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Adolescent Risk Factors for Adult Alcohol Use and Abuse: Stability and Change of Predictive Value across Early and Middle Adulthood

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Abstract

Aims—To examine age-18 risk factors for alcohol use and heavy drinking during early (ages 22 and 26) and middle (age 35) adulthood, and for symptoms of alcohol use disorders (AUDs) in middle adulthood.

Design—Nationally representative samples of U.S. adolescents in their senior year of secondary school (age 18) were followed into middle adulthood. Structural equation models estimated the associations between age-18 characteristics and current drinking and heavy drinking at ages 22, 26 and 35 and symptoms of AUDs at age 35.

Participants—The sample consisted of 21,137 respondents from 11 senior year cohorts (1976–1986) from the Monitoring the Future study.

Findings—Many predictor variables had stable associations with alcohol use over time, although their ability to explain variance in alcohol use declined with increasing time lags. Being White predicted alcohol use, but not symptoms of AUDs. Parental drinking, risk taking, and use of cigarettes and marijuana predicted heavy drinking through age 35. Planning to attend college predicted more heavy drinking at age 22 and less frequent heavy drinking by midlife. High school theft and property damage predicted later AUD symptoms. Most associations were invariant across gender, with variations typically taking the form of stronger associations between predictors and alcohol use for men. Invariance in findings across cohorts indicates that results reflect general developmental trends rather than specific historically bounded ones.

Conclusions—Many adolescent individual and contextual characteristics remain important predictors of adult alcohol use and abuse, and their predictive impact varies as a function of age and type of alcohol outcome. These associations are largely equivalent across gender and cohort, thus reflecting robust developmental linkages.

Keywords

Adolescence; alcohol; problem behavior

In any given year between seven and nine percent of the U.S. adult population suffer from alcohol abuse or dependence (1,2), suggesting the very large economic and human capital tolls of alcohol use disorders. At the same time, most adults who use alcohol do so without any short- or long-term difficulties. In fact, moderate drinking, defined by the U.S. Department of Health and Human Services and the U.S. Department of Agriculture (3) as no more than 1 drink/day for women and no more than 2 drinks/day for men, can have health-promoting effects (4). These unique qualities of alcohol – namely, the effects of its use being devastating for some and neutral or even salutary for others – underscore the importance of delineating the individual characteristics and experiences that contribute to variation in the etiology and course of alcohol use and abuse across the life span.

In particular, given that adolescence is when alcohol use typically onsets and escalates, as well as the pivotal role adolescence can play in adult health (5–7), an important set of questions pertain to how adolescent characteristics and experiences contribute to variation in adult alcohol use and abuse; due to the dearth of long-term prospective studies, these questions have received little attention. Of course, alcohol use and abuse during adulthood are not static, so in addition to inter-individual variation, there are important developmental variations, such that alcohol use and abuse tend to peak during early adulthood and then decline thereafter (8–13). Thus, not only is it important to examine the adolescent risk factors for adult alcohol use, it is also important to examine the extent to which the associations between such risk factors and alcohol outcome vary as a function of both age and the type of alcohol outcome under investigation. Accordingly, the purpose of the present study is to examine adolescent risk factors for early and middle adult alcohol use and abuse, within a U.S. national multi-cohort panel study following young people from age 18 through age 35.

Adolescent Risk Factors for Adult Alcohol Use and Alcohol Use Disorders

As typically measured, there is a distinction between alcohol use and heavy drinking; *alcohol use* refers to the frequency and/or quantity of use whereas *heavy drinking* is a subcategory referring to excessive use in a relatively short amount of time (sometimes called “binge drinking” and traditionally measured as having five or more drinks in a row) (11,14). Alcohol use disorders (AUDs), psychiatric disorders as defined by the DSM-IV (15), include alcohol abuse, a condition in which alcohol use is disruptive to an individual’s personal life or responsibilities, and alcohol dependency in which an individual becomes physically tolerant to or dependent on alcohol. Because alcohol use, heavy drinking, and AUDs represent varying levels of both normative alcohol involvement and disorder, they are likely to have different adolescent predictors; we include each as adult outcomes in the present study.

Adolescent risk factors for concurrent and future alcohol use and abuse are conceptualized to range from characteristics of the individual to facets of the individual’s social context (16–18). Given the purposes of this study, it was important to include a wide range of risk and protective factors capturing numerous aspects of adolescents’ lives including individual characteristics related to conventionality, education, peer involvement, risk taking, deviancy, and well-being, along with salient social context and demographic characteristics. We focus in particular on factors that are known to be contemporaneously related to alcohol use during adolescence so that we can determine their staying power in predicting adult alcohol use and abuse.

The associations between individuals’ social and family background and their alcohol use tend to be substantial during adolescence. In the U.S., White adolescents exhibit higher rates of alcohol consumption than nearly all other racial/ethnic groups particularly African Americans (2), a finding that may relate to higher religiosity among African-Americans (19) and may not be present much beyond adolescence (20). Children of divorce tend to exhibit higher adolescent

alcohol use (21) and more symptoms of drug and alcohol abuse (22); similarly, adolescents from single parent homes are more likely than those from two parent homes to exhibit problem substance use (23). However, whether these effects of parental divorce and single parenthood extend into adulthood is unclear. Having parents who abused alcohol is a well established risk factor for AUDs especially among males (24–27); this association is likely attributable to a combination of genetic risk, modeling of drinking behaviors, and the effects of parental drinking on the home environment.

Ties to broader social institutions can also be protective against alcohol use, at least during adolescence (17). It has been well documented that religiosity is an important protective factor (19); although it is unclear whether adolescent religiosity has any long-term predictive relation to adult alcohol use and abuse. Adolescent educational success and plans have been found to predict lower adolescent and adult alcohol use (17,28–30), although college attendance relates to heavier drinking and alcohol abuse during early adulthood and higher rates of alcohol use (but not disorders) into adulthood (31). Differential drinking patterns between young adults who attend college and those who do not are likely a result of early and heavier use among adolescents who do not go on to college, and heavy use among those in college due in part to the normative aspect of heavy drinking on many college campuses (12,28,32).

Many risk taking and externalizing behaviors that are uncommon among other age groups occur more frequently during adolescence. When they co-occur, these behaviors have been viewed as components of a problem behavior syndrome (33–34). Some of these behaviors have been found to be effective in predicting which individuals will use or misuse alcohol into adulthood. For example, externalizing behavior in adolescence (24) and adolescent deviant behaviors predict adult alcohol abuse and dependence (35–36).

Mental health and well-being also relate to alcohol use. Adolescent internalizing difficulties including depressive affect and anxiety relate to adolescent alcohol and other drug use (37) and also predict adult alcohol dependence (36,38). However, findings regarding the associations between alcohol use and mental health are mixed, with some suggesting the potential for AUDs to cause mood disorders (39) and others showing stronger associations between negative affect and problem drinking than between negative affect and more normative alcohol use (40). The relationship between heavy alcohol use and mental health are likely to be complex. For example, research examining patterns of heavy drinking over time finds less depressive affect among chronic heavy drinkers than among infrequent heavy drinkers (41).

Alcohol use is frequently associated with the use of other addictive and psychoactive substances. For example, a body of evidence suggests that drinking alcohol and smoking cigarettes have a high rate of co-occurrence (42–44). Cigarette smoking is the most stable of drug use behaviors in that it is usually initiated by the end of high school and, once established, desistance from smoking is less likely than desistance from use of other substances (9,29). Because rates of desistance from smoking are low and cigarette use co-occurs with alcohol use, we would expect cigarette use at the end of high school to be useful in predicting later alcohol use. High school use of marijuana and other illicit drugs may also relate to later drinking, either as a function of deviance-proneness or proclivity to use psychoactive substances.

Variation in Prediction as a Function of Developmental Period, Gender, and Cohort

Because adolescence is a time when many consequential life decisions are made, adolescent experiences should have strong implications for adult functioning. But adolescence is also a time when risky behaviors become temporarily more normative than they are at other times in the life span. For some adolescents, engaging in risky behaviors may be temporally limited,

while for others these behaviors are part of long-term problems (45–47). During adolescence those individuals for whom these behaviors are developmentally limited and those for whom they are indicative of lifelong disorders may look similar. Therefore the normative nature of risk taking and externalizing behaviors in late adolescence could limit their usefulness in predicting long-term drinking outcomes.

Similarly, because drinking behaviors follow a developmental pattern, predictors are likely to vary as a function of the age of assessment of adult alcohol use and abuse. Indeed, risk factors associated with drinking within one age group of adults may be unassociated with drinking among another age group (48). In the present study, we focus on three ages in adulthood: age 22 (corresponds with the peak of binge drinking), age 26 (an age by which the assumption of many adult roles has occurred for most), and age 35 (corresponds with beginning of middle adulthood) (28). We expect that the associations between adolescent risk factors (particularly those that become temporarily normative during adolescence) and alcohol outcomes will generally grow weaker across the three ages. Some of the risk factors (e.g., racial/ethnic group, parental education, single parent, and parental drinking) are static in that they do not change or at a minimum are well established by the end of high school; accordingly, they may be more likely to maintain their predictive power across adulthood.

