

SHORT COMMUNICATION

Overrepresentation of Adoptees in Children with the Attention Deficit Disorder

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In a sample (N = 200) from two populations of children diagnosed as having the attention deficit disorder (ADD: DSM-III diagnosis for "hyperactivity"), a 17% rate of nonrelative adoption was found. This figure represents an approximately eight-fold increase over the base rate of nonrelative adoption estimated in a non-ADD control group and in the general population.

KEY WORDS: attention deficit disorder; hyperactivity; hyperkinesis; minimal brain dysfunction; adoption.

INTRODUCTION

Of the children who receive general psychiatric treatment at mental health facilities, 4.3% are nonrelative (extrafamilial) adoptees [see Mech (1973) for review]. Although numerous studies have estimated the rate of nonrelative adoption among general psychiatric populations, no study exists which reports this rate in a population with a specific psychiatric diag-

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nosis. The purpose of this communication is to report an extremely high rate of nonrelative adoption in patients specifically diagnosed as having the attention deficit disorder (ADD; DSM-III, 1980)⁸, which is one of the most common psychiatric disorders of childhood (Weiss and Hechtman, 1979).

METHODS

Two populations of ADD patients were studied. The first sample ($N = 100$) was randomly drawn from cases diagnosed at the Child Development Clinic of the Hospital for Sick Children of Toronto, Ontario. The second sample ($N = 100$) was drawn randomly from cases diagnosed at the Educational, Behavioral, and Developmental Pediatric Clinic of Orange County, California. Diagnoses of ADD were obtained for these patients by application of the criteria of the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association Task Force, 1980).

Two non-ADD control populations were studied. The Toronto control group was obtained from children referred to the Hospital for Sick Children for kidney transplantation ($N = 130$). The Orange County control sample ($N = 100$) was randomly selected from the records of non-hyperactive patients of a private pediatric allergy clinic adjacent to the Educational, Behavioral, and Developmental Pediatric Clinic.

Children in the ADD and control groups were between 6 and 13 years of age at the time of their first clinic visit. This range corresponds to the age of risk for the disorder (Cantwell, 1975). The rates of nonrelative adoption in the ADD and control groups were calculated as a percentage of the total number of patients in each group.

Population estimates of the prevalence of nonrelative adoption for Ontario and California were calculated for the years 1970–1971; these represent the modal birth years for both the Toronto and the Orange County ADD subjects. For this 2-year period, the rate of nonrelative adoption for Ontario and California was determined [the annual number of nonrelative adoptions divided by the annual number of births, according to the procedure of Goodman *et al.* (1963)].

⁸ The diagnosis of ADD is detailed in the *Diagnostic and Statistical Manual of Mental Disorders*, 3rd ed. (American Psychiatric Association Task Force, 1980). This label emphasizes the cognitive components of the disorder and was designed to replace the terms "hyperactive child syndrome," "hyperkinetic child-impulse disorder," and "minimal brain dysfunction." In establishing the diagnosis of ADD, symptoms of impulsivity and inattention are specified. There are two subtypes of ADD, ADD with hyperactivity and ADD without hyperactivity, although it is not known whether they are forms of a single disorder or two distinct disorders. Patients in this study met the DSM-III criteria for either 314.01 (ADD with hyperactivity) or 314.00 (ADD without hyperactivity).

Table I. Rate of Nonrelative Adoption

	ADD	Control	Population
Toronto	21.0%	2.3%	2.5%
	SE = 0.04	SE = 0.01	SE = 0.0001
	N = 100	N = 130	N = 265,119
Orange County	13.0%	2.0%	2.0%
	SE = 0.03	SE = 0.01	SE = 0.0002
	N = 100	N = 100	N = 701,649

RESULTS

The *overall rates* of adoption estimated from the Toronto and Orange County ADD samples were 22 and 18%, respectively. The *rates of nonrelative adoption* for Toronto and Orange County were 21 and 13%, respectively. Nonrelative adoptees represent the vast majority of cases observed in general psychiatric populations (Mech, 1973) and in the reported samples. The base rates of *nonrelative* adoption estimated for the control groups for the general population were higher for Ontario than for California, as shown in Table I. The observed rates of nonrelative adoption in the two ADD samples represent an approximately eight-fold increase over the base rates for both of the control groups⁹ (2.3 and 2.0%) and for both general populations (2.5 and 2.0%).

Rates of nonrelative adoption were compared by *u*-tests for proportions from independent samples (Armitage, 1974). The Toronto ADD rate differed from both the control ($u = 4.61, P < 0.001$) and the population rates ($u = 3.74, P < 0.001$). The control group rate did not differ from the rate in the general population of Ontario ($u = 0.15, NS$). A similar pattern was manifested in the data from Orange County: the adoption rate in the ADD group differed from both the control ($u = 3.13, P < 0.005$) and the population rates ($u = 7.86, P < 0.001$). The control group rate did not differ from the rate in the general population of California ($u = 0.01, NS$).

