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## Antecedents and Consequences of Marijuana Use Trajectories over the Life Course in an African American Population\*

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### Abstract

**BACKGROUND**—We examined developmental trajectories of marijuana use among a cohort of urban African Americans followed from first grade to mid adulthood. We compared risk factors in childhood and adolescence and consequences in mid adulthood across trajectory groups.

**METHODS**—Using semiparametric group-based mixture modeling, five marijuana trajectories for men (n=455) and four trajectories for women (n=495) were identified extending from adolescence to young adulthood (age 32). We labeled the four trajectory groups similar for men and women “*abstainers*,” “*adolescent only users*,” “*early adulthood decliners*,” and “*persistent users*.” We named the unique fifth group for men “*late starters*.”

**RESULTS**—Multivariate multinomial logistic regressions show that childhood problem behaviors, adolescent family involvement, and dropping out of high school differentiated trajectory membership. Analyses comparing the trajectory groups on behavioral, social, and health outcomes at age 42 revealed that for both men and women, those in the persistent trajectory had the most problems, and those in the early adult decliner group also had specific problems. Male late starters also had poor outcomes.

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**CONCLUSIONS**—The findings point to the value of identifying specific patterns of substance use over the life course and understanding the differences in their correlates and consequences. The implications of these findings are discussed.

### Keywords

African Americans; marijuana use trajectories; semiparametric group-based approach; prospective study; antecedents; consequences

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## 1. Introduction

Marijuana use by adolescents and young adults is common, third in prevalence to alcohol and tobacco use (Johnston et al., 2006; Schulenberg et al., 2005). Although African American youth consistently use marijuana less than white youth (Johnston et al., 2006; Wallace, 1999), the rates among African American adults equal or exceed those of white adults, suggesting a “crossover effect” (Geronimus et al., 1993; National Institute on Drug Abuse, 2002). However, patterns of marijuana use across the life course have not been studied in depth. While our understanding of marijuana initiation is significant, we lack knowledge of the antecedents and consequences of patterns of use over time. How do antecedents that influence initiation differentiate patterns of use? A cross-over pattern suggests that African Americans would be more likely to initiate use of marijuana later in the life course and more likely to continue use into adulthood. More research is needed to better understand African American marijuana use trajectories and their antecedents and consequences.

### 1.1. Prior research on developmental trajectories of substance use

The literature suggests that substance use and other deviant behavior follow a developmental trajectory with adolescence as a peak time for deviant activities, which then decline with the transition to adulthood (Hirschi and Gottfredson, 1983; Moffitt, 1993; Shedler and Block, 1990; Wolfgang et al., 1987). Recent research, however, indicates substantial age variation in initiation and cessation of marijuana use, suggesting that not all marijuana users follow the same developmental trajectories (e.g., Windle and Wiesner, 2004; Schulenberg et al., 2005).

Variability among individuals with respect to the timing and duration of certain behaviors over time is of interest to life course researchers. There is growing recognition that the “typical course” of behavior in an age cohort really reflects a mixture of multiple courses or “trajectories” (e.g., Achenbach, 1990; Bates, 2000). For instance, two developmental theories of delinquency put age of onset as paramount in dictating the duration of any trajectory of deviant behavior (Patterson and Yoeger, 1993; Moffitt, 1993). Whether they are called life-course-persisters and adolescent limiteds (Moffitt, 1993) or early starters and late starters (Patterson and Yoeger, 1993), the implication is the same – there are different groups of marijuana users whose use duration will differ in relation to age of onset. Recent evidence on criminal offending suggests the possibility of many trajectories of deviance over time including late onset or low level chronic groups (see Moffitt, 2008).

Numerous studies have identified different trajectories of substance use during adolescence and the early 20s (e.g., Sher et al., 2004; White et al., 2004; Windle and Wiesner, 2004). For example, Ellickson et al. (2004) identified five marijuana groups for students ages 13–23: abstainers, occasional light users, stable light users, steady increasers, and early high users. Brown et al. (2004) identified differences in the developmental trajectories of marijuana use between white and African American adolescents. For the whites, there was a nonuser, an early onset, and a late onset group. For the African Americans, there was an early onset, mid

onset, and a late onset group, but no nonuser group. Since most studies examined trajectories only through the early 20s, they fail to capture patterns of use later in the life course. Given evidence of a crossover effect, it is important to examine trajectories past the early 20s, especially among African Americans.

## 1.2. Conceptual Framework

Much research on drug use predictors is framed according to developmental theory, underscoring the roles of individual characteristics, social relationships, and structural influences at different stages of development. Our work examining the influences on the etiology of drug use has drawn on life course/social field theory (Kellam et al., 1975, 2008), a dynamic perspective that focuses on social roles in key social contexts. An individual's success or failure in a social role is thought to be a critical influence on future behavioral trajectories. In prior work, we have found that first grade children who did not perform well in school were more likely to use drugs later as adolescents (Kellam et al., 1980; Ensminger et al., 1982). Specifically, first grade children rated by teachers as having aggressive behavior or the combination of shy and aggressive behavior were more likely to use alcohol, cigarettes, and marijuana in adolescence and early adulthood (Ensminger et al., 2002). Later in the life course, other social fields, such as family formation and employment, become more prominent, and lack of involvement in these fields relates to later life onset (Green et al., 2010).