Differences in alcohol use patterns between men and women indicate the importance of examining gender differences and interactions in alcohol research. Alcohol abuse and dependence occur more frequently in men than in women, and, on average, men consume more alcohol than women (1,2). In addition to mean level differences, normal developmental patterns include a slower decrease in drinking during adulthood among men than among women (49). Furthermore, the associations between risk factors and alcohol outcomes have been found to vary as a function of gender particularly for academic achievement and deviant behaviors (50) and possibly for depressive symptoms as well (51). Similarly, some evidence suggests greater heritability for AUDs among males than among females (27). Thus, we include a focus on gender differences and similarities in our predictive models.

Historical period may contribute to differences in levels of risk factors and outcomes, and perhaps more interestingly, to relationships among risk factors and outcomes (33,52). Because the MTF data set used here includes 11 cohorts (1976–1986) of high school graduates who were followed into adulthood, we have the unique opportunity to test the generalizability of results across 11 senior year cohorts in this paper, providing some insight about the extent to which findings reflect developmental trends and/or historical trends (i.e., cohort-specific effects or period effects).

This paper extends current knowledge regarding the associations between adolescent risk factors and later alcohol use and abuse by using U.S. multi-cohort national longitudinal data, by including multiple adolescent risk factors from a variety of domains, and by including up to four adult alcohol outcomes at three different ages. The goals of this paper are to determine 1) the associations between adolescent risk and protective factors and later alcohol outcomes, and 2) whether the associations between adolescent risk and protective factors and later alcohol outcomes vary with gender, age and type of outcome, and cohort.

Methods

Respondents

Respondents are from the Monitoring the Future (MTF) national panel study (11). Each year, MTF surveys a nationally representative sample of about 17,000 American adolescents who are in their senior year of secondary school (modal age 18). Approximately 2,400 respondents are selected randomly from each senior year cohort for follow-up into young adulthood and

beyond. Follow-up mail surveys are conducted on a biennial basis until age 30. After age 30, data are collected at five-year intervals. For the purpose of this study, we selected respondents who had completed at least the first follow-up (modal ages 19 to 20) and were old enough for potential inclusion in the age-35 survey (high school classes of 1976–1986). Of a possible approximately 26,400 respondents selected for follow-up, 21,137 (80%) provided sufficient data (5,263 did not respond to the first follow-up survey, and 113 failed to indicate their gender). Because high school students who reported drug use were oversampled for inclusion in the follow-up sample, analyses used selection weights.

Each respondent received one of five randomly distributed forms during their senior year, and was sent the same form for each follow-up. All forms contained information regarding respondents' alcohol use and many of the predictors used in this paper. In addition, one of the forms contained several items relevant to the current study that were not duplicated on any other form. Previous publications (11,28,53) provide more detailed information regarding the study's design, as does the study's Web site (54).

Measures

Adult Alcohol Outcomes—Thirty-day and heavy alcohol use were measured at ages 22, 26, and 35 (and at age 18), while symptoms of alcohol abuse and dependence were assessed only at age 35. These measures are described below, and means and standard deviations are presented in Table 1 by gender; as indicated, gender differences are significant for all measures at each age, with men having higher use and symptom counts than women.

Thirty-day alcohol use: Respondents were asked about the number of times they drank in the 30 days prior to each survey. Responses ranged from one (never) to seven (40 times or more).

Heavy drinking: Respondents were asked about the number of occasions on which they drank five or more drinks in a row during the two weeks prior to each survey. Responses ranged from one (never) to six (10 or more times).

Alcohol use disorders: symptoms of abuse and dependence: AUDs were measured through symptoms of both alcohol abuse and dependence. A nine-item symptom count indicating each respondent's number of symptoms of alcohol abuse in the five years prior to the age-35 survey was used to construct a count of abuse symptoms. The items in this symptom count (e.g., "Has your use of alcohol in the last five years hurt your relationship with your spouse?") are based on DSM-IV criteria and are consistent with the measurement of alcohol abuse in other large-scale surveys (55–57). A five-item scale indicated the number of symptoms of alcohol dependence present in the five years prior to the age-35 survey. Items included symptoms of both tolerance (e.g., "needed more to get the same effect") and physical dependence (e.g., "used alcohol to avoid hangovers"). These items are based on the DSM-IV criteria for alcohol dependence and are consistent with how alcohol dependence has been measured in the National Comorbidity Survey (58) and other large-scale studies (57).

Adolescent Risk Factors—Table 2 provides information regarding the measures of adolescent risk factors. At the time of the senior year survey, respondents provided information regarding their *race/ethnicity*, *parental education*, and whether they lived in a *single-parent home.* At the time of the age-35 survey, respondents were asked to recall their experience of *parental drinking*. In the senior year survey, respondents also answered questions regarding their *religious attendance, grades, college plans, truancy, evenings out, risk taking, aggression, theft and property damage, self-esteem,* and *depressive affect*[1]. They also reported their *cigarette use*, *marijuana use*, and use of *other illicit drugs*.

Attrition and Missing Data Strategy

As mentioned above, respondents who completed the first follow-up survey after high school and were eligible for the age 35 survey were included in the analyses regardless of their level of response to subsequent surveys. In order to minimize bias associated with attrition after ages 19 to 20[2] we used Full Information Maximum Likelihood (FIML) estimation, a missing data algorithm available within MPlus (59). Compared to simple case-wise deletion and most other missing data procedures, FIML is superior for minimizing bias due to attrition (60–62). FIML is also appropriate to use to account for data missing due to the planned missingness inherent in the multiple form structure of MTF (53). Although some of the variables (including risk taking, aggression, theft and property damage, self esteem, and depressive affect) were on only one of the five questionnaire forms (thus distributed to only a random 20% of respondents) FIML allows for the analyses of data from all respondents (60).

Analysis Plan

Preliminary analyses included zero-order correlations conducted separately for men and women between age 18 individual and contextual variables and alcohol use at age 18 and at each follow-up. To examine our primary research questions, path analyses using adolescent risk factors to predict each of the three domains of adult alcohol involvement (i.e., 30-day alcohol use, heavy drinking, and symptoms of alcohol abuse and dependence) were conducted within Mplus (60)– see Figure 1. The associations between adolescent risk factors and adult involvement with alcohol were modeled in three separate models, one for 30-day alcohol use, one for heavy drinking, and one for symptoms of alcohol abuse and dependence (two separate outcomes, modeled in same set of analyses). Within each of the three models, the adolescent risk factors were entered simultaneously as predictors of the adult alcohol problem behavior of focus; thus, the path coefficient for each risk factor represents the unique effect of each risk factor after accounting for the effects of each other risk factor. Given the relatively large sample sizes used, only results significant at the level of $p < .01$ are reported.

In order to determine (a) if the strength of association between adolescent risk factors at age 18 and adult alcohol problems at ages 22, 26, and 35 remained stable over time, and (b) whether the associations between adolescent risk factors at age 18 and adult alcohol problems at ages 22, 26, and 35 varied across gender and cohort, we conducted a series of model comparisons. Because these analyses involved models in which no variables were latent (i.e, path models), the baseline model, for which all associations were free to vary across time and gender, had a chi-square value of 0 as well as 0 degrees of freedom. Comparing each constrained model to the baseline model via a standard chi-square difference test remains appropriate in this situation (64).

The model comparisons assessing the extent of stability across time and the impact of gender were conducted by estimating a series of multivariate models using standard multiple-group analyses. In the baseline model, associations between the adolescent risk factors and the adult alcohol outcome were free to vary across age of outcome and across gender. In the next multivariate model, the association between one adolescent risk factor and alcohol outcome was constrained to be equal across all ages and both genders. In models where these constraints had no significant effect on model fit the constraints were retained. If the chi square of the

[1]To measure depressive affect we included items from the MTF survey reflecting self-derogation (feelings of worthlessness and guilt), which is an important aspect of depression (and consistent with items on the CES-D, 78). Symptoms of depression range from somatic disturbances to anhedonia, indicating that we are measuring just one aspect, albeit an important one, of depression.

