

RESEARCH REPORT

Risk domains associated with an adolescent alcohol dependence diagnosis[★]

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Abstract

Aims. To determine the contribution of familial, interpersonal, academic and early substance use factors to relative risk for an alcohol dependence (AD) diagnosis in adolescents. **Methods.** Information on 619 adolescents and their 390 sets of biological parents was obtained using the adolescent version of the Child Semi-Structured Assessment for the Genetics of Alcoholism (C-SSAGA) and the adult counterpart of this instrument, the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA). The C-SSAGA elicits a wide range of environmental, social, and psychiatric diagnostic information. Specific domain scale scores associated with an adolescent AD were computed, and generalized estimating equations (GEE) modeling was used to determine the odds ratio (relative risk) of the specified risk domains for an alcohol dependence diagnosis. **Findings.** Risk factors for a DSM-III-R AD diagnosis included being at least 16 years of age, as well as negative parent–child interactions, school and personal-related difficulties (including the presence of an externalizing or internalizing DSM-III-R non-alcohol-related diagnosis), and early experimentations with a variety of substances. **Conclusions.** An array of familial, interpersonal, academic and early substance use factors were strongly associated with adolescent AD. Given the findings of this study, further research to determine temporal relationships that might influence the onset of adolescent alcohol dependence is warranted.

Introduction

Studies indicate that heavy alcohol use is common in adolescents. O'Malley, Johnston & Bach-

man (1995) reported that among adolescents who drank alcohol in the last month, 13.5% of eighth-graders, 23.0% of tenth-graders and

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27.5% of twelfth-graders drank five or more drinks in a row at least once. Data from the *Monitoring the Future Study* (Johnston *et al.*, 1995) indicated that 3.7% of high school sophomores and 12.3% of seniors report being drunk at least 40 times. Researchers have long been interested in risk factors that may be useful in predicting adolescents who are at-risk for developing such problematic alcohol use. In their review of the literature, Hawkins, Catalano & Miller (1992) categorized adolescent risk factors into three domains: (1) *home and environmental* factors such as parental use/parental acceptance of alcohol/drug use, family bonding, family conflict, ease of obtaining alcohol, peer use, and peer attitudes towards alcohol/drug use; (2) *child behavioral* factors such as rebellion against parents, gaining of peer acceptance, stress reduction, enhancement of social competence, and self-treatment of mental health and/or academic problems; and (c) *societal norms* such as laws regarding alcohol use, prominence of alcohol in the community, neighborhood economic conditions, and neighborhood disorganization.

The literature is less clear about risk factors for adolescents with even more problematic alcohol use—i.e. sufficient to qualify for an actual alcohol related diagnosis—although data exist to describe risk factors in adolescence that correspond to an adult diagnosis of alcoholism. Predictors have been grouped into two domains: (1) *home and environmental* factors and (2) *child behavioral* traits. Robins and colleagues (Holmes & Robins, 1987) demonstrated that unfair, inconsistent and harsh discipline by parents predicted adult occurrence of both alcohol and depressive disorders independently of the influences of parental psychiatric history, the respondent's sex and childhood behavior problems. Similarly, McCord (1988) reviewed the records of 203 boys who were seen in a delinquency prevention program between 1926 and 1933. As adults, 61 (32%) of these individuals met her criteria for alcoholism. McCord described two types of families associated with an increased risk for the development of adult alcoholism; in one, boys tended to emulate their alcoholic fathers and in the second, boys who were hard to control by their mothers appeared to develop adult alcoholism later, along with antisocial behavior.

The same authors have also found an associ-

ation between childhood problematic behaviors and adult alcoholism. Robins (1966) linked juvenile delinquency to a variety of adult psychopathology including alcoholism; more recently, she has extended the relationship to include childhood conduct disorder (Robins, 1998). Similarly, Rydelius (1983), in his study of Swedish adolescents, demonstrated that adolescents with acting-out behavior, poor impulse control, restlessness and difficulties concentrating were more likely to become adults with alcohol abuse or dependence diagnoses. McCord and colleagues (McCord, 1988; Crum, Ensminger & McCord, 1998) in a series of studies using teacher ratings found the development of alcoholism to be associated with aggression, shyness, underachievement in the first grade, less parental involvement in the child's homework and dropping out of high school. Similarly, Caspi *et al.* (1996) reported that an alcohol dependence diagnosis at age 21 in males was associated with being impulsive, restless, and distractible at age 3.

