The Development of Heavy Drinking and Alcohol-Related Problems from Ages 18 to 37 in a U.S. National Sample*

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ABSTRACT. *Objective:* The purpose of this study is to add to the understanding of the development of heavy alcohol use and alcohol-related problems by examining data from the National Longitudinal Survey of Youth (NLSY), a general population sample that contains information on alcohol use for the ages 18-37. A key question in this study is how background characteristics of the individual influence this development and whether the influence of these background characteristics changes over time. *Method:* The data used in this study are a general population sample (N = 7,859) from the National Longitudinal Survey of Youth (NLSY). This study uses a multivariate outcome approach that focuses on individual variation in trajectories over age. The statistical analysis uses random coefficients in a latent variable framework. Across-age changes in the importance of the influence of background variables on the outcomes are modeled using varying centering points. *Results:* A key finding is that dropping out of high school has no effect on alcohol-related problems for individuals in their mid-twenties, but is associated with significantly increased levels of alcohol-related problems for individuals in their mid-thirties. In contrast, going on to college is associated with lower levels of heavy drinking when individuals reach their late twenties and their thirties. Strong gender and ethnicity effects seen in the twenties diminish when individuals reach their thirties. *Conclusions:* The trajectory analysis expands the knowledge of problematic alcohol development for individuals in their late twenties and thirties. The increasing detrimental effect of dropping out of high school up to the age 37 endpoint of the study raises questions about the effects in later life of dropping out of high school. (*J. Stud. Alcohol* **61:** 290-300, 2000)

THERE IS A LARGE BODY of research on the development of heavy alcohol use and alcohol-related problems. It is well recognized in the alcohol field that heavy drinking and alcohol-related problems typically accelerate in late adolescence, peak in the early twenties, and decelerate thereafter. This has been discussed in, for example, Bates and Labouvie (1997), Chen and Kandel (1995), Harford (1993), Johnston et al. (1994), Kandel (1980), Kandel and Logan (1984), Temple and Fillmore (1985-86), Windle (1988) and Zucker (1994). Similar types of developmental curves across these ages have also been found for antisocial behavior (Moffitt, 1993) and crime (Gottfredson and Hirschi, 1990; Nagin and Land, 1993). The purpose of this study is to add to the understanding of the development of heavy alcohol use and alcohol-related problems by examining data from the National Longitudinal Survey of Youth (NLSY; Center for Human Resource Research, 1994), a general population sample that contains information on alcohol use for those aged 18 to 37. A key question in this study is how background characteristics of the individual influence this development and whether the influence of these background characteristics changes with age.

Researchers have identified many important background characteristics related to heavy alcohol use and alcohol-related problems that will be used in this study. Studies of the influence of gender on alcohol problem development show that men and women typically accelerate alcohol use in their late teens and early twenties reaching a peak around age 21, with women peaking at a lower value than men (Bates and Labouvie, 1997; Schuckit et al., 1995; Wilsnack et al., 1984, 1991). Studies of the influence of ethnicity on alcohol use show that blacks have lower levels of alcohol use than do whites in their twenties, and similar levels in their thirties (Helzer and Canino, 1992; Herd, 1990). Studies of the influence of family history of alcoholism show that this is associated with an increased level of alcohol-related problems (Chassin et al., 1996; Dawson et al., 1992; Sher et al., 1991; Windle, 1996). Studies of the age of onset of regular drinking show that starting at earlier ages influences both drinking patterns and alcohol-related problems (Grant and Dawson, 1997; Jessor and Jessor, 1975; Margulies et al., 1977; Robins and Przyback, 1985; Windle, 1991). Studies of dropping out of high school show that this increases the risk for alcohol abuse and dependence (Crowley, 1991; Crum et al., 1992, 1998; Gfroerer et al., 1997; Jarjoura, 1993; Mensch and Kandel, 1988). Studies of the influence of education show that higher education is associated with a lower level of substance use at least after the college years (Gfroerer et al., 1997).