[2]In regard to adolescents who attrited before the age 19–20 follow-up, previous attrition analyses conducted with other samples from MTF (e.g. 79–80) found that those who remained in the study were more likely to be female and White; to be higher on parental education, religious attendance, high school grades and college expectations; and to be lower on substance use. These analyses also found that relations among variables were not affected by differential attrition.

constrained model was significantly different from the baseline model, then two additional models were estimated; one in which associations were constrained across age of outcome but free to vary across gender, and one in which associations were free to vary across age of outcome but constrained across gender. If the constraints imposed in either of these models had no significant effect on model fit then the constraints were retained. If for a given adolescent risk factor no constraints could be made without significantly affecting the fit, then all associations involving that adolescent risk factor remained free in the final model. Next, while still focusing on the same adult alcohol outcome, we switched focus to a different adolescent risk factor and repeated the above series of model comparisons. This pattern of analyses continued until all of the associations between the set of adolescent risk factors and the adult alcohol outcome of focus were examined. This process was completed for each model: 30 day drinking, heavy drinking, and symptoms of alcohol abuse and dependence.

In a final set of analyses, we examined whether the path coefficients in each model varied as a function of cohort. The 11 senior year cohorts used in this study were divided into three groups: 1976–1979, 1980–1983, and 1984–1986. For each model (i.e., 30 day drinking, heavy drinking and symptoms of abuse and dependence), a cohort model was estimated in which the constraints from the final models were retained, but allowed to vary across the three cohort groups. Then additional equality constraints across cohort groups were added to all parameters.

Results

Preliminary Results: Correlations

Table 3 describes the correlations among the adolescent risk and protective factors, with the correlations shown above the diagonal for men and below the diagonal for women. As shown, the associations between the substance use indicators were moderate to large. In addition both measures of age-18 alcohol use correlated moderately with many of the adolescent risk factors. Further, the intercorrelations among the adolescent risk factors ranged from small to moderate. In particular, parental education and high-school grades were positively associated with college plans, while truancy was negatively associated with college plans. In addition, truancy was positively associated with evenings out, aggression, and theft and property damage, while evenings out was itself positively associated with aggression and theft and property damage. The intercorrelations between the problem behaviors of risk taking, aggression, and theft and property damage were also moderate. Finally, the intercorrelation between self-esteem and depressive affect was both negative and significant.

Correlations between the adolescent risk and protective factors and alcohol outcomes are presented separately by gender and age of outcome in Tables 4 and 5. As presented in these tables, higher levels of alcohol use were generally associated with being White, higher parent education, higher parental drinking, lower religious attendance, higher truancy, frequency of evenings out for fun and recreation, risk taking, aggression, theft and property damage, and high school use of cigarettes, marijuana and other drugs. There are a few variables for which the associations with alcohol use varied across time, outcome, and gender. For example, parental education was associated with higher 30-day alcohol use for both men and women across time, but its positive association with binge drinking for men decreased over time. Although depressive affect was not associated with heavy drinking and was negatively associated with 30-day drinking (for women at ages 26 and 35), respondents with high depressive affect in high school reported more symptoms of alcohol abuse and dependence at age 35.

Path analyses

Models Predicting 30-Day Alcohol Use—The model comparisons, as described above in the *analysis plan* section, resulted in the selection of a 30-day alcohol use model [X^2(72, N = 21137) = 92.476, p = .0525, RMSEA 0.005, SRMR 0.007] with R-square values of .25, .12 and .09 among men and .24, .12 and .11 among women (at ages 22, 26 and 35, respectively). As shown in Table 6 being White and having more educated parents predicted 30 day drinking at each age (though the association decreased in magnitude across age) and the associations were the same for men and women. Parental drinking, truancy, risk taking and low depressive affect significantly predicted higher 30 day drinking and the strength of these associations did not vary with age of outcome or gender. College plans predicted higher 30 day drinking, but the strength of this association varied with both age and gender, increasing in strength over time for men. Evenings out during high school predicted 30 day alcohol use for both men and women, but only at age 22. Age 18 30-day alcohol use predicted later 30-day alcohol use, with associations diminishing over time, but invariant across gender[3]. Marijuana use also predicted 30 day drinking, with associations being stronger for men than for women at ages 22 and 26. Based on these multivariate models, several adolescent risk factors that were significantly correlated with 30 day drinking - including religious attendance, aggression, theft and property damage, cigarette use, and other illicit drug use - were not significant predictors of 30 day drinking at any age; also living in a single parent home, high school grades, and self esteem were not significant predictors (or correlates) of 30 day drinking at any age (and these non-significant associations were able to be constrained equal across age of outcome and gender).

Models Predicting Heavy Drinking—Again, a series of model comparisons resulted in the final model for heavy drinking [X^2(76, N = 21137) = 97.515, p = .049, RMSEA = .005, SRMR = .006] with R-square values of .21, .11 and .09 for men and .16, .08 and .07 for women (at ages 22, 26 and 35, respectively).

As shown in Table 7, being White and having more educated parents significantly predicted heavy drinking at age 22 (but not at 26 or 35) and these associations were invariant across gender. Having parents who drank predicted more heavy drinking across all ages of outcome, and in fact it increased in magnitude across the ages. Higher high school grades predicted less heavy drinking at all ages, with coefficients being invariant across ages and gender. College plans in high school predicted more heavy drinking at age 22 but *less* heavy drinking at age 35 (coefficients invariant across gender). Higher frequency of evenings out, risk taking, and smoking predicted higher levels of heavy drinking, with each of these associations being invariant across age of outcome and gender. Lower self esteem *and* lower depressive affect predicted more heavy drinking (invariant across age and gender); given that the associated zero-order correlations are non-significant, the predictive effects may be model dependent. Age 18 heavy drinking predicted later heavy drinking, but this association was stronger for men than for women and decreased in strength over time[3]. Similarly, although marijuana use significantly predicted adult heavy drinking, the association weakened with age. Despite being significantly correlated with adult heavy drinking, religious attendance, truancy, aggression, theft and property damage, and use of illicit drugs other than marijuana did not significantly predict adult heavy drinking in these multivariate analyses; living in a single parent home was also a non-significant predictor (these associations were invariant across age of outcome and gender).

[3]To assess the impact of autoregressive effects on model coefficients, additional models excluding age 18 alcohol use were tested for each alcohol use outcome (i.e., 30-day alcohol use, heavy drinking, and AUD symptoms). Generally speaking, the substantive findings were similar to those presented in this paper. Where there were differences, the effects of adolescent risk factors on later alcohol use were generally larger when age 18 alcohol use was excluded. In particular, the effects of age 18 parental education, truancy, and marijuana use on later alcohol outcomes were more pronounced.

Models Predicting Symptoms of Abuse and Dependence—Another series of model comparisons resulted in a final model for symptoms of abuse and dependence [X^2(29, N = 21137) = 46.699, p = .02, RMSEA = .008, SRMR = .007] in which R-square values were .12 and .09 for men's abuse and dependence symptoms, respectively; and .12 and .10 for women's abuse and dependence symptoms, respectively.

As shown in Table 8 symptoms of alcohol abuse and symptoms of dependence were significantly predicted by higher parental drinking, higher truancy, theft and property damage, cigarette use, age 18 heavy drinking[3], marijuana use, and other illicit drug use. Most of these associations were invariant across gender, although parental drinking was a stronger predictor of abuse symptoms for men, theft/property damage was a stronger predictor of abuse symptoms for women, and marijuana use was a stronger predictor of both abuse and dependence symptoms for men than for women. Aggression predicted *fewer* symptoms of alcohol dependence, but the zero-order correlation was non-significant; aggression did not predict abuse symptoms (but was positively correlated). Despite being consistently correlated with both abuse and dependence symptoms at age 35, age 18 religious attendance, grades, college plans, evenings out, risk-taking, theft/property damage, and depressive affect did not significantly predict abuse or dependence symptoms in the multivariate models. Finally, being White, parent education, and living in a single parent did not significantly predict later abuse and dependence for either men or women.

Cohort Invariance—Overall, we found no significant cohort variation. In taking the final models (as described above) and adding constraints across the three cohort groups, we found that the cohort constrained models were not significantly different (at an alpha of .01, as explained above) from the final model for 30-day drinking, $\Delta X^2(72) = 96.073$, $p = 0.03$, heavy drinking $\Delta X^2(64) = 86.412$, $p = 0.03$ or abuse and dependence $\Delta X^2(84) = 102.410$, $p = 0.08$. These findings indicate that the associations between adolescent predictors and later alcohol involvement are invariant across cohorts.

Discussion

Advances in the understanding of substance use etiology can be made by viewing alcohol and other drug use, and addiction in general, from a life span development perspective. There are many reasons to expect connections between adolescent and adult functioning, such that adult alcohol abuse follows in a cascading manner from adolescent difficulties; at the same time, the normativeness of substance use and externalizing behaviors during adolescence may make it difficult to predict from this age period to adult functioning (13,65). Addressing such questions about the predictability of adolescent characteristics and experiences on adult substance abuse has been difficult given the scarcity of long-term prospective studies. Thus the present study, in conjunction with the other articles in this supplemental issue, offers a needed perspective on lifespan linkages of addiction.

