

# Level of Education and Alcohol Abuse and Dependence in Adulthood: A Further Inquiry

## ABSTRACT

**Objectives.** Prospectively gathered data were used to reexamine and to strengthen previously described observations about education and the risk of alcohol abuse and dependence. The hypothesis was that individuals who dropped out of high school and those who entered college but failed to get a college degree might be at increased risk for an alcohol disorder.

**Methods.** Study subjects were selected between 1980 and 1984 by taking probability samples of roughly 3000 adult household residents at each of the five Epidemiologic Catchment Area Program survey sites. To assess the occurrence of psychiatric conditions, staff administered the Diagnostic Interview Schedule soon after sampling and again at follow-up, roughly 1 year later.

**Results.** Individuals who had dropped out of high school were 6.34 times more likely to develop alcohol abuse or dependence than were individuals with a college degree. For those who had entered college but failed to achieve a degree, the estimated relative risk was 3.01. To extend these analyses, estimates for annual incidence were calculated, and an exploratory evaluation of interaction is presented.

**Conclusions.** If these findings can be replicated, they should help identify subgroups at higher risk for the development of alcohol disorders. (*Am J Public Health.* 1993; 83:830-837)

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### Introduction

The relationship between an individual's educational achievement and the subsequent development of alcoholism (alcohol abuse, dependence, or both) merits attention for several reasons. Recent cross-sectional studies have found an association between level of educational achievement and alcohol use, as well as other substance use.<sup>1,2</sup> In addition, there are social psychiatric and psychological theories that link failure to meet social role expectations with subsequent behavioral disorders.<sup>3-9</sup> Finally, in theory, educational achievement might be an important modifiable risk factor for alcohol disorders.

As described in a previous report,<sup>10</sup> we used prospectively gathered data to test an a priori hypothesis about education and risk of alcohol disorders: that persons who entered a specific level of training, such as high school, but then failed to achieve a diploma might be at increased risk for the development of alcohol abuse or dependence during adulthood.<sup>10</sup> The resulting evidence indicated that school-leavers (whether from high school or college) were at higher risk to develop alcohol abuse or dependence in adulthood than were persons with a college degree or postgraduate education.

However, one limitation of the earlier report involves an issue of uncontrolled confounding. For example, previous psychiatric disturbances (such as major depression) might be causal agents in the development of alcoholism and also might affect an individual's ability to complete an intended educational goal.

The purpose of the present report is to extend current evidence on the previously reported association between educational level and the risk of alcohol abuse

or dependence by accounting for some of the disorders thought to increase risk of alcohol abuse or dependence, including affective disorders, both unipolar<sup>11-16</sup> and bipolar<sup>17,18</sup>; anxiety disorders, including panic,<sup>19-21</sup> phobia,<sup>22-24</sup> and obsessive-compulsive disorder<sup>25</sup>; schizophrenic disorders<sup>26-28</sup>; and dependence on controlled substances such as marijuana and cocaine.<sup>29-31</sup>

In this study we used prospectively gathered data from the National Institute of Mental Health Epidemiologic Catchment Area surveys conducted in five US communities. The use of prospective data is important because it provides for more direct examination of factors associated with developing a case of alcohol abuse or dependence for the first time, and it provides for direct estimation of incidence rates for specific subgroups of the population.

Our hypotheses about education and the risk of alcohol abuse or dependence required a sharpened focus on the personal and behavioral characteristics of individuals, achievable only by constraining the influence of community-level or macrosocial risk factors. For example, it is plausible that persons of lower educational achievement and socioeconomic status are more likely to live in neighbor-

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hoods with more retail outlets for alcoholic beverages (such as bars and late-hour liquor stores)<sup>32-34</sup> and where there might be more relaxed community norms about drinking to excess. The surveys did not measure these community-level risk factors directly, but we used a poststratification and matching strategy to hold neighborhood characteristics constant while testing our hypotheses about education and the risk of alcoholism.

## Methods

Between 1980 and 1984, collaborators in the National Institute of Mental Health Epidemiologic Catchment Area Program recruited 18 572 adult participants after a probability sample selection of census tracts and households in five metropolitan areas: New Haven, Conn; Baltimore, Md; St. Louis, Mo; Durham-Piedmont, NC; and Los Angeles, Calif. To assess occurrence of psychiatric conditions over time, staff administered the Diagnostic Interview Schedule<sup>35</sup> soon after sampling and again at follow-up, roughly 1 year later. The mean survey participation rate was 76% (range, 68% to 79%), with a 20% loss to follow-up at re-interview. Details of the methods involved in the study are presented elsewhere.<sup>10,36</sup> A summation follows.

Of the 18 572 household residents surveyed, 4899 (26%) did not complete either the baseline or follow-up personal interviews and were excluded from the analyses because essential data were not available, leaving 13 673. An additional 1802 individuals (10%) were excluded because their interviews at baseline revealed that they had active alcohol disorders or had had alcohol disorders in the past and were no longer at risk for future occurrence of alcohol abuse or dependence. These exclusions left 11 871 household residents who were at risk for the development of alcohol abuse or dependence between the baseline and follow-up interviews, and who therefore constituted the sample.

