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## Illicit Drug Use in Young Adults and Subsequent Decline in General Health: The Coronary Artery Risk Development in Young Adults (CARDIA) Study

Stefan G. Kertesz<sup>\*,†</sup>, Mark J. Pletcher<sup>‡,||</sup>, Monika Safford<sup>\*,†</sup>, Jewell Halanych<sup>\*,†</sup>, Katharine Kirk<sup>†,§</sup>, Joseph Schumacher<sup>\*</sup>, Stephen Sidney<sup>¶</sup>, and Catarina I. Kiefe<sup>\*,†</sup>

<sup>\*</sup>*Division of Preventive Medicine, University of Alabama at Birmingham School of Medicine, AL, 1530 3<sup>rd</sup> Ave South, MT608, Birmingham AL 35294, Office: (205) 934-2958, Fax (205) 934-7959, Email: skertesz@uab.edu*

<sup>†</sup>*Deep South Center on Effectiveness, Veteran's Affairs Medical Center, Birmingham, AL*

<sup>‡</sup>*Department of Epidemiology and Biostatistics, University of California, San Francisco, CA*

<sup>||</sup>*Division of General Internal Medicine, University of California, San Francisco, CA*

<sup>§</sup>*Department of Biostatistics, School of Public Health, University of Alabama at Birmingham, Birmingham, AL*

<sup>¶</sup>*Division of Research, Kaiser Permanente, Oakland, CA*

### Abstract

**Background**—The long-term health consequences of drug use among healthy young adults in the general population are not well described. We assessed whether drug use predicted decline in general self-rated health (GSRH) in a community-based cohort, healthy at baseline.

**Methods**—A prospective cohort of 3124 young adults (20-32 years old) from 4 US cities, the Coronary Artery Risk Development in Young Adults Study, was followed from 1987/88 to 2000/01. All reported “Good” or better GSRH at baseline, with reassessment in 2000/01. Drug use in 1987/88 was as follows: 812 participants were Never Users; 1554 Past Users Only; 503 Current Marijuana Users Only; and 255 Current Hard Drug Users (e.g. cocaine, amphetamines, opiates). Analyses measured the association of drug use (1987/88) with decline to “Fair” or “Poor” GSRH in 2000/01, adjusting for biological and psychosocial covariates.

**Results**—Reporting health decline were: 7.2% of Never Users; 6.5%, Past Use Only; 7.0%, Current Marijuana Only; and 12.6%, Current Hard Drugs ( $p < 0.01$ ). After multivariable adjustment, Current Hard Drug Use in 1987/88 remained associated with health decline (Odds Ratio (OR), referent Never Use: 1.83, 95% Confidence Interval 1.07-3.12). The health decline associated with Current Hard Drugs appeared to be partly mediated by tobacco smoking in 2000/01, which independently predicted health decline (OR 1.66, 95% CI 1.08-2.50) and weakened the apparent effect of Current Hard Drugs (OR 1.21, 95% CI 0.62-2.36).

**Conclusions**—Hard drug use in healthy young adults, even when hard drug use stops, is associated with a subsequent decrease in general self-rated health that may be partially explained by persistent tobacco use.

## Keywords

cohort study; drug use; epidemiology; cocaine; health status; consequences

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## 1. INTRODUCTION

Illicit drug use is common among young adults. In the United States National Survey on Drug Use and Health (2004), 16.1% of 18-to-24-year-olds reported marijuana, 2.1% reported cocaine, and 19.4% reported any illicit drug use in the prior 30 days. Among these, only a minority met criteria for abuse or dependence (Substance Abuse and Mental Health Services Administration Office of Applied Studies, 2005). While longitudinal research has clarified factors associated with initiation of drug use among young adults (Bachman et al., 1997), and prognosis among persons enrolled in drug treatment programs (Simpson et al., 2002), there are fewer data concerning major long-term health consequences of drug use among young adults in the general population. General population samples are distinct from groups assembled in a clinical context in that only a minority will have diagnosable dependence/abuse; also, the majority of young adults will typically cease use of illicit drugs during their twenties or early thirties, without reaching clinical attention (Bachman et al., 2002; Vega et al., 2002). Consequences of drug use profiled in drug-dependent users (Fugelstad et al., 1997; Hser et al., 2001; Ribeiro et al., 2004), a minority among users in the general population, are not likely to apply to most users. Thus while many young adults use drugs, the long-term health consequences of such behaviors are not well defined. This lack of prognostic data constrains the evidence base that could guide clinicians who offer preventive care to young adults in the general population. Accordingly, the available guidelines for the United States Preventive Services Task Force recommend generalized screening for at-risk drinking (U.S. Preventive Services Task Force, 2004), but find insufficient data to recommend screening for drug use in primary care (U.S. Preventive Services Task Force, 1996).

The challenges for research on health consequences of drug use among young adults in the general population include: (1) a paucity of long-term data related to risks of drugs other than marijuana; (2) a relative lack of clarity regarding physical harms, compared to extensive data on psychosocial outcomes; and (3) a continuing concern that observational research on drug use and health outcomes is susceptible to confounding from social and psychological factors associated with both drug use and health (Macleod et al., 2004). For instance, an apparent association between marijuana use and mortality in a Swedish cohort of military conscripts was explained by other variables such as a psychiatric diagnosis and a history of legal problems (Andréasson and Allebeck, 1990). Others have noted a lack of outcomes data for young adults (compared to data on adolescents), and a tendency for studies to rely on clinical as opposed to general population samples (Newcombe et al., 1999). For all these reasons the problem of tracing adult health consequences to earlier drug use has been described as “a difficult and formidable task” (Newcomb, 1997).

The Coronary Artery Risk Development in Young Adults (CARDIA) Study provides a unique opportunity to evaluate the long-term consequences of illicit drug use among young adults in the general population. CARDIA provides repeated measures of drug use, health outcomes, and in-depth social and psychological measures over 15 years of follow-up in a national community-based sample of black and white young adults (Friedman et al., 1988) with a pattern of drug use resembling mainstream drug use patterns reported in the United States and other developed countries (Bachman et al., 1997; Vega et al., 2002). Because no single disease outcome is particularly common among young healthy adults, and because the health consequences of drug use are likely to involve multiple mechanisms (e.g. neurochemical,

pathophysiologic, and psychosocial), we analyzed an omnibus health outcome of decline in general self-reported health. Our objective, therefore, was to measure the association between illicit drug use during young adulthood and subsequent decline in general self-reported health. Given our interest in late health effects of drug use among typical young adults, the great majority of whom are healthy, we focused on only those reporting good health at baseline.

## 2. METHODS

### 2.1 Study design and sample

The Coronary Artery Risk Development in Young Adults (CARDIA) study is a longitudinal study of risk factors for heart disease in a cohort of black and white women and men (n=5115) aged 18-30 years at the time of original recruitment in 1985/86. The sampling strategy resulted in a cohort balanced on race/ethnicity (52% black, 48% white), sex (54% female), and age (45% 18-24 years, 55% 25-30 years) (Friedman et al., 1988; Hughes et al., 1987).