This study shows that risk factors measured at age 18 can be useful in predicting alcohol use, heavy drinking, and symptoms of alcohol abuse and dependency through age 35. The findings regarding the lack of cohort variation in the magnitude and patterns of predictors provides strong evidence that the identified risk factors were not given to historical variation during the period of this study, and reflect robust developmental linkages (rather than cohort-specific ones). Among the background characteristics found to predict later drinking, being White was associated with 30-day drinking through age 35, but was only associated with heavy drinking at age 22 and was unassociated with symptoms of abuse or dependence at age 35. This decease in racial/ethnic differences with age is consistent with other research (20) and suggests that future research should examine the associations between alcohol use and its predictors separately by racial/ethnic group. Parental education was a risk factor for 30-day alcohol use

at all ages and heavy drinking at age 22, but was not associated with symptoms of abuse or dependence. As expected, parental drinking was a risk factor for all alcohol outcomes across all points of measurement, and in fact increased in predictive power over time for heavy drinking; it was generally a stronger predictor for men than for women. These findings are consistent with prior research (27) suggesting greater heritability for AUDs among males than among females.

High school grades were protective against heavy drinking but unassociated with 30 day drinking or symptoms of abuse or dependence perhaps reflecting previously documented associations between intelligence and light drinking (66) or the effects of school success and institutional identification as protective factors (29,30). College plans predicted more heavy drinking at age 22 but less heavy drinking at age 35, suggesting the differential college-based course of heavy drinking across adulthood; it is equally interesting that college plans predicted greater 30 day drinking at all ages, but was unrelated to alcohol abuse and dependence symptoms at age 35. These associations suggest that although respondents who attended college drank more heavily during their college years, they were not at greater risk for AUDs than others, a finding consistent with other studies (67–68). That college attendance was a short-term risk factor for alcohol use and abuse is nonetheless worrisome and suggests the utility of studies aimed at identifying characteristics that differentiate desisters from those who experience long-term alcohol problems (12).

As expected, indices of adolescent risk taking and externalizing behaviors were all positively correlated with adult alcohol use, heavy drinking, and AUD symptoms. But based on the multivariate models, there were some notable inconsistencies in the pattern of these predictors that suggest different pathways to adult use and abuse (69). Risk taking consistently predicted both 30-day alcohol use and heavy drinking, but did not predict age 35 AUD symptoms, suggesting that risk taking is more associated with use (even heavy use) than with abuse or dependence symptoms. Truancy was a consistent predictor of 30 day alcohol use, but not of heavy drinking, and it predicted abuse and dependence symptoms; this suggests that truancy in high school may reflect problems that later manifest as AUDs. The findings that aggression did not predict either 30 day drinking or heavy drinking at all (and was inconsistently related to abuse and dependence symptoms) are consistent with the argument that aggression during late adolescence reflects a mix of ongoing and developmentally limited externalizing behaviors and thus may be of little value in predicting later difficulties at the population level (46). Similarly, theft/property damage did not significantly predict 30-day or heavy drinking at any age. But interestingly, theft and property damage was a particularly important predictor of both abuse and dependence symptoms, with a gender difference indicating a stronger association with abuse (but not dependence) symptoms for women than for men. Further research is needed to investigate whether the more normative nature of theft or property damage among male adolescents contributes to the gender difference. Of course, because all of these indices were included together, it is likely that some of the inconsistencies were due to some “competition” among the predictors, suggesting appropriate caution in interpreting these findings.

Higher depressive affect in high school predicted *lower* adult 30 day alcohol use and heavy drinking (but not age 35 AUD symptoms), suggesting the social aspect of much of adult drinking, consistent with findings that loneliness serves a protective function against heavy drinking (30). Similarly, evenings out with friends in high school predicted higher adult 30 day alcohol use and heavy drinking, but not age 35 AUD symptoms. The lack of a strong association between adolescent depressive affect and symptoms of AUDs in middle adulthood in this study may reflect limitations of our depressive affect measure (e.g., the absence of somatic symptoms and the focus on self-derogation) or the presence of complex non-linear associations between high school mental health and later alcohol use and abuse (70–72).

High school use of cigarettes, alcohol and marijuana were risk factors for all adult drinking measures, although adolescent drinking and marijuana use were better predictors of later heavy drinking for men than for women. Whether these associations reflect an individual's phenotypic tendency toward substance use (73) or similarity of risk factors across multiple substances (74), their strength highlights the importance of identifying and intervening with adolescent poly drug users in an effort to reduce adult alcohol and other drug use problems.

The associations between many of the risk and protective factors and later alcohol use were largely stable across gender and age of outcome. This was true for parental education, truancy, risk taking and depressive affect as predictors of 30-day drinking and for grades, evenings out, risk taking, self-esteem, depressive affect and cigarette use as predictors of heavy drinking. Other significant associations varied by age of outcome, gender or both. These include being White, parental education (as a predictor of heavy drinking), college plans, age 18 drinking and marijuana use. Coming from a single parent home was the only risk factor included in this study that was found to have no significant association with alcohol use when entered into a multivariate analysis. This suggests that the association between living with a single parent and alcohol use may be limited to the adolescent period (21–23). Overall, although effects were typically small and much variance remains unaccounted for, the ability of adolescent predictors to significantly account for alcohol use and abuse up to 17 years later shows that despite the multitude of more developmentally proximal influences on adult alcohol use and abuse, adolescent risk factors remain important.

Strengths and Limitations

This study is unique in its use of both US national multi-cohort long-term longitudinal data and four different alcohol outcomes. In particular, by using national data from 11 different cohorts (thus essentially providing 11 national studies spanning senior year cohorts 1976–1986), we were able to test whether there were important historical variations in the relationships. That there were no such variations demonstrates the robustness of the findings and further argues that we are tapping into developmental/age effects rather than cohort or secular trend effects across this historical period. One important limitation to our sample is that by starting with high school seniors, we missed high school drop-outs, representing about 15% of the population. Other analyses in a separate MTF study that included drop-outs (29) indicate that many of the relationships found here would have been stronger, suggesting our findings reflect lower-bound estimates. In general, we cover a wide range of adolescent characteristics and experiences, but not all relevant aspects of adolescence; likewise, in terms of measures, ours do not always provide in-depth considerations of relevant constructs. Because the assessments for this study began during the respondents' late adolescence it is difficult to distinguish between those respondents whose problem behaviors began in adolescence and those whose problem behaviors had an earlier onset in childhood or early adolescence. Distinguishing these two groups could be important when we use adolescent problem behaviors as predictors of later alcohol use. Previous research has indicated differing outcomes among individuals with life-course persistent and adolescence-limited antisocial behaviors (45,46). Building on our analyses, future efforts should be aimed at processes and mechanisms that connect adolescent risk factors to later outcomes, focusing on adult characteristics and experiences that serve to mediate and moderate long term linkages.

Conclusion

Alcohol use disorders across adulthood are among the strongest predictors of morbidity and mortality (75–76), and a better understanding of their developmental antecedents can facilitate efforts to diminish their negative influence on individuals, families, and communities. This study shows that many predictors of alcohol use measured during adolescence retain their predictive value through young adulthood and into early midlife. Adolescence is marked by

rapid change, exploration, and behavior that often is risky. Many individuals move beyond the unsafe behaviors of their teenage years, but the choices made during adolescence can set in motion behaviors and experiences that contribute to adult functioning and adjustment (77).