A third domain that has also been implicated in the development of adult alcoholism is early experimentation with substances such as alcohol and tobacco. Grant & Dawson (1997) reported that the age of first use of alcohol is a powerful predictor of life-time alcoholism; 40% of young adults aged 18–29 years, who initiated drinking before the age of 15 years, were classified as alcohol-dependent compared to approximately 10% who began drinking after the age of 19.

Thus, the literature suggests that three domains (home and environmental factors, difficult child behavior and early substance use) are risk factors for problematic alcohol use in adolescents but is less explicit about risk factors associated with an actual diagnosis of adolescent alcohol dependence. These three domains have been examined separately and a combined assessment is needed in order to determine their relative strengths as predictors of an adolescent alcohol dependence diagnosis. The present study, using data from a multi-site family study of alcohol dependence that included children and adolescents, examined variables in each of the following domain categories: “family/friend” (F/F), “individual/personal attributes” (IPA) and “early substance use” (ESU). The F/F domain, drawing from the literature review on home and environmental variables, included parental use and

acceptance of alcohol/drug use, family bonding, family conflict, ease of obtaining alcohol, peer use and peer attitudes towards alcohol/drug use. The IPA domain, based on child problematic behaviors, included rebellion against parents, the gaining of peer acceptance, stress reduction, enhancement of social competence and self-treatment of mental health and/or academic problems. The ESU domain included age of first use of alcohol, tobacco, marijuana and other illicit drugs.

The present study was designed to estimate the relative risk (RR) for an adolescent DSM-III-R alcohol dependence diagnosis in relation to each of the proposed domains. There was no a priori hypothesis that one domain would be the more powerful predictor of an adolescent alcohol dependence diagnosis.

Methods

The sample of adolescents examined was part of the Collaborative Study on the Genetics of Alcoholism (COGA); a multicenter family study conducted at six research centers located in California, Connecticut, Iowa, Indiana, Missouri and New York. Institutional Review Boards at all six sites independently approved the study design and copies of all interview instruments. Parents and their adolescents provided informed consent and assent, respectively, for participation in this study. Ascertainment rules and procedures for the two types of COGA families are described by Begleiter *et al.* (1995).

Adolescent subjects in this study were defined as all available children between the ages of 13 and 17 who had interview data available on themselves and both their biological parents. Trained research assistants administered a semi-structured interview to all subjects. Both biological parents were interviewed using the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA), a highly reliable (Bucholz *et al.*, 1994, 1995) and valid (Hesselbrock *et al.*, 1999) diagnostic instrument for DSM-III-R diagnoses. Adolescents were interviewed with the adolescent version of the Child Semi-Structured Assessment for the Genetics of Alcoholism (C-SSAGA-A), which is derived in part from the Diagnostic Interview for Children and Adolescents (DICA) (Reich *et al.*, 1982). A corroborative interview also was obtained from one of the

adolescent's parents (usually the mother), using the parent version of this instrument, the C-SSAGA-P. Life-time adolescent DSM-III-R diagnoses were made by combining information from both adolescent and parent interviews in the method of Bird, Gould & Staghezza (1992) such that an endorsement by either informant for a particular question was coded positive. A diagnosis of alcohol dependence, based on the presence of three of the nine criteria clustered for a minimum of 1 month, was used to group the adolescents. Using this method to make diagnoses, a 1-week test-retest administration of the C-SSAGA- A and C-SSAGA-P resulted in an overall mean kappa of 0.72 (SD = 0.17) for the eight non-alcohol dependence psychiatric diagnoses evaluated in this study and was 0.86 for the diagnosis of alcohol dependence, representing substantial diagnostic agreement (Landis & Koch, 1977). Due to their small number, 12 subjects who had a DSM-III-R diagnosis of alcohol abuse (i.e. the presence of only two of the nine DSM-III-R symptoms) were eliminated from further analysis.

