events remains uncertain.²² Laboratory studies have shown decreased driving-related skills after smoking marijuana.¹⁰ In one experimental study, driving performance declined substantially after ingesting marijuana and alcohol together, but did not decline after taking either substance alone.²³

In a Swedish study following a cohort of 45,540 male military conscripts for 15 years, heavier cannabis users had a nearly three times greater risk of death than nonusers, but the association did not remain statistically significant after control for the use of alcohol, other drugs, and social background variables.²⁴ In another study of the same Swedish cohort, heavier cannabis users had an elevated risk of schizophrenia compared with nonusers, even after adjusting for psychosocial covariates.²⁵

As the first evidence based on medical records of nontobacco smoking, daily marijuana users, our results make a unique contribution to the growing research on the harmful health effects of marijuana. Our finding of an increased risk of respiratory-related outpatient visits expands the evidence suggesting that frequent marijuana smoking may increase the risk of respiratory illness independent of tobacco smoking. Marijuana smokers in our

TABLE 4.—Relative Risk (RR) of Outpatient Medical Visits for Respiratory, Injury, and Other Conditions by Duration of Marijuana Smoking (n = 895)*

Duration of Marijuana Exposure, yr	Type of Visit					
	Respiratory		Injury		Other	
	RR	95% CI	RR	95% CI	RR	95% CI
Nonsmokers (reference)	1.00	--	1.00	--	1.00	--
<5	1.40	1.07, 1.83	1.10	0.83, 1.47	0.99	0.89, 1.11
5-9	1.34	1.07, 1.67	1.25	0.99, 1.58	1.26	1.16, 1.38
10-14	1.12	0.90, 1.39	1.35	1.07, 1.68	1.02	0.94, 1.12
≥15	0.91	0.61, 1.35	1.99	1.43, 2.76	0.93	0.79, 1.08

CI = confidence interval

*Adjusted for sex, age, race, educational level, marital status, and alcohol consumption.

study also reported a higher prevalence of upper respiratory tract infections compared with nonsmokers. On the other hand, the duration of marijuana smoking appeared to be inversely related to the risk of outpatient visits for respiratory problems. This result was contrary to our expectation and remains an issue for future research. In our data, long-term marijuana smokers may be the "survivors" of a selection process in which persons who experienced respiratory symptoms were more likely to quit smoking marijuana early in the process.

We also found increased risks of injury-related and other (nonrespiratory, noninjury) outpatient visits among marijuana smokers, suggesting that marijuana use may have many adverse health effects. The complex interaction between marijuana and alcohol use in relation to the risk of medical care use in both of these areas underscores the important role of alcohol in combination with marijuana.^{26,27} The duration of marijuana use appeared to be positively related to the risk of making injury-related visits. As with respiratory-related visits, this result was unexpected. It is not clear why a longer use of marijuana would be associated with a greater injury risk and a lower respiratory risk, but these results deserve additional study. The duration of marijuana use was not related to the risk of other types of outpatient visits.

Marijuana smokers in our study also tended to have an elevated risk of being admitted to a hospital. Although the association was not statistically significant, it was consistent with our results regarding medical office visits and thus supports the hypothesis that marijuana smoking is associated with adverse health effects.

Several caveats should be noted. We had no data regarding the use of other drugs such as cocaine; if associated with marijuana use, they may account for the observed differences. Only 6% of the marijuana smokers, however, reported having serious problems with drugs at their index MHC.

Another potential problem is our reliance on self-reporting. The use of illegal or socially undesirable substances such as tobacco, alcohol, marijuana, and other drugs may well be underreported.²⁸ We are unable to assess this possible bias. Our study subjects, however, completed their questionnaires in a health care setting in which confidentiality was assured.

Finally, our study was intended to serve as a pilot "hypothesis-generating" study of marijuana smoking and health. Restricting subjects to nonsmokers of tobacco allowed us to efficiently assess an association between marijuana use and respiratory illnesses independent of tobacco use but at the cost of studying an unrepresentative sample of marijuana smokers, many of whom smoke tobacco.²⁹

In summary, daily marijuana smoking appears to be associated with respiratory conditions even among persons who never smoked tobacco. This association is consistent with a possible independent deleterious effect of marijuana smoking on respiratory health. Frequent marijuana use also appears to be intimately linked to alcohol consumption as a risk factor for injury-related and other

medical care. These data are limited, but a larger study in progress (S.S., principal investigator) should elucidate the joint roles of tobacco and marijuana in relation to respiratory health and of alcohol and marijuana in relation to traumatic injuries and other illnesses. This study will include never users, former users, and current users of marijuana, tobacco, and alcohol and will examine medical experience and mortality over a longer period.

Physicians and other primary care professionals may wish to consider counseling patients who frequently smoke marijuana about the potentially widespread harm its use may entail. In our study, physicians recorded marijuana use in the medical records of only 3% of the marijuana smokers, all of whom smoked daily or almost daily. As evidence of the health consequences of smoking marijuana accumulates, physicians should take note of this possibly important health behavior.

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* * *

HOW TO IMAGINE DEAFNESS

Darken your ears until the tunnels
with their intricate clockwork
are sheathed in pitchy calm.
Hum a little blue, to yourself,
but keep it secret. The small bones
will dip delicately, like willow leaves
that merely brush the water's surface,
in their repose. The small hairs
will lie down together like tentacles.
Listen: the lake stops its lapping
repetition of sibilance
(physicist, Sisyphus, sassafras)
and the great snail unfurls itself,
stretches its tongue longingly
toward the distant echo surge
that must be the heart.

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