While failure in major social fields is expected to increase deviance, theoretically, adolescence is also a time of experimentation, and it is normative for well adapting youth to try drugs in adolescence (Moffitt, 1993; Shedler and Block, 1990). We found that children who scored well on the school readiness tests were more likely to use substances as adolescents (Fleming et al., 1982), yet they were more likely to quit use by early adulthood (Ensminger et al., 2002). In Moffitt's (1993) terms, school readiness was related to adolescent-limited behavior, while being rated as both shy and aggressive was related to "life course persistent" behavior. Our research is also guided by social control theory (Hirschi, 1969), which explains that those who are strongly bonded to important social institutions are less likely to engage in deviant behavior. In adolescence, important bonds include those with family and school, and in adulthood, influential bonds include family, employment, and community organizations.

## 1.3. Antecedents/correlates of marijuana use trajectories

Prior marijuana use trajectory research has examined familial, behavioral, and psychosocial correlates to trajectory membership. Schulenberg et al. (2005) showed that their six marijuana trajectories were related to differences in parental education, religion, high school grades, and employment. Windle and Wiesner (2004), using a white sample, found that their "high chronic" group compared less favorably to the other four trajectory groups on delinquency, academic performance, drug-using friends, and stressful life events. Further work is needed to identify risk factors for marijuana trajectories among African Americans.

Although substantial gender differences exist in substance use prevalence and etiology (Ensminger et al., 2002), only a few studies have examined gender differences in marijuana trajectories. In one study, Flory et al. (2004) found similar trajectories for males and females (nonusers, late onset, early onset), but trajectories differed in size and in their predictors. Separate trajectory analyses for males and females are critical for understanding gender differences in patterns of use over time.

## 1.4. Consequences of marijuana use trajectories

Although marijuana is commonly perceived as relatively harmless, it has been associated with poor health and social outcomes (e.g., Fergusson and Horwood, 1997; Hall and Degenhardt, 2009; Kandel, 1984; Newcomb and Bentler, 1988). However, we know little about how consequences vary according to differences in timing and duration of use, particularly for African Americans. Brown et al. (2004) examined the outcomes of three marijuana trajectory groups they identified among African American adolescents (i.e., early, mid, and late-onset). They found that those who began using marijuana around 8th grade had significantly higher past-year marijuana use and more arrests at age 20 than either the early onset group (6th grade initiates) or the late onset group. Similarly, Windle and Wiesner (2004) found that high chronic users had higher current substance use, and lower educational attainment. Schulenburg et al. (2005) found that trajectory groups varied in patterns of other substance use and problem behaviors (e.g., theft and property damage, interpersonal aggression, risk taking). These studies have focused on trajectories in adolescence and outcomes in early adulthood. No known studies have examined outcomes in mid adulthood among African Americans. Furthermore, the impact of these trajectories on social roles and health has received less attention.

## 1.5. The current study

The current study fills a gap in the research by identifying marijuana use trajectories from childhood to age 32 separately for men and women among a cohort of African Americans. We examine whether membership in the identified trajectory groups is related to childhood and adolescent risk factors known to be related to marijuana use, guided by two related theories: life course/social field theory (Kellam et al., 1975; 2008) and social control theory (Hirschi, 1969). We expect that those who have troubles adapting in childhood and those with poor social bonds will be more likely to be in trajectories with more problematic use, while those who adapt well in childhood and have strong social bonds will be in the trajectories with low problem use.

We also examine how the identified patterns of marijuana use are related to a variety of behavioral, social, and mental health problems at age 40–42. In accordance with the life course/social field theory, we expect that those who use marijuana beyond the adolescent experimental stage will have more problems at mid adulthood. Specifically, based on the literature and our prior work (Green et al., 2006; 2010), we hypothesize that those with problematic patterns of use will have problems with social roles (e.g., marriage, employment), social adaptation (e.g., drug use, crime), and health (e.g., depression).

## 2. Materials and Methods

### 2.1. Woodlawn Study

This prospective, longitudinal study has followed a cohort of 1,242 first grade children in Woodlawn, an African American, inner city community on the South side of Chicago, since 1966. The Woodlawn community was the fifth poorest of the 76 Chicago communities. In the initial assessment, over 99% of the first graders were African American. First grade teachers were asked about each child's classroom behavior; clinicians observed the children in standardized play situations; and mothers (or mother surrogates) were interviewed about their child and their family. In 1975–1976, 939 of the mothers/mother surrogates and 705 of the teenagers were re-interviewed. Teenagers gave self reports on drug use, psychological constructs, family and school life, delinquency, sexual activity, and social bonds (Ensminger et al., 1983). In 1992–93 (at ages 32–33), 952 study participants were interviewed. In 2002–03 (at ages 42–43), 833 were re-interviewed (see Crum et al., 2006; Ensminger et al., 1997).