Approximately 70% of the adolescents in this study were members of high-risk families defined as containing at least three adults who met the COGA definition of alcohol dependence—i.e. a DSM-III-R diagnosis of alcohol dependence and a Feighner (Feighner *et al.*, 1972) diagnosis of definite alcoholism. The remaining adolescents were members of community control families; these families were recruited from dental and family practice clinics, businesses, churches and driver's license renewal lists. Control families were not selected with respect to the presence or absence of any psychiatric disorder, including alcohol dependence. Within the control families, 3.3% of the mothers and 24.1% of the fathers had a life-time diagnosis of alcohol dependence compared to 28.6% of the mothers and 39.1% of the fathers (FET, $p < 0.0001$ for both). Based upon the above criteria, a total of 619 adolescents from 390 families (an average of 1.6 adolescents per family) composed the study's sample; 54 adolescents (8.7%) had a DSM-III-R diagnosis of alcohol dependence (AD) and 565 (91.3%) adolescents did not (NAD). Surprisingly, the percentage of control family adolescents with an AD diagnosis (6.6%) was not different from the percentage of adolescents from high-risk families (9.6%).

For the overall sample, the average ages in

years of the 619 adolescents and their 390 biological mothers and fathers were 15.2 ± 1.4 (range 13–17 years), 40.8 ± 6.2 and 43.8 ± 6.8 , respectively. Males comprised 51.2% of the adolescents. Three hundred and thirty (53.3%) of the adolescents lived with both parents. The distribution of adolescents who had a biological parent(s) with a life-time diagnosis of alcohol dependence included: neither a mother nor a father (35.5%), both a mother and a father (8.6%), only a father (34.7%) and only a mother (21.2%). Since over 94% of the adolescents lived in their biological mother's home, SES calculations were based on this residence. Income was divided into \$10 000 blocks and ranged from less than \$10 000 to over \$150 000. The median income block for this study was \$30 000 to \$39 999; the modal income block was \$50 000 to \$59 999.

Males comprised approximately 50% of both the NAD and AD groups. The percentage of high-risk families in the two groups was also similar at approximately 70%. The NAD group was younger, with a mean age of 15.1 ± 1.4 years compared to 16.1 ± 1.0 years for the AD group ($T = -5.54$, $df = 617$, $p < 0.00001$).

As expected, adolescents in the AD group were frequent drinkers and consumed significant quantities of alcohol. Eighty per cent of this group compared to 13% of the NAD adolescents drank 1–2 times per week for a period of at least 2 months. Forty-one per cent of AD adolescents had a history of drinking nearly every day for a period of at least 2 weeks compared to just 2% of the NAD group. For the AD adolescents who drank every day, the number of drinks consumed in a typical day ranged from 1 to 36 with an average consumption of eight drinks per day.

Risk domains

Seventeen variables comprised the F/F risk domain. Ten of these pertained to interactions between the adolescent and his/her mother or to interactions between the adolescent and his/her father (does not do things together, teases or hurts your feelings, frequently criticizes you, does not compliment you, and does not feel close to you). Five variables pertained directly to parental characteristics (your mother does not care about others, your father does not care about others, your mother fights more with your father than other parents, your father fights more

with your mother than other parents, and a parent has a diagnosis of alcohol dependence). Two variables were related to friends (at times all your friends drank a lot and your parents dislike some of your friends). An F/F scale score was created by assigning a value of 0 (not present) or 1 (present) for each variable and then summing the results. The F/F scale had a Cronbach's alpha score of 0.70 and an overall mean score of 4.0 ± 3.2 . The F/F score was significantly different for the two groups of adolescents, with the NAD group having a lower (less pathological) mean F/F score than the AD group (3.7 ± 3.0 versus 7.3 ± 3.4 , $T = -8.4$, $df = 617$, $p < 0.0001$).

Twelve variables, based upon a review of the literature, were selected as constituting the IPA risk scale. The first one consisted of daily cigarette smoking while the next three dealt with school-related difficulties (held back a grade, dropped out of school and no extracurricular activities). The remaining eight items were life-time psychiatric diagnoses and included externalizing disorders (attention deficit hyperactivity disorder, oppositional defiant disorder and conduct disorder), internalizing disorders (major depressive disorder, separation anxiety disorder and overanxious disorder) and substance use disorders (marijuana abuse and other drug abuse). Similarly to the manner described previously for the F/F scale, an IPA scale score was constructed, resulting in a Cronbach's alpha score of 0.62. The overall mean score for the IPA scale was 2.2 ± 1.6 . This score was significantly different for the two groups of adolescents, with the NAD group having a lower (less pathological) mean IPA score than the AD group (2.0 ± 1.3 vs. 4.7 ± 2.1 , $T = -13.8$, $df = 617$, $p < 0.0001$).