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References

1. Grant BF, Dawson DA, Stinson FS, Chou SP, Dufour MC, Pickering RP. The 12-month prevalence and trends in DSM-IV alcohol abuse and dependence: United States, 1991–1992 and 2001–2002. Drug Alcohol Depend 2004;74:223–34. [PubMed: 15194200]
2. SAMHSA (Substance Abuse and Mental Health Services Administration). Results from the 2004 National Survey on Drug Use and Health: national findings. NSDUH Series H-28, DHHS Publication No. SMA 05-4062. Rockville (MD): Office of Applied Studies; 2005.
3. US Department of Health and Human Services and the U.S. Department of Agriculture. Dietary guidelines for Americans. Washington, DC: USDA; 2005.
4. Gunzerath L, Faden V, Zakhari S, Warren K. National Institute on Alcohol Abuse and Alcoholism Report on Moderate Drinking. Alcohol Clin Exp Res 2004;28:829–47. [PubMed: 15201626]
5. Oesterle S, Hill KG, Hawkins JD, Guo J, Catalana RF, Abbott D. Adolescent heavy episodic drinking trajectories and health in young adulthood. J Stud Alcohol 2004;65:204–12. [PubMed: 15151351]
6. Schulenberg, JE.; Maggs, JL.; Hurrelmann, K., editors. Health risks and developmental transitions during adolescence. New York: Cambridge University Press; 1997.
7. Susman, EJ.; Feagans, LV.; Ray, WJ., editors. Emotion, cognition, health, and development in children and adolescents. Hillsdale (NJ): Lawrence Erlbaum Associates; 1992.
8. Chassin, L.; Ritter, J. Vulnerability to substance use disorders in childhood and adolescence. In: Ingram, RE.; Price, JM., editors. Vulnerability to psychopathology: Risk across the lifespan. New York (NY): Guilford Press; 2001. p. 107-34.
9. Chen K, Kandel DB. The natural history of drug use from adolescence to the mid-thirties in a general population sample. Am J Public Health 1995;85:41–7. [PubMed: 7832260]
10. Harford TC, Grant BF, Yi H, Chen CM. Patterns of DSM-IV alcohol abuse and dependence criteria among adolescents and adults: results from the 2001 National Household Survey on Drug Abuse. Alcohol Clin Exp Res 2005;29:810–28. [PubMed: 15897727]
11. Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. College students and adults ages. NIH Publication No. 07-6205. Vol. II. Bethesda (MD): National Institute on Drug Abuse; 2007. Monitoring the Future national survey results on drug use, 1975–2006; p. 19-45.
12. Schulenberg JE, Maggs JL. A developmental perspective on alcohol use and heavy drinking during adolescence and the transition to young adulthood. J Stud Alcohol 2002;14(Supplement):54–70.
13. Zucker, RA. Alcohol use and alcohol use disorders: A developmental-biopsychosocial systems formulation covering the life course. In: Cicchetti, D.; Cohen, DJ., editors. Developmental psychopathology. 2nd ed. Volume 3: Risk, disorder, and adaptation. Hoboken (NJ): John Wiley & Sons; 2006. p. 620-56.
14. 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. Newark (NJ): Lawrence Erlbaum Associates; 2002.
15. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. Vol. 4. Washington, DC: American Psychiatric Association; 1994.

16. Chassin, L.; Hussong, A.; Barrera, M.; Molina, BS.; Trim, R.; Ritter, J. Adolescent substance use. In: Lerner, RM.; Steinberg, L., editors. Handbook of adolescent psychology. Vol. 2. Hoboken (NJ): Wiley; 2004. p. 665-96.

17. Hawkins JD, Catalano RF, Miller JY. Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. Psych Bulletin 1992;112:64–105.

18. Maggs, JL.; Schulenberg, JE. Initiation and course of alcohol consumption among adolescents and young adults. In: Galanter, M., editor. Recent developments in alcoholism, Vol 17: alcohol problems in adolescents and young adults. New York: Kluwer Academic/Plenum Publ; 2005. p. 29-47.

19. Wallace JM, Brown TN, Bachman JG, LaVeist TA. The influence of race and religion on abstinence from alcohol, cigarettes and marijuana among adolescents. J Stud Alcohol 2003;64:843–8. [PubMed: 14743948]

20. Muthen BO, Muthen LK. The development of heavy drinking and alcohol-related problems from ages 18 to 37 in a U.S. national sample. J Stud Alcohol 2000;61:290–300. [PubMed: 10757140]

21. Hetherington EM, Bridges M, Insabella GM. What matters? What does not? Five perspectives on the association between marital transitions and children's adjustment. Am Psychol 1998;53:167–84. [PubMed: 9491746]

22. D'Onofrio BM, Turkheimer E, Emery RE, Slutske WS, Heath AC, Madden PA, et al. A genetically informed study of marital instability and its association with offspring psychopathology. J Abnorm Psychol 2005;114:570–86. [PubMed: 16351381]

23. Barrett AE, Turner RJ. Family structure and substance use problems in adolescence and early adulthood: examining explanations for the relationship. Addiction 2006;101:109–120. [PubMed: 16393197]

24. Alati R, Najman JM, Kinner SA. Early predictors of adult drinking: a birth cohort study. Am J Epidemiology 2005;162:1098–107.

25. Jacob T. Family studies of alcoholism. J Fam Psychol 1992;5(Special issue):319–59.

26. Jacob, T.; Johnson, SL. Family influences on alcohol and substance abuse. In: Ott, PJ.; Tarter, RE.; Ammerman, RT., editors. Sourcebook on substance abuse: etiology, epidemiology, assessment, and treatment. Needham Heights (MA): Allyn & Bacon; 1999.

27. King SM, Burt A, Malone SM, McGue M, Iacono WG. Etiological contributions to heavy drinking from late adolescence to young adulthood. J Abnorm Psychol 2005;114:587–98. [PubMed: 16351382]

28. 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. Mahwah (NJ): Lawrence Erlbaum Associates; 1997.

29. Bachman, JG.; O'Malley, PM.; Schulenberg, JE.; Johnston, LD.; Freedman-Doan, P.; Messersmith, EE. The education–drug use connection: how successes and failures in school relate to adolescent smoking, drinking, drug use, and delinquency. New York: Lawrence Erlbaum Associates/Taylor & Francis; 2008.

30. Schulenberg JE, Bachman JG, O'Malley PM, Johnston LD. High school educational success and subsequent substance use: a panel analysis following adolescents into young adulthood. J Health Soc Behav 1994;35:42–62.

31. Bartholow BD, Sher KJ, Krull JL. Changes in heavy drinking over the third decade of life as a function of collegiate, fraternity and sorority involvement: a prospective, multilevel analysis. Health Psych 2003;22:616–26.

32. Wechsler H, Dowdall GW, Maenner G, Gledhill-Hoyt J, Lee H. Changes in binge drinking and related problems among American college students between 1993 and 1997: results of the Harvard School of Public Health College Alcohol Study. J Am Coll Health 1998;47:57–68. [PubMed: 9782661]

33. Donovan JE, Jessor R, Costa FM. Adolescent problem drinking: stability of psychosocial and behavioral correlates across a generation. J Stud Alcohol 1999;60:352–61. [PubMed: 10371263]

34. Jessor, R.; Jessor, SL. Problem behavior and psychosocial development: a longitudinal study of youth. New York: Academic Press; 1977.

35. Clapper RL, Buka SL, Goldfield EC. Adolescent problem behaviors as predictors of adult alcohol diagnoses. Int J Addict 1995;30:507–23. [PubMed: 7601574]

36. D'Amico EJ, Ellickson PL, Collins RL, Martino S, Klein DJ. Processing linking adolescent problems to substance-use problems in late young adulthood. J Stud Alcohol 2005;66:766–75. [PubMed: 16459938]
37. Trim RS, Meehan BT, King KM, Chassin L. The relation between adolescent substance use and young adult internalizing symptoms: findings from a high-risk longitudinal sample. Psychol Addict Behav. in press
38. Flemming JE, Offord DR. Epidemiology of childhood depressive disorders. J Am Acad Child Adol Psychiatry 1990;29:571–80.
39. Schuckit MA. Comorbidity between substance use disorders and psychiatric conditions. Addiction 2006;101:76–88. [PubMed: 16930163]
40. Colder CR, Chassin L. The psychosocial characteristics of alcohol users versus problem users: data from a study of adolescents at risk. Dev Psychopathol 1999;11:321–48. [PubMed: 16506537]
41. Chassin L, Pitts SC, Prost J. Binge drinking trajectories from adolescence to emerging adulthood in a high-risk sample: predictors and substance use outcomes. J Cons Clin Psych 2002;70:67–78.
42. Istvan J, Matarasso JD. Tobacco, alcohol, and caffeine use: a review of their interrelationships. Psych Bull 1984;95:301–26.
43. Sher KJ, Gotham HJ, Erickson DJ, Wood PK. A prospective high-risk study of the relationship between tobacco dependence and alcohol use disorders. Alcohol Clin Exp Res 1996;20:485–92. [PubMed: 8727241]
44. Sartor CE, Lynskey MT, Heath AC, Jacob T, True W. The role of childhood risk factors in initiation of alcohol use and progression to alcohol dependence. Addiction 2007;102:216–25. [PubMed: 17222275]
45. Moffitt TE. "Life-course persistent" and "adolescence limited" antisocial behavior: a developmental taxonomy. Psychol Rev 1993;100:674–701. [PubMed: 8255953]
46. Moffitt, TE. Life-course-persistent versus adolescent-limited antisocial behavior. In: Cicchetti, D.; Cohen, DJ., editors. Developmental psychopathology. 2nd ed. Volume 3: risk, disorder, and adaptation. Hoboken (NJ): John Wiley & Sons; 2006. p. 570-98.
47. Moffitt TE, Caspi A. Childhood predictors differentiate life-course persistent and adolescence-limited antisocial pathways among males and females. Dev Psychopathol 2001;13:355–75. [PubMed: 11393651]
48. Schulenberg, JE.; Zarrett, NR. Mental health during emerging adulthood: continuity and discontinuity in courses, causes, and functions. In: Arnett, JJ.; Tanner, JL., editors. Emerging adults in America: coming of age in the 21st century. Washington DC: American Psychological Association; 2006. p. 135-72.
49. Karlamangla A, Zhou K, Reuben D, Greendale G, Moore A. Longitudinal trajectories of heavy drinking in adults in the United States of America. Addiction 2005;101:91–9. [PubMed: 16393195]
50. Windle M, Mun EY, Windle RC. Adolescent-to-young adulthood heavy drinking trajectories and their prospective predictors. J Stud Alcohol 2005;66:313–22. [PubMed: 16047520]
51. Poulin C, Hand D, Boudreau B, Santor D. Gender differences in the association between substance use and elevated depression symptoms in a general adolescent population. Addiction 2005;100:525–35. [PubMed: 15784067]
52. Brown TN, Schulenberg JE, Bachman JG, O'Malley PM, Johnston LD. Are risk and protective factors for substance use consistent across historical time?: national data from the high school classes of 1976 through 1997. Prev Sci 2001;2:29–43. [PubMed: 11519373]
53. Bachman, JG.; Johnston, LD.; O'Malley, PM.; Schulenberg, JE. The Monitoring the Future project after thirty-two years: design and procedures. Monitoring the Future Occasional Paper No. 64. Ann Arbor (MI): Institute for Social Research; 2006.
54. Monitoring the Future [Online]. [October 2007]. Web site. URL: http://www.monitoringthefuture.org
55. Harford TC, Muthén BO. The dimensionality of alcohol abuse and dependence: a multivariate analysis of DSM-IV symptom items in the National Longitudinal Survey of Youth. J Stud Alcohol 2001;62:150–7. [PubMed: 11327181]
56. Muthén BO. Psychometric evaluation of diagnostic criteria: application to a two-dimensional model of alcohol abuse and dependence. Drug Alcohol Depend 1996;41:101–12. [PubMed: 8809498]