All study data on educational achievement and other suspected determinants of alcohol disorders were gathered with standardized interview methods. Case ascertainment for alcohol abuse or dependence was based on computerized diagnoses using data from the Diagnostic Interview Schedule, with criteria according to the *Diagnostic and Statistical Manual of Mental Disorders*, third edition.<sup>37</sup> One important implication of this approach is that a drinker is not considered to have an alcohol disorder

until all diagnostic criteria have been met. A drinker who has an alcohol problem in only one domain (e.g., someone who has been charged with driving while intoxicated) does not meet the criteria for alcohol abuse or dependence and remains at risk for developing a case (i.e., meeting all of the criteria). We have taken this approach to be consistent with the standard convention used in all previous Epidemiologic Catchment Area reports on the prevalence and incidence of alcohol use disorders.<sup>1,10,38-41</sup> However, in a supplementary analysis, we excluded drinkers who partially met criteria for alcohol disorders; this exclusion did not alter study conclusions about the education-alcohol association, as discussed elsewhere.<sup>10</sup>

Neither subjects nor interviewers were aware that the education-alcohol association would be evaluated. Other survey details, data on precision and accuracy of the Diagnostic Interview Schedule diagnoses, and a discussion of methods used to define and identify cases of alcohol disorder have been presented in detail elsewhere.<sup>36,40-44</sup>

The 11 871 at-risk participants were sorted into risk sets defined by the census tract or enumeration district where they were living when sampled and by age in years at baseline (18 through 19, 20 through 24, 25 through 29, 30 through 34, 35 through 39, and so forth). Computerized diagnoses based on the follow-up data were used to determine that 160 candidates, arising from the 156 risk sets, developed an alcohol disorder during the 1-year observation interval. This procedure of poststratification and matching put a limit on the possibility that observed associations might be confounded by age or by the residence-related factors mentioned in our introduction and in previous reports from this research group.<sup>10,45-48</sup>

Educational achievement and other suspected determinants of alcohol abuse and dependence were dummy-coded in preparation for data analysis. The education variables were defined to reflect years of schooling and academic credentials such as the regular high school diploma, the General Equivalency Diploma, and college degrees. Subjects were identified as those with neither schooling nor academic credentials; those with 1 to 8 years of schooling but with no diploma (either regular or the General Equivalency Diploma) or degree; those who attended from 9 to 12 years without earning a diploma (either regular or General Equivalency Diploma) or degree; those who obtained a General Equivalency Diploma,

regardless of years of schooling; those who attended college but did not obtain a college degree; and those who qualified for the associate of arts degree or a higher degree. For one case subject (0.6% of all case subjects) and three noncases (0.6% of all noncase subjects), data were missing for the education variable; these subjects were excluded from analyses involving these variables.

Individuals were placed in the educational category corresponding to the highest level of education achieved. For example, those who obtained a college degree were placed in that category, even if they had also earned the General Equivalency Diploma. The highest educational category was chosen to include persons with an associate of arts or higher degree; through separate analyses we have found that a separate classification for individuals with the bachelor of arts or higher degree yielded consistent estimates but with larger standard errors. Furthermore, on theoretical grounds, we speculated that going to graduate school would not increase the risk of alcohol disorders, and in the distribution there were too few subjects ( $n = 14$ ) with advanced degrees to justify a separate category.

Other potentially confounding sociodemographic variables included in these analyses were sex, race, marital status, employment status (working for pay), household composition (number in the household), and current student status (whether an individual was enrolled in school at the time of the baseline interview). One case subject (0.6% of all case subjects) and five noncases (1.0% of all noncase subjects) provided no information on racial background and were excluded from the racial category analyses. Information on number in the household was not available for one noncase subject (0.2% of all noncase subjects), who was excluded from analyses involving household composition. In addition, information on current student status was not available for one case subject (0.6% of all case subjects) and for one noncase subject (0.2% of all noncase subjects); these subjects were excluded from analyses involving this variable.

We studied the possibility of confounding by active and previous psychiatric disorders, using lifetime diagnoses from the Diagnostic Interview Schedule: antisocial personality, bipolar disorder, cognitive disorder, major depression, a major depression syndrome that was defined to include grief reactions,<sup>46</sup> dysthymia, obsessive-compulsive disorder, panic, phobia,

**TABLE 1—Frequency Distribution and Relative Risk Estimates for Subjects with Incident Cases of Alcohol Abuse or Dependence and Age- and Residence-Matched Noncase Subjects**

Psychiatric or Illicit Substance Use Disorder <sup>b</sup>	Case Subjects (n = 160)		Noncase Subjects (n = 526)		Estimated Relative Risk <sup>a</sup> (95% CI)	P
	No.	%	No.	%		
Grouped psychiatric disorders <sup>c</sup>						
Affective disorder <sup>d</sup>	17	10.6	31	5.9	1.62 (0.85, 3.08)	.143
Anxiety disorder <sup>e</sup>	26	16.3	90	17.1	1.00 (0.60, 1.68)	.991
Schizophrenic disorders <sup>f</sup>	7	4.4	11	2.1	1.77 (0.65, 4.83)	.263
Any illicit drug use disorder <sup>c</sup>	18	11.3	26	4.9	3.14 (1.54, 6.38)	.002
Specific psychiatric disorders <sup>c</sup>						
Antisocial personality	3	1.9	3	0.6		
Bipolar disorder	2	1.3	3	0.6		
Cognitive disorder	2	1.3	4	0.8		
Depression	13	8.1	27	5.1	1.38 (0.67, 2.82)	.380
Depression with grief	15	9.4	32	6.1	1.45 (0.74, 2.83)	.280
Dysthymia	3	1.9	8	1.5		
Obsessive-compulsive disorder	4	2.5	13	2.5		
Panic disorder	4	2.5	4	0.8		
Phobia	21	13.1	81	15.4	0.92 (0.53, 1.59)	.765
Schizophrenia	7	4.4	7	1.3	2.80 (0.91, 8.62)	.073
Schizophreniform disorder	0	0.0	4	0.8		
Somatization	1	0.6	2	0.4		
Specific illicit drug use disorders <sup>c</sup>						
Amphetamines	4	2.5	3	0.6		
Barbiturates	2	1.3	3	0.6		
Cannabis	13	8.1	20	3.8	3.38 (1.49, 7.65)	.003
Cocaine	0	0.0	0	0.0		
Hallucinogens	1	0.6	0	0.0		
Opioids	2	1.3	3	0.6		

*Sources.* Results are based on bivariate conditional regression analyses of data from the Epidemiologic Catchment Area Surveys in New Haven, Conn; Baltimore, Md; St. Louis, Mo; Durham, NC; and Los Angeles, Calif, 1980 through 1985.