The recruitment was from four urban communities, with participants solicited by random digit dialing in Birmingham, Alabama; Chicago, Illinois; and Minneapolis, Minnesota, with supplemental door-to-door recruitment in Minneapolis areas with low telephone subscription rates. In Oakland, California, participants were drawn at random from membership files of the Kaiser Permanente Medical Care Program, which has broad market penetration. Subjects with any health condition were eligible to participate, provided their condition would not fully preclude participation in the study examination itself (e.g. unable to walk on treadmill). Across all 4 study sites, persons attending the initial study exam in 1985/86 represented 51.0% of eligible invited participants. Attendees at this initial exam were more apt to be white (49.4 vs 38.6%), male (45.2% vs 41.0%), older (54.8% vs 46.3% in the 25-30 year age category), and more educated (59.5% vs 47.6% with more than high school education) (Friedman et al., 1988). Data at baseline, 2, and 15 years were used in this report. All subjects gave informed consent in person, and this project is under continuing approval of the relevant Institutional Review Boards for Human Subjects research at the participating institutions.

The present analysis included subjects who met the following criteria: (a) reported "Good" or "Excellent" health status (1985/86) (89% of cohort) in response to the general self-reported health question "Would you say your health, in general, is excellent, good, fair or poor?" (this general health status question was not asked of participants in 1987/88); (b) completed the CARDIA Year 2 (1987/88) examination, when drug use was comprehensively assessed; and (c) attended the CARDIA Year 15 (2000/01) examination (Figure 1).

Analyzed participants (n=3124), who attended the Year 15 (2000/01) examination, differed from participants who did not follow up at the 2000/01 exam (n=941, 30.1%) in that they were more likely than excluded subjects to be white (56.2% versus 43.3%), and female (55.3% versus 49.6%). Differences in reported drug use in 1987/88 were modest between analyzed and unanalyzed participants, with similar proportions reporting ever having smoked marijuana (73.3% versus 74.1%) or used cocaine (37.0% versus 36.0%).

### 2.2 Primary exposure variable

The main exposure variable was drug use based on self-report from 1987/88, the first CARDIA examination year at which these data were collected. In CARDIA, use of marijuana, cocaine, amphetamines, and opiates (including heroin and opiate pain relievers used nonmedically) was assessed in 1987/88 and again in 2000/01 with similar interviewer-administered instruments. For each substance participants were asked: "Have you ever used (substance)?" "During the last 30 days, on how many days did you use (substance)?" These 2 intervals are also queried in the National Survey on Drug Use and Health (Johnston et al., 2005; Substance Abuse and

Mental Health Services Administration Office of Applied Studies, 2005). Preliminary analyses by specific drugs revealed small numbers of current amphetamine and opiate users, so that we combined cocaine, amphetamines, and opiates into “hard” drugs. We wanted to create a discrete number of analyzable categories that would reflect degrees of drug use involvement that primary care clinicians would find practical (e.g. current versus past use, and marijuana versus nonmarijuana “hard” drugs). Based on reviewing the pattern of responses to use “ever” and in “the last 30 days” in 1987/88, we categorized subjects as follows: never having used any illicit drug (Never Use); drug use that occurred over 30 days before (Past Use Only); current use of marijuana only (i.e. last 30 days), with or without past use of other drugs (Current Marijuana Only); and current use of “hard drugs” (i.e. cocaine, opiates, and/or amphetamines in the last 30 days) with or without marijuana use (Current Hard Drugs). These categories reflect a plausible gradient of degrees of drug use involvement.

### 2.3 Outcome: decline in general self-reported health

The primary outcome variable was decline in general self-reported health (GSRH). A single-item GSRH question, derived from the Medical Outcomes Study short form instrument (Ware et al., 1996) is easy to administer, stable (Eriksson et al., 2001), and sensitive to change (Diehr et al., 2001). In CARDIA, the GSRH question was asked at study entry in 1985/86, and at follow-up in 2000/01 [response options: Excellent, (“Very Good” was included in 2000/01), Good, Fair, Poor]. Because of our interest in examining long-term health effects of drug use in typically healthy young adults, only subjects responding Good or better in 1985/86 were included in this analysis. A “decline” was defined as responding Fair or Poor in 2000/01. A collapsed dichotomization of the scale, undertaken in this instance because of slight differences in the response options between the initial and follow-up exams, has been shown to produce results similar to analyses of scaled responses (Manor et al., 2000). In the aforementioned systematic review, poor or fair responses (collapsed) predicted a doubling of the odds of mortality, even after controlling for a wide range of sociodemographic variables (DeSalvo et al., 2006).

### 2.4 Other covariates

In multivariable analysis we included additional measures that had plausible or theoretic potential to confound the relationship between drug use and health. Because our interest was in confounding exposures contemporaneous with the main exposure of drug use, we limited these items to those measured in 1987/88, with the exception of risky family of upbringing (see below). We included age, sex and race. Socioeconomic status was reflected by both by high school graduation and responses to the question “how hard is it for you and your family to pay for the very basics (like food, medical care and heating)?” (responses: Very Hard, Hard, Somewhat Hard, Not Very Hard). The age range of 20-32 years (where some young adults in college may have low income but high socioeconomic status) makes the latter question more appropriate than a report of personal income. Current smoking was by self-report, classified as Current versus Never/Past (combined). We classified “risky drinking” based on the sex-specific weekly/daily maximum drinking limits published by the National Institute on Alcohol Abuse and Alcoholism [for males (females): >14 (>7) standard drinks/week or >4 (>3) drinks/day](National Institute on Alcohol Abuse and Alcoholism, 2005). Given that drug use patterns differ for married and unmarried cohabiting couples (Bachman et al., 1997), we classified marital status as: married, unmarried-cohabiting and “other” (e.g. single, noncohabiting). Other variables include body mass index ( $\text{kg}/\text{m}^2$ ), and a score of physical activity from a validated instrument soliciting the frequency of 13 types of physical activity (ranging from running to home maintenance) over 12 months (typical range is from 100 to 500 exercise units with values under 250 reflecting low and values over 400 reflecting high levels of physical activity) (Sidney et al., 1991). We included a simple count of potentially-serious chronic medical conditions,

since disease counts have been associated with health status over time (Bayliss et al., 2004;Kertesz et al., 2005). Items elicited by self-report were: high blood pressure, high cholesterol, diabetes, heart problems, kidney problems, thyroid problem, stomach/duodenal ulcer, liver problems, gallstones/gallbladder problems, asthma, cancer, or “other major disease or health problem.” Importantly, “nervous” and “mental” disorders were not included as part of this count. The count ranged from 0 to 12 (categorized 0, 1, 2+ in multivariable models). Social support was devised from a continuous score measure that combines instrumental support, emotional support and social networks, with a typical range from 2 (low) to 9 (high) (Allen et al., 2001;Seeman and Syme, 1987). A history of ever having been diagnosed with mental illness or a nervous disorder was by self-report.