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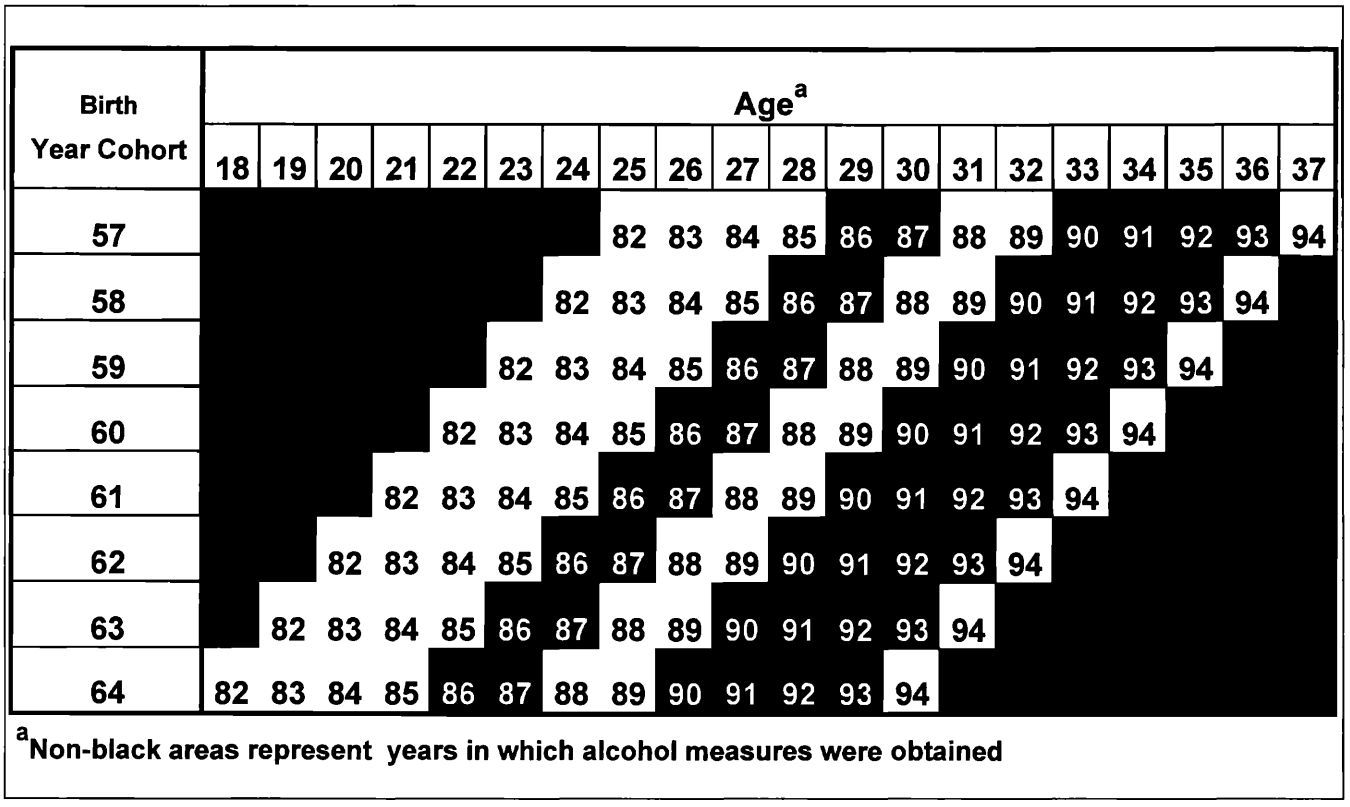

FIGURE 1. NLSY multiple-cohort data structure for the alcohol measures

This study contributes to the understanding of alcohol development in three ways. First, because of the wide range of ages represented in the NLSY, it is possible to study the influence of the background variables at several different life stages to determine if a risk factor such as early onset of drinking has different importance at different stages such as in the late teens, in the early twenties, in the late twenties, and in the thirties. Second, because the NLSY is a general population household sample, it is possible to include an education variable that contains information on both high school and college experience, allowing the study of the influence of dropping out of high school on alcohol-related problems. Third, the study uses the multivariate analysis technique of random coefficient growth modeling, which is a powerful method for modeling individual variation in development, for assessing the ability of background variables to explain this variation, and for studying the change across ages in the importance of background variables.

Method

Subjects

The study uses data from the National Longitudinal Survey of Youth (NLSY), which is a nationally representative household sample of 12,686 men and women born between 1957 and 1964. The NLSY has several features that make it particularly suitable for this study. Because it is a longitudinal dataset with multiple cohorts, and respondents were interviewed annually from 1979 through 1994, the range of ages represented in the sample is 15-37. Second, because the National Institute on Alcohol Abuse and Alcoholism (NIAAA) supported the inclusion of a supplement of alcohol-related questions in 1982, 1983, 1984, 1985, 1988, 1989 and 1994, it is the only nationally representative sample containing alcohol measures over such a long period of time, representing ages 18 to 37. Figure 1 shows the multiple-cohort structure of the data for the alcohol outcome measures and the ages represented in the study. The nonblack areas represent years in which alcohol measures were obtained.

The NLSY data were collected as a multistage probability sample with an oversampling of black, Hispanic and economically disadvantaged non-black and non-Hispanic youths. Personal interviews lasting approximately 1 hour were conducted each year between January and May since 1979. As of 1989, the overall retention rate of the sample was 93%. All age eligible siblings in a household were interviewed.

The sample for the study includes 7,859 individuals who in 1989 gave a positive answer to the question: "Have you ever had a drink of an alcoholic beverage?" and for whom there were complete data on the variables used in the growth model analyses. Table 1 shows the characteristics of the sample as defined by the background variables and the outcome variables. It reflects the oversampling of blacks, Hispanics and economically disadvantaged non-black and non-Hispanic youths. For example, there are 18% high school dropouts compared to 11% reported in 1994 for the population aged 16 to 24 (McMillen et al., 1994).

Measures

Outcome variables. Two outcome variables related to alcohol use are considered in this study. The first, heavy drinking, is measured by the question: "How often have you had 6 or more drinks on one occasion during the last 30 days?" The responses are recorded as: never (0); once (1); 2 or 3 times (2); 4 or 5 times (3); 6 or 7 times (4); 8 or 9 times (5); and 10 or more times (6). This variable was measured in 1982, 1983, 1984, 1985, 1988, 1989 and 1994, representing ages 18-37. In the analyses, 1985 is excluded given that a question format change was made that year that may have made across-time comparisons invalid (Harford, 1994). The second outcome variable, an alcohol-related problem severity score, is based on 22 symptom items designed to approximate the DSM-IV (American Psychiatric Association, 1994) diagnoses of alcohol dependence and abuse. Each symptom item is scored 1 if the event occurred at least once in the last year, and 0 otherwise. These symptom items were measured in 1989 and 1994, representing ages 25-37. From a factor analysis of these items, a sum of the 17 items measuring the most severe dimension was created to form a variable that is referred to as the alcohol problem severity score.