<sup>a</sup>Because of the small subgroup sample size for many of the individual psychiatric and illicit substance use disorders, relative risk estimates with associated 95% confidence intervals and *P* values are reported only for the disorder categories with more than five case subjects and noncase subjects.

<sup>b</sup>Cases were diagnosed according to criteria published in the *Diagnostic and Statistical Manual of Mental Disorders*,<sup>37</sup> by means of the lay-administered Diagnostic Interview Schedule.<sup>35</sup> The categories for the psychiatric and substance use disorders are not mutually exclusive and any individual reporting a history of more than one disorder is included in each classification.

<sup>c</sup>The reference category is composed of individuals without the specific disorder being evaluated.

<sup>d</sup>Affective disorders include bipolar disorder, major depression, depression with grief, and dysthymia.

<sup>e</sup>Anxiety disorders include panic disorder, phobic disorders, and obsessive-compulsive disorder.

<sup>f</sup>Schizophrenic disorders include schizophrenia and schizophreniform disorder.

schizophrenia, schizophreniform and somatization disorders, and abuse or dependence involving controlled substances; these diagnoses were grouped into categories used for previous Epidemiologic Catchment Area reports.<sup>49</sup>

After preparatory analyses, the conditional logistic regression model was used to estimate the degree of association between level of educational achievement and later occurrence of alcohol abuse or

dependence. This model took into account the poststratification of subjects into risk sets, provided statistical control of potential confounding variables, and allowed exploration of effect modification.<sup>50-52</sup>

The incidence rates presented here were obtained from the entire study sample before post-stratification (n = 11 871). To be consistent with previous Epidemiologic Catchment Area incidence analyses, the definition of incidence rate used in

this study was that of first incidence<sup>41</sup>: the numerator was composed of all new cases of alcohol abuse or alcohol dependence found to have fulfilled the diagnostic criteria for the first time during the observation interval between the baseline and follow-up interviews. The denominator was composed of all individuals at risk for developing alcohol abuse or dependence during the observation interval. Because the observation interval was roughly 1 year, the reported values may be regarded as approximate annual cumulative incidence rates, according to Rothman's definition of cumulative incidence.<sup>50</sup>

## Results

### Suspected Risk Factors for Alcohol Abuse and Dependence

There were 160 subjects with incident alcohol abuse or dependence and 526 noncase subjects in 156 risk sets defined by census tract and age. The remaining 11 185 subjects were members of risk sets with no incident alcohol disorder. Initial relative risk (RR) estimates were calculated for specific sociodemographic variables; these estimates have been presented in a previous report.<sup>10</sup> Corresponding estimates for psychiatric disorders are presented in Table 1. A history of abuse or dependence involving controlled substances, especially marijuana, was associated with a threefold later excess risk for developing alcohol abuse or dependence. Associations involving other drug categories and other psychiatric disorders were neither strong nor statistically significant, in part because the number of subjects with these diagnoses was small.

Extending these analyses, we were able to estimate the education-alcohol association while controlling for age, sex, race, marital status, employment status, household composition, student status, age of first intoxication, and a history of disorders identified by the Diagnostic Interview Schedule (Table 2). With this model, we found that individuals who had dropped out of high school were more than six times more likely to develop alcohol abuse or dependence, and those who entered college but failed to get a degree were three times more likely to develop alcohol abuse or dependence, than were those with a college degree. Furthermore, we found that adults who left school before completing the ninth grade were also at increased risk relative to those with a college degree.



Other characteristics found to be associated with risk of alcohol abuse or dependence were male sex (RR = 8.32); being separated or divorced (RR = 4.50), being widowed (RR = 3.73), or never having married (RR = 2.22); and becoming intoxicated for the first time before the age of 18 years (RR = 5.92). Currently working for pay was associated with a lower risk of alcoholism (RR = 0.47). Under the multiple regression model, illicit drug disorders did not signal a substantially increased risk for alcohol abuse or dependence once the sociodemographic variables were held constant (RR = 1.59,  $P = .338$ ), and the relative risk estimate for illicit drug disorders was lower and the  $P$  value was higher than values observed in the initial regression model (Table 2 vs Table 1).

### Exploratory Study of Possible Interactions Involving Comorbidity

Because of previous research linking alcoholism with illicit drug disorders and affective disorders,<sup>e.g.,29-31,53,54</sup> we decided to examine whether the presence of an affective disorder only, an illicit drug disorder only, or both types of disorder might be associated with risk of developing alcohol abuse or dependence. In this analysis, individuals who had neither a drug use disorder nor an affective disorder at baseline served as the reference group, because we thought this might be the lowest risk category and it contained the largest number of subjects.

In this exploratory test for interaction, we found no excess risk of alcohol abuse or dependence for persons with a history of an affective disorder but without an illicit drug disorder, relative to those with neither disorder at baseline (RR = 1.08, 95% confidence interval [CI] = 0.4, 3.0,  $P = .88$ ) (Figure 1). A similar relative risk estimate was obtained for individuals with a history of drug abuse or dependence but with no affective disorder (RR = 1.19, 95% CI = 0.4, 3.2,  $P = .73$ ). However, individuals with a history of both an illicit drug disorder and affective disorder were about 12 times more likely to develop alcohol abuse or dependence than were individuals with neither of these disorders (RR = 11.86, 95% CI = 0.9, 158.2). This may be an important lead for future research.