Finally, we included a continuous score indicating the degree to which the participant’s childhood environment in the family of origin qualified as “risky,” based on a 7-item questionnaire developed for this purpose and administered in 2000/01, yielding a score from 7 (low risk) to 28 (high risk), which we z-transformed for our analyses (Taylor et al., 2004). Risky families are described as lacking in nurturance, and characterized by extensive conflict or neglect, with or without overt abuse. Extensive data suggest such a family upbringing influences health through multiple pathways including emotional processing, stress-response biological systems and social behaviors (Lehman et al., 2005;Repetti et al., 2002).

## 2.5 Statistical Analysis

Bivariate relationships were examined between drug use and decline in health status (i.e. GSRH), and between drug use and the other covariates. Outcomes were also compared by drug use within the 4 race-sex strata (black female, black male, white female, white male).

Multivariable logistic regression was used to test for independent associations between drug use in 1987/88 and health decline (from 1985/86 to 2000/01). To address potential collinearity among covariates in the multivariable models, we checked correlations amongst the covariates and none were  $>0.4$ . We prepared a model including the primary predictor of drug use and adjusting for only age, race, and sex. We then added risky drinking and current smoking (1987/88). Finally, we added all sociodemographic, health, and family characteristics (Full model). Models were repeated with adjustment for recruitment sites. We tested the following interactions with drug use on decline in health status: smoking, risky drinking, difficulty paying for basic necessities, race, sex and the participant’s baseline self-reported health status (Excellent or Good). To assess whether potential effects of Current Marijuana Only were restricted to persons with heavier use, the full model was repeated after dropping Current Marijuana Only users with  $<4$  days’ use in the preceding month. To assess whether past use of hard drugs influenced findings for Current Marijuana Only, the model was repeated after dropping persons with past hard drug use from this category. A separate model further adjusted for baseline health status to assess whether it confounded the associations.

Finally, three analyses were conducted to assess whether continuing use of alcohol, tobacco or drugs in 2000/01 mediated apparent associations between drug use (1987/88) and health decline (2000/01). These included replacing the 1987/88 indicators for alcohol and tobacco use with measures from 2000/01, and a separate model that included a term for continued hard drug use in 2000/01, which was uncommon ( $n=86$ , 2.75% of the cohort). To assess if early drug use was associated with later health decline despite cessation of use, we repeated the model after excluding all participants still using drugs in 2000/2001.

All analyses were run with SAS version 9.0 (Cary, North Carolina).

### 3. RESULTS

#### 3.1 Study sample

The 3124 members of the study sample were 43.8% black, 44.8% male (18.3% black males, 25.5% black females, 26.4% white males, 29.7% white females), and mean age was 27.2 (s.d. 3.6) years in 1987/88. For drug use, 812 (26.0%) subjects were Never Users in 1987/88, 1554 (49.7%) were Past Users Only, 503 (16.1%) were Current Marijuana Only Users, and 255 (8.2%) were Current Hard Drug Users, for a total of 24.3% current illicit drug use in 1987/88 (Table 1).

Among Current Hard Drug Users in 1987/88, 89.4% reported current cocaine (powdered or crystal “crack” form), in 1987/88. The majority of Current Hard Drug Users reported current marijuana use as well. Many subjects in the Past Use Only, Current Marijuana Only and Current Hard Drug categories reported using a variety of drugs “ever” in their lives (Table 1). However, significantly fewer subjects in the Past Use Only and Current Marijuana Only categories reported lifetime use of hard drugs >10 times, compared to Current Hard Drug Users; for example, 11.8% of Past Use Only and 21.3% of Current Marijuana Only subjects reported use of cocaine >10 times, compared to 62.4% of Current Hard Drug Users. At follow-up in 2000/2001, only 12.7% of participants reported any current drug use (down from 24.3% in 1987/88), and only 2.8% (8.2% in 1987/88) reported current hard drugs. Among persons who had been Current Hard Drug Users in 1987/88, in 2000/01 34.1% reported current use of marijuana, 14.5% use of cocaine, 0.4% use of amphetamines and 2.8% use of opiates.

In 1987/88, black women were more likely to be Never Users compared to black men, white women and white men. White women were more likely to be Past Users Only, compared to the other 3 groups. Males, white and black, were more likely Current Hard Drug Users compared to women (Table 1). Risky alcohol drinking and current cigarette use were markedly more common among Current Hard Drug Users and less common among Never Drug Users. A history of being diagnosed with a mental or nervous disorder was significantly more common among Current Marijuana Users compared to Never Users or Current Hard Drug Users (Table 1).

#### 3.2 Incidence of decline in general self-reported health

By 2000/01, 7.3% of the sample reported a decline to Poor or Fair general health status. This decline was significantly more frequent among Current Hard Drug Users (12.6%) compared to the 3 other categories, among whom about 7% declined ( $p=0.008$  for comparison across 4 drug use categories) (Figure 2). Decline in general self-rated health was also most common among Current Hard Drug Users in each of the four race-sex strata (Figure 2).

#### 3.3 Multivariable analyses

Sequential models, accounting for potential covariates, are shown in Table 2. In the full model adjusting for all possible confounders at baseline, the association between Current Hard Drug Use in 1987/88 and health decline remained significant. The odds ratio (OR) for health decline among Current Hard Drug Users compared with Never Users in 1987/88 was 1.83 (95% Confidence Interval, CI, 1.07-3.12).

Many included variables demonstrated the expected associations with health decline over 13 years. For example, black race, smoking, low educational attainment, higher body mass index, physical inactivity, the number of self-reported chronic medical disorders reported as of 1987/88, self-report of mental illness, and coming from a more risky family were all associated with decline in health status. Of note, Current Marijuana Only Use did not behave similarly to Current Hard Drug Use in its association with health decline. Even after restricting the Current

Marijuana Only Use category to persons with >4 uses per month, the OR for health decline in the Current Marijuana Use category was 0.68 (95% CI 0.36-1.29). Similarly, restricting “Current Marijuana Users” to persons with no prior hard drug use (n=154, 31% of Current Marijuana Users) did not materially alter the finding that only the category of Current Hard Drug Use was at increased odds for general health decline (OR 1.81, 95% CI 1.06-3.10). Further adjustment for baseline health status did not alter the association of Current Hard Drug Use and health decline (OR 1.73, 95% CI 1.01-2.95).