Background variables. Background variables include gender, ethnicity, family history of problem drinking, early onset of drinking, high school dropout and college education. Gender is represented by a 0/1 dummy variable, with

TABLE 1. NLSY sample characteristics (N = 7,859)

	Frequency	Percentage
Male	3,817	48.6
Black	2,397	30.5
Hispanic	1,455	18.5
Family history 1[a]	1,138	14.5
Family history 23[b]	1,625	20.7
Family history 123[c]	889	11.3
Early onset[d]	812	10.3
High school dropout	1,438	18.3
College education	2,748	35.0

	Heavy drinking		Alcohol problem severity score		
Age	N	Mean (±SD)	Corr.	N	Mean (±SD)
18	935	0.66 ± 1.31	–	–	–
19	2,023	0.89 ± 1.53	–	–	–
20	3,177	1.02 ± 1.61	–	–	–
21	3,328	1.06 ± 1.64	–	–	–
22	3,309	1.04 ± 1.59	–	–	–
23	3,065	1.03 ± 1.60	–	–	–
24	3,772	1.02 ± 1.56	–	–	–
25	4,624	0.95 ± 1.52	0.51	921	0.75 ± 1.91
26	3,933	0.88 ± 1.47	0.53	1,076	0.62 ± 1.75
27	3,073	0.84 ± 1.46	0.52	1,150	0.56 ± 1.57
28	2,155	0.82 ± 1.43	0.46	1,083	0.49 ± 1.58
29	1,979	0.86 ± 1.51	0.47	1,068	0.53 ± 1.65
30	2,703	0.85 ± 1.51	0.51	1,811	0.58 ± 1.73
31	2,779	0.73 ± 1.41	0.54	1,915	0.60 ± 1.78
32	1,987	0.69 ± 1.41	0.48	1,982	0.44 ± 1.48
33	1,086	0.69 ± 1.37	0.44	1,083	0.49 ± 1.68
34	1,069	0.71 ± 1.37	0.50	1,068	0.56 ± 1.69
35	910	0.76 ± 1.47	0.49	890	0.56 ± 1.73
36	858	0.66 ± 1.32	0.52	839	0.51 ± 1.68
37	833	0.58 ± 1.28	0.52	832	0.40 ± 1.51

[a] Family history of problem drinking among first-degree relatives.
[b] Family history of problem drinking among second- or third-degree relatives.
[c] Family history of problem drinking among first- and second- or third-degree relatives.
[d] Starting to drink at age 14 or younger.