57. Muthén BO, Grant B, Hasin D. The dimensionality of alcohol abuse and dependence: a multivariate analysis of DSM-IV symptom items in the National Longitudinal Survey of Youth. Addiction 1993;88:1079–90. [PubMed: 8401162]
58. Nelson CB, Heath AC, Kessler RC. Temporal progression of alcohol dependence symptoms in the US household population: results from the National Comorbidity Survey. J Consult Clin Psychol 1998;66:474–83. [PubMed: 9642885]
59. O'Malley PM, Johnston LD, Bachman JG. Alcohol use among adolescents. Alcohol Health Res World 1998;22:85–93. [PubMed: 15706782]
60. Muthén, LK.; Muthén, BO. Mplus user's guide. Vol. 4. Los Angeles (CA): Muthén & Muthén; 2006.
61. Arbuckle, J. Full information estimation in the presence of incomplete data. In: Marcoulides, G.; Schumacker, R., editors. Advanced structural equation modeling: issues and techniques. Mahwah (NJ): Lawrence Erlbaum Associates; 1996.
62. Enders C, Bandalos D. The relative performance of full information maximum likelihood estimation for missing data in structural equation models. Structural Equation Modeling 2001;8:430–57.
63. Enders C. A primer on maximum likelihood algorithms available for use with missing data. Structural Equation Modeling 2001;8:128–41.
64. Muthén, BO. Fit indices discussion [Online]. Dec. 2006 Available: http://www.statmodel.com/discussion/messages/22/72
65. Schulenberg, JE.; Maggs, JL.; O'Malley, PM. How and why the understanding of developmental continuity and discontinuity is important: the sample case of long-term consequences of adolescent substance use. In: Mortimer, JT.; Shanahan, MJ., editors. Handbook of the life course. New York: Plenum Publishers; 2003. p. 413-36.
66. Rodgers B, Windsor TD, Anstey KJ, Dear KBG, Jorm AF, Christensen H. Non-linear relationships between cognitive function and alcohol consumption in young, middle-aged and older adults: The PATH Through Life Project. Addiction 2005;100:1280–90. [PubMed: 16128717]
67. Lanza ST, Collins LM. A mixture model of discontinuous development in heavy drinking from ages 18 to 30: the role of college enrollment. J Stud Alcohol 2006;67:552–61. [PubMed: 16736075]
68. Slutske WS. Alcohol use disorders among US college students and their non-college-attending peers. Arch Gen Psychiatry 2005;62:321–7. [PubMed: 15753245]
69. Zucker, RA. Pathways to alcohol problems and alcoholism: a developmental account of the evidence for multiple alcoholisms and for contextual contributions to risk. In: Zucker, RA.; Howard, I.; Boyd, GM., editors. The development of alcohol problems: exploring the biopsychosocial matrix of risk. NIAAA Research Monograph 26. Rockville (MD): U.S. Department of Health and Human Services; 1994. p. 255-89.
70. Alati R, Lawlor DA, Najman JM, Williams GM, Bor W, O'Callaghan M. Is there really a 'J-shaped' curve in the association between alcohol consumption and of depression and anxiety? Findings from the Mater-University Study of Pregnancy and its outcomes. Addiction 2005;100:643–51. [PubMed: 15847622]
71. Caldwell TM, Rodgers B, Jorm AF, Christensen H, Jacomb PA, Korten AE, Lynskey MT. Patterns of association between alcohol consumption and symptoms of depression and anxiety in young adults. Addiction 2002;97:583–94. [PubMed: 12033659]
72. Rodgers B, Korten AE, Jorm AF, Jacomb PA, Christensen H, Henderson AS. Non-linear relationships in associations of depression and anxiety with alcohol use. Psych Med 2000;30:421–32.
73. Tyndale RF. Genetics of alcohol and tobacco use in humans. Ann Med 2003;35:94–121. [PubMed: 12795339]
74. Agrawal A, Neale MC, Prescott CA, Kendler KS. Cannabis and Other Illicit Drugs: Comorbid Use and Abuse/Dependence in Males and Females. Beh Gen 2004;34:217–28.
75. Laatikainen T, Manninen L, Poikolainen K, Vartiainen E. Increased mortality related to heavy alcohol intake pattern. J Epi Comm Health 2003;57:379–384.
76. Rehm J, Greenfield TK, Rogers JD. Average volume of alcohol consumption, patterns of drinking, and all-cause mortality: results from the US National Alcohol Survey. Am J Epi 2001;153:64–71.
77. Clausen JS. Adolescent competence and the shaping of the life course. Am J Soc 1991;96:805–42.
78. Radloff LS. The CES-D scale: a self report depression scale for research in the general population. Applied Psych Measurement 1977;1:385–401.

79. Messersmith EE, Schulenberg JE. Can we expect the unexpected? Predicting educational attainment when it differs from previous expectations. J Social Issues. 2007

80. Schulenberg J, Wadsworth KN, O'Malley PM, Bachman JG, Johnston LD. Adolescent risk factors for binge drinking during the transition to young adulthood: Variable- and pattern-centered approaches to change. Dev Psychol 1996;32:659–674.

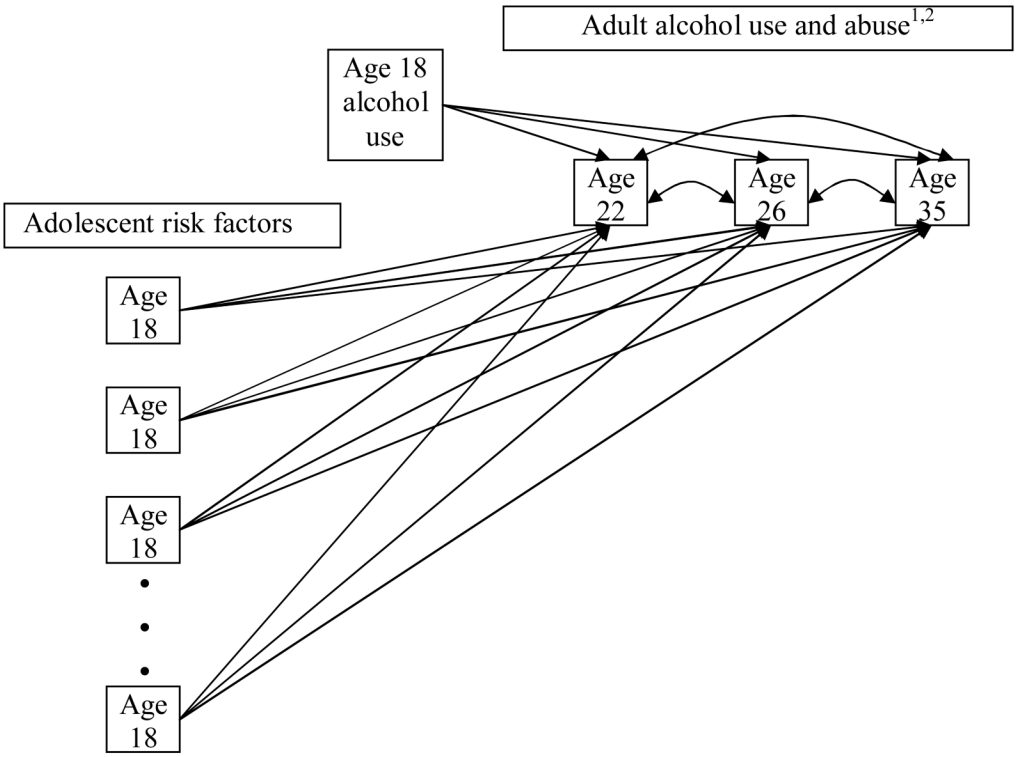

Figure 1. General path model used to assess stability in associations across time

[1]Three separate models were conducted for 30-day alcohol use, heavy drinking, and alcohol abuse and dependence.