Additional analyses considered whether use of alcohol, tobacco or illicit drugs (2000/01) mediated the association between early Current Hard Drug Use (1987/88) and health decline by 2000/01. Continued tobacco smoking (2000/01), most prevalent among persons with Current Hard Drug Use in 1987/88 (58%, compared to 34% of Never Drug Users), was (a) associated with health decline (OR 1.66, 95% CI 1.08-2.50); and (b) weakened the apparent association between Current Hard Drug Use (1987/88) with health decline (OR for Hard Drug Use, Relative to Never Use, 1.21, 95% CI 0.62-2.36). No similar findings were seen for risky drinking, or for continuing hard drug use in 2000/01, although the latter was rare (n=86 persons). The association between Current Hard Drug Use (1987/88) and health decline was unchanged after excluding all persons reporting current drug use in 2000/2001, suggesting that use in the young adult years carried long-term risk even if that use subsequently ceased.

We found no evidence of 2-way interactions on decline in health status between drug use category and race, sex, tobacco, drinking, difficulty paying for necessities, baseline health status, or between race and sex. Models adjusting for recruitment sites were unchanged from the full model.

#### 4. DISCUSSION

In this cohort of young adults who were in good health at baseline, we found a significant association between hard drug use and general health decline over a 15-year period. Health decline from 1985/86 to 2000/01 was more common among participants who reported Current Hard Drug use in 1987/88, even among those participants who had no continuing illicit drug use in 2000/01. Separately, we note that neither current marijuana use (in 1987/88) nor past drug use were associated with general health decline.

Since most young adults eventually “mature out” of illicit drug use (Bachman et al., 2002; Vega et al., 2002), evidence of any persistent downstream health risk is a public health concern. The association between hard drug use and health decline was independent of demographic, psychosocial and health characteristics. However, continued tobacco smoking (2000/01) independently predicted health decline and partly explained the association between young adult hard drug use and subsequent health decline. Previous studies have suggested that tobacco abuse is an underestimated but important source of long-term morbidity and mortality among persons who have sought treatment for addiction (Hser et al., 1993; Hurt et al., 1996; McCarthy et al., 2002; Richter and Arnsten, 2006). The present study highlights a parallel risk among young adult hard drug users in the general population.

Our main finding warrants interest as young adulthood represents a period of expanded drug use and experimentation and, compared to adolescence, is relatively free from the restraints of parents, teachers and other social institutions (Arnett, 2005). Data concerning the long-term health consequences of drug use among young adults in the general population, as opposed to clinically-identified drug-dependent samples (Hser et al., 2001; Ribeiro et al., 2004), have been sparse. Much available data concern psychosocial outcomes of adolescent marijuana use in particular (Macleod et al., 2004), including adolescent marijuana use and schizophrenia (Smit et al., 2004). For example, one prospective analysis of mainly white, middle-income high

school students (n=929) suggested that participants were more likely to report health problems that they personally attributed to drug use, if they had reported any drug use 12 years earlier (Guy et al., 1993). However, this study did not directly compare overall health status between drug-users and non-users, and the drug use history was obtained during adolescence.

We chose to evaluate general health decline and not more specific health conditions because of the young age of the study population, and the infrequent occurrence of any single disease in a generally healthy sample. This measure, although nonspecific, is responsive to changes in overall health status (Diehr et al., 2001), and it predicts mortality and health care utilization, even after adjustment for psychosocial and other health-related covariates (DeSalvo et al., 2006; DeSalvo et al., 2005). A systematic review of 22 prospective cohort studies found that poor GSRH was associated with doubling of the odds for death during follow-up, independent of factors such as age, sex, socioeconomic factors and other potential confounders (DeSalvo et al., 2006). It correlates more closely with physical ( $r=0.69$ ) than with mental ( $r=0.37$ ) health status (Ware et al., 1994). Its validity is underscored by our finding that a wide variety of accepted health risks (e.g. smoking, high body mass index, low physical activity) were also associated with similarly increased likelihood of health decline.

In principle, a range of consequences described in drug abuse samples could account for health decline in this sample, including consequences of cocaine (the predominant nonmarijuana illicit drug used by this sample), which has been associated with pulmonary (Tashkin et al., 1992), cardiovascular (Lange and Hillis, 2001), neuropsychiatric (Burnett and Adler, 2004), and infectious/immunologic complications (Friedman et al., 2003; Halpern et al., 2003), and trauma (Brookoff et al., 1993). However, this 15-year cohort was unlikely to have recruited or retained substantial numbers of long-term drug-dependent adults, and tobacco appears to have been an important determinant of health status at follow-up. Tobacco's effects on respiratory and cardiovascular functioning, and exercise tolerance are thus likely to have influenced the perceptions of general health status reported in this sample.

There are notable strengths to our study. To our knowledge, longitudinal comparisons of the associations between hard drug and marijuana use, and general health outcomes in a community-based, nonclinical sample of young adults have not previously been reported. The strength of our findings is reinforced by the independent effect of drug use even after adjusting for the wealth of demographic, psychosocial, and clinical information in the CARDIA dataset. A number of variables in the final model reflect characteristics that would be expected to confound the association between drugs and health outcomes, including socioeconomic status (education and economic status), smoking, and risky family of origin. While these latter characteristics were indeed associated with drug use, and did predict health decline, the remaining independent association between hard drugs and health decline suggests a potential cause-and-effect relationship. Such a relationship appears to be mediated, partially, by continued tobacco smoking into middle age.

This study has some limitations. Since recruitment depended mostly on random-digit dialing and random selection among health plan members, the study is unlikely to include substantial numbers of participants who were severely dependent and/or immersed in the drug culture. However, our main interest was to examine the implications of "mainstream" patterns of drug use among relatively healthy young adults, rather than the implications of clinical drug dependence. Bias due to selective retention within this cohort is unlikely to account for our findings, since drug use prevalence was not substantially different within the retained sample, compared to persons not followed up. Importantly, among retained participants, the proportions reporting illicit drug use were similar to or slightly higher than same-epoch comparison figures from the National Household Survey on Drug Abuse. For instance, 7.3% of our 20-32 year old CARDIA participants reported past-month cocaine use in 1987/88, compared to 6.3% of



persons aged 26-34 years in the 1985 National Household Survey on Drug Abuse (Office of Applied Studies, 1999). This comparison confirms that our sample likely represents general population young adults, and for that reason we did not attempt to impute missing data. Also a limitation is that the original health status measure (1985/86) predates the drug use assessment by 2 years. While it is possible that for some participants a health decline predated the drug use assessed in 1987/88, we think this is unlikely given the young age of the cohort at baseline, and the short time interval between assessments.