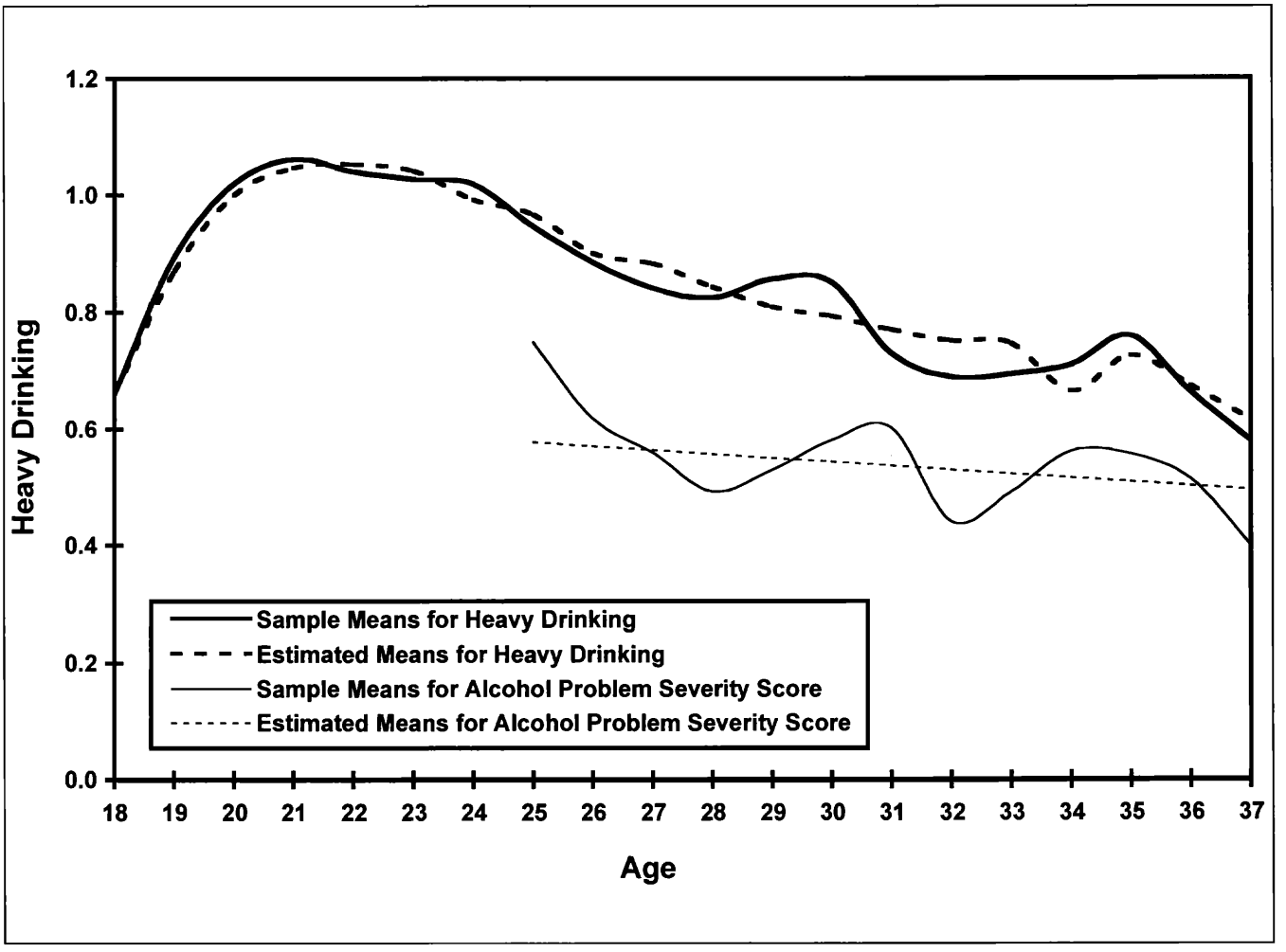

FIGURE 2. Sample means and estimated means for heavy drinking and the alcohol problem severity score

1 representing men. Ethnicity is captured by two 0/1 dummy variables, one for black and one for Hispanic, with 1 representing minority status. Family history of problem drinking is measured by the 1988 question: "Have any of your relatives listed on this card been alcoholics or problem drinkers at any time in their lives?" Three 0/1 dummy variables are considered for family history of problem drinking, with 1 representing the presence of the problem: problem drinking among only first-degree relatives; among only second- or third-degree relatives; and among first- and second- or third-degree relatives. Early onset of drinking was measured in 1982 by the following query: "How old were you when you first started drinking?" Probe: "For example, having two or more drinks a week." Early onset of drinking is scored as a 0/1 dummy variable, with 1 representing early onset, which is defined as starting to drink at age 14 or younger. Dropping out of high school is measured as not having completed high school by age 22. It is scored as a 0/1 dummy variable, with 1 representing dropping out of high school. College education is measured as having some college education by age 22. It is scored as a 0/1 dummy variable, with 1 representing some college education by age 22.

Analysis methods

Random coefficient growth modeling, also known as multilevel or mixed linear modeling, is used to study the influence of the set of background variables on the two alcohol outcome variable trajectories. The growth models are estimated by maximum likelihood using the latent variable structural equation modeling program Mplus (Muthén and Muthén, 1998). Testing of differences in model structure across the eight cohorts is carried out using a multiple-population (multiple-group) analysis with and without cohort invariance. Growth models are estimated for frequency of heavy drinking and for the alcohol problem severity score.

Although all age-eligible siblings in a household were interviewed in the NLSY, given the low average number of

siblings per household and the low intraclass correlation for households with respect to frequency of heavy drinking, this lack of independence of observations can be ignored in the estimation. The intraclass correlations for heavy drinking range from 0.19 in 1982 to 0.06 in 1989. The average number of siblings per household is 1.4. As pointed out in Muthén (in press), the small intraclass correlations in conjunction with the small average household size is unlikely to affect the results due to nonindependence of observations.

Heavy drinking modeling. Given the shape of the mean curve for heavy drinking, which is shown in Figure 2, a quadratic growth model with three random coefficients was chosen for this outcome variable. The model expresses the development of the heavy drinking outcome variable over time as a quadratic function of random coefficients η:

$$y_{it} = \eta_{1i} + \lambda_t \eta_{2i} + \lambda_t^2 \eta_{3i} + \varepsilon_{it} . \quad (1)$$

Here, the subscript i denotes individuals (i = 1, 2, ..., 7859), the subscript t denotes time points (t = 1, 2, ..., 20), η_{1i} is an intercept term, η_{2i} a linear term, and η_{3i} a quadratic term. In this study the analysis is carried out within a latent variable framework (see, e.g., Muthén and Curran, 1997) where these terms are referred to as growth factors. In Equation 1, λ_t denotes time steps and ε_{it} denotes time-specific residuals that are uncorrelated with the η's and describe the part of individual i's trajectory not explained by the growth processes. Adjacent ε's are allowed to be correlated. The variation across individuals in the three growth factors is described by the set of background variables. The quadratic growth analysis of heavy drinking uses two special features: (1) varying the centering point, which gives a more informative analysis, and (2) estimating rather than fixing the time steps, which results in a better fitting model.

In a conventional quadratic growth model, the λ_t time step values are fixed. They may be scored as age values (18, 19, ..., 37) but are typically fixed at 0, 1, 2, ...,T-1 for T time points (here, T = 20). In the latter case the intercept η_{1i} is interpreted as initial status of the growth process. This interpretation arises because by setting $\lambda_t = 0$ for t = 1 (at age 18), the first time point of Equation 1 may be expressed as $y_{i1} = \eta_{1i} + \varepsilon_{i1}$ so that the intercept η_{1i} gives rise to the part of the variation of y_{it} at age 18 that is explained by the growth process. More generally, λ_t may be set to zero for a t value other than the first in which case the intercept η_{1i} is interpreted at that age. The age at which the intercept is defined is referred to as the centering point. The growth analyses of heavy drinking vary the centering point to describe the influence of background variables at different ages. Models with different centering points are reparameterizations of each other and result in the same model fit. Note that this is not the same as doing regular regression for the outcome variable at these different ages. Regular regression does not draw on information from all time points and is less powerful than random coefficient growth modeling.

