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The Association Between Early Marijuana Use and Subsequent Academic Achievement and Health Problems: A Longitudinal Study

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Abstract

In this prospective longitudinal study, the authors investigated the association between marijuana use over a period of 13 years and subsequent health problems by age 30. A community sample of 749 participants from upstate New York were interviewed at mean ages of 14, 16, 22, and 27 years. Marijuana use over time was significantly associated with increased health problems by the late twenties, including respiratory problems, general malaise, neurocognitive problems, and lower academic achievement and functioning. Effective prevention and intervention programs should consider the wide range of physiological and psychosocial outcomes associated with marijuana use over time.

Keywords

Marijuana; Health; Achievement

INTRODUCTION

Marijuana is the most commonly used illicit drug in the United States.⁽¹⁾ Several investigators have noted that marijuana use contributes to later drug abuse and dependence.⁽²⁾ The early onset of marijuana use poses other significant social problems as well. Adolescent marijuana use is associated with a decreased likelihood of graduating from high school, and increased risks of self-deviance, risky sexual behaviors, violence towards others, contact with the justice system, depression, and suicidal behaviors.^(3–7)

Research has begun to examine the adverse physiological effects of smoking marijuana. Numerous researchers have found a wide spectrum of serious respiratory and neurocognitive health risks associated with smoking marijuana.^(8–10) Prior research has also documented a relationship between marijuana use and lower academic achievement and functioning.^(6,7,11) However, there are a limited number of longitudinal studies⁽⁷⁾ focusing on earlier marijuana use and later lower academic achievement and functioning. Furthermore, several other authors have highlighted the need for further research into the related areas of the cognitive and neuropsychological effects of marijuana use.⁽¹²⁾

It is essential, therefore, to understand the various adverse consequences of marijuana use to better inform prevention and treatment strategies. This is the first study to examine the health consequences as well as the neurocognitive functioning in youngsters using

prospective data collected at multiple points in time from childhood and adolescence to the late twenties and early thirties.

Previous studies have found a significant relationship between age, gender, education, income, and marijuana use.⁽¹³⁾ Therefore, we decided to control for these variables in our analyses to ensure that our results are indeed based on the association of earlier marijuana use with later selected health variables. We also controlled for two possible confounding factors to highlight the consequences of marijuana use. These two factors are mother's marijuana use and childhood aggression. Furthermore, we controlled for a co-occurring mental health disorder, Major Depressive Disorder, in adolescence, which may be a confounding factor in linking early marijuana use to later adverse health outcomes.

Building on the existing research, the present longitudinal study seeks to address several negative health outcomes associated with smoking marijuana over time in a community sample spanning the course of development from childhood through the late twenties to the early thirties. In particular, this study focuses on lower academic achievement and functioning and the following health risks as dependent variables: respiratory ailments, neurocognitive impairment, and general malaise. These dimensions tap physical, psychological and behavioral functioning. To our knowledge, this is the first study to look at an array of discrete medical problems (e.g., general malaise, or feeling general discomfort) as they relate specifically to the duration of marijuana use from mean age 14 to 27 years old. We hypothesized that individuals who reported smoking marijuana over a long period of time are at increased risk for the health problems noted above. More specifically, we hypothesized that in our sample there is an association between the duration and amount of earlier marijuana use and later neurocognitive impairment, as well as lower academic achievement and functioning.