## 2.2. Sample attrition

As in all prospective studies, the Woodlawn Study has experienced attrition. An extensive attrition analysis suggests only a few differences among those who were followed and those who were not. In the 1975–76 follow-up, study dropouts were more likely to have mothers who were teen parents, to have moved frequently, and to have attended parochial schools in first grade (Kellam et al., 1980). In the 1992–94 follow-up, we found that those who were below official poverty line in first grade were less likely to be interviewed than those who were not (73% versus 81%). Those in a single-mother family in first grade were less likely to be interviewed than those from a family with a mother and father (Ensminger et al., 1997). In 2002–2003 high school dropouts were less likely to be interviewed than those with a general equivalency diploma (GED) or regular high school diploma (Crum et al., 2006). Attrition was not associated with marijuana use during adolescence or young adulthood.

## 2.3. Measures

**2.3.1. Marijuana use**—Marijuana trajectories were constructed from retrospective reports of age of first and last marijuana use provided during young adulthood (age 32). This information was annualized such that a person is coded as a marijuana user in each year between the age of first use and the age of last use. This coding assumes that a person uses in every year between the ages of first and last use, which may overestimate the continuity of use. However, based on theories of continuity (Farrington, 1991; Gottfredson and Hirschi, 1990; Huesmann et al., 1984; Jessor et al., 1991; Nagin and Paternoster, 2000) and empirical evidence supporting these theories (e.g., Brook et al., 1996; Caspi et al., 1989; Fothergill et al., 2009; Hamil-Luker et al., 2004), the assumption is not unreasonable and allows us to establish general trajectories of use over the life course. We assess the validity of this assumption in the results section.

**2.3.2. Childhood and adolescent risk factors**—Family background: Mother's education (completing high school vs. not) and whether the child's mother began childbearing as a teenager (age 19 or less when first child was born or not) were based on mothers' reports during the first grade interview.

First grade aggressive and shy behavior: Teachers rated the child's adaptation to first grade tasks (see Kellam et al., 1975). Two ratings were: 1) aggressive behavior; and 2) shy behavior. Children rated as adapting were compared to those rated as maladapting.

Academic achievement: Scores on a standardized school readiness test, math grades in the first grade, and standardized math scores in seventh and eighth grades were included. Dropping out of high school (based on school board records and self-reports) was dichotomized as completing versus not completing high school. Adolescent school bonds (5 items,  $\alpha=.68$ , 6 point scale) reflected the teenager's attachments and commitments to school. Adolescents with low bonds were compared with those who had medium or high bonds (=top two thirds)

Family involvement and parental drug rules: Family involvement (5 items,  $\alpha = .69$ , 6 point scale) was measured by asking teenagers how often they do various activities with adults in their family. Those with low involvement were compared with those with medium or high involvement. Parental drug rules (3 items,  $\alpha=.63$ , 6 point scale) was based on adolescents' reports of their parents' rules about use of 1) beer and wine, 2) drugs, and 3) cigarettes. Those in the lowest quartile were considered to have low parental drug rules (see Ensminger et al., 1983).

**2.3.3. Behavioral variables in midlife**—Substance use disorders were assessed with the Michigan version of the Composite International Diagnostic Interview (CIDI), which was developed for the National Comorbidity Survey (NCS) (Kessler et al., 1994). Those who met the criteria for drug abuse or dependence since 1992 (age 32) were categorized as having a substance use disorder in midlife. Participation in an outpatient alcohol and drug rehabilitation program since 1992 was measured by self reports. Incarceration was indicated by time in jail or prison since 1992.

**2.3.4. Social and mental health variables in mid adulthood**—Current employment (no/yes), current marital status (currently married, previously married, never married), and poverty (no vs. yes) were the social outcomes during mid adulthood. Using U.S. Census Bureau 2000 estimates for the poverty threshold based on past year household income and family size; households below 100% of this threshold were in poverty. Diagnosis of major depressive disorder (MDD) in young adulthood and midlife was assessed with questions adapted from the Michigan version of the CIDI (Kessler et al., 1994). Lifetime MDD was based on questions adapted from the Michigan version of the CIDI (Kessler et al., 1994), reported at either young adulthood or midlife.

## 2.4. Statistical analysis

We used a group-based mixture method (Nagin, 2005) to identify developmental trajectories of marijuana use. The semi-parametric group-based mixture modeling (SGM) approach allows for identifying trajectory groups with appropriate statistical tests to evaluate the suitability of the solution and the accuracy of classification. It provides a stronger statistical model for decision making about the number and shapes of trajectories relative to other classificatory models, and it is better able to accommodate the nonnormal distribution of marijuana use at each age. Bernoulli distributions were fitted to the binary outcome marijuana use at each year. To determine how many groups define the best fitting model, we used the Bayesian Information Criteria (BIC) and other model diagnostics, such as population estimates for each group, average posterior probabilities of assignment, and odds of correct classification (see Nagin, 2005). SGM was estimated with a customized SAS macro developed by Jones and colleagues (2001).