Alcohol problem severity score modeling. Figure 2 shows that the mean curves for the outcome variables frequency of heavy drinking and the alcohol problem severity score are similar for the ages where both are observed, 25 to 37. The severity score is based on items asked in 1989 and 1994. An advantage of the multiple-cohort design is that this results in coverage of a wide age range, 25 to 37 (see Figure 1). With two time points, a general random coefficient growth model cannot be identified even when restricted to a linear model, but a simplified linear model can be identified when restricted to have a random coefficient only for the intercept while letting the slope be fixed (i.e., not varying across individuals). The assumption of a linear growth model with fixed slope is plausible for the severity score in the 25 to 37 age range for three reasons. First, this age range is past the normative peak age and shows a linear decline. Second, estimates for heavy drinking show that most of the individual variation can be captured by variation in the intercept defined at 25. Third, the slope is still allowed to vary as a function of the background variables.

TABLE 2. Growth model estimates centering at age 18 for heavy drinking and at age 25 for the alcohol problem severity score

	Heavy drinking growth factors			Alcohol problem severity score growth factors	
Background variables	Intercept	Linear	Quadratic	Intercept	Linear
Intercept	0.66[a]	0.25[a]	-0.04[a]	0.58[a]	-0.01
Male	0.44[a]	0.26[a]	-0.04[a]	0.49[a]	-0.00
Black	-0.62[a]	-0.10[a]	0.03[a]	-0.15[a]	0.03[a]
Hispanic	-0.30[a]	-0.08	0.02[a]	0.01	-0.00
Family history 1	-0.02	0.07	-0.01	0.44[a]	-0.03[a]
Family history 23	0.12	0.01	0.00	0.25[a]	-0.02
Family history 123	0.16	0.02	-0.01	0.53[a]	-0.03[a]
Early onset	0.93[a]	-0.19[a]	0.01	0.50[a]	-0.03[a]
High school dropout	0.10	0.00	0.00	-0.10	0.07[a]
College education	-0.18[a]	0.07	-0.02[a]	-0.25[a]	0.01

[a]Significant at 5% level.

