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Minor Physical Anomalies and Obstetrical Complications: Their Relationship to Hyperactive, Psychoneurotic, and Normal Children and Their Families[1]

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Hyperactive, psychoneurotic, and normal control boys and their families were examined for minor physical anomalies (MPA). The results revealed that the hyperactive boys and their families had more MPA than the combined group of psychoneurotic and normal control children and their families. There were no differences in the mean number of MPA within families. Hyperactive probands also had more pre- and perinatal complications than the combined proband group. Furthermore, it was quite evident that the combination of numerous obstetrical complications and a high number of MPA significantly increased the probability of a child being diagnosed as hyperactive. The results are discussed in relation to the genetic transmission of MPA and the use of MPA as high risk indicators.

The increased incidence of minor physical anomalies (MPA) in hyperactive boys (HA) compared to normal control children has been well documented (Firestone, Peters, Rivier, & Knights, 1978; Rapoport & Quinn, 1975; Waldrop & Halverson, 1971; Firestone & Peters, Note 1). The results with girls are tenuous, but there is some evidence that numerous MPA may be associated with withdrawn behavior (Halverson & Victor, 1976; Waldrop & Goering, 1971).

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The etiology of MPA is as yet unclear. There is evidence that MPA can develop due to toxic elements ingested by mothers during the first trimester of pregnancy (Rapoport & Quinn, 1975; Smith, 1970). There are also data revealing elevated MPA in HA children with histories of obstetrical complications (Quinn & Rapoport, 1974; Rapoport & Quinn, 1975; Quinn, Renfield, Burg, & Rapoport, 1977).

The findings of Firestone et al. (1978) support a genetic hypothesis for the transmission of MPA. This study compared MPA in the families of hyperactives, idiopathic retardates, and normal controls. The results revealed that the hyperactives, retardates, their siblings, and their parents had equal numbers of MPA that were significantly higher than in the normal-control children and their families, who did not differ from each other. Of particular interest was the finding that although hyperactives and their siblings had equal MPA, when they were interviewed there were virtually no reports from the families of these siblings exhibiting deviant behavior. However, the lack of clinical investigation or objective behavior rating scales on the siblings precluded a definite acceptance of this observation. Nevertheless, within the confines of the study it was not clear why one child with numerous MPA might develop a behavior disorder, while a sibling with similar MPA did not. Perhaps, as Rapoport and Quinn (1975) have suggested, MPA may be "markers" for children at risk, and pregnancy or birth complications may act as "releasers" of this predisposition.

The following study was an attempt to investigate the role of genetic and gestational factors in the development of MPA and hyperactivity. The questions asked included these: (a) Do HA children and their families have more MPA than psychoneurotic (PN) and normal control (NC) children and their families? (b) Are pre- and perinatal complications associated with hyperactivity? (c) Within the HA families do the probands have more pre- and perinatal complications than their siblings? (d) Do the siblings of hyperactives demonstrate any behavior disorders?

METHOD

Subjects

Fifty-two male children between the ages of five and 12 attending the Children's Hospital of Eastern Ontario, and their families, were studied. The children were not on psychotropic medication and were living with at least one biological parent and sibling. Further criteria for inclusion into the study for the probands were an IQ of 80 or higher on the Peabody

Picture Vocabulary Test (PPVT) and no history or indications of epilepsy, brain damage, or psychosis.

Hyperactive Subjects (HA). These children were referred to the psychology department by physicians because of hyperactivity. They were then evaluated by a psychologist (P.F.) to confirm this diagnostic label. The children would be best described by the DSM-III (1980) diagnosis of Attention Deficit Disorder with Hyperactivity. Their history had to include chronic inattentiveness, impulsivity, and overactivity (present from 3 years of age or younger). Furthermore, each child was required to have a hyperactivity index of 15 or higher on the Conners Teacher Rating Scale (Goyette, Conners, & Ulrich, 1978).

Psychoneurotic Subjects (PN). These children had been referred by physicians for various psychological complaints and then assessed by psychologists. Their charts were screened once again by a member of the research team (P.F.). Their diagnoses might be best conceptualized as Transient Situational Disturbances and Withdrawing or Overanxious Reaction of Childhood (DSM-II, 1970). In addition, their hyperactivity index was required to be less than 10.

Normal Control Subjects (NC). These patients were selected from the general outpatient clinics in the hospital. They had no record of serious medical or psychological problems. All NC children had a hyperactivity index of 10 or less.

Rating Scales

Conners Rating Scale. Conners (1969) developed a widely used rating scale for teachers (TRS), which has 39 items and has been factor-analyzed to produce five factors. Only the hyperactivity index (Goyette et al., 1978) was used as an inclusion criterion.