As with any method, there are advantages and disadvantages to using the group-based method, and the decision to use this particular application was based on the balance of these pros and cons (for a review see Eggleston et al., 2004; Sampson et al., 2004; Piquero 2008). In addition, it should be noted that there is considerable debate regarding the optimal number of groups (Sampson et al., 2004), whether or not trajectory groups can be derived from a continuous but non-normal distribution (Bauer and Curran, 2003), and whether trajectory groups actually exist.<sup>1</sup> Moreover, these trajectory groupings are not immutable or deterministic, and all results should be interpreted with this in mind.

We next identified risk factors for the different user groups using multinomial logistic regression varying the reference group. In order to avoid bias from missing data on childhood and adolescent predictors, we used multiple imputations using STATA ICE (Royston, 2005), creating 10 imputed data sets for the 950 cohort members (455 males; 495 females) who had trajectory information. For midlife outcomes, chi-square analyses were used to compare the consequences of marijuana across trajectory groups.

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<sup>1</sup>The reader is encouraged to read the exchange between Nagin and Tremblay (2005a) and Raudenbush (2005) in the special issue of the *Annals of the American Academy of Political and Social Science* and the exchange between Nagin and Tremblay (2005b) and Sampson and Laub (2005) in *Criminology* to gain a better understanding of the theoretical and methodological nuances affiliated with the group-based method.



### 3. Results

#### 3.1. Identifying trajectories of marijuana

We used the SGM approach to identify trajectories of marijuana from ages 7 to 32 for men and women. Using BIC as an initial indicator of the comparative fit of models with different numbers of classes, we noted the BIC values, as well as other indicators such as the AIC, continued to increase past five groups for males and four groups for females. However, the five group model for males and four group model for females were selected on the basis of parsimony, the shape of the marijuana use trajectories, and additional model diagnostics such as the average posterior probabilities, which ranged between .93 and 1.00 for both the males and females, and evaluation of the odds of correct classification, which were well above the recommended number five (see Nagin, 2005 for more details on these diagnostics).

Figure 1 shows the five marijuana use trajectories for men. We label trajectory groups based on patterns of marijuana use relative to others in the cohort. We label these groups “*abstainers*,” “*adolescent only users*,” “*early adulthood decliners*,” “*late starters*,” and “*persistent users*.”<sup>2</sup> The *abstainer* group (49.4%) consists of men with a very low probability of using marijuana from ages 7 to 32. The *adolescent only group* starts in late childhood but desist by late adolescence (7.2%). The *early adulthood decliner* group uses marijuana at an early age but desists by age 32 (11.5%). Two additional groups used marijuana in adulthood but with different times of initiation: the *late starter* group (8.6%) began to use marijuana after age 20 and continued to age 32, and the *persistent user* group (23.2%) began to use marijuana in late childhood/early adolescence and continued use through age 32.

Figure 2 shows the four marijuana trajectories for women. In this model, we label the groups similarly to the men: “*abstainers*” (65.2%), “*adolescent only users*” (10.7%), “*early adulthood decliners*” (5.0%), and “*persistent users*” (19.1%).

As a check on the validity of the marijuana trajectories, we related them with age 32 substance use under the assumption that those in the trajectory groups still using marijuana at age 32 would be more likely to use other substances. For females, persistent users had the highest prevalence of current cigarette smoking at age 32 ( $\chi^2 = 38.35$ ,  $p < .01$ ), current heavy alcohol use ( $\chi^2 = 58.44$ ,  $p < .01$ ), and past year cocaine use ( $\chi^2 = 179.18$ ,  $p < .01$ ), with the abstainers having the lowest rates for each of these. For males, those in the persistent user trajectory had the highest prevalence of current cigarette smoking at age 32 ( $\chi^2 = 50.94$ ,  $p < .01$ ) and past year cocaine use ( $\chi^2 = 179.95$ ,  $p < .01$ ), while the late starters had the highest prevalence for current heavy alcohol use followed by the persistent users ( $\chi^2 = 39.1$ ,  $p < .01$ ). Similar to females, the male abstainers had the lowest rates of each substance in young adulthood.<sup>3</sup>

#### 3.2. Childhood risk factors and trajectory groups

In the multinomial logit analyses, we first contrasted *abstainers* with other marijuana trajectories. Childhood classroom behaviors were predictors for marijuana trajectories with male *later starters* (OR=2.13) more likely to be aggressive than *abstainers* and female

<sup>2</sup>It should be noted that the group labels used in each model are not meant to reflect groups that occur in reality. The technique is used as a heuristic device to cluster the data with respect to their developmental trajectories over time.

<sup>3</sup>These findings provide evidence that the assumption of marijuana use in each year between the first and last age of use is valid. Although it is possible that a person does not use marijuana in each and every year, the general distinction between persistent users versus non-users as well as the timing of last use seems valid and is consistent with theories of continuity, which have been supported by numerous empirical studies (e.g., Hamil-Luker, 2004; Caspi & Moffitt, 1993).

*adolescent only users* (OR=2.51) more likely to be shy than *abstainers*. *Abstainers* did not differ on childhood factors from *persistent users* or *early adult decliners* for either men or women (See Table 1). When we changed the reference group to other trajectories, no additional findings emerge (results not shown).