### Estimates of Annual Cumulative Incidence

To strengthen the body of evidence on education and the risk of alcohol abuse or dependence in adulthood, we com-

**TABLE 2—Relative Risk Estimates for 160 Subjects with Incident Cases of Alcohol Abuse or Dependence and 526 Age- and Residence-Matched Noncase Subjects**

Baseline Characteristic	Reference Category	Estimated Relative Risk (95% CI)	$P$
Age <sup>a</sup>		0.95 (0.81, 1.12)	.546
Sex: male	Female	8.32 (4.44, 15.60)	<.001
Race: Black	Non-Black	1.08 (0.47, 2.51)	.857
Marital status			
Never married	Married	2.22 (0.96, 5.16)	.064
Separated/divorced	Married	4.50 (1.91, 10.59)	<.001
Widowed	Married	3.73 (1.04, 13.30)	.043
Employment status: currently working for pay	Not working for pay	0.47 (0.24, 0.92)	.027
Household composition: living alone	Not living alone	0.50 (0.22, 1.14)	.099
Student status			
Full-time student	Nonstudent	0.62 (0.20, 2.00)	.427
Part-time student	Nonstudent	0.71 (0.25, 2.07)	.534
Age of intoxication <sup>b</sup> : before 18 y	18 y or older	5.92 (3.14, 11.11)	<.001
History of psychiatric or illicit substance use disorder <sup>c</sup>			
Affective disorder	Absence of specific disorder	1.51 (0.57, 4.01)	.410
Anxiety disorder	Absence of specific disorder	1.26 (0.56, 2.84)	.573
Illicit drug abuse or dependence	Absence of specific disorder	1.58 (0.62, 4.03)	.338
Schizophrenic disorder	Absence of specific disorder	1.34 (0.28, 6.42)	.717
Educational level <sup>d</sup>			
None, no diploma	Associate or higher degree	1.67 (0.12, 23.61)	.706
1-8 y, no diploma	Associate or higher degree	3.01 (0.99, 9.15)	.052
9-12 y, no diploma	Associate or higher degree	6.34 (2.42, 16.61)	<.001
General Equivalency Diploma	Associate or higher degree	1.60 (0.40, 6.36)	.504
High school diploma	Associate or higher degree	1.76 (0.73, 4.27)	.208
College, no degree	Associate or higher degree	3.01 (1.22, 7.38)	.016

Sources. Results are based on multiple conditional regression analyses of data from the Epidemiologic Catchment Area Surveys in New Haven, Conn; Baltimore, Md; St. Louis, Mo; Durham, NC; and Los Angeles, Calif, 1980 through 1985.

<sup>a</sup>Estimated relative risk was calculated with age as a continuous variable. Although age strata were used to define the risk sets, there proved to be a residual association between age and risk of alcohol abuse or dependence and a term for age was retained in the multiple regression model.

<sup>b</sup>Age of first intoxication is included in the model as a dichotomous variable (before 18 y; 18 y or older). Persons who said they had never been intoxicated were placed in the 18 y or older category. The reference category includes individuals with late age of first intoxication (18 or older) and those who stated they had never been intoxicated. A separate analysis treated age at first intoxication as if it were a continuous variable, which led to little change in the regression estimates for the education variables.

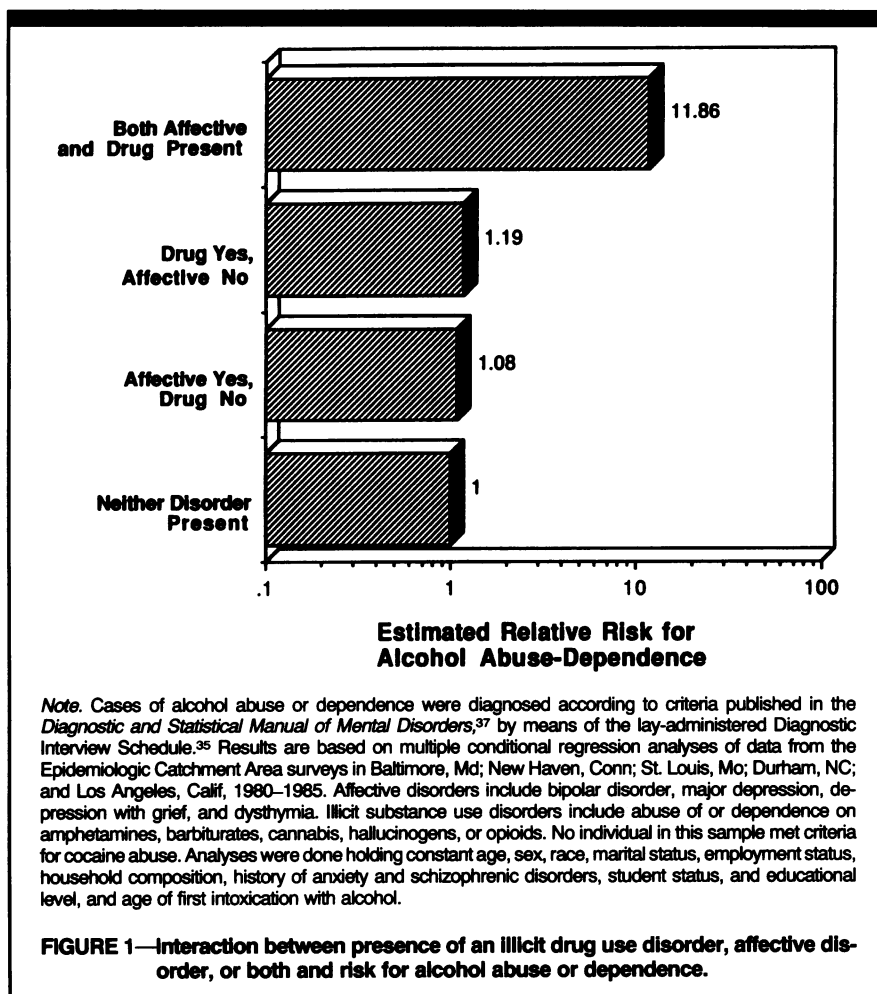
<sup>c</sup>History of psychiatric disorder was determined on the basis of data from the Diagnostic Interview Schedule.<sup>35</sup>

<sup>d</sup>Individuals were placed in the category corresponding to the highest level of education achieved. For example, those who obtained a college degree were placed in the degree category without regard for years of schooling. "No diploma" includes those without a regular diploma or a General Equivalency Diploma.

puted direct estimates for the first-time occurrence of an alcohol disorder in relation to each of the education categories and by age. These estimates for annual cumulative incidence of alcohol abuse or dependence were calculated from data from all 11 871 subjects who were at risk for developing alcohol abuse or dependence during the 1-year observation interval between baseline and follow-up. The overall estimated crude annual incidence rates for

alcohol abuse or dependence for persons aged 18 through 44 years, 45 through 64 years, and 65 years and older (Table 3) were similar to rates reported by Eaton et al. on the basis of data from four Epidemiologic Catchment Area survey sites.<sup>41</sup> Incidence estimates tended to decline across increasing age strata from peak values for adults between 18 and 44 years.

