Development of Alcoholism in Adoptees Raised Apart From Alcoholic Biologic Relatives

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- Male adoptees raised apart from alcoholic biologic parents were followed up and compared with adoptees of nonalcoholic biologic parents. Significant associations were found between adoptee alcoholism and an alcoholic biologic background and between childhood conduct disorder and the development of alcoholism as an adult. None of the environmental factors—psychiatric or alcohol problems in adoptive family, socioeconomic status of the adoptive family, or exposure to discontinuous mothering as an infant—predicted adoptee alcoholism. These findings suggest the importance of a genetic factor in alcoholism and are in accord with previous work that failed to show an independent effect of an alcoholic environment in development of adoptee alcoholism.

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Compelling evidence of a genetic factor in alcoholism has been described with the use of different research methodologies: family, twin, and adoption studies. Family studies consistently demonstrate increased prevalence of alcoholism among both male (25%) and female (5% to 10%) relatives of alcoholics. Both of these rates represent dramatic increases over the estimated population prevalences for alcoholism, which are 3% to 5% for men and 0.1% to 1% for women.1

Three Scandinavian twin studies2-4 and one US twin study5 showed greater concordance for alcoholism in monozygotic than in dizygotic twins. While these findings suggest genetic control over drinking behavior, the 40% to 50% discordance in monozygotic twins points to relatively strong environmental effects.

Adoption studies are a superior methodologic tool with which to assess the relative importance of heredity vs environment and the interaction of the two in the development of a condition such as alcoholism. In the commonest type of study, adopted-away offspring of alcoholic biologic parents are compared with adopted-away offspring of nonalcoholic biologic parents. Both groups of adoptees are followed up to assess incidence of alcoholism. With this design four recent adoption studies on alcoholism—two from Scandinavian countries6-9 and two from the United States10-11—showed significant correlations between alcoholism in biologic parents and alcoholism in the adoptees.

Cadoret and Gath12 looked at environmental variables and biologic background of alcoholism with the use of a multiple regression approach. Environmental variables included socioeconomic status of the adoptive parents, psychiatric conditions in adoptive family, time spent in foster care before adoptive placement, and age of the adoptee. The only significant predictor of alcoholism in the adoptee was a biologic background of alcoholism. Although it is not yet clear how a genetic predisposition to alcoholism interacts with the environment to produce the condition, there clearly is a strong genetic component.

The present study looks at male adoptees with first-degree (biologic mother or father) alcoholic relatives, adoptees with second-degree (brothers and sisters of biologic parents, grandparents of adoptee) alcoholic relatives, and a control group of adoptees whose biologic relatives have other psychiatric diagnoses or no psychiatric diagnosis. The purpose of the study is to assess the contribution of biologic background of alcoholism, the contribution of various environmental variables, and the interaction of the two in the development of adoptee alcoholism.

METHOD

The study combines two samples of male adoptees separated at birth from biological parents. Both samples were part of a large study that used adoption records from Iowa's Children's and Family Services of Des Moines. The original sample has been reported in detail elsewhere.11-12 Basically, it included two groups of adoptees: group 1, those adoptees whose biologic parents showed evidence of psychiatric or behavior disturbance; group 2, those adoptees whose biologic parents showed no evidence of psychiatric illness. The two groups of adoptees were matched on age, sex, time spent in foster care, and age of biologic mother at the birth of the child. The second sample of male adoptees was collected under a similar sampling procedure: group 1, adoptees whose biologic parents showed no evidence of psychiatric illness but whose second- or third-degree relatives had psychiatric or behavior disturbance; group 2, adoptees whose biologic parents or relatives showed no evidence of psychiatric disturbance. The two groups were matched on the same variables as above.

We used all male subjects aged 18 and over (N = 93) from these two samples. The design of the study called for telephone interviews, by a research assistant blind to the biologic background, with both the adoptive parents and the adoptee. The adoptive parent interview was composed of about 150 items dealing with temperament, development, social adjustment, school achievement, drinking, and drug-taking behavior. Parents were also questioned about family drinking habits, psychiatric problems, and basic demographic information. The adoptee interview consisted of a brief social history and a structured psychiatric interview allowing diagnoses by the Feighner criteria13 to be made for the following conditions: alcoholism, drug dependence, antisocial personality, unipolar and bipolar affective disorder, hysteric anxiety neurosis, obsessional neurosis, and schizophrenia.