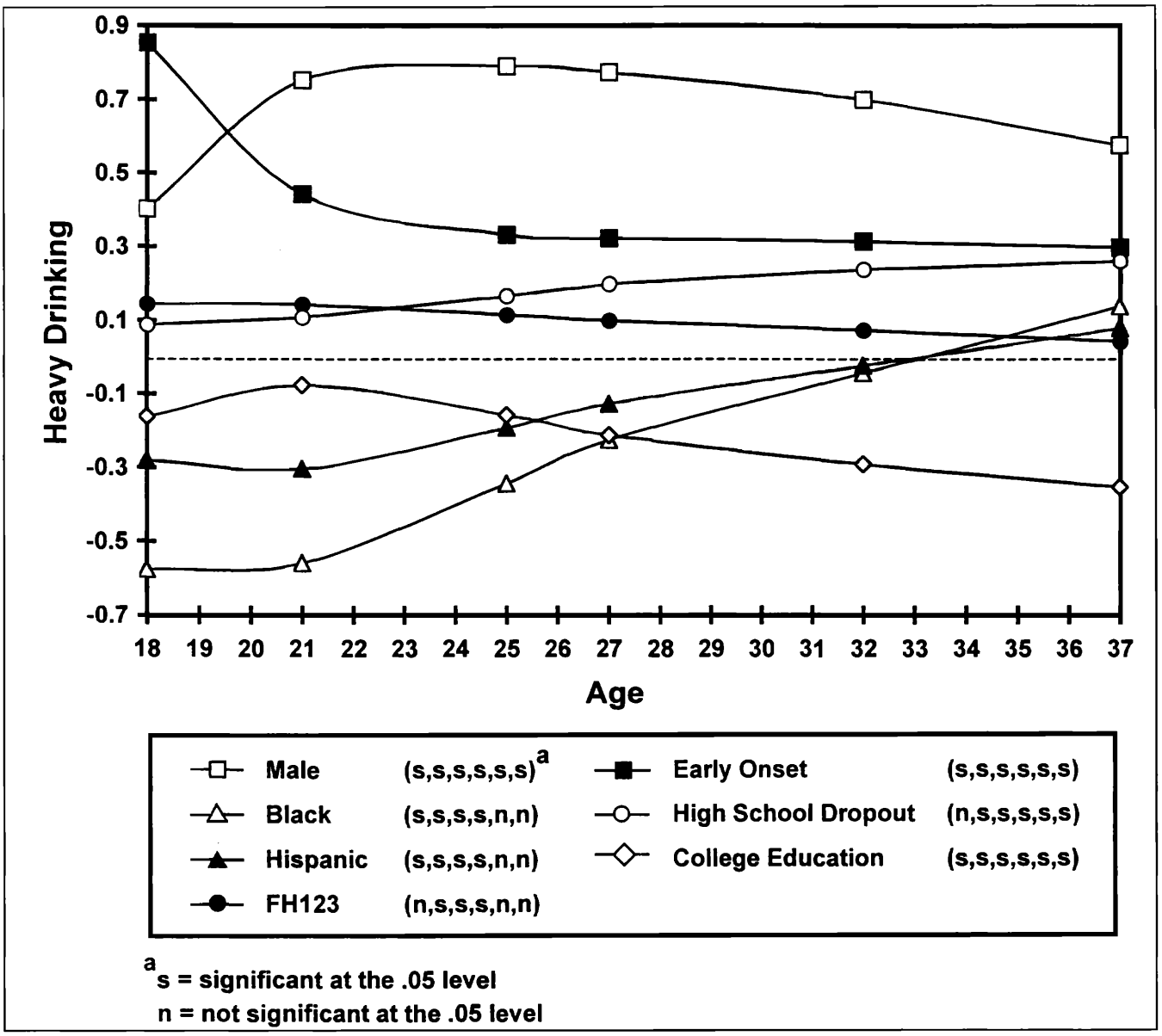

FIGURE 3. Effects of background variables on heavy drinking at different ages

Results

Table 1 contains the means, standard deviations and sample sizes for the two alcohol outcome variables, frequency of heavy drinking and the alcohol problem severity score, by age along with their correlations. Figure 2 shows a plot of the observed sample means for the two outcome variables across age and the corresponding means estimated from the growth model.

Heavy drinking

The quadratic growth model for heavy drinking over ages 18 to 37 using fixed time steps was found to strongly overestimate heavy drinking at ages 18 and 19. The addition of free time steps was found to fit the data significantly better (χ^2 = 274.99, 17 df, p = .000, n = 7,859). The overall fit of the model with free time steps was also good (χ^2 = 376.88, 323 df, p = .021, n = 7,859). Important deviations from invariance in the growth model were not found except for the mean of one of the background variables, early onset of drinking, which increased from 0.08 for the cohort born in 1957 to 0.14 for the cohort born in 1967. Allowing for these cohort differences did not change the growth estimates.

Table 2 shows the partial regression coefficients for the regressions of the three growth factors for heavy drinking

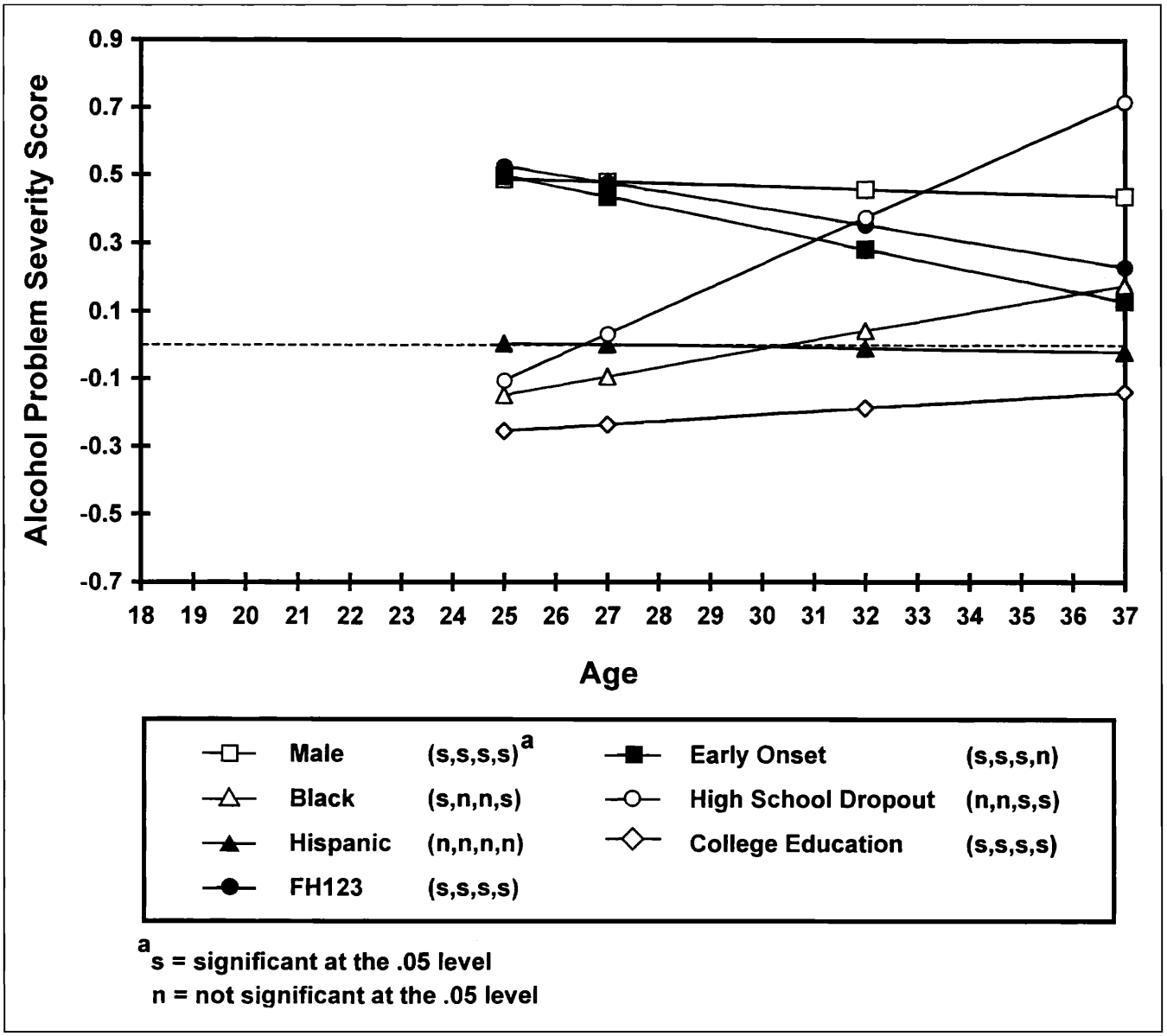

FIGURE 4. Effects of background variables on the alcohol problem severity score at different ages

on the background variables. These results use age 18 as the centering point, which means that the intercept growth factor, the part of the variation in the level of heavy drinking explained by the growth process, is defined at age 18.