Of relevance to the interpretation of our findings, the drug exposure categories of “Past Drugs,” “Current Marijuana Only,” and “Current Hard Drugs” reflect differences in the degree of drug use involvement (including combinations of drugs) rather than categorical differences in “ever” using specific drugs. Thus while meaningful percentages of persons in the Past Drug or Current Marijuana Only categories had used hard drugs at some time in their life, the Current Hard Drug Users were likely to have had a more extended period of regular use in the young adult years, and more commonly reported >10 lifetime uses. This contrast is concordant with the notion that in epidemiologic outcome studies, the study of regular, rather than “ever” use is likely to be of greater relevance (Macleod et al., 2005). Additionally, our drug use categories represented a natural hierarchy of use that emerged from examination of our data and accords with the typical patterns seen in national data. In the 2004 National Survey on Drug Use and Health, isolated use of marijuana (absent other illicit drugs) was common, and the use of illicit drugs other than marijuana typically co-occurred with marijuana (Substance Abuse and Mental Health Services Administration Office of Applied Studies, 2005). This epidemiologic pattern makes it difficult to statistically test effects of hard drugs in a manner that is completely independent of marijuana (our study was not adequately powered to do so). Finally, we caution that these data are observational (leaving open the possibility of residual confounding by unmeasured characteristics), and such data cannot fully exculpate any single drug, including marijuana.

## 5. Conclusions

These data are consistent with a long-term health risk of hard drug use among healthy young adults in the general population, and suggest that this risk is at least partly mediated by tobacco use in middle age. The findings were similar for women and men, for blacks and whites, and for those with and those without financial difficulties. To the extent that our community-based sample is similar to others, it is likely that only a minority of our subjects would have warranted a diagnosis of substance dependence or abuse. Moreover, it is worrisome that the well-described epidemiologic transition to reduced drug use by age 30 did not appear to protect against the health decline in later life. We believe these data should spur clinicians to caution their young adult clients who acknowledge current use of hard drugs, even in the absence of diagnosed dependence or abuse. It is notable that the last published statement of United States Preventive Services Task Force reported that evidence remained insufficient to recommend screening for illicit drug use in primary care (U.S. Preventive Services Task Force, 1996). The present data suggest that where illicit drug use is identified, the risks of long-term legal substances (e.g. tobacco) are likely to be equally if not more relevant to future health status. Continued accrual and analyses of long-term follow-up data should ultimately help to clarify the thresholds of risk associated with the patterns of drug use common among young adults in the United States and other developed countries.

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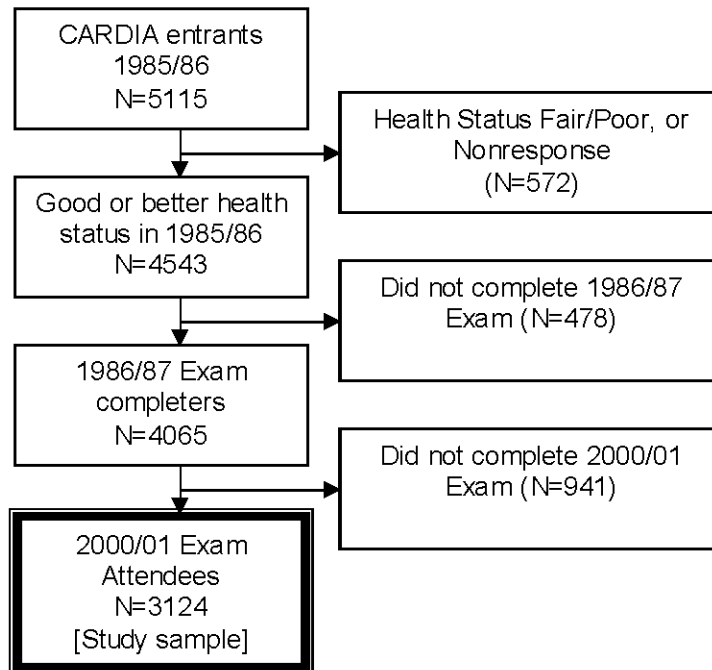
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## REFERENCES

- Allen J, Markovitz J, Jacobs DR Jr, Knox SS. Social support and health behavior in hostile black and white men and women in CARDIA. *Coronary Artery Risk Development in Young Adults*. *Psychosom Med* 2001;63:609–618. [PubMed: 11485115]
- Andréasson S, Allebeck P. Cannabis and mortality among young men: a longitudinal study of Swedish conscripts. *Scand J Soc Med* 1990;18:9–15. [PubMed: 2320981]
- Arnett JJ. The Developmental Context of Substance Use in Emerging Adulthood. *J Drug Issues* 2005;35:235–253.
- Bachman, JG.; O'Malley, PM.; Schulenberg, JE.; Johnston, LD.; Bryant, AL.; Merline, AC. *The decline of substance use in young adulthood: changes in social activities, roles, and beliefs*. Erlbaum; Mahwah, New Jersey: 2002.
- Bachman, JG.; Wadsworth, KN.; O'Malley, PM.; Johnston, LD.; Schulenberg, JE. *Smoking, Drinking, and Drug Use in Young Adulthood: The Impacts of New Freedoms and New Responsibilities*. Lawrence Erlbaum Associates, Publishers; Mahwah, NJ: 1997.
- Bayliss EA, Bayliss MS, Ware JE Jr, Steiner JF. Predicting declines in physical function in persons with multiple chronic medical conditions: what we can learn from the medical problem list. *Health Qual Life Outcomes* 2004;2:47. [PubMed: 15353000]
- Brookoff D, Campbell EA, Shaw LM. The underreporting of cocaine-related trauma: drug abuse warning network reports vs hospital toxicology tests. *Am J Public Health* 1993;83:369–371. [PubMed: 8438974]
- Burnett, LB.; Adler, J. Toxicity, Cocaine. *eMedicine*. Available at <http://www.emedicine.com/emerg/topic102.htm>. Accessed on October 25, 2006
- DeSalvo KB, Bloser N, Reynolds K, He J, Muntner P. Mortality prediction with a single general self-rated health question. *J Gen Intern Med* 2006;21:267–275. [PubMed: 16336622]
- DeSalvo KB, Fan VS, McDonell MB, Fihn SD. Predicting mortality and healthcare utilization with a single question. *Health Serv Res* 2005;40:1234–1246. [PubMed: 16033502]
- Diehr P, Williamson J, Patrick DL, Bild DE, Burke GL. Patterns of self-rated health in older adults before and after sentinel health events. *J Am Geriatr Soc* 2001;49:36–44. [PubMed: 11207840]
- Eriksson I, Uden AL, Elofsson S. Self-rated health. Comparisons between three different measures. Results from a population study. *Int J Epidemiol* 2001;30:326–333. [PubMed: 11369738]
- Friedman GD, Cutter GR, Donahue RP, Hughes GH, Hulley SB, Jacobs DR Jr, Liu K, Savage PJ. CARDIA: study design, recruitment, and some characteristics of the examined subjects. *J Clin Epidemiol* 1988;41:1105–1116. [PubMed: 3204420]
- Friedman H, Newton C, Klein TW. Microbial infections, immunomodulation, and drugs of abuse. *Clin Microbiol Rev* 2003;16:209–219. [PubMed: 12692094]
- Fugelstad A, Anell A, Rajs J, Agren G. Mortality and causes and manner of death among drug addicts in Stockholm during the period 1981-1992. *Acta Psychiatr Scand* 1997;96:169–175. [PubMed: 9296546]
- Guy SM, Smith GM, Bentler PM. Adolescent socialization and use of licit and illicit substances: impact on adult health. *Psychol Health* 1993;8:463–487.
- Halpern JH, Sholar MB, Glowacki J, Mello NK, Mendelson JH, Siegel AJ. Diminished interleukin-6 response to proinflammatory challenge in men and women after intravenous cocaine administration. *J Clin Endocrinol Metab* 2003;88:1188–1193. [PubMed: 12629105]
- Hser YI, Anglin D, Powers K. A 24-year follow-up of California narcotics addicts. *Arch Gen Psychiatry* 1993;50:577–584. [PubMed: 8317951]
- Hser YI, Hoffman V, Grella CE, Anglin MD. A 33-year follow-up of narcotics addicts. *Arch Gen Psychiatry* 2001;58:503–508. [PubMed: 11343531]

