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Antisocial Behavior at Age 37: Developmental Trajectories of Marijuana Use Extending from Adolescence to Adulthood

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Abstract

This investigation studied the association between developmental trajectories of marijuana use extending from adolescence to age 32 and later antisocial behavior at age 37. Semi-parametric group-based modeling and logistic regression analyses were used to analyze the data. Five distinct trajectories of marijuana use were identified: never-users, quitters/decreasers, occasional users, chronic users, and increasing users. Being either a chronic user or an increasing marijuana user was associated with an increase in the risk of exhibiting antisocial behavior in adulthood. Both chronic and increasing use of marijuana may serve as predictors of adult antisocial behavior. Treatment programs to prevent antisocial behavior across the life course should include a component to address earlier and concurrent marijuana use.

Keywords

Antisocial Behavior; Trajectories of Marijuana Use

INTRODUCTION

Adult antisocial behavior is a profoundly impairing problem behavior characterized by a pervasive pattern of disregard for and violation of the rights of others, societal customs, and laws, without remorse. The precursors of adult antisocial behavior often begin in childhood and adolescence with a variety of problem behaviors [1]. Understanding the childhood and adolescent predictors of later antisocial behavior is necessary for prevention in both the public health and criminal justice systems. The current research study endeavors to build on the existing literature by examining an important predictor of antisocial behavior in adulthood: marijuana use. The present study is focused on the association between earlier trajectories of marijuana use extending from adolescence to age 32, and later antisocial behavior assessed at age 37.

Marijuana use is associated with a number of problem behaviors, such as rebelliousness, delinquency, and risky sexual behavior [2], poor school performance, and low educational and occupational expectations [2]. These findings are consistent with problem behavior theory [3], which incorporates a number of the problem behaviors into an overall syndrome of problem behavior. Marijuana use is also associated with antisocial behaviors [4]. Developmental changes occur with age in problem behaviors [e.g., antisocial behavior and drug use; 5]. For example, Goldstein et al. [6] reported that adult antisocial behavior is

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Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

highly comorbid with drug use disorders among adults in the general population. Our study assesses specific trajectories of marijuana use beginning in early adolescence, which are associated with antisocial behavior occurring in the fourth decade of life. A more complete delineation of this relationship over 23 years will contribute information for early preventive interventions.

Semi-parametric, group-based statistical approaches [7] have been used to analyze developmental trajectories of problem behaviors in the areas of delinquency and criminal behavior [8–9], alcohol use [10], cigarette use [11], and marijuana use [12]. Differentiation among patterns of development of substance use provides information about the causes of substance use [12]. This analytic approach can distinguish among trajectories of marijuana use and predict the likelihood of developing later antisocial behavior from earlier patterns of marijuana use. The present research extends previous studies by examining individuals from age 14 to age 37.

In addition to marijuana use, certain adolescent personality and behavioral factors predict adult antisocial behavior [1,13]. Early delinquent and internalizing problem behaviors, such as depression and anxiety, are related to adult antisocial behavior [14], as is earlier academic underachievement or low educational aspirations [15]. Therefore, we statistically controlled for these factors in our analyses.

The present study addresses the following hypotheses: (1) trajectories of marijuana use extending from age 14 in adolescence to age 32 in adulthood predict later adult antisocial behavior; and (2) the relationship of earlier marijuana use to later antisocial behavior is maintained despite control on demographic characteristics and adolescent personality and behavioral factors, such as earlier delinquency, internalizing problem behaviors, and educational aspirations and expectations.

METHODS

Participants and Procedure

Data for the participants in this study came from a community-based random sample residing in one of two upstate New York counties first assessed for drug use in 1983. We compared the distributions of the total sample with the 1980 survey conducted by the U.S. Bureau of Census. We found there was a close match of the participants on family income, maternal education, and family structure with the 1980 census data [16–17]. Interviews of youths were conducted in 1983 (T2, N=756), 1985–1986 (T3, N=739), and 1992 (T4, N=750). Three more interviews of the youth participants were conducted in 1997 (T5, N=749), 2002 (T6, N=673), and 2005–2006 (T7, N=607). The mean ages (SDs) of participants were 14.05 (2.80) at T2, 16.26 (2.81) at T3, 22.28 (2.82) at T4, 26.99 (2.80) at T5, 31.90 (2.83) at T6, and 36.61 (2.83) at T7, respectively. Trajectory analyses for the current study were based on those participants who participated in the study at least at two points in time from T2 through T6 (N=806). We examined the association between earlier trajectories of marijuana use (T2–T6) and adult antisocial behavior at T7, using logistical regression analysis (N=607). The participants with missing data regarding antisocial behavior at T7 (N=199) were excluded from analyses of the association between earlier trajectories of marijuana use and adult antisocial behavior.