METHODS

Participants and Study Procedures

The participants are from a random sample of children living in two upstate New York counties who were interviewed first in 1983 ($N=975$). The sample was based on an earlier study using maternal interviews to determine problem behaviors of youth between the ages of 1–10 (Time 1=T1). For complete details about the original sampling procedures, see Brook, Whiteman, Gordon and Cohen (1986).⁽¹⁴⁾ Albany County was identified as one of the poorest counties in New York State, and adjacent Saratoga County as one of the wealthiest. These two counties were chosen for study by means of a sample survey. Primary sampling units were created from enumeration districts and block groups, which, when taken together, comprise the entire area and population of the target counties. The primary sampling units in each county were stratified by urban/rural status, the proportion of Whites, and median income. A systematic sample of primary units in each county was then drawn with probability proportional to the number of households, and probabilities equal for members of all strata. Segments of blocks were then selected with probability proportional to size (number of households), and each was surveyed in the field with a proportion of the households being selected according to the predetermined sampling ratio. Address lists were compiled in this process, and interviewers were sent to the selected addresses. Those households with at least one child between the ages of 1–10 years old were qualified for the study. In each qualified household the interviewer, by use of a set of Kish Tables, randomly selected one child from those in the appropriate range. For further details about the sampling procedures, please see Brook et al (1986)⁽¹⁴⁾. In general, the participants were representative of families in the Northeastern United States at the time the data was initially collected (1975) based on socioeconomic status and other demographic variables, with the exception of ethnicity. The 1997 participants ($N=749$) were: 94% White, including some individuals

who did smoke marijuana and some individuals who did not, 2% African American, and 4% Other. While the 749 participants at T5 constitute 77% of the original sample, the time span between T2 and T5 was fourteen years. Moreover, there were no differences on the demographic factors, childhood aggression, and maternal marijuana use between those participants who remained in the sample and those who dropped out. Fifty percent were women. The participants we are focusing on were the follow-up group to the T1 sample: the families including the randomly selected children who were initially interviewed in 1975. The data was collected over four subsequent time waves (Time 2–5=T2–T5) (1983, 1985–1986, 1991–1993, and 1997). The mean ages of the participants were 14.05 years (S.D.=2.80) at T2, 16.7 years (S.D.=2.80) at T3, 22.0 years (S.D.=2.80) at T4, and 27.0 (S.D. =2.80) at T5. Informed consent was obtained from the participants and a NIH Certificate of Confidentiality was obtained for all interviews. The present study focuses on the associations among health outcomes as well as academic achievement at T5 (mean age=27), and the history of marijuana use between T2–T4.

Measures

The measurement of health problems at T5 was based on responses to questions regarding physical symptoms characteristic of respiratory illness, cognitive problems, and general malaise. The health items were adapted from the Hopkins Symptom Checklist 90-R.⁽¹⁵⁾ The Hopkins SCL 90-R has frequently been used as an outcome measure; it has been found to have high internal consistency and test-retest reliability; it has been shown to be valid in international samples; and in specific relation to the present study it has previously been used to assess general malaise and neurocognitive problems.^(15–19) Participants were asked whether they had experienced specific health problems during the past 4 months. There were 26 items overall, and the participants had the option of responding *No* (=0) or *Yes* (=1). Respiratory illness was assessed by four items: I) sore throat or cold with fever; II) shortness of breath with light exercise; III) trouble with sinus congestion, runny nose, or sneezing; and IV) colds. Cognitive problems were assessed by three items: I) trouble remembering things; II) difficulty thinking or concentrating; and III) trouble learning new things. General malaise was assessed by six items: I) acid indigestion or heartburn after eating; II) stomach flu or virus with vomiting or diarrhea; III) trouble sleeping; IV) trouble getting started in the morning; V) staying home most or all of the day; and VI) appetite loss. For each of these indices, participants were included in the risk group if they scored one standard deviation above the mean or more. 10.3% of participants suffered from respiratory problems; 19.2% suffered from neurocognitive problems; 11.6% suffered from general malaise; and 14.3% suffered from lower academic achievement and functioning scores.

The measurement of lower academic achievement and functioning was based on the responses to the following questions: I) For your age, how well do you read? (5) *very poorly*, (4) *poorly*, (3) *about average*, (2) *slightly above average*, (1) *well above average*; II) For your age, how good are you in math? (5) *very poor*, (4) *poor*, (3) *fair*, (2) *good*, (1) *excellent*; III) When you do something, how important is it for you to do it exactly right? (3) *not very important*, (2) *fairly important* (1) *very important*; IV) When you read at one sitting how long do you usually spend reading? (6) *less than half hour*, (5) *more than half hour, but less than hour*, (4) *one to less than two hours*, (3) *two to less than three hours*, (2) *three to less than four hours*, (1) *four hours or more*; V) How often do you lose your train of thought, that is, your mind drifts from one thing to another? (4) *often*, (3) *sometimes*, (2) *hardly ever*, (1) *never*; and VI) How careful are you about things? Would you say you are? (4) *not careful on purpose*, (3) *not careful accidentally*, (2) *careless*, (1) *careful*. For the scale measuring lower academic achievement and functioning, participants were included in the results if they scored at or above the mean on the measure of low academic achievement.