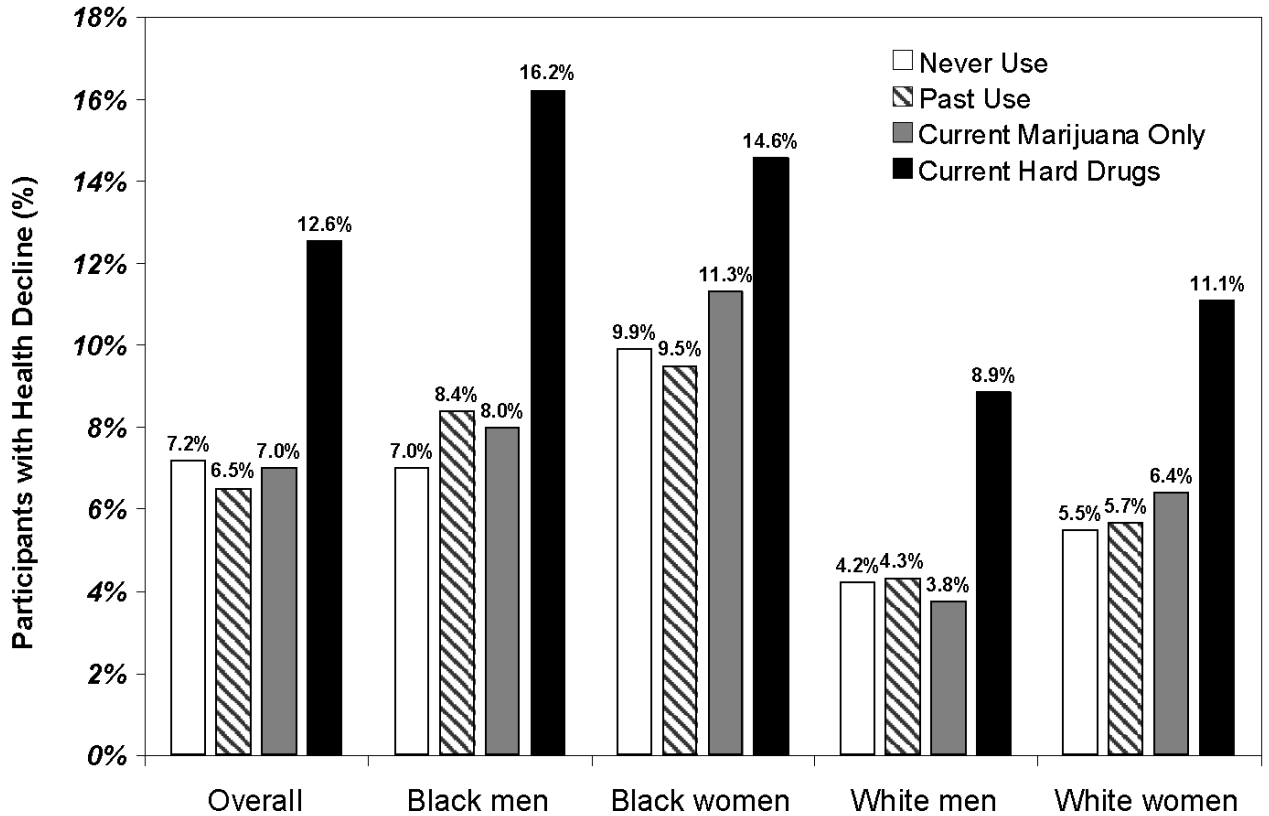
- Hughes GH, Cutter G, Donahue R, Friedman GD, Hulley S, Hunkeler E, Jacobs DR Jr, Liu K, Orden S, Pirie P, et al. Recruitment in the Coronary Artery Disease Risk Development in Young Adults (CARDIA) Study. *Control Clin Trials* 1987;8:68S–73S. [PubMed: 3440391]
- Hurt RD, Offord KP, Croghan IT, Gomez-Dahl L, Kottke TE, Morse RM, Melton LJ 3rd. Mortality following inpatient addictions treatment. Role of tobacco use in a community-based cohort. *JAMA* 1996;275:1097–1103. [PubMed: 8601929]
- Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the Future national survey results on drug use, 1975-2004: Volume 2, College students and adults ages 19-45. National Institute on Drug Abuse; Bethesda, MD: 2005. (NIH Publication No. 05-5728) Accessed on October 25, 2006
- Kertesz SG, Larson MJ, Horton NJ, Winter M, Saitz R, Samet JH. Homeless chronicity and health-related quality of life trajectories among adults with addictions. *Med Care* 2005;43:574–585. [PubMed: 15908852]
- Lange RA, Hillis LD. Cardiovascular complications of cocaine use. *N Engl J Med* 2001;345:351–358. [PubMed: 11484693]
- Lehman BJ, Taylor SE, Kiefe CI, Seeman TE. Relation of childhood socioeconomic status and family environment to adult metabolic functioning in the CARDIA study. *Psychosom Med* 2005;67:846–854. [PubMed: 16314588]
- Macleod J, Hickman M, Smith GD. Reporting bias and self-reported drug use. *Addiction* 2005;100:562–563. [PubMed: 15784073]
- Macleod J, Oakes R, Copello A, Crome I, Egger M, Hickman M, Oppenkowski T, Stokes-Lampard H, Davey Smith G. Psychological and social sequelae of cannabis and other illicit drug use by young people: a systematic review of longitudinal, general population studies. *Lancet* 2004;363:1579–1588. [PubMed: 15145631]
- Manor O, Matthews S, Power C. Dichotomous or categorical response? Analysing self-rated health and lifetime social class. *Int J Epidemiol* 2000;29:149–157. [PubMed: 10750617]
- McCarthy WJ, Zhou Y, Hser YI, Collins C. To smoke or not to smoke: impact on disability, quality of life, and illicit drug use in baseline polydrug users. *J Addict Dis* 2002;21:35–54. [PubMed: 11916371]
- National Institute on Alcohol Abuse and Alcoholism. Helping Patients Who Drink Too Much: A Clinician's Guide. National Institutes of Health; Rockville, MD: 2005. Available at: [http://pubs.niaaa.nih.gov/publications/Practitioner/CliniciansGuide2005/clinicians\\_guide.htm](http://pubs.niaaa.nih.gov/publications/Practitioner/CliniciansGuide2005/clinicians_guide.htm). Accessed on October 24, 2006
- Newcomb MD. Psychosocial predictors and consequences of drug use: a developmental perspective within a prospective study. *J Addict Dis* 1997;16:51–89. [PubMed: 9046445]
- Newcombe MD, Vargas-Carmona J, Galaif ER. Drug problems and psychological distress among a community sample of young adults: predictors, consequences, or confound. *J Community Psychol* 1999;27:405–429.
- Office of Applied Studies. 1998 National Household Survey on Drug Abuse: Summary Tables. Prevalence Estimates, standard errors, and p-values. 1& 2. Substance Abuse and Mental Health Services Administration; 1999. Available at: <http://oas.samhsa.gov/NHSDA/98DetailedTables/sumtab98.pdf>. Accessed on October 12, 2006
- Repetti RL, Taylor SE, Seeman TE. Risky families: family social environments and the mental and physical health of offspring. *Psychol Bull* 2002;128:330–366. [PubMed: 11931522]
- Ribeiro M, Dunn J, Laranjeira R, Sesso R. High mortality among young crack cocaine users in Brazil: a 5-year follow-up study. *Addiction* 2004;99:1133–1135. [PubMed: 15317633]
- Richter KP, Arnsten JH. A rationale and model for addressing tobacco dependence in substance abuse treatment. *Subst Abuse Treat Prev Policy* 2006;1:23. [PubMed: 16907984]
- Seeman TE, Syme SL. Social networks and coronary artery disease: a comparison of the structure and function of social relations as predictors of disease. *Psychosom Med* 1987;49:341–354. [PubMed: 3615763]
- Sidney S, Jacobs DR Jr, Haskell WL, Armstrong MA, Dimicco A, Oberman A, Savage PJ, Slattery ML, Sternfeld B, Van Horn L. Comparison of two methods of assessing physical activity in the Coronary Artery Risk Development in Young Adults (CARDIA) Study. *Am J Epidemiol* 1991;133:1231–1245. [PubMed: 2063831]