### 3.3. Adolescent predictors

In the multivariate analyses, *abstainers* were more likely to finish high school compared to *persistent users* (OR=1.88 for men; OR=2.30 for women) and to male *early adult decliners* (OR=2.60). Female *persistent users* were more likely to have low adolescent family involvement than *abstainers* (OR=2.00) (See Table 2). When we changed the reference group, no adolescent risk factors differentiated *early adult decliners*, *late users*, or *persistent users* (results not shown).

### 3.4. Consequences of marijuana trajectories in mid adulthood

In midlife, for both males and females, *persistent users* had the highest prevalence of substance use disorders, were more likely to have been incarcerated in the past 10 years (ages 32–42), and reported a high rate of lifetime MDD. The male *early adult decliners* and the *late starters* also reported high levels of MDD. The male *persistent users* reported the highest rate of being never married. Going to a rehabilitation program was more frequent among three trajectory groups: male *persistent users*, male *late starters*, and female *early adulthood decliners* (See Table 3).

## 4. Discussion

African Americans have disproportionately high rates of drug use in adulthood, yet there is little research on their distinct patterns of use over time. This study addresses this gap in the literature by identifying distinct trajectories of marijuana use over time and examining their risk factors and consequences among a cohort of urban African American men and women followed for more than 35 years. In accordance with life course/social field and social control theories, we found that early social adaptation, academic performance, and social bonds differentiate patterns of marijuana use, and persistent and previous use was related to a constellation of problems in mid-adulthood.

Our trajectory analyses revealed patterns of use that differed in timing of initiation and desistance as well as duration. In general, the trajectory groupings were similar for males and females and consistent with those found in prior studies among predominantly white populations (e.g., Flory et al., 2004). One exception to this similarity is the late starting male trajectory group (8.6%), which contrasts with previous findings that the probability of initiating marijuana use after age 20 is very small (e.g., Kosterman et al., 2000). This highlights the importance of using a developmental approach to understand marijuana use over the life course.

Childhood and adolescent factors that differentiated the marijuana trajectory groups were first grade teacher ratings of behavior, dropping out of high school, and low family involvement. While prior research has highlighted the effects of adolescent risk factors on later substance use, no known studies have linked these early factors to specific patterns of use over time among African Americans. These findings extend our understanding of risk development by allowing us to pinpoint the patterns of marijuana use related to these early risk factors. In accordance with the life course/social field theory, we found that aggressive behavior, shy behavior, and high school completion predict marijuana use patterns into the 30s. In line with social control theory, we found that low adolescent social bonds relate to persistent marijuana use among females.



Our investigation suggests the potential impact of marijuana use also differs by trajectory. For males in general, those in the three groups with more problematic use (early adult decliners, late starters, and persistent users) were more likely to have a substance use disorder, be incarcerated, never marry, and have high levels of MDD. The male persistent users were at highest risk overall. For females, those in the persistent user group were also at highest risk, with higher levels of substance use disorder, incarceration, and MDD. Interestingly, females in the adolescent only group had the second highest level of MDD, which is intriguing as they would be expected to have fewer mental health problems than those who continue using marijuana into adulthood. However, since we examined only bivariate associations, and the depression variable was a lifetime diagnosis, we do not know if the depression influenced trajectory membership, resulted from membership, or merely correlated with the marijuana trajectory. Further studies are needed to identify how depression and marijuana trajectories are related developmentally.

In addition, we found trajectory membership was related to midlife marital status among men but not women. Males in the persistent user group had significantly higher rates of being never married at midlife, followed by the late user group, suggesting that drug use into the adult years may reduce the likelihood of getting married. In contrast, those in the abstainer and desistance groups were more likely to be married than those in the other trajectory groups, which builds upon prior research that found a relationship between lower drug use and marriage (Maume et al., 2005).

Overall, the findings support the life course/social field theory's tenet that maladaptive behavior is positively associated with poor outcomes (e.g., substance use disorder, incarceration). Certain patterns of marijuana use may lead to not only more serious drug use problems but also to a deviant lifestyle and its negative consequences, such as incarceration. Finding differences in outcomes between groups underscores the value in studying patterns of use and in research that considers the timing of outcomes.

There are several limitations of this study to be considered. First, despite having prospective data from childhood, our trajectories rely on retrospective reports of age at first and age at last marijuana use at young adulthood, which may lead to some misreporting. In a published report of the Woodlawn data, which analyzed the consistency between adolescent reports and adult retrospective reports of adolescent marijuana use and frequency of use, Ensminger et al. (2007) found that the majority of participants were mostly consistent in their retrospective reports. Moreover, only 9% were inconsistent in their reporting of the age of initiation between adolescence and adulthood. Second, we assume continuity of use between first and last marijuana use even though some users may cycle in and out of use. However, our check of validity with age 32 substance use provided evidence that the trajectories represent general patterns of marijuana use in this population. Further, since all cohort members were living in the same neighborhood in first grade, the findings may not generalize to all Americans, or even all African Americans. However, the findings clearly add to our understanding of drug use among African Americans in urban settings, where drug use is prevalent.