Marijuana use was measured over eight years and was based on responses to specific questions at each point in time regarding marijuana use. These questions assessed how frequently the participants used marijuana. At T2 the participants were asked how often they ever used marijuana. At T3 and T4, participants were asked how often they used marijuana over the past two and five years respectively. The answer options for frequency of marijuana use were as follows: (0) *Never*; (1) *Not since last interview* (adjusted); (2) *Once*; (3) *Twice*; (4) *A few times*; (5) *Once a week*; (6) *Several times a week*; and (7) *Every day*. A summative index of marijuana use was then constructed and included the sum of the frequency of use at T2–T4. This measure of “marijuana use” served as the independent variable. This measure is an accepted measure of marijuana use as documented by O’Malley, Johnston and Bachman (1999)⁽²⁰⁾, and has been found to predict major depressive disorder, alcohol dependence, and substance use disorders.⁽¹³⁾ The mean (SD) marijuana use scores were 0.58 (1.21), 0.76 (1.33), 1.03 (1.40), and 0.95 (1.40) for T2–T5 respectively.

The control measures included the following: age, gender, major depressive disorder in adolescence, parental education and income, mother’s marijuana use, and maternal report of child’s aggression at T1. The measurement of major depressive disorder (MDD) was based on interviews at T3 (mean age=16.7). Answer options to the following questions included (0) No, (1) Yes, or (9) Does not apply. MDD was diagnosed if participants responded “Yes” to experiencing five or more of the following items during the same 2-week period: (1) depressed mood most of the day nearly every day, or (2) markedly diminished interest or pleasure in all, or almost all, activities (1 must be present); (3) significant weight loss or gain when not dieting; (4) hypersomnia or insomnia nearly every day; (5) psychomotor agitation or retardation; (6) feeling tired nearly every day; (7) feeling worthlessness or inappropriate guilt; (8) problems concentrating; and (9) recurrent thoughts about death. The assessments of MDD were based on a modified version of the University of Michigan Composite International Diagnostic Interview, and MDD was considered present only if DSM-IV criteria were met as noted above.^(21–23) (For further information on the validity and reliability of this instrument, please see Wittchen et al).^(22,24) The measurement of mother’s marijuana use was based on her self-report assessments from T2–T4, which asked the participants’ mothers how often they used marijuana. The answer options included (0) *Never*; (1) *Not at all since the last interview*; (2) *A few times a year or less*; (3) *About once a month*; (4) *Several times a month*; and (5) *Once a week or more*. Aggression was also used as a control variable. The following questions were asked at T1: *When your child gets angry, does he/she usually: Kick things? Throw things? Roll on the floor?* The answer choices for each item are: *No* (0) or *Yes* (=1).

Statistical Analysis

Logistic regression analyses were conducted to examine the relationship of marijuana use during childhood, adolescence, and the early twenties, and health problems and lower academic achievement and functioning in the late twenties and early thirties. We obtained adjusted odds ratios (AORs) and 95% confidence intervals. The sociodemographic characteristics and psychosocial factors, i.e. the participants’ age (T5), gender, and childhood aggression (T1), parental educational level and income (T2–T4), and maternal marijuana use (T2–T4), were statistically controlled in the logistic regression analyses.