[2]For alcohol abuse and dependence data were available at age 35 only.

Table 1

Mean levels of alcohol use by gender and age

		Females *N* = 11402		Males *N* = 9735		*t*-test of gender differences
	Range	**Mean**	**SD**	**Mean**	**SD**	
Age 18						
30-Day Alcohol Use	0–7	2.41	1.26	2.86	1.43	**
Heavy Drinking	0–5	1.59	0.96	2.12	1.24	**
Age 22						
30-Day Alcohol Use	0–7	2.69	1.31	3.34	1.45	**
Heavy Drinking	0–5	1.59	0.94	2.25	1.59	**
Age 26						
30-Day Alcohol Use	0–7	2.27	1.20	3.03	1.46	**
Heavy Drinking	0–5	1.28	0.67	1.79	1.06	**
Age 35						
30-Day Alcohol Use	0–7	2.22	1.24	2.93	1.49	**
Heavy Drinking	0–5	1.23	0.63	1.69	1.05	**
Abuse Symptoms	0–9	0.30	0.04	0.48	0.43	**
Dependence Symptoms	0–5	0.47	0.74	0.77	0.97	**

** Note: = $p < 0.001$

Table 2

Family and adolescent risk factors for adult drinking behavior

FAMILY BACKGROUND	
Race/ethnicity	Dichotomous variable: 0 = African American, Hispanic or not White, 1 = White and non-Hispanic
Parental education	Mean of mother's education and father's education (or one parent's education if only one is reported): 1 = grade school or less, 6 = graduate or professional school after college
Single-parent home	Number of parents in the home at age 18: 0 = two-parent home, 1 = single-parent home
Parental drinking	At age 35, respondents were asked to recall how much of the time their parents "often drank heavily" when they were growing up: 1 = Not at all, 4 = 6 or more years
ADOLESCENT RISK FACTORS	
Religious attendance	How often respondents attended religious services. 1 = never, 4 = about once a week or more
High School Grades	"Average grades so far in high school." 1 = D or below, 9 = A
College plans	How likely it was that respondents would "graduate from college" after high school, 1 = definitely won't to 4 = definitely will
Truancy	Two items: "How many whole days of school have you missed because you skipped?" "How often have you gone to school but skipped a class when you weren't supposed to?"
Evenings out	How often respondents went out at night unsupervised for "fun and recreation."
Risk taking	Two items: "like to do risky things just to test myself," "I get a kick out of doing dangerous things" Alpha = .83
Aggression	Five items: hit supervisor, fight at work or school, participate in gang fights, hurt someone badly enough to need a doctor, threatened someone with a weapon. Alpha = .65
Theft/property damage	Nine items: stole something worth under $50, store something worth over $50, shoplift, steal a car, steal part of a car, trespassing, arson, damage school property, damage work property. Alpha = .72
Self-esteem	Four items: "I take a positive attitude toward myself," "I feel I am a person of worth," "I am able to do things as well as most other people," "I am satisfied with myself" (1 = disagree to 5 = agree). Alpha = .84
Depressive affect	Four items: "I feel I do not have much to be proud of," "sometimes I think that I am no good at all," "I do the wrong thing," "My life is not useful" (1 = disagree to 5 = agree). Alpha = .81
Cigarettes	Cigarette smoking in last month (0 = none, 6 = more than 2 packs a day)
Marijuana	Marijuana use in past 12 months (0 = none, 7 = 40 times or more)
Other drugs	Use of illicit drugs other than marijuana in past 12 months (0 = none, 1 = one or more)

Table 3

Correlations among predictors (men's correlations shown above the diagonal, women's under the diagonal).

	1	2	3	4	5	6	7	8	9		11
1. White		0.12**	−0.11**	−0.04*	0.01	0.10**	0.01	0.00	0.05**	0.01*	−0.04
2. Parental education	0.14**		−0.02	−0.04*	0.06**	0.16**	0.31**	0.01	−0.03	0.02	−0.02
3. Single parent home	−0.18**	−0.01		0.11**	−0.14**	−0.06**	−0.04**	0.06**	0.01	0.02	0.04
4. Parental drinking	−0.03	−0.04**	0.11**		−0.14**	−0.06**	−0.04*	0.07**	0.05**	−0.01	0.03
5. Religious attendance	−0.02*	0.05**	−0.12*	−0.11**		0.15**	0.14**	−0.18**	−0.11**	−0.09**	−0.07*
6. Grades	0.15**	0.15**	−0.09**	−0.08**	0.16**		0.41**	−0.22**	−0.12**	−0.11**	−0.14**
7. College plans	−0.01	0.31	−0.02	−0.05**	0.13**	0.33**		−0.12**	−0.11**	−0.05	−0.12**
8. Truancy	0.04**	0.02**	0.04**	0.07**	−0.19**	−0.19**	−0.08**		0.25**	0.16**	0.21**
9. Evenings out	0.15**	0.01**	−0.02	0.05	−0.10**	−0.09**	−0.10**	0.25**		0.19**	0.21**
10. Risk taking	0.12**	0.08**	−0.01	0.04	−0.12**	−0.10**	0.00	0.23**	0.18**		0.17**
11. Aggression	−0.01	−0.07*	0.04	0.01	−0.08**	−0.11**	−0.10**	0.14**	0.15**	0.20**	
12. Theft/prprty damage	0.04	0.00	0.04	0.04	−0.14**	−0.12**	−0.06*	0.32**	0.21**	0.25**	0.36**
13. Self esteem	−0.07**	0.02	0.02	0.00	0.04	0.02	0.06*	−0.07*	−0.02	−0.11**	−0.02
14. Depressive affect	0.05*	−0.03	0.01	0.01	−0.05*	−0.14**	−0.10**	0.07**	0.01	0.11*	0.04
15. Cigarettes	0.09**	−0.07**	0.04**	0.11**	−0.23**	−0.25**	−0.22**	0.29**	0.29**	0.19**	0.24**
16. Age 18 30 day alc use	0.20**	0.05	−0.03	0.07	−0.22**	−0.12	−0.07	0.32**	0.21**	0.27**	0.18**
17. Age 18 heavy drinking	0.13**	−0.00	−0.02	0.06	−0.17**	−0.16**	−0.11**	0.30**	0.16**	0.24**	0.18**
18. Marijuana	0.08**	−0.01	0.04**	0.10**	−0.27**	−0.20**	−0.15**	0.40**	0.35**	0.22**	0.19**
19. Other drugs	0.13**	0.01	0.03**	0.11**	−0.22**	−0.15**	−0.12**	0.34**	0.26**	0.24**	0.19**

	12	13	14	15	16	17	18	19
1. White	0.01	−0.02	0.02	0.06**	0.13	0.11	0.06**	0.07**
2. Parental education	−0.00	−0.02	0.02	0.06**	0.01	−0.01	0.06**	0.07**
3. Single parent home	0.01	0.00	−0.01	0.02	−0.01	−0.01	0.04**	0.03*
4. Parental drinking	0.03	−0.01	0.02	0.08**	0.10	0.09	0.11**	0.10**
5. Religious attendance	−0.10**	0.06*	−0.03	−0.16**	−0.19**	−0.17**	−0.23**	−0.20**