Further, in these analyses examining the midlife conditions associated with the trajectories, we did not examine potential mediators. This is an important next step. Marijuana may be associated with later outcomes for a variety of reasons, and we have yet to explore these pathways. In addition, when we ran the multinomial logistic regression analyses with each of the non-abstainer groups as a reference group, none of childhood and adolescent risk factors significantly distinguished these groups from the others. This may be due to low frequency of certain groups (e.g., 5% of early adulthood decliners for females, 8.6% of late starters for males).

Despite these limitations, the study makes important contributions. We used longitudinal data to identify marijuana trajectories from early childhood to young adulthood within an underinvestigated ethnic group. The examination of early social adaptation and social bonds as predictors of trajectory membership extends what has been learned about substance use initiation to more complex patterns of use. Finally, the finding of differential consequences of marijuana use trajectories further substantiates the importance of studying specific patterns of use over time. Further research is needed to build upon these findings regarding patterns, their predictors, and their consequences.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

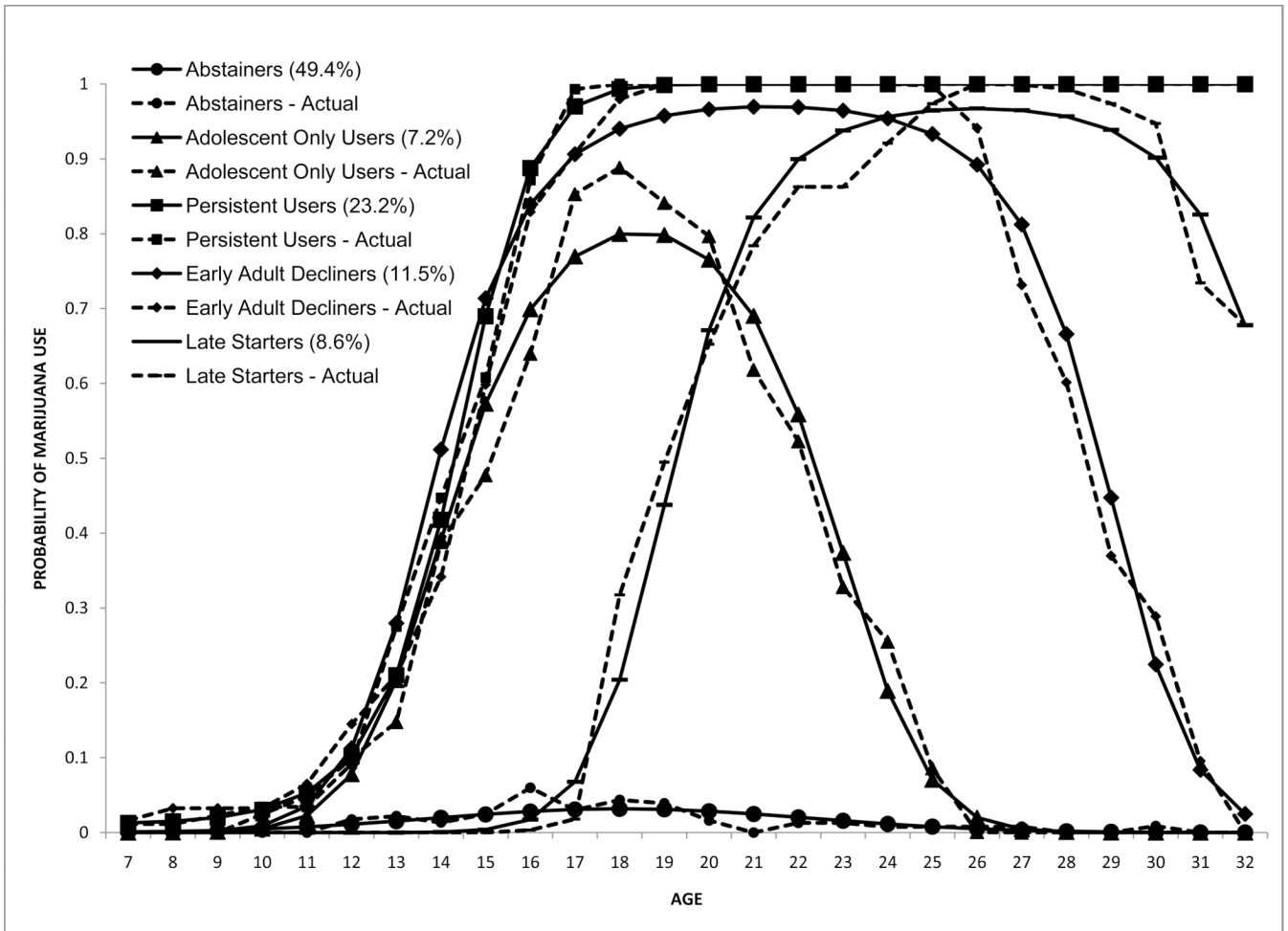
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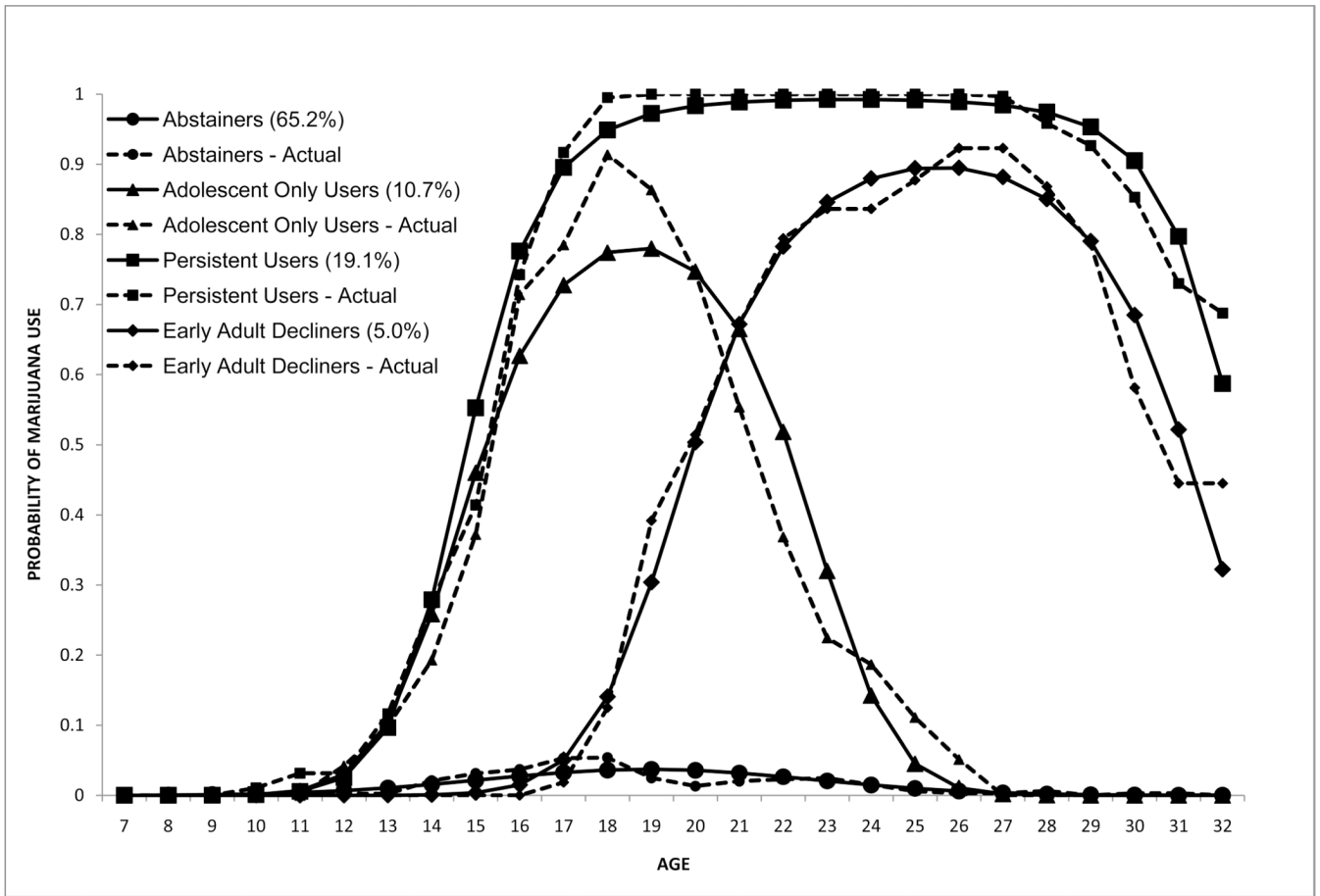
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**Figure 1.**  
Trajectories of Marijuana Use, Males (n=455)