As shown in Table 3, 18 through 44-year-old persons who started but did not



complete high school and those who entered college but failed to get a degree had higher incidence rates than did subjects at other educational levels. The education-related differences were substantially smaller for the older age strata.

The differences across subgroups shown in Table 3 indicated a possible age-education interaction. With increasing age, the incidence of alcohol abuse and dependence declined for each educational category. The decline was particularly steep for individuals with 9 to 12 years of schooling who did not get a diploma and for individuals who entered college but failed to get a degree.

In addition to estimating cumulative incidence by educational level, we calculated incidence rates among persons with a history of illicit drug disorder or psychiatric disorder (data not shown in a table). Persons in the 18- through 44-year-old group with a history of drug abuse or dependence had a very high incidence rate (53.3 per 1000 persons; 95% CI = 29.3, 77.2). However, in the older age groups, only eight individuals had a history of il-

licit drug disorder, and none of these developed alcohol abuse or dependence.

Individuals with a history of psychiatric disorder were found to have similar incidence rates in the 18- through 44-year-old stratum (21.5 per 1000 persons; CI = 14.5, 28.6) and in the 45- through 64-year-old stratum (21.0 per 1000 persons; CI = 10.1, 31.9). A lower incidence of alcohol abuse or dependence was found among subjects aged 65 and older with a history of psychiatric disorder (1.7 per 1000 persons; CI = 0.0, 4.9).

## Discussion

### *Educational Level and Other Suspected Determinants of Alcoholism*

By holding constant potential confounding by previous psychiatric disorder as well as sociodemographic characteristics, we have strengthened findings concerning the relationship between educational level and the development of alcohol abuse or dependence.<sup>10</sup> In both

the previous study<sup>10</sup> and the present study, individuals who left high school or college before obtaining a diploma or degree were consistently found to be at higher risk for alcohol disorders than were those with a college degree. Furthermore, completing 1 through 8 years of education was associated with a modest increase in risk, relative to college graduates. This unanticipated finding merits continued study in future investigations.

We also examined associations between specific types of psychiatric disorders and risk of alcohol disorders. Much of the literature examining the association of alcohol disorders with psychiatric disorders has been based on prevalent rather than incident cases. The temporal relationship between disorders is often difficult to determine from cross-sectional data. For example, when depression is present concurrently with alcoholism, it may not be possible to assess whether it is the affective disorder that resulted in the onset of problem drinking or the alcohol disorder that caused depressive symptoms. We attempted to address some of these issues by analyzing prospectively gathered data.

From the conditional multiple logistic regression analyses (Table 2), we found that a history of affective, anxiety, schizophrenic, or illicit drug use disorder independently did not signal a greater risk for developing an alcohol disorder. However, because some studies have linked affective disorders with illicit substance use,<sup>e.g.,<sup>54</sup></sup> we also conducted an exploratory analysis to examine the interactive relationship of affective disorders with illicit drug abuse and dependence. We found that drug abuse or dependence alone did not appear to signal a greater likelihood for the development of an alcohol disorder. The reverse relationship yielded similar results: an affective disorder alone was not associated with higher risk for alcoholism. However, individuals with a history of both illicit drug disorder and affective disorder were at much higher risk than persons with neither type of disorder. Although these were intended as exploratory analyses, this work raises some new questions needing attention in future studies. For example, is risk of alcoholism greater among individuals who have a history of both disorders because these individuals have more severe symptoms or a more chronic disease course or because coexistent affective and drug disorders are more difficult to treat? To tease apart these etiologic relationships, future investigations will need to consider the de-

velopmental sequence of the disorder, the severity and chronic character of the symptoms, and responses to treatment.

### Estimated Annual Cumulative Incidence

The annual incidence estimates from this study illustrate several noteworthy patterns across the age and educational group categories. There were sharp differences in incidence across the educational groups, particularly those hypothesized to be at increased risk for alcohol abuse or dependence (i.e., persons who entered high school but failed to get a diploma and persons who entered college but did not get a degree). The differences were stronger for younger adults, which suggests the possibility of an interaction between age group and educational level in respect to the development of these alcohol disorders. One interpretation of these results implies that individuals who fail to achieve their educational goals may be at increased risk for alcohol abuse or dependence only during the younger and early middle years of adulthood. This makes some intuitive sense. It is plausible that the associated risk for these disorders among those who drop out of school would be most pronounced during the period nearest the time of exposure. It is also plausible that lack of educational achievement has a continuing stressful effect but that alcohol abuse is more likely to be chosen as a coping mechanism at earlier rather than later ages, reflecting generational differences in the acceptability of alcohol as a means of coping. These findings may also signify a possible secular difference in relation to educational level, perhaps reflecting the fact that high school diplomas and college degrees have become more important in the later decades of the 20th century. It is conceivable that the older adults in this study might have had different educational goals when they were in school more than 40 years ago. For these individuals, leaving school (particularly college) early may have had less significance for risk of alcohol disorders.