Figure 3 shows the effects of the set of background variables on heavy drinking at ages 18, 21, 24, 27, 32 and 37. These results are obtained by varying the centering point so that the intercept factor is defined for different ages. All solutions have the same model fit as reported earlier. In this figure, detrimental effects are those with positive values, while protective effects are those with negative values. The broken horizontal line in the figure indicates zero.

The partial regression coefficients plotted in Figure 3 are standardized coefficients. To provide comparability with the alcohol problem severity score, the coefficients are divided by the standard deviation estimates for the intercept factor at a given age. As a result, they will differ slightly for age 18 from the coefficients in Table 2. These differences are small because the standard deviations are very close to 1 at all ages for both outcome variables. The legend below Figure 3 shows which background variables are significant at the .05 level, where *s* represents significant and *n* represents not significant.

To help interpret the size of the partial effects at age 37, it should be noted that the standard deviation of heavy drinking at that age is 1.28. At age 37, the largest partial

effect is that of being male, which corresponds to approximately half a standard deviation.

Fifty-five percent of the variation in heavy drinking at age 37 is explained by the intercept growth factor. The amount of the variation in the intercept growth factor at different ages explained by the background variables is: 22% at 18; 23% at 21; 24% at 25; 23% at 27; 18% at 32; and 9% at 37.

Alcohol problem severity score

The overall fit of the simplified linear model for the alcohol problem severity score over ages 25 to 37 was good (χ^2 = 195.26, 187 df, p = .324, n = 7,859). The estimated growth curve from this model is included in Figure 2.

Table 2 shows the partial regression coefficients for the regressions of the two growth factors for the alcohol problem severity score on the background variables. Age 25 is used as the centering point.

Figure 4 shows the effects of the set of background variables on the alcohol problem severity score at ages 25, 27, 32 and 37. This is obtained by varying the centering point so that the intercept factor is defined at different ages. All these solutions have the same model fit as reported earlier. In this figure, detrimental effects are those with positive values, while protective effects are those with negative values. Zero is indicated by the broken horizontal line in the figure.

The standard deviation of the alcohol problem severity score at age 37 is 1.52. This means that the age 37 partial effect of dropping out of high school corresponds to slightly more than half a standard deviation. The amount of the variation in the age 37 alcohol problem severity score explained by the intercept factor is 36%. For this model, the amount of the variation in the intercept factor explained by the background variables is the same for all ages, 11%.

Discussion

Key findings for heavy drinking

Education has a strong impact on the development of heavy drinking from ages 18 to 37. Individuals who drop out of high school have higher levels of heavy drinking into their late thirties, whereas individuals who went on to college have lower levels of heavy drinking into their late thirties. The level of heavy drinking for high school graduates falls between these two. For individuals who went on to college, the protective effect increases as they become older and is significant up to and including age 37. For individuals who dropped out of high school, the detrimental effect was not significant at age 18 but was significant at all other ages.

Ethnicity has a strong impact on heavy drinking. From 18 to 27, the non-black, non-Hispanic group has the highest levels of heavy drinking, followed by the Hispanic group, with the black group having the lowest levels of heavy drinking. Beginning at age 28, these differences diminish until age 32, after which the groups are indistinguishable. Minority status remains a significant protective factor until age 32.

Being male is the strongest predictor of heavy drinking for all ages except 18 where early onset of drinking is the strongest predictor. Early onset remains a strong predictor for all ages. Family history shows a small effect over all age ranges but is significant from only 21 through 27.

Key findings for the alcohol problem severity score

Education has a strong impact on the development of alcohol-related problems from ages 25 to 37. At age 25, there is little difference in the level of alcohol-related problems for individuals who have dropped out of high school, individuals who have graduated from high school, and individuals who have gone on to college. By age 37, the level of alcohol-related problems for individuals who have dropped out of high school has increased sharply, whereas the level of alcohol-related problems for individuals who completed high school or went on to college has decreased. The difference between the level of alcohol-related problems for those who dropped out of high school and those who went on to college corresponds to approximately half of a standard deviation in alcohol-related problems at age 37. At age 37, dropping out of high school is the most important predictor of alcohol-related problems.

Ethnicity has a strong impact on alcohol-related problems in the age range of 25 to 37. In this age range, blacks have a lower level of alcohol-related problems at age 25 than do Hispanics and the non-black, non-Hispanic group, which are about the same. By age 37, the level of alcohol-related problems for blacks has increased whereas the level of alcohol-related problems for the other two groups has decreased. At age 37, blacks have the highest level of alcohol-related problems of the three groups. At this age, there is a significant detrimental effect for blacks.

At age 25, family history of problem drinking is the strongest predictor of alcohol problems closely followed by early onset of drinking and being male. The gender effect remains largely the same through age 37, while the effects of family history and early onset of drinking diminish with increasing age.