Adoption agency records provided information of variable quality about the biologic relatives of the adoptee. Information about the biologic mother was most complete since it was based on a series of interviews by adoption workers during a three- to four-month period. Information on the biologic father was obtained from the biologic mother, her parents, and often the home county social work agency. Whenever either the biologic mother or father had been hospitalized for medical or psychiatric reasons or had been in reformatory or prison, confirmatory letters from these institutions were included in the adoption record. Biologic mothers were always asked if they or the fathers had mentally ill or alcoholic family members, and family relationship and nature of problem were recorded in the adoption record.
Psychiatric diagnoses on all biologic relatives were made by a psychiatrist (R.C.) using modified Feighner criteria (see Cadoret and Gath). The criteria for diagnosing alcoholism were as follows: two or more social or medical complications associated with alcoholism (as defined by Feighner et al.) or hospitalization for detoxification.

Adult adoptive diagnoses were made by a psychiatrist (R.C.), blind to diagnoses in biologic relatives, using Feighner's criteria. If no adoptee interview was not available, diagnosis was based on the adult section of the parent entrevist. It was possible for an adoptee to have 1, 2, or 3 adult psychiatric diagnoses following the concept of primary and secondary psychiatric conditions developed by Robins and Guze.

Child psychiatric diagnosis were made by two child psychiatrists using ICD-9 criteria developed by Rutter et al. Child psychiatrists were blind to biologic background and adult outcome of the adoptees.

Sample Bias

One hundred sixty-seven male adoptees aged 18 years and older were identified from the records of these, 19 (11%) could not be located, leaving a remaining sample of 148 adoptees. Of those contacted, 56 (38%) refused to participate in both the adoptive parent and the adoptive interviews, leaving a final sample of 92 subjects.

Of the 92 men on whom we collected data, five (5%) of the adoptive parents refused to be interviewed but the adoptee was interviewed; in 22 cases (33%), the adoptive parent was interviewed but the adoptee was not interviewed. Both the parents and the adoptee were interviewed in the remaining 55 cases.

In the area of adoptions it is difficult to determine the direction of sample bias. Adoptive parents are often quite sensitive about their children and the confidentiality associated with the biologic background, and our data show these factors result in increased refusal rates. Also, adoptees in general have an increased incidence of professional contact for psychiatric and behavioral problems, and unwillingness of adoptive parents to discuss these problems could further bias the refusals. The data we have on refusers vs cooperators show no difference on the following variables: percentage of sample with psychiatric disorder in biologic background, age of adoptees, or type of psychiatric diagnosis in biologic background. Thus, when measured on the available characteristics, the refusers and cooperators looked similar and there was no evidence that having an adoptee with an alcoholic or other psychiatric diagnosis biologic background led to a greater rate of refusal by adoptive parents.

Definition of Variables

The present analysis uses multiway frequency tables to describe the relationships between the factors under consideration. Child- hood conduct disorder and biologic and environmental variables are assessed in relationship to adoptee alcoholism. Biologic factors are alcoholism in first-degree biological relatives and alcoholism in second-degree biological relatives. Environmental factors and their definitions are as follows:

- Psychiatric or behavior disturbance in adoptive home—includes any treated psychiatric problem in adoptive parents or siblings including alcoholism
- Discontinuous mothering—exposure as an infant to discontinuous mothering at Iowa State University's Home Management House in Ames. (Exposure consisted of a neonate's being placed at the State University for three to six months and cared for by 17 to 30 rotating female students. Each student had primary care responsibility for five days. These Home Management Houses are described by Pease and Gardner and by Gardner et al.) A significant relationship between this exposure and adolescent antisocial behavior is described in Cadoret and Cain. Twenty-seven of the subjects in the present analysis had this exposure.)

All variables were coded as binary variables, i.e., present or absent. The BMD program PFS was used for the analysis. The analysis is based on fitting a log-linear model to the cell frequencies, that is, the logarithm of the expected cell frequency is written as an additive function of main effects and interactions.

Because the six-way (five independent variables and one dependent variable in Table 1) contingency table has so many cells (2 x 2 x 2 x 2 x 2 = 96) and so few observations, it would be difficult to estimate the effects of interest with precision. A reasonable approach is to adjust the cell counts to make the empty cells nonzero. Often 0.5 is added to each cell. However, Bishop et al. show that a procedure that works as well as and often better than this is to estimate all the cells using empirical Bayes estimators. In this case this amounts to shrinking all cell counts back toward the average cell count by 0.001 to 0.01. It was this adjusted table that was submitted to analysis.

**RESULTS**

A log-linear model was fit to describe the relationships between adoptee alcoholism and the biologic and environmental predictors. As detailed in Bishop et al., this involves fitting a multiple regression model of the following type:

$$\log(\text{odds in favor of adoptee alcoholism}) = \beta_1 \times \text{biologic background predictors} + \beta_2 \times \text{environmental predictors}$$

The right side of the equation includes all the independent variables described in the methods section. Both main effects and interactions between independent variables were examined. In particular, hierarchical model fitting was used. This method, like an analysis of variance factorial design, includes multiway interactions. For example, simultaneous presence of both second-degree biologic relatives with alcoholism and psychiatric disturbance in the adoptive family is a two-way interaction, whereas simultaneous presence of three independent variables is a three-way interaction. From a model with all possible interactions, those that are not statistically significant are eliminated. The model that is left is then interpreted.