### Limitations of the Study and Avenues for Future Research

Several limitations of this study should be discussed. First, we were not able to examine all potential and suspected determinants of alcohol abuse or dependence. These included, for example, a positive family history for alcoholism, as well as specific personality and behavioral traits that may have a confounding relationship in respect to the as-

TABLE 3—Crude Estimated Annual Incidence Rates per 1000 Persons for Alcohol Abuse or Dependence, by Age Group

	Annual Incidence per 1000 Persons (95% CI)		
	18–44 y	45–64 y	65 y and older
All persons <sup>a</sup>	20.3 (16.6, 24.0)	11.1 (7.2, 15.1)	4.5 (2.3, 6.7)
Educational level <sup>b</sup>			
0–8 y, no diploma	21.1 (5.6, 36.6)	16.5 (6.4, 26.6)	2.6 (0.05, 5.1)
9–12 y, no diploma	39.8 (26.3, 53.3)	12.1 (2.5, 21.7)	8.5 (1.1, 15.9)
High school diploma or General Equivalency Diploma	15.6 (10.1, 21.1)	9.3 (2.9, 15.7)	8.5 (1.7, 15.4)
College, no degree	29.5 (19.1, 39.9)	12.7 (0.3, 25.1)	0.0 (..)
Associate or higher degree	9.3 (4.5, 14.2)	5.0 (–1.9, 11.8) <sup>c</sup>	2.6 (–2.5, 7.8) <sup>c</sup>

*Note.* Cases of alcohol abuse or dependence were diagnosed according to criteria published in the *Diagnostic and Statistical Manual of Mental Disorders*,<sup>37</sup> by means of the lay-administered Diagnostic Interview Schedule.<sup>35</sup>

*Sources.* Data are from the Epidemiologic Catchment Area Surveys in New Haven, Conn; Baltimore, Md; St. Louis, Mo; Durham, NC; and Los Angeles, Calif, 1980 through 1985 (n = 11 871).

<sup>a</sup>For three noncase subjects (0.03% of all noncase subjects), data were missing for the age variable; these subjects were excluded from the age-group analyses.

<sup>b</sup>Individuals were placed in the category corresponding to the highest level of education achieved. For example, those who obtained a college degree were placed in the degree category without regard for years of schooling. "No diploma" includes those without a regular diploma or a General Equivalency Diploma. For 1 case subject (0.9% of case subjects) and 38 noncase subjects (0.7% of noncase subjects) in the 18- through 44-year age group, for 11 noncase subjects (0.4% of noncase subjects) in the 45- through 64-year age group, and for 23 noncase subjects (0.6% of noncase subjects) in the 65 years and older age group, data were missing for the education variable. These subjects were excluded from the age-group analyses involving this variable.

<sup>c</sup>The lower bounds for these confidence intervals are in the negative range because of our use of standard symmetrical methods (i.e.,  $\pm 1.96$  [standard error]).

sociation of educational level and risk of alcohol disorders. However, this report improves on previous work<sup>10</sup> by incorporating into the analysis a number of psychiatric disorders in addition to sociodemographic characteristics. Thus, the possible confounding effects of these factors have been controlled, with no appreciable change in conclusions about the education–alcohol association.

Second, there was nonparticipation at baseline as well as sample attrition during follow-up.<sup>55</sup> These aspects of the study must be considered when drawing inferences and making generalizations from these prospectively gathered data. If they were present, differential attrition for subjects cross-classified by education and new onset of alcoholism would complicate inferences from these data, especially in relation to external validity (generalizability). For example, it is conceivable that attrition was most severe for the education categories found to be at lower risk (e.g., those with a college degree). However, Eaton et al.<sup>55</sup> did not find this relationship in their study of attrition within the same sample.

Third, it was not possible to evaluate the temporal development of symptoms for the onset of alcohol abuse or depen-

dence. It can be argued that some persons may have met some of the Diagnostic and Statistical Manual criteria for alcohol abuse or dependence but did not fulfill the criteria for the full syndrome. These subjects would not have been removed from the study sample. As a method to control for this problem, we included age of first intoxication as a variable in the logistic regression analysis. Furthermore, in a supplementary analysis we evaluated the education–alcohol association after removing from the analysis subjects who met even some of the criteria for alcohol abuse or dependence. The results of this supplementary analysis did not alter the conclusions of the study, as discussed in detail in a previous report.<sup>10</sup> In the present study, we also acknowledge another concern involving the psychopathologic diagnoses. We were not able to include information regarding the onset of any specific psychiatric or illicit substance use disorder as part of the modeling strategies. This information might have significant implications. For instance, for some cases, early drinking behavior may have resulted in depressive symptoms. It is conceivable that for these subjects, problem drinking may have caused the depressive syndrome and not the reverse; these subjects

may later have developed a full-fledged alcohol dependence syndrome or alcohol abuse.

Notwithstanding these limitations, the results of the present study merit attention for several reasons. First, this study strengthens the previously described finding that failure to meet a specific educational goal, such as obtaining a high school diploma or a college degree, signals greater risk for the future development of alcohol abuse or dependence. If these results can be replicated, they should enhance the identification of subgroups at higher risk for the development of alcohol use disorders. Second, educational achievement may be an important modifiable characteristic for the targeting of future prevention and intervention programs. Furthermore, the other suspected risk factors identified in this study merit continuing attention. Finally, our exploratory analysis suggests a possible interaction between illicit drug disorder, affective disorder, and later risk of alcohol disorders. This finding can be a focus for future studies of psychiatric comorbidity. □