RESULTS

Table 1 presents the results of the logistic regression analyses. The dependent variables were health problems (respiratory, neurocognitive, and general malaise) and lower academic achievement and functioning at T5, and the independent variable was standardized marijuana use (T2–T4). As shown in Table 1, marijuana use was significantly associated

with an increased likelihood of each of the later health problems studied; namely, respiratory problems, neurocognitive problems, and general malaise. Marijuana use also was significantly associated with an increased likelihood of lower academic achievement and functioning. As an example, participants whose use of marijuana was exactly one standard deviation greater than the mean of marijuana use were 1.44 times more likely to have respiratory problems, 1.36 times more likely to have neurocognitive problems, 1.52 times more likely to have general malaise, and 1.26 times more likely to have lower academic achievement and functioning. In addition, with participants whose use of marijuana was exactly two standard deviations above the mean, the likelihood of having the reported adverse effects was doubled.

Additional logistic regression analyses were conducted to examine the relationship of marijuana use during childhood, adolescence and the early twenties (T2–T5), to health problems and lower academic achievement and functioning in the late twenties (T5). As shown in Table 1, the results were similar to those obtained when we examined associations between marijuana use during childhood and/or adolescence and the early twenties, and health problems and lower academic achievement and functioning in the late twenties.

DISCUSSION

To our knowledge, this is the first community-based longitudinal study to provide evidence that marijuana use during childhood, adolescence, and the early twenties predicts respiratory problems, neurobehavioral and cognitive problems, general malaise, and low academic achievement in the late twenties. These associations were not significantly moderated by age, gender, maternal marijuana use, childhood aggression, or the social disadvantage of the family. Thus, the results of our study support our hypotheses and clearly document the risks of marijuana use in the development of later health problems. It is important to note that given the relatively low levels of marijuana use that were reported in this study, there is still a significant association between earlier marijuana use and later health problems when taking into account both duration and frequency of use.

Earlier marijuana use predicts several areas of later functioning. These areas of functioning are generally independent of one another. Indeed, our findings indicated low or non-significant correlations among the four dependent variables; namely, the three health areas and lower academic achievement and functioning. Although the four dependent variables are individually relatively independent of each other, neurocognitive problems are significantly associated with both health problems (general malaise and respiratory problems) and low academic functioning.

There are a number of plausible physiological and psychosocial mechanisms that may intervene between earlier marijuana use and later health problems. For example, in regards to marijuana's impact on respiratory problems, studies show that smoking marijuana may affect the medulla oblongata in the brain, which controls cardiorespiratory activity; this effect of marijuana has been documented in rodents.⁽²⁵⁾ It is possible that a similar mechanism may exist in humans. Marijuana use is also associated with direct pulmonary and respiratory effects.^(8,10,26,27) From an epidemiological standpoint, marijuana use is associated with nicotine use, which may also contribute independently to the development of respiratory problems.⁽²⁸⁾

Several investigators have hypothesized that marijuana use may be a contributing factor to impairment of cognition, memory and problem solving.⁽²⁹⁾ Our finding that there is an association between earlier marijuana use over time and later lower academic achievement and functioning may reflect the association of earlier marijuana use and later neurocognitive

problems. Neurocognitive impairment may be a mechanism that mediates the association between marijuana use and lower academic achievement and functioning. Marijuana use is associated with other illicit drug use, which may contribute independently to neurocognitive impairment.⁽⁵⁾ Marijuana users also tend to engage in unconventional behaviors such as deviant behaviors and other risky behaviors, and also exhibit a lower orientation towards achievement.^(3,5-8) Marijuana users also select like-minded peers (assortative peer selection) who may reinforce not only drug-using behaviors, but also low achievement.⁽⁴⁾

Earlier marijuana use is related to later symptoms of general malaise. A possible psychosocial mechanism that may mediate between earlier marijuana use and later general malaise is the association of marijuana use with depression⁽¹³⁾, which may explain some of the symptoms of general malaise such as trouble sleeping, trouble getting started in the morning, and staying home most or all of the day. This association between marijuana use and general malaise requires further study.