Except for gender ($\chi^2(1)=28.24$, $p\text{-value}<0.001$) and earlier educational expectations and aspirations ($t=-2.28$, $p\text{-value}=0.02$), there was no association between those included in the analysis of adult antisocial behavior (N=607) and those who were excluded (N=199) from it with respect to age ($t=-0.74$, $p\text{-value}=0.46$), parental educational level ($t=-1.66$, $p\text{-value}=0.10$), or parental income ($t=-0.12$, $p\text{-value}=0.91$).

value=0.10), earlier delinquency ($t=1.92$, $p\text{-value}=0.06$), and earlier internalizing behavior ($t=0.14$, $p\text{-value}=0.89$).

Extensively trained and supervised lay interviewers administered interviews in private. Written informed consent was obtained from participants and their mothers in 1983, 1986, and 1992, and from participants only in 1997, 2002, and 2007. The Institutional Review Boards of the Mount Sinai School of Medicine, New York Medical College, and New York University School of Medicine authorized the use of human subjects in this research study. Additional information regarding the study methodology is available in prior publications [16–17].

Measurements

Adult Antisocial Behavior—At T7, we assessed adult antisocial behavior using an adaptation of the UM-CIDI antisocial personality disorder measure [18]. A participant received a score of 1 on the measure of adult antisocial behavior if the participant met the following two criteria: First, a pervasive pattern of disregard for and violation of the rights of others, as indicated by three (or more) of seven criteria listed in DSM-IV (e.g., irritability and aggressiveness). Second, antisocial behavior did not occur exclusively during the course of a schizophrenic or manic episode. Otherwise, a participant received a score of 0 on the measure of adult antisocial behavior. We also constructed a continuous measure of antisocial behavior using the items in the adaptation of the UM-CIDI. The internal reliability was satisfactory (Cronbach's $\alpha=0.78$).

Marijuana Use—Data were obtained from interviewer-administered questionnaires. The questions about marijuana use [adapted from the Monitoring the Future study; 19] concerned the frequency of using marijuana at each time wave (T2–T6): in childhood (during or before 1983; prior to T2); during the last two years in adolescence (1985; T2–T3); during the last five years in the early twenties (1992; T3–T4); in the late twenties (1997; T4–T5); and in the early thirties (2002; T5–T6). The marijuana use measure at each point in time had a scale coded as none (0), a few times a year or less (1), once a month (2), several times a month (3), once a week (4), several times a week (5), and every day (6). The mean (SD) marijuana use scores at each time point were 0.58 (1.21), 0.76 (1.33), 1.03 (1.40), 0.95 (1.40), and 0.71 (1.35), for T2–T6 respectively.

Personality and Behavioral Attributes at T2—At T2, we assessed personality and behavioral attributes of the participants. First, we included a measure of internalizing behavior problems ($\alpha=0.85$), which consisted of five items assessing depression (e.g., “Over the last few years, how much were you bothered by feeling low in energy or slowed down?” [20]), four items assessing anxiety (e.g., “Over the last few years, how much were you bothered by feeling fearful?” [20]), and six items assessing interpersonal difficulties (e.g., “Over the last few years, how much were you bothered by feeling easily annoyed or irritated with other people?” [20]). Second, we included a measure of educational aspirations and expectations (two items, e.g., “How far do you expect you will go in school?” [Original]). Third, we also included a measure of delinquency ($\alpha=0.75$; five items, e.g., “How often have you gotten into a serious fight at school or work?” [21]). The above measures of the personality and behavioral attributes have been found to predict psychopathology [17].