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## References

- Helzer JE, Burnam A, McEvoy LT. Alcohol abuse and dependence. In: Robins LN, Regier DA, eds. *Psychiatric Disorders in America*. New York, NY: The Free Press; 1991:81-115.
- Mensch BS, Kandel DB. Dropping out of school and drug involvement. *Sociol Educ*. 1988;61:95-113.
- Jessor R, Jessor SL. *Problem Behavior and Psychosocial Development: A Longitudinal Study of Youth*. New York, NY: Academic Press; 1977.
- McCord W, McCord J. A longitudinal study of the personality of alcoholics. In: Pittman DJ, Snyder CR, eds. *Society, Culture and Drinking Patterns*. New York, NY: John Wiley & Sons Inc; 1962:413-430.
- Robins LN, Bates WM, O'Neal P. Adult drinking patterns of former problem children. In: Pittman DJ, Snyder CR, eds. *Society, Culture and Drinking Patterns*. New York, NY: John Wiley & Sons Inc; 1962:395-412.
- Jones MC. Personality correlates and antecedents of drinking patterns in adult males. *J Consult Clin Psychol*. 1968;32:2-12.
- Jones MC. Personality antecedents and correlates of drinking patterns in women. *J Consult Clin Psychol*. 1971;36:61-69.
- Loper RG, Kammeier ML, Hoffmann H. MMPI characteristics of college freshman males who later became alcoholics. *J Abnorm Psychol*. 1973;82:159-162.
- Kellam SG, Ensminger ME. Theory and method in child psychiatric epidemiology. In: Earls F, ed. *Studies of Children*. New York, NY: Prodist; 1980:145-180.
- Crum RM, Bucholz KK, Helzer JE, Anthony JC. The risk of alcohol abuse and dependence in adulthood: the association with educational level. *Am J Epidemiol*. 1992;135:989-999.
- Aneshensel CS, Huba GJ. Depression, alcohol use, and smoking over one year: a four-wave longitudinal causal model. *J Abnorm Psychol*. 1983;92:134-150.
- Haack MR, Harford TC, Parker DA. Alcohol use and depression symptoms among female nursing students. *Alcohol Clin Exp Res*. 1988;12:365-367.
- Parker DA, Parker ES, Harford TC, Farmer GC. Alcohol use and depression symptoms among employed men and women. *Am J Public Health*. 1987;77:704-707.
- Powell BJ, Read MR, Penick EC, Miller NS, Bingham SF. Primary and secondary depression in alcoholic men: an important distinction? *J Clin Psychiatry*. 1987;48:98-101.
- Lewis CE, Rice J, Andreasen N, Endicott J, Hartman A. Clinical and familial correlates of alcoholism in men with unipolar major depression. *Alcohol Clin Exp Res*. 1986;10:657-662.
- Schuckit MA. The clinical implications of primary diagnostic groups among alcoholics. *Arch Gen Psychiatry*. 1985;42:1043-1049.
- Reich LH, Davies RK, Himmelhoch JM. Excessive alcohol use in manic-depressive illness. *Am J Psychiatry*. 1974;131:83-86.
- O'Sullivan K, Rynne C, Miller J, et al. A follow-up study on alcoholics with and without co-existing affective disorder. *Br J Psychiatry*. 1988;152:813-819.
- George DT, Nutt DJ, Dwyer BA, Linnola M. Alcoholism and panic disorder: is the comorbidity more than coincidence? *Acta Psychiatr Scand*. 1990;81:97-107.
- Nunes E, Quitkin F, Berman C. Panic disorder and depression in female alcoholics. *J Clin Psychiatry*. 1988;49:441-443.
- Cox BJ, Norton GR, Dorward J, Ferguson PA. The relationship between panic attacks and chemical dependencies. *Addict Behav*. 1989;14:53-60.
- Stockwell T, Bolderston H. Alcohol and phobias. *Br J Addict*. 1987;82:971-979.
- Stravynski A, Lamontagne Y, Lavallée Y-J. Clinical phobias and avoidant personality disorder among alcoholics admitted to an alcoholism rehabilitation setting. *Can J Psychiatry*. 1986;31:714-719.
- Hall SM. The abstinence phobias: links between substance abuse and anxiety. *Int J Addict*. 1984;19:613-631.
- Eisen JL, Rasmussen SA. Coexisting obsessive compulsive disorder and alcoholism. *J Clin Psychiatry*. 1989;50:96-98.
- Freed EX. Alcoholism and schizophrenia: the search for perspectives. *J Stud Alcohol*. 1975;36:853-881.
- Alterman AI, Ayre FR, Williford WO. Diagnostic validation of conjoint schizophrenia and alcoholism. *J Clin Psychiatry*. 1984;45:300-303.
- Ban TA. Alcoholism and schizophrenia: diagnostic and therapeutic considerations. *Alcohol Clin Exp Res*. 1977;1:113-117.
- Anthony JC, Petronis KR. Epidemiologic evidence on suspected associations between cocaine use and psychiatric disturbances. In: Schober S, Schade C, eds. *The Epidemiology of Cocaine Use and Abuse*. Washington, DC: National Institute on Drug Abuse; 1991. DHHS publication ADM 91-1787. Research Monograph 110: 71-94.
- Anthony JC, Helzer JE. Syndromes of drug abuse and dependence. In: Robins LN, Regier DA, eds. *Psychiatric Disorders in America*. New York, NY: The Free Press; 1991:116-154.
- Hesselbrock MN, Meyer RE, Keener JJ. Psychopathology in hospitalized alcoholics. *Arch Gen Psychiatry*. 1985;42:1050-1055.
- Colon I. The influence of state monopoly of alcohol distribution and the frequency of package stores on single motor vehicle fatalities. *Am J Drug Alcohol Abuse*. 1982-1983;9:325-331.
- Stone GP. Drinking styles and status arrangements. In: Pittman DJ, Snyder CR, eds. *Society, Culture and Drinking Patterns*. New York, NY: John Wiley & Sons Inc; 1962:121-140.
- Clinard MB. The public drinking house and society. In: Pittman DJ, Snyder CR, eds. *Society, Culture and Drinking Patterns*. New York, NY: John Wiley & Sons Inc; 1962:270-292.
- Robins LN, Helzer JE, Orvaschel H, et al. The Diagnostic Interview Schedule. In: Eaton WW, Kessler LG, eds. *Epidemiologic Field Methods in Psychiatry: The NIMH Epidemiologic Catchment Area Program*. Orlando, Fla: Academic Press; 1985:143-170.
- Eaton WW, Kessler LG, eds. *Epidemiologic Field Methods in Psychiatry: the NIMH Epidemiologic Catchment Area Program*. Orlando, Fla: Academic Press; 1985.
- American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 3rd ed. Washington, DC: American Psychiatric Association; 1980.
- Myers JK, Weissman MM, Tischler GL, et al. Six-month prevalence of psychiatric disorders in three communities. *Arch Gen Psychiatry*. 1984;41:959-967.
- Robins LN, Helzer JE, Weissman MM, et al. Lifetime prevalence of specific psychi-