**Figure 2.**  
Trajectories of Marijuana Use, Females (N=495)

**Table 1**

Multivariate Multinomial Logistic Regression of Marijuana Trajectory: Early Risk Factors in Childhood<sup>§</sup>

	Adolescent Only vs. Abstainers OR (95% CI)	Late Starters vs. Abstainers OR (95% CI)	Persistent Users vs. Abstainers OR (95% CI)
<b>Males (n=455)</b>			
<u>Family background</u>			
-mother education (0=12+; 1=0-11)	0.89 (0.44, 1.80)	0.52 (0.25, 1.10)	1.35 (0.78, 2.33)
-teenage parenting (0=no; 1=yes)	0.81 (0.40, 1.62)	0.90 (0.43, 1.92)	0.93 (0.55, 1.57)
<u>Classroom behavior rated by teacher</u>			
Shy behavior (0=no; 1=yes)	0.55 (0.24, 1.26)	1.55 (0.74,3.26)	0.71 (0.40, 1.24)
Aggressive behavior (0=no; 1=yes)	1.05 (0.49, 2.26)	2.13 (1.01, 4.55)*	1.14 (0.66, 1.97)
<u>Academic achievement</u>			
-MRT scores (0=low to superior; 1=immature)	0.50 (0.15, 1.65)	0.67 (0.23, 1.96)	0.98 (0.44, 2.18)
-Math grade (0=A or B; 1=C or D)	0.99 (0.47, 2.09)	1.25 (0.53, 2.96)	0.95 (0.53, 1.71)
<b>Females (n=495)</b>			
<u>Family background</u>			
-Mother education (0=12+; 1=0-11)	0.91 (0.50, 1.68)		0.76 (0.47, 1.24)
-Teenage parenting (0=no; 1=yes)	0.57 (0.30, 1.10)		1.01 (0.60, 1.70)
<u>Classroom behavior rated by teacher</u>			
Shy behavior (0=no; 1=yes)	2.51 (1.34, 4.72)*		1.14 (0.67, 1.96)
Aggressive behavior (0=no; 1=yes)	0.84 (0.40, 1.75)		1.49 (0.87, 2.55)
<u>Academic achievement</u>			
-MRT scores (0=low to superior; 1=immature)	0.65 (0.24, 1.79)		0.78 (0.33, 1.80)
-Math grade (0=A or B; 1=C or D)	1.01 (0.52, 1.94)		0.80 (0.43, 1.49)