The ESU scale was derived from five C-SSAGA-A items. These consisted of age of first use of: alcohol, tobacco, marijuana and other drugs (cocaine, speed, opiates, hallucinogens or downers). Additionally, age of first intoxication was added to this scale. Similar to Grant & Dawson (1997), these five "age of first use" variables were converted to dichotomous values with the separation age being "less than 14" and "14 and above". The ESU domain scale had a Cronbach's alpha score of 0.72; the overall mean score for the ESU domain scale was 0.4 ± 0.8 . This score was significantly different for the two groups of adolescents, with the control

group having a lower mean ESU score than the AD group (0.3 ± 0.7 vs. 1.2 ± 1.4 , $T = -8.3$, $df = 617$, $p < 0.0001$).

Statistical analyses

Using a diagnosis of alcohol dependence as the dependent variable, Generalized Estimating Equations (GEE) modeling, which adjusts for correlations among siblings, was used to compute the relative risk and the significance level of having an alcohol dependence diagnosis based on the presence of an elevated domain scale score. For this study, children from the same family were clustered by mothers. Because it was anticipated that older male adolescents from high-risk families might influence the results, gender (male vs. female), age (13 to less than 16 years vs. 16 to less than 18 years) and family type (control vs. high-risk) were used as covariates. The exchangeable working correlation matrix was calculated in all cases using SAS (Proc GenMod). Since the data were binary, the "logit link" function was used, corresponding to logistic regression. Goodness-of-fit was assessed using the measures of scaled deviance and scaled Pearson chi-square provided by the procedure. In all cases these measures were less than 1, suggesting a good fit of the model.

To better clarify the effect of each domain scale score on the risk for an alcohol dependence diagnosis, they were dichotomized ("not elevated" and "elevated") based on value of the median score for that scale plus one. This resulted in scale dichotomies of ≥ 3 for the F/F domain and ≥ 2 for both the ESU and IPA domains. The initial GEE model included the following independent variables and potential interaction terms: age, gender, family type, the three dichotomized domain scale scores and all first-order interaction terms of age, gender and family type across the three domain scores. Results indicated no significant first-order interactions; therefore, the final GEE model included the three domain scale scores as the independent variables with age, gender and family type retained as covariates.

Results

As mentioned previously, the GEE model included the three domain scores as the independent variables with gender, age, and family type

retained as covariates. Table 1 presents the number and percentages of NAD and AD adolescents by the specified categories of the dichotomous covariate and independent variables. Neither male gender nor being part of a high-risk family significantly increased the risk of having an AD. Older adolescents (16–18 years of age) were 7.63 times more likely to have an AD than younger adolescents ($p < 0.0001$). Elevated scale scores in each of the separate three domains (Table 1a) were seen more commonly in the AD group. An elevated F/F domain scale score resulted in a 3.91-fold increased risk for an AD ($p < 0.005$). Similarly, an elevated IPA domain score was associated with an 8.88 relative risk increase for an AD ($p < 0.0004$). Finally, an elevated ESU domain score produced a 4.69-fold increase in risk for an AD ($p < 0.0002$). Therefore, the relative risk was increased for older adolescents, regardless of gender or family type, who had elevated domain scores on any of the three scales.

The rate of adolescents with multiple elevated domain scales was examined next. Only two combinations of multiple elevated domain scales occurred in the alcohol-dependent adolescents. These were the combinations of elevated F/F + IPA scales and elevated F/F + IPA + ESU scales. A final GEE model (Table 1b) utilizing these two combinations along with the covariates of gender, age and family-type was used to determine the increase risk for AD associated with having multiple elevated scales. Effects of the covariates were not different to those of the first model. The combination of elevated domain scores for F/F + IPA increased the risk for adolescent AD by 7.58-fold ($p < 0.0001$). However, having all three elevated domain scores increased the risk for an adolescent AD over 40-fold ($p < 0.0001$), a substantial increase in the risk compared to the change in risk associated with any single independent variable.