Minor Physical Anomaly Scale. Weighted MPA were obtained using the method of Waldrop and Halverson (1971). Male and female norms for head circumference for children up to 18 years were obtained from Nellhaus (1968). Norms for intercanthal distance were obtained from Finegold and Bossert (1974). Rapoport (Note 2) provided norms for adults' (19 years of age and over) head circumference.

Subjects were rated for MPA by one examiner; then an assistant, naive as to the diagnostic group, independently reexamined 15 of the children and adults in the three diagnostic categories. A Pearson correlation coefficient of .76 ($p < .001$) was obtained between the two judges.

Revised Birth and Pregnancy Questionnaire. This questionnaire was used previously by Links, Stockwell, Abichandani, and Simeon (1980) and indicated that autistic children had more pre- and perinatal complications than their same-sexed twin. The scale had been adapted from Zax, Sameroff, and Babigian (1977).

It is divided into four major parts that yield information regarding (a) pregnancy, (b) labor, (c) delivery, and (d) postnatal complications. The score to be reported in the present study is a measure of the total number of complications since analyses of subscores did not achieve significance. In the present study mothers' reports concerning these factors, based upon an interview, were utilized since attempts to get physicians' reports and hospital records were rather unfruitful. Data from the hospitals and physicians were often inaccessible, inaccurate, or unintelligible.

An assistant naive to the diagnostic categories reinterviewed mothers of 13 children. A Pearson correlation coefficient of .61 ($p < .05$) was obtained on the scores from the two interviewers.

Procedure

The families of all subjects were telephoned and informed of the nature of the study. If the family agreed, they were seen at the hospital and signed consent was obtained. The families were assessed for MPA and then mothers were interviewed regarding circumstances surrounding the pregnancies and births of their children. Rating scales were sent to the teachers after signed consent was obtained.

RESULTS

The ages and IQs of the three groups are presented in Table I. Analyses of variance did not reveal significant differences among the groups on these factors.

Table II provides the TRS ratings. Several significant findings resulted from the ANOVA performed on these data. Scheffé's (1959) post hoc tests were performed on these and all other significant findings resulting from the ANOVA. The HA children were rated significantly more problematic than the other groups on the hyperactivity index, conduct-problem, and inattentive-passive factors ($p < .01$), while the other groups did not differ from each other. In the case of the sociability factor, the hyperactives were reliably different from the controls ($p < .01$), but no other differences were evident.

Table III lists the MPA scores for the various family members. A one-way ANOVA indicated that there were reliable differences in mean

Table I. Mean Age and IQ for the Three Groups

	Hyperactive		Psychoneurotic		Control	
	M	*SD*	*M*	*SD*	*M*	*SD*
Age in months	96	16	111	30	93	19
	(21)[a]		(12)		(19)	
IQ	116	16	118	14	110	15
	(21)		(8)		(19)	

[a]Sample size.

Table II. Mean Factor Scores on Conners Teacher Rating Scale for the Groups

	Hyperactive		Psychoneurotic		Control			
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p* <
Hyperactivity index	17.33	3.53	3.92	3.55	4.77	3.09	82.48	.001
	(21)[a]		(12)		(13)[b]			
Conduct problem	.72	.47	.18	.34	.08	.14	14.79	.001
Tension-anxiety	.68	.52	.63	.65	.55	.71	.16	n.s.
Inattentive-passive	1.43	.62	.58	.54	.47	.42	15.52	.001
Sociability	.71	.60	.30	.56	.10	.28	6.14	.004

[a]Sample size.
[b]The parents of six control probands described them as having no problems, but the teachers did not return the TRS.

Table III. Family Members' MPA Scores

	Hyperactive		Psychoneurotic		Control			
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p* <
Probands	3.48	1.08	2.42	1.56	1.58	1.12	12.16	.0001
	(21)[a]		(12)		(19)			
Female siblings	3.13	1.77	1.50	1.85	1.83	.83	2.49	.10
	(15)		(8)		(12)			
Male siblings	3.21	2.04	1.67	1.12	2.00	1.18	4.32	.02
	(14)		(9)		(11)			
Mothers	2.77	1.95	2.25	.75	1.16	1.21	6.01	.005
	(22)		(12)		(19)			
Fathers	3.35	1.46	2.18	1.40	2.22	1.52	3.59	.04
	(20)		(11)		(18)			

[a]Sample size.

Table IV. Mean Number of Pregnancy plus Birth Complications

	Hyperactive		Psycho-neurotic		Control			
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p* <
Probands	2.95	1.73	2.00	1.81	1.89	1.37	2.53	.09
	(21)[a]		(12)		(19)			
Female siblings	1.33	1.29	1.14	1.57	1.31	.95	.06	n.s.
	(15)		(7)		(13)			
Male siblings	1.67	1.49	2.17	1.80	1.68	1.34	.49	n.s.
	(21)		(12)		(19)			

[a]Sample size.