- atric disorders in three sites. *Arch Gen Psychiatry*. 1984;41:949-958.
40. Regier DA, Boyd JH, Burke JD, et al. One-month prevalence of mental disorders in the United States—based on five Epidemiologic Catchment Area sites. *Arch Gen Psychiatry*. 1988;45:977-986.
  41. Eaton WW, Kramer M, Anthony JC, Dryman A, Shapiro S, Locke BZ. The incidence of specific DIS/DSM-III mental disorders: data from the NIMH Epidemiologic Catchment Area Program. *Acta Psychiatr Scand*. 1989;79:163-178.
  42. Robins LN, Helzer JE, Croughan J, Ratcliff KS. National Institute of Mental Health Diagnostic Interview Schedule: its history, characteristics, and validity. *Arch Gen Psychiatry*. 1981;38:381-389.
  43. Anthony JC, Folstein M, Romanoski AJ, et al. Comparison of the lay Diagnostic Interview Schedule and a standardized psychiatric diagnosis. Experience in eastern Baltimore. *Arch Gen Psychiatry*. 1985;42:667-675.
  44. Eaton WW, Kramer M, Anthony JC, Chee EML, Shapiro S. Conceptual and methodological problems in estimation of the incidence of mental disorders from field survey data. In: Cooper B, Helgason T, eds. *Epidemiology and the Prevention of Mental Disorders*. London, England: Routledge; 1989:108-127.
  45. Anthony JC, Tien AY, Petronis KR. Epidemiologic evidence on cocaine use and panic attacks. *Am J Epidemiol*. 1989;129:543-549.
  46. Anthony JC, Petronis KR. Suspected risk factors for depression among adults 18-44 years old. *Epidemiology*. 1991;2:123-132.
  47. Petronis KR, Anthony JC. An epidemiologic investigation of marijuana- and cocaine-related palpitations. *Drug Alcohol Depend*. 1989;23:219-226.
  48. Petronis KR, Samuels JF, Moscicki EK, Anthony JC. An epidemiologic investigation of potential risk factors for suicide attempts. *Soc Psychiatry Psychiatr Epidemiol*. 1990;25:193-199.
  49. Regier DA, Farmer ME, Rae DS, et al. Comorbidity of mental disorders with alcohol and other drug abuse. Results from the Epidemiologic Catchment Area (ECA) Study. *JAMA*. 1990;264:2511-2518.
  50. Rothman KJ. *Modern Epidemiology*. Boston, Mass: Little, Brown & Company; 1986.
  51. Kleinbaum DG, Kupper LL, Morgenstern H. *Epidemiologic Research: Principles and Quantitative Methods*. New York, NY: Van Nostrand Reinhold; 1982.
  52. Breslow NE, Day NE. *Statistical Methods in Cancer Research. Vol 1. The Analysis of Case-Control Studies*. Lyon, France: International Agency for Research on Cancer; 1980. IARC scientific publication 32.
  53. Woodruff RA, Guze SB, Clayton PJ, Carr D. Alcoholism and depression. In: Goodwin DW, Erickson CK, eds. *Alcoholism and Affective Disorders: Clinical, Genetic, and Biochemical Studies*. New York, NY: Spectrum Publications; 1979:39-48.
  54. Disalver SC. The pathophysiologies of substance abuse and affective disorders: an integrative model? *J Clin Psychopharmacol*. 1987;7:1-10.
  55. Eaton WW, Anthony JC, Tepper S, Dryman A. Psychopathology and attrition in the Epidemiologic Catchment Area surveys. *Am J Epidemiol*. 1992;135:1051-1059.

## Call for Abstracts for Latin American and Social Medicine Congresses

"Health at the End of Millennium/Challenges and Alternatives for Change" will be the theme of the 6th Latin American Congress and the 8th Social Medicine World Congress, to be held March 20-24, 1994, at the Villa Primavera Hotel, Guadalajara, Mexico. The congresses are sponsored by the Latin American Association of Social Medicine, the International Association of Health Policy, and the University of Guadalajara.

The congresses' objective is to bring together health and related professionals to exchange experiences and new ideas on health problems at the end of the millennium. Topics as they relate to health will include the following: social medicine research; citizenship and community participation; professional training; population, gender, age groups; history and society; new epidemiological profiles; ethnicity and mi-

norities; social inequality and poverty; ethics; ecology; technology; alternative models of health care; education; financing health research; health in large cities; social politics; social environment; financing health policy; mental health; violence; culture; drugs and the pharmaceutical industry; and maternal and child.

Precongress courses will be held March 17-19, 1994, at the University of Guadalajara, Guadalajara, Mexico.

The deadline for the receipt of abstracts is July 31, 1993. For more information, contact the Organizing Committee, 6th Latin American Congress and 8th Social Medicine World Congress, c/o Jesus Galindo, Villa 2941, Jardines de la Paz, Guadalajara, Jalisco, Mexico 44860; tel. 52-3-617-78-46; fax 52-3-617-55-06 and 52-3-635-91-22; Bitnet alames@leon.dca.udg.mx or alames@sectec.sscnet.ucla.edu.