Table 1 shows frequencies of occurrence of all variables used in the analysis.

The model fitted to this data by the hierarchical procedure given above is summarized in Table 2. The model was retained because (1) it parsimoniously describes the data with a few predictors; (2) it is the best fitting model with so few predictors; (3) when other variables are added to this model, they do not improve the prediction of adoptee alcoholism. In this model the main effects of first- and second-degree biologic background for alcoholism were significant, individually and together. The first line of Table 1 gives the overall significance level for the complete model (i.e., the model that includes all of the terms). The
likelihood ratio \( \chi^2 \) used here is calculated such that high probability levels indicate good fit to the data. The next two lines indicate the individual contribution of each variable to the prediction. The \( \chi^2 \) on these lines are calculated such that a high value indicates an association between a biologic background variable and adoptee alcoholism.

The absence of the environmental predictor variables from the final model indicates the following:

1. In this sample the environmental variables, taken alone, explain less than the biologic predictors taken alone.

2. In this sample when the environmental variables are added to the biologic background variables, prediction of adoptee alcoholism does not improve.

3. In this sample there is no evidence that environmental variables interact significantly with biologic variables, to potentiate or ameliorate the risks of adoptee alcoholism due to biologic background.

From a genetic point of view, it is of further interest to examine the relative influences of first-degree and second-degree biologic background. On any genetic model the first-degree biologic background of alcoholism should have greater influence on development of adoptee alcoholism than second-degree biologic background. This is, of course, because a proband has, on average, more genes in common with first-degree than with second-degree relatives. Although crude, it was decided to test the significance of the difference between the effects of first- and second-degree biologic background on adoptee alcoholism. The statistic for this test is given the appropriate assumptions, approximately a \( t \) test for correlated means (the asymptotic covariance of the \( b \) coefficients was estimated using a weighted least-squares program). The statistic calculated for the difference was not significant \((t(85) = .1180)\).

**COMMENT**

The association of alcoholism in adoptees with a history of alcoholic biologic relatives suggests a genetic component in alcoholism. This interpretation is likely, given the early separation of the adoptees from biologic relatives, thus minimizing learned behavior. Possible confounding of a genetic effect could have occurred if the adoptive parents were aware of a history of alcoholism in the biologic family. Only one set of adoptive parents was aware of this condition, and the adoptee turned out to be a primary alcoholic. Removal of this one case from the sample would not substantially alter the analysis.

Several adoptive families had an alcoholic member, but absence of alcoholism in any adoptees from these families suggests lack of an environmental effect. In addition our analyses show no relationship between any psychiatric disorder (including alcoholism) in the adoptive family and alcoholism in the adoptee. These findings are in accord with Goodwin's work that fails to show an independent effect of an alcoholic environment in adoptee alcoholism.

The association between childhood conduct disorder and adult alcoholism has previously been demonstrated by Shuckit et al., Goodwin et al., and Cadoret and Gath. Because our data on childhood behavior were obtained retrospectively from adoptive mothers, it is possible that the mothers distorted the early childhood behavior in view of the present personality of the adoptee. It is difficult to assess the extent of this bias, but it is of note that in only two cases of alcoholic adoptees did the parents express awareness of the drinking problems of their children. It would be advantageous to collect childhood data in a prospective manner and then observe the adoptee in adulthood to determine if conduct disorder is indeed a risk factor for the development of alcoholism.

Because alcoholism is often contaminated by simultaneous presence of antisocial personality, it is possible that an alcoholic biologic background is predicting antisocial personality and that alcoholism is a sequela to that disorder. To investigate the likelihood of this hypothesis, we examined the biologic backgrounds of adoptees with psychiatric diagnoses of both antisocial personality and alcoholism. This combination of diagnoses was equally likely whether the adoptee had a biologic background of alcoholism (14%), other psychiatric diagnoses (8%), or no diagnosis (8%). Thus, it appears that alcoholism in biologic relatives specifically predicts adoptee alcoholism, regardless of presence or absence of adoptee antisocial personality.

The final environmental variable examined was exposure of the adoptee as an infant to discontinuous mothering, a type of maternal deprivation. This variable was entered because it was strongly correlated with antisocial behavior in adolescence in a previous analysis. No association with adoptee alcoholism was found.

Socioeconomic status (SES) of the adoptive parents was entered in an early model and no association with adoptee alcoholism was found. Adoptive parents are selected for stability of life-style and are largely a middle-class sample. It is thus difficult to use adoption studies to demonstrate an effect of low SES independent of a biologic background of alcoholism.

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**References**