Note:

\* p<.05

<sup>§</sup>Multivariate models used multiple imputation (STATA ICE module) to account for missing data.

**Table 2**

Multivariate Multinomial Logistic Regression of Marijuana Trajectory: Early Risk Factors in Adolescence<sup>§</sup>

	Adolescent Only vs. Abstainers OR (95% CI)	Early Adult Decliners vs. Abstainers OR (95% CI)	Late Starters vs. Abstainers OR (95% CI)	Persistent Users vs. Abstainers OR (95% CI)
<b>Males (n=455)</b>				
<u>Social bond</u>				
-School bonds (0=med/high; 1=low)	1.13 (0.44, 2.91)	1.30 (0.67, 2.53)	0.84 (0.30, 2.37)	1.85 (0.91, 3.76)
-Family involvement (0=med/high; 1=low)	1.59 (0.74, 3.43)	0.74 (0.36, 1.54)	0.40 (0.13, 1.29)	0.97 (0.51, 1.82)
-Parental supervision (re: drug) (0=high; 1=low)	1.14 (0.47, 2.77)	1.23 (0.60, 2.54)	0.84 (0.35, 2.02)	1.54 (0.72, 3.29)
<u>Academic achievement in adolescence</u>				
-Math scores (49–136)	1.03 (0.99, 1.06)	1.02 (0.99,1.05)	1.00 (0.96, 1.04)	0.99 (0.95, 1.02)
-High school dropout (0=graduate; 1=dropout)	0.56 (0.18, 1.78)	2.60 (1.30,5.20) **	1.42 (0.56, 3.60)	1.88 (1.02, 3.44)*
<b>Females (n=495)</b>				
<u>Social bond</u>				
-School bonds (0=med/high; 1=low)	1.25 (0.58, 2.70)	1.49 (0.51, 4.36)		1.28 (0.63, 2.63)
-Family involvement (0=med/high; 1=low)	1.74 (0.69, 4.42)	2.33 (0.83, 6.53)		2.00 (1.06, 3.77)*
-Parental supervision (re: drug) (0=high; 1=low)	1.06 (0.53, 2.10)	1.99 (0.70, 5.67)		1.78 (0.96, 3.31)
<u>Academic achievement in adolescence</u>				
-Math scores (60–136)	1.00 (0.98, 1.03)	0.99 (0.96, 1.04)		1.01 (0.97, 1.03)
-High school dropout (0=graduate; 1=dropout)	1.69 (0.75, 3.79)	1.01 (0.28, 3.66)		2.30 (1.15, 4.60)*

Note.

\* p<.05;

\*\* p<.01

<sup>§</sup>Multivariate models used multiple imputation (STATA ICE module) to account for missing data.

**Table 3**  
Consequences of Membership in Marijuana Trajectory Group in Mid Life (Age 42)

	Consequences							
	% Meeting criteria for substance use disorder (ages 32-42)	% Attending substance use rehabilitation program	Incarceration (ages 32-42)	% Unemployed	% Never married	% Living in poverty	% Lifetime MDD (ages 32-42)	
<b>Males (n=323)</b>								
Abstainers	6.7	5.2	12.6	27.5	26.0	24.1	11.5	
Adolescent Only	26.2	2.9	17.6	11.8	11.8	12.5	9.5	
Early Adulthood Decliners	43.5	4.3	28.3	25.5	31.9	20.5	24.2	
Late Starters	36.8	16.7	29.2	33.3	37.5	13.0	23.7	
Persistent Users	48.3	16.9	32.3	27.7	44.6	34.4	24.1	
$\chi^2$	80.86**	13.17*	14.28*	4.52	15.42*	7.97	13.36*	
df	4	4	4	4	8	4	4	
<b>Females (n=406)</b>								
Abstainers	5.0	1.5	3.0	24.2	34.3	27.0	15.9	
Adolescent Only	20.0	4.3	4.3	27.7	23.4	19.1	23.6	
Early Adulthood Decliners	25.0	20.0	5.0	40.0	30.0	45.0	16.7	
Persistent Users	40.4	8.1	14.9	33.8	41.9	39.4	29.5	
$\chi^2$	78.13**	21.17*	15.92**	4.53	7.83	8.94	9.45*	
df	3	3	3	3	6	3	3	

Note.

\* p <.05;

\*\* p<.01