- Simpson DD, Joe GW, Broome KM. A national 5-year follow-up of treatment outcomes for cocaine dependence. *Arch Gen Psychiatry* 2002;59:538–544. [PubMed: 12044196]
- Smit F, Bolier L, Cuijpers P. Cannabis use and the risk of later schizophrenia: a review. *Addiction* 2004;99:425–430. [PubMed: 15049742]
- Substance Abuse and Mental Health Services Administration Office of Applied Studies. Results from the 2004 National Survey on Drug Use and Health: National Findings. Rockville, MD: 2005. Report No.: DHHS Publication No. SMA 05-4062, NSDUH Series H-28. Available at: <http://www.oas.samhsa.gov/NSDUH/2k4nsduh/2k4tabs/toc.htm>. Accessed on November 26, 2005
- Tashkin DP, Gorelick D, Khalsa ME, Simmons M, Chang P. Respiratory effects of cocaine freebasing among habitual cocaine users. *J Addict Dis* 1992;11:59–70. [PubMed: 1486094]
- Taylor SE, Lerner JS, Sage RM, Lehman BJ, Seeman TE. Early environment, emotions, responses to stress, and health. *J Pers* 2004;72:1365–1393. [PubMed: 15509286]
- U.S. Preventive Services Task Force. Guide to clinical preventive services. 2nd ed.. Williams & Wilkins; Baltimore, MD: 1996.
- U.S. Preventive Services Task Force. Screening and behavioral counseling interventions in primary care to reduce alcohol misuse: recommendation statement. *Ann Intern Med* 2004;140:554–556. [PubMed: 15068984]
- Vega WA, Aguilar-Gaxiola S, Andrade L, Bijl R, Borges G, Caraveo-Anduaga JJ, DeWit DJ, Heeringa SG, Kessler RC, Kolody B, Merikangas KR, Molnar BE, Walters EE, Warner LA, Wittchen HU. Prevalence and age of onset for drug use in seven international sites: results from the international consortium of psychiatric epidemiology. *Drug Alcohol Depend* 2002;68:285–297. [PubMed: 12393223]
- Ware J Jr, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care* 1996;34:220–233. [PubMed: 8628042]
- Ware, JE.; Kosinski, M.; Keller, SD. SF-36 Physical & Mental Health Summary Scales: A User's Manual. The Health Institute; Boston: 1994.



CARDIA Exam Year Exam Calendar Year`	<b>0</b> <b>1985/86</b>	<b>2</b> <b>1987/88</b>	<b>15</b> <b>2000/01</b>
Health status (outcome)	X		X
Drug use (exposure)		X	
Covariates (except Risky Family score, assessed 2000/01)		X	

**Figure 1.**  
Composition of the study sample and timeline of essential data collection



**Figure 2.**

Figure depicts the percentage of CARDIA participants (overall, and by gender/race category) experiencing a decline in general self-reported health from 1985/86 to 2000/01 according to the category of illicit drug use (marijuana, cocaine/crack, amphetamines and opiates) reported in 1987/88. Past Use reflects any illicit drug use >30 days before the 1987/88 assessment interview. Current Marijuana Only refers to marijuana but no other illicit drugs in the preceding 30 days. Current Hard Drugs refers to use of cocaine, amphetamines or opiates (either heroin or opiate pain relievers) during the prior 30 days, with or without concurrent marijuana. The contrast between drug use categories, according to the chi-squared test, resulted in  $p=0.008$  (overall),  $p=0.13$  (black men),  $p=0.72$  (black women),  $p=0.30$  (white men),  $p=0.44$  (white women). A test of interaction between gender and race was nonsignificant ( $p=0.70$ ).