Demographic characteristics assessed included gender, age, and socioeconomic status (i.e., the highest level of parental education).

Analysis

Several developmental trajectories describe the course of marijuana use over time. The goal of the present data analysis was: (1) to identify distinctive developmental trajectories of marijuana use over an 18-year time span, using data collected at ages 14, 16, 22, 27, and 32 years; and (2) to determine the association between the participants' membership in each marijuana use trajectory group and later adult antisocial behavior at age 37. We used the growth mixture model (GMM) approach [7] to identify the developmental trajectories of marijuana use. In a structural equation model (SEM) framework, GMM estimates the mean growth curves for each group, described by growth factors such as the intercept and slope, and captures individual variation around these growth curves [22]. For the missing data, primarily due to individuals' missing waves of data collection, we applied the full information maximum likelihood (FIML) approach in the analysis [23].

GMM analyses using the Bayesian Information Criterion (BIC) empirically determined the number of trajectory groups. To avoid local maxima, we set 50 random sets of starting values to generate in the initial stage and two optimizations to use in the final stage. We treated the dependent variable (marijuana use at each time point) as an ordinal variable. The within group variations were captured by the variances of the growth factors (i.e., intercept, slope, quadratic term, and cubic term). The GMM analyses used a multinomial logistic regression model for unordered polytomous responses [7] to predict group membership. The control variables in the analyses were gender and age at T2. Finally, to calculate the average marijuana use score at each time point displayed in Figure 1, we assigned each participant to the trajectory group with the highest Bayesian posterior probability.

After setting the number of groups at five, the posterior probability of group membership was calculated for each participant using Mplus, which allowed assignment to the specific group with the highest posterior probability of belonging. We conducted logistic regression analyses using SAS to investigate the associations between the trajectories of marijuana use and adult antisocial behavior. We created five dichotomous variables representing the group memberships, and we used four of them as the independent variables (one of them was chosen as the reference group). First, we conducted bivariate analyses. Then, we conducted multivariate analyses by including earlier internalizing problem behaviors, earlier educational expectations and aspirations, earlier delinquency, and demographic factors, including gender, age, and parental educational level, as control variables.

RESULTS

Trajectories of Marijuana Use

After exploratory analyses, a cubic rather than a linear growth model was selected because of the improvement in data fit using the BIC. Further, we tested a three-group model (BIC = 7804.20), a four-group model (BIC = 7620.79), and a five-group model (BIC = 7578.11). We were unable to attain convergence for a six-group solution. Based on the BIC criteria, a five-group model was selected as the best fitting model as it had the lowest BIC score. Participants were then assigned to the marijuana trajectory group that best depicted their marijuana use over time. For each group, the mean Bayesian posterior probability of the participants who were assigned to that group ranged from 81% to 88%.

Figure 1 presents the five observed marijuana use trajectories. For ease of interpretation, we added descriptive labels to the trajectory groups. The trajectory groups were named: a) chronic users (12.0%); b) quitters/decreasers (23.3%); increasing users (7.7%), occasional users (30.8%), and never-users (26.2%). As noted in Figure 1, the chronic users started early, achieved their maximum level, using weekly in late adolescence, and then tapered off gradually from that level. Quitters/decreasers started early, then tapered off from late

adolescence into adulthood. Increasing users started late, increased use from late adolescence to the late twenties (using on a weekly basis), and then leveled off. Occasional users started late and used marijuana less than on a monthly basis.

Marijuana Group Membership as a Predictor of Adult Antisocial Behavior

We conducted logistical analyses of marijuana group membership as predictors of adult antisocial behavior (N=607). A description of the demographic characteristics of the sample appears in Table 1. There was no association between those included in the analysis of adult antisocial behavior (N=607) and those who were excluded (N=199) from it with respect to the marijuana group memberships ($\chi^2(4)=6.22$, $p\text{-value}=0.18$). Among those participants included in the analyses, 9.7% were assigned a score of 1 on the measure of adult antisocial behavior. The prevalence of adult antisocial behavior in never-users, quitters/decreasers, occasional users, increasers, and chronic users was 4.3%, 5.4%, 7.4%, 24.4%, and 29.9%, respectively.