Limitations

There are several caveats that should be considered related to the findings of the present study. First, the majority of the sample for this study was White; therefore our results can only generalize to other White samples. It would be worthwhile to investigate whether similar findings are present in other ethnic and racial groups. Second, the information was obtained from the participants via self-report interviews. Collateral information, such as the use of independent physical histories and direct medical data, would provide more valid measures of the severity of the reported health problems. However, the categories used in this study are in accord with medical tradition and research using a symptom checklist.⁽³⁰⁾ Third, though we mentioned several possible mechanisms that may intervene between earlier marijuana use and later health problems and low academic achievement, future studies should include some of these postulated mechanisms in their research. Fourth, we were unable to control a number of factors in attempting to link early marijuana use with later adverse health outcomes, such as traumatic brain injury or other neurological conditions, although we were able to control for a co-occurring mental health disorder, Major Depressive Disorder, in adolescence. Such factors should be included in future research.

Implications

Despite the limitations of this study, this research contributes to an understanding of the development of certain health problems and decreased academic achievement that are associated with earlier marijuana use. This prospective investigation followed individuals from the mean age of 14 until the mean age of 27. In contrast, many other studies of the correlates of marijuana use have not followed individuals after they reach their early 20's. Thus, the present study adds to previous results by demonstrating that the effects of earlier marijuana use may extend well into adulthood. In contrast to the view of those who believe or maintain that the adverse effects of marijuana use may diminish with age, the results of the present investigation suggest that may not be the case.⁽³¹⁾

The results of this investigation highlight the significance of preventing or delaying the use of marijuana and preventing the continuation of use, despite the fact that marijuana use is considered a benign drug by some researchers.⁽²⁷⁾ This research suggests that marijuana use over a long period of time may have significant adverse effects on health, and academic achievement and functioning. The associations between marijuana use over time and later functioning in these areas were maintained despite the fact that we controlled for age, gender, SES, parental educational level, maternal marijuana use, and early childhood aggression, all of which may interact with or contribute to marijuana use. The findings of

this research suggest that drug intervention and prevention programs might consider including a focus on health problems and low academic achievement since marijuana use appears to affect these areas of functioning. Therefore, individuals who design drug prevention programs should also take into consideration a number of these later adverse effects associated with marijuana use, and should also be aware of the role parents' marijuana use may have in influencing adolescents in their decision to use marijuana. Likewise, parents should be aware that early marijuana use is a problem that could lead to later adverse health and achievement problems. Given the emphasis of this study on early marijuana use, parents are in a good position to intervene at an age that may be early enough to help prevent the later adverse problems we studied.

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Table 1

Marijuana Use During Childhood, Adolescence and the Early Twenties as Related to Risks of Health Problems, i.e., Respiratory Problems, Neurocognitive Problems, and General Malaise, and Lower Academic Achievement and Functioning in the Late Twenties (N=749).

Health Problems and Low Achievement at T5				
	Respiratory Problems	Neurocognitive Problems	General Malaise	Lower Academic Achievement and functioning
	N = 77 (10.3%)	N = 143 (19.1%)	N = 87 (11.6%)	N = 144 (19.2%)
	A.O.R. (95% C.I.)	A.O.R. (95% C.I.)	A.O.R. (95% C. I.)	A.O.R. (95% C.I.)
Marijuana Use (T2–T4)	1.44(1.12–1.85) **	1.36(1.12–1.66) **	1.52(1.20–1.92) ***	1.26(1.03–1.53) *
Marijuana Use (T2–T5)	1.47(1.16–1.87) **	1.36(1.13–1.64) **	1.58(1.26–1.99) ***	1.32(1.09–1.59) **

Note:

¹ *p<.05; **p<0.01; ***p<0.001;

² The analyses were done with control on participants' age, gender, and childhood aggression, adolescent major depressive disorder, parental educational level and income, and maternal marijuana use;

³ Marijuana use (T2–T4) and marijuana use (T2–T5) were standardized;

⁴ A.O.R. represents odds ratio adjusted for age, gender, and childhood aggression, adolescent major depressive disorder, parental educational level and income, and maternal marijuana use.

⁵ T2, T3, T4 and T5 represent **mean** ages 14, 17, 22, and 27 at Times 2,3,4 and 5 respectively.