DISCUSSION

The data in Table I indicate that an approximately eight-fold increase in the rate of nonrelative adoption over base rates is found in two groups

⁹ The nonrelative adoptees ($N = 3$) in the Toronto control population were legally classified as "foster" in order to obtain maximum benefits from the Canadian health insurance system; were it not for these benefits, the parents would have declared the children to be in nonrelative adoptive custody.

Table II. Number of Relative Adoptees, Nonrelative Adoptees, and Biological Offspring in the Toronto and Orange County Populations of ADD Patients (by sex)

	Toronto (N)		Orange County (N)	
	Males	Females	Males	Females
Relative adoptee	1	0	5	0
Nonrelative adoptee	15	6	11	2
Biological offspring	65	13	73	9
Total	81	19	89	11

of ADD patients. The average rate of nonrelative adoption in the two ADD samples, 17.0%, is approximately four times as great as that reported by Mech (1973) for children referred for general psychiatric treatment.

What is the significance of the finding of overrepresentation of adoptees among populations of ADD patients? The finding leads to the prediction of a high number of ADD children in populations of adoptees. The conditional probability of the diagnosis of ADD, given adoptive status, can be estimated by the following formula:

$$P(\text{ADD} \mid \text{adopted}) = \frac{P(\text{adopted} \mid \text{ADD}) \times P(\text{ADD})}{P(\text{adopted})} = \frac{0.170 \times 0.030}{0.0225} = 0.227, \quad (1)$$

where ADD indicates the diagnosis of ADD, and "adopted" indicates the nonrelative adoptive status. Based on the literature and the present data, the best estimates available for the three probabilities which enter into the right side of the equation are the following:

- $P(\text{ADD})$ = estimate of the prevalence of ADD among the school-aged-children population, conservatively estimated to be 0.03 (Cantwell, 1975; Weiss and Hechtman, 1979);
- $P(\text{adopted})$ = estimate of the rate of nonrelative adoption in the general population, 0.0225 in this study, averaging across both populations; and
- $P(\text{adopted} \mid \text{ADD})$ = estimate of the rate of nonrelative adoption in the surveys of ADD children reported above, 0.17.

This analysis suggests that approximately 23% of all adopted children would be expected to have ADD. How might the estimates of these probabilities be questioned?

First, the estimates of $P(\text{ADD})$ fluctuate widely according to diagnostic criteria, procedures for collection of prevalence data, and other factors (Weiss and Hechtman, 1979). A less conservative estimate, but one more widely cited as the prevalence of ADD in the general population, is 0.05. Substituting this figure for the 0.03 figure in the example above leads to a predicted $P(\text{ADD} | \text{adopted})$ of 0.378.

Second, the most widely cited estimate of the rate of nonrelative adoption in the general population, $P(\text{adopted})$, is 0.01 (Mech, 1973). This estimate is lower than the figure obtained in this study. Substituting the 0.010 figure for the 0.0225 in the example above would yield a $P(\text{ADD} | \text{adopted})$ of 0.510.

Third, the ratio of males to females in the ADD population affected the magnitude of $P(\text{ADD} | \text{adopted})$ estimates. If half of all ADD children were male and half female, then the $P(\text{ADD} | \text{adopted}) = 0.227$ will hold for both sexes. However, the ratio of males to females in the ADD population is not 1:1. Wender (1971) estimates it to be 9:1, and in the Toronto and Orange County populations it was 4.26:1 and 8.09:1, respectively (see Table II). If the conditional probability of $P(\text{ADD} | \text{adopted})$ were calculated separately for males and females based on the three sex ratios cited above, the values for males increase and those for females decrease, as seen in Table III. Thus, the estimated probability that a male adoptee will have symptoms of ADD is 0.367 (averaging over both population estimates) if the 9:1 ratio is incorporated into the calculation.

Table III. Estimates of $P(\text{ADD}|\text{adopted})$ by Sex for Four Sex Ratios^a

Sex ratio (male:female) for ADD	$P(\text{ADD} \text{Adopted})$		
	Males	Females	Total
Toronto population (4.26:1) ^b	0.363	0.139	0.210
Orange County population (8.09:1) ^b	0.328	0.064	0.130
Combined Orange County and Toronto populations (5.67:1) ^c	0.347	0.107	0.227
Wender (1971) estimate (9.00:1) ^c	0.367	0.071	0.227

^a $P(\text{ADD})$ is assumed to equal 0.030. $P(\text{sex})$, the probability of an individual's in the general population being a male or female, is assumed to be equal to 0.500. $P(\text{ADD}|\text{sex})$ was calculated using the formula: $P(\text{ADD}|\text{sex}) = [P(\text{sex}|\text{ADD}) \cdot P(\text{ADD})]/P(\text{sex})$. $P(\text{ADD}|\text{sex})$ was substituted for $P(\text{ADD})$ in formula (1) for the calculations of $P(\text{ADD}|\text{adopted})$ by sex.