The results of the logistic regression analyses are presented in Table 2. The findings indicate that chronic users were more likely to exhibit antisocial behavior in adulthood than never-users, quitters/decreasers, and occasional users (9.48, 7.39, and 5.32 times, respectively). In addition, increasers, as compared to never-users, quitters/decreasers, and occasional users, were more likely to exhibit antisocial behavior in adulthood (7.2, 5.61, and 4.03 times, respectively). The differences in the prevalence of adult antisocial behavior among never-users, quitters/decreasers, and occasional users were not statistically significant ($p>0.05$). In addition, the difference in the prevalence of adult antisocial behavior between increasers and chronic users was not statistically significant.

Table 2 also shows the results of the multivariate logistic regression analyses. The analyses were conducted while statistically controlling for earlier internalizing problem behaviors, earlier educational expectations and aspirations, earlier delinquency, and demographic factors (i.e., gender, age, and parental educational level). As indicated in Table 2, chronic users were still more likely to exhibit antisocial behavior in adulthood than never-users, quitters/decreasers, and occasional users (8.16, 5.39, and 6.12 times, respectively). Increasers, as compared to never-users and occasional users, were more likely to exhibit antisocial behavior in adulthood (4.36 and 3.27 times, respectively). Therefore, as Table 1 indicates, being either an increaser or a chronic user as compared to a never-user or an occasional user was associated with an increase in the risk of engaging in antisocial behavior in adulthood, even after the covariates were controlled. Moreover, as compared to quitters/decreasers, being a chronic user was associated with an increase in the risk of displaying antisocial behavior in adulthood. The adjusted odds ratios indicated that the differences among never-users, quitters/decreasers, and occasional users and the difference between chronic users and increasers were not statistically significant ($p>0.05$).

DISCUSSION

The findings suggested that two trajectories of continuous marijuana use extending from adolescence to age 32 were related to adult antisocial behavior at age 37. Specifically, increasers and chronic marijuana users, as compared with occasional users or never-users, were associated with an increased risk for later antisocial behavior. In addition, chronic users differed from quitters/decreasers on adult antisocial behavior. These relationships were maintained despite control on earlier delinquency, internalizing problem behaviors, educational expectations and aspirations, and demographic factors.

Overall, our findings were consistent with previous research, which recognizes different subgroups of marijuana users. For example, Schulenberg et al. [12] identified six marijuana

use groups, i.e., chronic use, decreased use, increased use, a ‘fling’ pattern of frequent use, rare use, and nonuse. Windle and Wiesner [24] found five trajectory groups: 1) high chronic users; 2) decreaseers; 3) increaseers; 4) experimental users; and 5) abstainers.

The results indicated that increaseers and chronic marijuana users, who used more marijuana over a longer period of time, fared the worst in terms of their risk for engaging in adult antisocial behavior. Despite control on earlier delinquency, there still was a relationship between trajectories of chronic and increasing use of marijuana and later antisocial behavior. Even among individuals with earlier delinquency, greater marijuana use over time (over 18 years) was associated with an increased probability of antisocial behavior. Clearly, this group is on a maladaptive developmental path, and may use marijuana to cope with the normative developmental tasks of young adulthood and adulthood [25].

Although there were no significant differences between increaseers and chronic users with regard to adult antisocial behavior after controls, with age increaseers may surpass chronic users in the frequency of marijuana use. Since heavy use of marijuana over time is related to adult antisocial behavior, increaseers may have a greater tendency to develop adult antisocial behavior than chronic users. Helping people to stop using marijuana might reduce the later development of antisocial behavior. Our findings are also consistent with those of previous researchers, who reported that increaseers and chronic users are characterized by unconventional personality attributes, maladaptive family relations, and negative psychosocial outcomes [12]. Since we did not assess these factors in this study, future research efforts would benefit from including measures of these dimensions as well.

There were no significant differences among the quitters/decreaseers, occasional users or never-users in terms of adult antisocial behavior, controlling for earlier delinquency, internalizing problem behaviors, educational expectations and aspirations, and demographic factors. Quitters/decreaseers showed the greatest decline in marijuana use in young adulthood; they may also give up other more serious forms of deviant behavior.