	1	2	3	4	5	6	7	8	9	11
6. Grades	−0.14**	0.09**	−0.14**	−0.23**	−0.18**	−0.19**	−0.22**	−0.19**		
7. College plans	−0.13**	0.14**	0.12**	−0.24**	−0.12**	−0.15	−0.15**	−0.12**		
8. Truancy	0.32**	−0.03	0.07**	0.23**	0.32**	0.31**	0.40**	0.34**		
9. Evenings out	0.25**	−0.01	−0.04	0.21**	0.32**	0.20**	0.36**	0.29**		
10. Risk taking	0.25**	0.01	0.00	0.11**	0.23**	0.21**	0.16**	0.19**		
11. Aggression	0.46**	−0.07*	0.07	0.16**	0.28**	0.31**	0.22**	0.26**		
12. Theft/prprty damage		−0.09**	0.11*	0.22**	0.34**	0.32**	0.39**	0.36**		
13. Self esteem	−0.05*		−0.22**	−0.06	−0.02	−0.02	−0.05	−0.06		
14. Depressive affect	0.07	−0.13**		0.06*	0.02	0.05	0.05	0.06*		
15. Cigarettes	0.29**	−0.02	0.06*		0.34**	0.33**	0.43**	0.36**		
16. Age 18 30 day alc use	0.32**	−0.04	0.04	0.40**		0.76**	0.52**	0.40**		
17. Age 18 heavy drinking	0.28**	−0.03	0.04	0.38**	0.69**		0.49**	0.37**		
18. Marijuana	0.38**	−0.06*	0.04	0.52**	0.52**	0.44**		0.67**		
19. Other drugs	0.31**	−0.07*	0.09**	0.42**	0.41**	0.37**	0.60**			

*Note: = p < 0.01

**= p < 0.001

Table 4

Correlations of age 18 predictors with 30-day alcohol use

	Age 22		Age 26		Age 35	
Predictor	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
White	0.11**	0.19**	0.07**	0.10**	0.07**	0.11**
Parental education	0.09**	0.15**	0.07**	0.12**	0.10**	0.13**
Single parent home	−0.01	−0.03*	−0.01	−0.00	−0.01	−0.00
Parental drinking	0.10**	0.05**	0.05**	0.05**	0.06**	0.05**
Religious attendance	−0.13**	−0.15**	−0.10**	−0.09**	−0.11**	−0.10**
Grades	−0.06**	−0.00	−0.04*	0.02	0.00	0.03
College plans	0.01	0.10**	0.02	0.08**	0.06**	0.10**
Truancy	0.17**	0.19**	0.12**	0.14**	0.11**	0.13**
Evenings out	0.10**	0.07**	0.03**	0.04**	0.06**	0.06**
Risk taking	0.12**	0.21**	0.13**	0.11**	0.14**	0.10**
Aggression	0.09**	0.06*	0.07*	0.07*	0.06	0.02
Theft/property damage	0.15**	0.18**	0.11**	0.11**	0.13**	0.11**
Self esteem	0.00	−0.01	−0.05	0.00	−0.01	0.02
Depressive affect	−0.06	0.01	0.01	−0.07**	−0.02	−0.05
Cigarette use	0.17**	0.19**	0.11**	0.12**	0.09**	0.12**
Marijuana use	0.34**	0.29**	0.25**	0.21**	0.21**	0.22**
Other illicit drug use	0.23**	0.21**	0.17**	0.14**	0.14**	0.15**

* Note: = $p < 0.01$

** = $p < 0.001$

Table 5

Correlations of age 18 predictors with heavy drinking, abuse and dependence

	Heavy Drinking						Abuse		Dependence	
	Age 22		Age 26		Age 35		Age 35		Age 35	
Predictor	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
White	0.11**	0.13**	0.04*	0.02	0.03	0.01	0.03	0.04**	0.01	0.01
Parental education	−0.01**	0.08**	−0.01	−0.00	−0.04*	0.14**	0.00	0.01	0.00	0.01
Single parent home	−0.01	−0.02	0.01	0.01	0.00	0.02	0.01	0.04**	0.02	0.05**
Parental drinking	0.09**	0.05**	0.10**	0.06**	0.11**	0.09**	0.16**	0.13**	0.12**	0.12**
Religious attendance	−0.17**	−0.11**	−0.09**	−0.09**	−0.09**	−0.07**	−0.09**	−0.11**	−0.08**	−0.07**
Grades	−0.19**	−0.06**	−0.13**	−0.10**	−0.11**	−0.09**	−0.12**	−0.10**	−0.08**	−0.07**
College plans	−0.15**	0.03**	−0.07**	−0.06**	−0.07**	−0.08**	−0.06**	−0.04**	−0.05**	−0.05**
Truancy	0.31**	0.17**	0.14**	0.13**	0.11**	0.12**	0.17**	0.18**	0.13**	0.14**
Evenings out	0.20**	0.06**	0.06**	0.06**	0.07**	0.08**	0.05**	0.07**	0.02	0.05**
Risk taking	0.21**	0.18**	0.14**	0.13**	0.12**	0.06	0.14**	0.14**	0.13**	0.10**
Aggression	0.31**	0.08**	0.11**	0.10**	0.12**	0.05	0.10**	0.08**	0.07	0.02
Theft/property	0.32**	0.16**	0.12**	0.13**	0.14**	0.11**	0.16**	0.26**	0.13**	0.18**
Self esteem	−0.03	0.01	−0.06	−0.01	0.00	−0.01	−0.09	−0.05	−0.11*	−0.03
Depressive affect	0.00	0.02	0.03	−0.00	0.00	0.02	0.08	0.09**	0.09	0.07*
Cigarette use	0.32**	0.21**	0.16**	0.17**	0.16**	0.19**	0.18**	0.20**	0.15**	0.16**
Marijuana use	0.49**	0.25**	0.24**	0.18**	0.20**	0.19**	0.27**	0.25**	0.20**	0.19**
Other illicit drug use	0.41**	0.20**	0.18**	0.16**	0.14**	0.14**	0.20**	0.22**	0.15**	0.16**

* Note: = $p < 0.01$

** = $p < 0.001$

Table 6

Standardized regression coefficients for 30-day alcohol use outcome

Predictor	Age 22	Age 26	Age 35
White	0.18**	0.08**	0.08**
Parental education	0.07**	0.06**	0.06**
Single parent home	−0.00	−0.00	−0.00
Parental drinking	0.03**	0.03**	0.03**
Religious attendance	−0.01	−0.01	−0.01
Grades	0.01	0.01	0.01
College plans	0.04**/0.11**	0.04**/0.07**	0.07**/0.08**
Truancy	0.02*	0.02*	0.02*
Evenings out	0.03**	0.00	−0.01
Risk taking	0.05**	0.05**	0.05**
Aggression	−0.03	−0.03	−0.03
Theft/property damage	0.03	0.03	0.03
Self esteem	−0.02	−0.02	−0.02
Depressive affect	−0.05**	−0.05**	−0.05**
Cigarette use	0.01	0.01	0.01
Age 18 30-day alcohol use	0.34**	0.21**	0.18**
Marijuana use	0.15**/0.09**	0.13**/0.07**	0.10*
Other illicit drug use	−0.04	−0.04	−0.04

* Note: = $p < 0.01$

** = $p < 0.001$; Where two coefficients appear the left is for men and the right is for women

Table 7

Standardized regression coefficients for heavy drinking outcome.

Predictor	Age 22	Age 26	Age 35
White	0.13**	−0.00	−0.03
Parental education	0.03**	0.00	−0.01
Single parent home	−0.00	−0.03	−0.03
Parental drinking	0.05**	0.06**	0.07**
Religious attendance	−0.00	−0.00	−0.00
Grades	−0.03**	−0.03**	−0.03**
College plans	0.05**	−0.01	−0.02*
Truancy	0.01	0.01	0.01
Evenings out	0.02**	0.02**	0.02**
Risk taking	0.03*	0.03*	0.03*
Aggression	−0.01	−0.01	−0.01
Theft/property damage	0.03	0.03	0.03
Self esteem	−0.03*	−0.03*	−0.03*
Depressive affect	−0.03*	−0.04*	−0.04*
Cigarette use	0.04**	0.05**	0.05**
Age 18 heavy drinking	0.34**/0.25**	0.24**/0.12**	0.20**/0.10**
Marijuana use	0.08**	0.04**	0.04**
Other illicit drug use	0.04	0.04	0.04

*Note: = $p < 0.01$

**= $p < 0.001$; Where two coefficients appear the left is for men and the right is for women

Table 8

Standardized regression coefficients for alcohol abuse and dependence at age 35

Predictor	Abuse	Dependence
White	0.03	0.00
Parental education	0.00	0.02
Single parent home	−0.01	0.05
Parental drinking	0.12**/0.09*	0.09**
Religious attendance	0.00	0.01
Grades	−0.02	−0.00
College plans	−0.00	−0.00
Truancy	0.02*	0.03*
Evenings out	0.00	−0.01
Risk taking	0.04	0.05
Aggression	0.01	−0.07*
Theft/property damage	0.09*/0.15*	0.12**
Self esteem	−0.03	−0.02
Depressive affect	0.00	0.03
Cigarette use	0.05*	0.04**
Age 18 heavy drinking	0.09*	0.08**
Marijuana use	0.13**/0.05*	0.10**/0.06* **
Other illicit drug use	0.07*	0.15*

*Note: = $p < 0.01$

**= $p < 0.001$; Where two coefficients appear the left is for men and the right is for women