^b $P(\text{adopted}|\text{ADD})$ was calculated separately from the Orange County and Toronto populations; for the first two columns, the calculations were made separately for sex within each population. $P(\text{adopted})$ was assumed to equal population estimates for each respective population, i.e., 0.020 for Orange County and 0.025 for Toronto.

^c $P(\text{adopted}|\text{ADD})$ was calculated separately for sex with the combined Orange County and Toronto data. $P(\text{adopted})$ was assumed to equal the average population estimate pooling across the Orange County and Toronto populations, i.e., 0.0225.

Fourth, an ascertainment bias may have inflated the estimate of $P(\text{adopted} \mid \text{ADD})$. If high-SES parents are more likely than low-SES parents to take their children for medical treatment, then the figure may be inflated, since adoption agencies selected parents on the basis of higher SES (Mech, 1973). The figure would be inflated if adoptive parents seek psychiatric treatment for their adopted children more often than nonadoptive parents. One may speculate that adoptive parents require extensive social-agency contact prior to adoption and that this contact predisposes adoptive parents to seek out subsequent agency services to a greater extent than do nonadoptive parents. But Bradley (1966) reported that applicants to adoption agencies did not require extended agency contact.

These sources of possible bias cannot be discounted. However, recent evidence from the NIH Collaborative Perinatal Project suggests that symptoms associated with ADD are overrepresented in populations of adoptees (Nichols and Chen, 1981); among children living with adoptive or foster parents at age 7 years, they found nearly twice as many "severely" affected children with hyperactivity and impulsivity as expected.¹⁰

Both environmental and genetic hypotheses may be offered to explain the high estimated $P(\text{ADD} \mid \text{adopted})$. Tentative environmental hypotheses include the following: (a) Stress placed on adoptive families may increase the use of mental health facilities, a hypothesis entertained by Mech (1973). (b) The symptoms of ADD may be sequelae of separation anxiety in adoptees, the possibly damaging effects of which have been discussed by Yarrow (1964, 1965). (c) Substance abuse by the biological mother of the adoptee during pregnancy, perhaps accompanied by poor nutrition, may have a behavioral teratogenic effect on her offspring, manifesting itself as "hyperactivity" (Streissguth *et al.*, 1978).

One genetic hypothesis is suggested by the study by Horn *et al.* (1975) of unwed mothers. According to the U.S. Department of Health, Education and Welfare (1970), 88% of the biological mothers of nonrelative adoptees are unwed mothers. Horn *et al.* (1975) found that, with the effects of pregnancy controlled, unwed mothers are characterized by substantial elevations in measures of psychopathology (five of the nine clinical subscales of the MMPI). To the extent that genetic factors contribute to the origin of this psychopathology, the adopted-away offspring of unwed mothers may exhibit an incidence of the disorders exceeding expectancy for the general population.¹¹

Regardless of ascertainment bias or explanation, the results of the present study are clear: a high percentage of children referred for medical

¹⁰ The subjects in the NIH Collaborative Perinatal Project were assessed for the presence of two symptoms present in the DSM-III definition of "ADD with hyperactivity": "hyperkinesis" (hyperactivity, the motor component of the disorder) and "impulsivity."

¹¹ What would be the nature of this genetic "association" between unwed mothers (and

treatment of the attention deficit disorder is adopted. As discussed above, the reason for this elevated rate of adoption above baseline cannot be specified at present, but the possible existence of referral bias, environmental factors, and/or genetic factors deserves further investigation.

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← possibly fathers) of adopted-away children and the presence of ADD? There is considerable evidence for a genetic component of ADD and its earlier label, the hyperactive child syndrome [see Cantwell (1975) for review]. Adoption studies of "hyperactive" probands have revealed a high incidence of alcoholism, sociopathy/psychopathy, and hysteria in biological relatives in comparison to adoptive relatives of hyperactive probands (Cantwell, 1975). There is evidence that some of the symptoms of ADD may persist into adulthood and contribute to the development of sociopathy/psychopathy (Cantwell, 1978). The observation of elevated "psychopathic deviancy" on the MMPI in unwed mothers who gave their children up for adoption (Horn *et al.*, 1975) is consistent with a genetic association between ADD and sociopathy/psychopathy.

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