Conclusions

The findings of this general population study agree with current knowledge about alcohol development in late adolescence and early adulthood: an acceleration in the late teens, a peak in the early twenties, and a deceleration in the late twenties with a higher peak for men than for women. Regarding ethnicity, the finding that blacks change from having fewer alcohol-related problems than the non-black,

non-Hispanic group at age 25 to more alcohol-related problems at age 37 agrees with Helzer and Canino (1992) and Caetano (1984), whereas Herd (1989) did not find this increase with age. For Hispanics, it was found that heavy drinking and alcohol-related problems develop similarly to the non-black, non-Hispanic group in the 25-37 age range.

It was found that the importance of the background variables studied is different for the two alcohol outcome variables at different ages. For heavy drinking, early onset of drinking has a strong detrimental effect at age 18 that levels out, while maintaining its significance in the 25 to 37 age range. For the alcohol problem severity score, early onset of drinking has a strong detrimental effect at age 25, but this effect steadily diminishes until age 37, where it is not significant. High school dropout has a much stronger increase in its detrimental effect on alcohol-related problems in the 25 to 37 age range than for heavy drinking. Going on to college increases its protective effect on heavy drinking in the 25 to 37 age range, whereas it decreases its protective effect on alcohol-related problems in the 25 to 37 age range.

A major finding of this study is the detrimental effect of dropping out of high school on alcohol-related problems. This effect warrants further attention. Taken together with the protective effect seen with college education, this also points to alcohol-related problems in the general population being underestimated when using high school-based and college-based studies. This is because the level of alcohol-related problems is decreased due to both the inclusion of college students who have fewer alcohol-related problems and the exclusion of high school dropouts who have more alcohol-related problems.

It is interesting that dropping out of high school has no effect on alcohol-related problems for individuals in their mid-twenties whereas there is an increasing detrimental effect in their thirties. This delayed effect of dropping out of high school is presumably due to the fact that dropping out may be associated with many factors that have a cumulative negative effect on a person. It is certainly the case that not completing high school has a strong negative impact on future job opportunities and income (Catterall, 1987; Rumberger, 1987). In line with the discussions in Crum and associates (1998), it is also plausible that dropping out of high school is associated with deviant behavior and also contributes to low self-esteem and a sense of failure, which can increase susceptibility to future deviant behavior including alcohol abuse and related problems. The increasing detrimental effect of dropping out of high school on alcohol-related problems shown in Figure 4 raises the question of what effect dropping out of high school has later in life and what the total costs of dropping out are both to the individual and to society.

It is of interest to characterize the group of individuals dropping out of high school, comparing their background characteristics with those who graduated from high school and/or went on to college. The high school dropout group has an overrepresentation of men (52% vs 48%), blacks (35% vs 29%), Hispanics (31% vs 16%), those who begin drinking early (13% vs 10%) and those who have a family history of problem drinking among first-degree relatives (19% vs 13%). The largest overrepresentation is for Hispanics where the percentage of Hispanics among high school dropouts is almost twice as large as the percentage of Hispanics among students who graduate from high school or go on to college.

High school dropout prevention (see, for example, Eggert et al., 1990) is important and needs to focus not only on the educational progress of students but also on their general mental health and involvement in deviant behavior. In this context, understanding the antecedents of dropping out of high school is important. Research on this issue includes the Ellickson and associates (1998) study showing that Grade 7 smoking is a strong predictor of dropping out of high school, except for Latinos where early marijuana use is a predictor, and the Rumberger (1995) study on dropping out of middle school finding that overall socioeconomic status and being held back in an earlier grade were strong predictors. Rumberger (1995) also found differences across ethnic groups: socioeconomic status was a strong predictor for Hispanics and whites, but not for blacks, while misbehavior, changing schools and low grades were predictive for blacks.

Limitations and directions for future research

Discussion of the results should take into account the limitations of the NLSY data. An inherent shortcoming is the reliance on self-reports. Also, the drinking measures are limited to use in the past 30 days. Several of the background variables may be measured with error and therefore weaken their estimated influence on drinking. Family history of problem drinking may contain measurement error because we do not know how the respondents decided that their relatives had such a problem; their reports were not validated by other sources. The age of onset of drinking may have differential amounts of error for different cohorts given that this question was asked in 1982 for all cohorts, resulting in different lengths of time for recalling the event. Dropping out of high school and attending college were determined at age 22, and an individual's status may have changed after that.

This study also points to the need for more research on the development of heavy alcohol use and alcohol-related problems. The results show that while important background variables for these outcomes have been found, by the time the subjects reach age 37 only about 10% of the variation in the growth trajectories explained by the growth factors for the two processes can be accounted for by these background variables. This calls for a search for further important background variables. Additional unexplained variation is indicated by the finding that much of the variation in the outcomes at all ages is age-specific—at age 37 as much as 45% of the heavy drinking variation and 64% of

the alcohol problem variation is not explained by the growth factors, but is due to variation in unobserved factors specific to that age. A joint analysis of heavy drinking and the alcohol problem severity score, not reported here, shows that the relationships between the two growth processes are relatively weak, and that the alcohol problem severity score cannot be predicted accurately by heavy drinking 1 year earlier. These results suggest that it will be of interest to further extend the growth modeling to include age-specific background variables, such as movements in and out of employment and movements in and out of marriage.

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