Discussion

The analyses provide information about the relative power of several domains of variables for estimating adolescent risk for an alcohol dependence diagnosis. Elevated F/F and IPA scales were found relatively commonly in both adolescent groups; approximately 60% of the no alcohol diagnosis (NAD) group and over 90% of the alcohol dependence (AD) group had elevated

Table 1. Changes in relative risk for an adolescent with an alcohol dependent diagnosis utilizing GEE modeling

Variable	NAD Adolescents N (%)	AD Adolescents N (%)	Increased risk for an alcohol dependence diagnosis (confidence interval)	<i>p</i> value
(a) Independent variables are age, gender, family type, F/F domain score, IPA domain score, and ESU domain score				
Age (> 15 years)	220 (38.9)	44 (81.5)	7.63 (3.56, 16.39)	0.0001
Gender (male)	273 (48.2)	29 (53.7)	1.43 (0.75, 2.72)	0.28
Family type (high-risk)	395 (69.1)	42 (77.8)	1.29 (0.60, 2.76)	0.51
Family/friend domain scale (≥ 3)	319 (56.5)	49 (90.7)	3.91 (1.53, 10.01)	0.005
Individual/personal domain scale (≥ 2)	300 (53.1)	51 (94.4)	8.88 (1.01, 10.75)	0.0004
Early substance use domain scale (≥ 2)	35 (6.2)	15 (27.8)	4.69 (2.05, 10.75)	0.0002
(b) Independent variables are age, gender, family type, combination of elevated F/F + IPA domain scores and combination of elevated F/F + IPA + ESU domain scores†				
Family/friend domain scale (≥ 3)	180 (31.9%)	32 (59.3%)	7.58 (3.25, 17.70)	0.00001
Individual/personal domain scale (≥ 2)				
Family/friend domain scale (≥ 3)	21 (3.7%)	15 (27.8%)	41.01 (13.85, 121.5)	0.00001
Individual/personal domain scale (≥ 2)				
Early substance use domain scale (≥ 2)				

† Independent variables of age, gender, and family type were not different then those of the first model and are not reproduced here.

scores in these domains. An elevated ESU scale was less common; approximately 6% of the NAD group versus 28% of the AD group had an elevated score in this domain. Furthermore, an elevated ESU score was associated with having both the F/F and IPA scores elevated. All 15 of the adolescents in the AD group with an elevated ESU scale had elevated scales scores for all “three” domains, and this combination resulted in the largest increase in relative risk for an AD diagnosis.

There were two unanticipated findings in this study. First, there was an almost 5 : 1 ratio of adolescents with a diagnosis of alcohol dependence versus alcohol abuse. Although this may be accounted for by confusion among the adolescents in regards to the effects of acute intoxication versus chronic effects of alcohol use, this is unlikely due to the training of the research assistants who administered the C-SSAGA interviews. Another consideration is that this

finding may be partially accounted for by familial factors since the vast majority of adults with an alcohol diagnosis in the COGA high-risk families had a diagnosis of alcohol dependence and not abuse. Another explanation may be related to the fact that there are minimal differences in a DSM-III-R diagnosis of alcohol dependence versus abuse; this difference is based on number and not severity of symptoms. A second unexpected finding is that while the risk for an AD was increased 1.38-fold in association with being a member of a COGA high-risk family, this was not significant. Perhaps this finding is simply related to the relatively young average age of our sample and the fact that NAD adolescents on average were a year younger than AD adolescents; as the current NAD group ages perhaps more of these adolescents will develop an AD and this might be preferential in those from high-risk families.

This investigation has several strengths. First,

the study employed data from multiple sites to make a large sample. Secondly, study adolescents and their parents were carefully interviewed using trained research assistants and rigorous protocols. Thirdly, the pattern of age of onset of substance use reported by the adolescent sample appeared consistent with other groups of adolescents with substance use/abuse behavior (Werch & Anzalone, 1995) and therefore provided some check on the quality of data collected by the C-SSAGA-A. Finally, generalized estimating equations (GEE) analysis allowed the data to be adjusted for family data that may be overlapping among siblings.

The current study design was not able to indicate which, if any, of the domain scales (or even variables within the domain items) were causal for the diagnosis of alcohol dependence. For example, impulsive behavior is common to both attention deficit hyperactivity disorder (ADHD) and conduct disorder (CD). Additionally, impulsive behavior is associated with problematic relationships with parents and peers, poor academic performance and difficulties with alcohol use. Therefore, impulsive behavior by itself may be an indicator of a personality trait for which alcohol dependence is only one possible outcome. The *etiology* of impulsive behavior may reflect genetic transmission, early parental influences, or the combination of both; thus the need still exists to show why some individuals with an elevated domain score (e.g. a positive diagnosis of CD and/or ADHD) develop AD and others do not. Future analyses, utilizing modeling techniques that combine variables across the three identified domains, as well as techniques to identify the temporal course of the onset of these symptoms, are planned as a means to further refine the key variables that have been shown to be important determinants for an increased risk for the development of adolescent alcohol dependence.

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