Participant characteristics by Illicit Drug Use Category: the CARDIA study, 1987/88\*

Table 1

Characteristic	Never Use N=812	Drug Use Category, Based on Self-Report in 1987/88 (n=3124)			p <sup>†</sup>
		Past Use Only N=1554	Current/Marijuana Only N=503	Current Hard Drugs N=255	
<b>Demographics</b>					
Age, mean years (SD) <sup>‡</sup>	26.4 (3.8)	27.6 (3.4)	27.1 (3.6)	27.1 (3.3)	<.001
Sex					<.001
Female (%)	60	59	43	40	
Race					<.001
Black (%)	57	36	46	48	
Sex/Race					<.001
Black Female (%)	37	22	21	19	
Black Male (%)	20	14	25	29	
White Female (%)	23	37	22	21	
White Male (%)	21	27	32	31	
Education					.002
>High School Graduate (%)	3	2	4	7	
Marital Status					<.001
Married	36	37	24	22	
Partnered	6	12	21	18	
<b>Physical</b>					<.001
Body Mass Index: mean kg/m <sup>2</sup> (SD) <sup>‡</sup>	25.7 (5.6)	24.7 (4.9)	25.0 (4.9)	24.9 (4.6)	
Physical Activity Score: mean Exercise Units (SD) <sup>‡</sup>	333.7 (283.5)	391.5 (275.2)	443.5 (304.1)	429.3 (298.2)	<.001
Number of Chronic Medical Conditions: mean (SD) <sup>‡</sup>	0.43 (0.75)	0.53 (0.78)	0.51 (0.84)	0.55 (0.81)	.017
<b>Psychosocial</b>					
Psychiatric					.007
Mental Disorders, Ever (%)	4	7	9	5	<.001
Difficulty Paying Bills (%) <sup>‡</sup>					
Not difficult	75	76	67	64	
Difficult	25	24	33	36	
Social Support (2-9): mean (SD) <sup>‡</sup>	5.9 (1.7)	6.0 (1.7)	5.8 (1.8)	5.8 (1.7)	.02
Risky Family Score (4-28): mean (SD) <sup>‡</sup>	10.8 (3.7)	11.6 (4.1)	12.1 (4.1)	11.9 (3.9)	<.001
<b>Substance Use</b>					
Current (last 30 days, any) Drug Use (1987/88) (%)					
Marijuana	-	-	100	76	<.001
Cocaine	-	-	-	89	<.001
Amphetamines	-	-	-	12	<.001
Opiates	-	-	-	4	<.001
Ever (any) Drug Use (1987/88) (%)					
Marijuana	-	99	100	100	<.001
Amphetamines	-	39	61	95	<.001
Cocaine	-	30	45	60	<.001
Opiates	-	6	9	16	<.001
Lifetime Drug Use >10 times (1987/88) (%)					
Marijuana	-	52	93	93	<.001
Cocaine	-	12	21	62	<.001
Amphetamines	-	10	17	32	<.001
Opiates	-	1	3	4	<.001
Alcohol Use (1987/88) (%) <sup>‡</sup> <.001					
Risky Drinking	16	33	57	73	
Moderate	49	57	41	25	
Abstain	35	10	2	2	
Cigarette Use (1987/88) (%) <sup>‡</sup>					<.001
Current (last 30 days)	9	22	42	51	

Characteristic	Never Use N=812	Drug Use Category, Based on Self-Report in 1987/88 (n=3124)		p <sup>†</sup>
		Past Use Only N=1554	Current Marijuana Current Hard Drugs N=255	
Past Use	4	18	15	16
Never Smoked	87	59	43	33

\* Drug use pattern was based on self-report of drug use in 1987/88. Never Use indicated neither current nor past use of any of the 4 drugs. Past Use Only refers to use that had occurred greater than 30 days prior to the interview date. Current Marijuana and Current Hard Drugs (cocaine, amphetamines, opiates) refer to use during the 30 days prior to the interview. Other characteristics were also assessed in 1987/88, except for Risky Family Score (assessed 2000/01, pertains to childhood environment)

<sup>†</sup> Categorical data are compared with Chi-squared tests. Continuous variables were compared with Analysis of Variance.

<sup>‡</sup> Missing data for Age (n=0), BMI (n=14), Physical Activity (n=9), Chronic Medical Problems (n=1), Alcohol Use (n=9), Cigarette Use (n=18), Difficulty paying bills (n=1), Risky Family Score (n=10).



**Table 2**

Adjusted Odds Ratios (95% Confidence Intervals) for General Health Decline Over 15 Years: the CARDIA Study, 1985-2001\*

Predictor Variable <sup>†</sup>	Accounting for Age/Race/Sex	Accounting for Age/Race/ Sex and Tobacco/Drinking	Full Model
Current Drug Use, 1987/88			
Never Use	1.0	1.0	1.0
Past Use Only	1.00 (0.71-1.42)	0.94 (0.66-1.33)	0.99 (0.69-1.42)
Current Marijuana Only (last 30 days)	1.07 (0.69-1.66)	0.90 (0.57-1.45)	0.89 (0.55-1.45)
Current Hard Drugs (last 30 days)	2.04 (1.28-3.25)	1.68 (1.00-2.80)	1.83 (1.07-3.12)
Demographics			
Female vs. Male	1.30 (0.98-1.72)	1.26 (0.94-1.67)	1.01 (0.74-1.38)
Age (+1 years)	1.03 (0.99-1.07)	1.03 (0.99-1.07)	1.02 (0.98-1.06)
Black vs. White	1.91 (1.44-2.53) <sup>§</sup>	1.74 (1.30-2.32)	1.40 (1.03-1.91)
Tobacco and Alcohol			
Current Tobacco, 1987/88	-	1.89 (1.38-2.59)	1.60 (1.15-2.22)
Risky Drinking, 1987/88	-	0.79 (0.57-1.09)	0.78 (0.56-1.09)
Health and Psychosocial			
High School Graduate	-	-	0.51 (0.29-0.92)
Hard to Pay for Necessities of Life (Yes/No)	-	-	1.33 (0.98-1.80)
Marital Status (Married, Cohabiting, Other)			
Married (vs. Other)	-	-	0.74 (0.52-1.05)
Cohabiting/Unmarried (vs. Other)	-	-	0.69 (0.43-1.09)
Body Mass Index (+5 kg/m <sup>2</sup> )	-	-	1.35 (1.20-1.52)
Physical Activity Score (+1 s.d.)	-	-	0.81 (0.68-0.95)
Mental or Nervous Disorder, ever diagnosed	-	-	2.11 (1.33-3.35)
Number of Chronic Medical Disorders	-	-	1.25 (1.05-1.48)
Social Support (+1 s.d.)	-	-	0.88 (0.76-1.03)
Risky Family Score (+1 s.d.) <sup>//</sup>	-	-	1.26 (1.10-1.45)
c-statistic	0.62	0.63	0.73

\* A general health decline was defined based on a “Fair” or “Poor” response to the general self-reported health question in 2000/01, among those participants who had responded “Good” or better in 1985/86 (entire study sample). Drug use behaviors were elicited in 1987/88. Each column represents one multiple logistic regression model. Bolded results are statistically significant at the p=.05 level.

<sup>†</sup> Predictor variables were recorded/coded in 1987/88, except for Risky Family (questions about childhood upbringing were asked in 2000/01).

<sup>‡</sup> Four multivariable logistic regressions are shown, with all adjusted variables for each model shown in a single column.

<sup>§</sup> Bolded results are statistically significant at the p=.05 level.

<sup>//</sup> Risky family or origin score is derived from a questionnaire administered in 2000/01, asking questions about the family in which the subject was raised (Taylor et al., 2004)