Several psychosocial and physiological mechanisms might explain our findings. Marijuana use may interfere with the normative decrease of antisocial behavior that occurs with age [26]. Thus, marijuana use has been associated with difficulties in assuming age-appropriate conventional adult roles, which may inhibit antisocial behavior [12]. Second, substance use has been associated with interrupted education which is a major risk factor for the development of antisocial behavior [27]. Third, marijuana use may activate genetic risk factors, leading to adult antisocial behavior [28].

Limitations

The present study has several limitations. First, because the participants were predominantly white, we can only generalize to a population of white youth and adults. Second, data on marijuana use were obtained via the participants’ self-reports, and were not independently verified; self-reports of marijuana use and biological assays are generally congruent [29]. Third, factors not examined in this study may explain the linkage between continuous marijuana use and adult antisocial behavior (e.g., genetic factors). Fourth, the vast difference in group numbers may impact the study’s analyses and findings, given the low rate of antisocial behavior. Nevertheless, had we had a higher rate of antisocial behavior, our findings might have been stronger.

Despite these caveats, the study has important implications for the prevention of antisocial behavior in adulthood. Indeed, several investigators have demonstrated that the prevention and treatment of marijuana use in adolescence is associated with decreased antisocial behavior in adulthood [30]. Our study with its emphasis on the developmental aspects of

marijuana use points to the need to consider chronicity and age of the onset as well as the frequency of marijuana use in the prevention of antisocial behavior. Investigators who study adult marijuana use [25] should consider the different patterns of use of marijuana over several developmental stages starting in early adolescence. For example, adolescents with more frequent use of marijuana in conjunction with earlier delinquency may be more susceptible to increasing or chronic use over time, which may be related to later antisocial behavior. Since ongoing marijuana use may inhibit the normative decline in antisocial behavior, interventions to reduce marijuana use (particularly among chronic or increasing users of marijuana) may decrease the occurrence of antisocial behavior.

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Figure 1. Developmental trajectories of marijuana use extending from adolescence to age 32

Note:

The marijuana use score refers to the following:

0 = none; 1 = a few times a year or less; 2 = once a month; 3 = several times a month; 4 = once a week; 5 = several times a week, and 6 = every day.

Table 1

Demographic characteristics of the sample (N = 607)

Ethnicity
White: 94.9%
Others: 5.1%
Gender
Male: 45.6%
Female: 54.4%
Age at T7
Mean age at T7 36.6 years (SD=2.8)
Educational Level at T7
Lower than High School: 5.6%
High school or equivalent: 28.5%
Some college or greater: 65.9%
Marital Status at T7
Single (never married): 22.2%
Married: 66.4%
Divorced: 10.4%
Widowed: 1.0%
Employment Status at T7
Employed (full time or part time): 89.8%
Unemployed: 3.1%
Full time homemaker: 7.1%

Table 2

Odds Ratios for Marijuana Use Trajectories (T2-T6) as Related to Antisocial Behavior at T7 (N=607).

Marijuana Use Trajectory	Antisocial Behavior	
	O.R. (95% C.I.)	A.O.R. (95% C.I.)
Increases vs. Never-Users	7.20 (2.54–20.34) ***	4.36 (1.45–13.11) **
Increases vs. Quitters/Decreasers	5.61 (2.05–15.36) ***	2.83 (0.79–10.10)
Increases vs. Occasional Users	4.03 (1.65–9.89) **	3.27 (1.27–8.43) *
Chronic Users vs. Never-Users	9.48 (3.79–23.81) ***	8.16 (2.71–24.54) ***
Chronic Users vs. Quitters/Decreasers	7.39 (3.05–17.90) ***	5.29 (2.07–13.48) ***
Chronic Users vs. Occasional Users	5.32 (2.50–11.32) ***	6.12 (2.13–17.54) ***

Notes

* 1. $p < 0.05$,

** $p < 0.01$, and

*** $p < 0.005$ (Bonferroni Adjustment for 10 tests);

2. O.R. = Odds ratio without controls;

3. A.O.R. = Adjusted odds ratios by including earlier delinquency, internalizing behavior, education expectation and aspiration, and demographic factors (i.e., gender, age, and parental educational level) as controls.