MPA scores between groups for groups, sisters, brothers, mothers, and fathers. However, post hoc tests produced significant differences only between the HA and NC groups ($p < .01$) and the HA mothers and NC mothers ($p < .01$). Since the PN group contained relatively few subjects and since there were no differences found between the NC and PN groups, their MPA data were combined and two-tailed *t* tests carried out comparing the combined group and the HA group. These analyses revealed significant differences between the groups for probands, $t(50) = 4.46, p < .001$; brothers, $t(51) = 3.50, p < .001$; mothers, $t(50) = 2.77, p < .008$; and fathers, $t(47) = 2.71, p < .009$.

The ANOVA comparing MPA scores of family members within the three groups did not result in any significant effects.

For the total population of children, a significant correlation was obtained between the hyperactivity index and MPA scores ($r = .22, p < .01$). In addition, within the total group there was a significant correlation between MPA and PPVT IQ scores ($r = .25, p < .04$), IQ scores were not collected from other family members.

Table V. High and Low Minor Physical Anomalies and Pregnancy plus Birth Complications Associated with Hyperactivity

	High MPA, high complications	Low MPA, low complications
Hyperactive	5	6
Nonhyperactive	0	22
	$\bar{X}(1) = 11.79, p < .001$	
	High MPA, low complications	Low MPA, high complications
Hyperactive	6	4
Nonhyperactive	4	5
	$\bar{X}(1) = .43$, n.s.	

Table IV depicts the pregnancy and birth complications of the children in the study. A one-way ANOVA did not reveal any differences between groups or brothers or sisters, although a trend was evident in the probands. Once again because of the small number of children in the PN group and lack of differences between this and the NC group, they were combined. The subsequent t tests did produce significant differences, $t(51) = 2.27$, $p < .03$, but not for the brothers or sisters.

The within-group ANOVA resulted in a significant finding only in the HA group, $F(2, 49) = 3.87$, $p < .03$, indicating that hyperactive boys had more pregnancy and birth complications than their sisters ($p < .01$).

In order to assess the relationship involving MPA, pregnancy and birth complications, and hyperactivity, a series of chi-square analyses were carried out. Since only children who had undergone intensive screening could be considered for these analyses, only the probands were studied. Furthermore, since no significant differences were evident in MPA or pregnancy plus birth complications between the PN and NC groups, they were combined for these analyses. These analyses revealed only one reliable finding, namely, that the combination of numerous MPA and pregnancy plus birth complications increased the probability of being diagnosed as hyperactive (Table V).

DISCUSSION

The major goals of the present study were to replicate several previous studies and to attempt further clarification of the role of MPA and obstetrical history in the etiology of hyperactivity. Once again, HA children demonstrated a greater number of MPA than normal controls. However, hyperactives did not differ from psychoneurotics in number of MPA, although their mean MPA were higher. Neither did PN and NC children differ in number of MPA, replicating the finding of Steg and Rapoport (1975) with learning-disabled and psychoneurotic children. It is also of interest to note that when Quinn and Rapoport (1974) more stringently separated a group of diagnosed hyperactive boys into the classifications of unsocialized aggression, hyperactive reaction, and overanxious reaction, the latter group had the lowest number of MPA ($\bar{X}$ = 4.00, 3.58, and 2.53, respectively). The lack of significant differences between the HA and PN children in the present study might be due to at least three factors. First, it is possible that PN are indistinguishable from the HA and NC because, in fact, they generally do have more MPA than NC and fewer than HA. It would then be suggested that MPA are somehow related to the psychoneuroses. There is little evidence to support or refute this hypothesis since this type of pathological group has not been sufficiently studied with respect to MPA. Second, it is possible that the small number of PN children studied precluded the achievement of statistical significance. This hypothesis receives some support because of the relatively small number of PN children studied and the fact that Steg and Rapoport (1975) did find a reliable difference in MPA between learning-disabled and psychoneurotic children. Finally, it is not inconceivable that the diagnostic labels of hyperactive and psychoneurotic, in general, or the diagnostic procedures used in the present study, in particular, require refinement. Possibly if the "true" hyperactives and psychoneurotic children were compared, there would be a difference in the presence of MPA.

Hyperactives and their brothers, mothers, and fathers had reliably more MPA than the combined group of psychoneurotic and normal control children and their brothers, mothers, and fathers. It is not clear why the difference between the sisters did not achieve significance. Furthermore, there were no differences in MPA evident within the family members. In essence, this replicates the finding of Firestone et al. (1978) supporting a genetic component in the transmission of MPA.

As in several other studies (Halverson & Victor, 1976; Halverson & Waldrop, 1976; Waldrop, Pedersen, & Bell, 1968), a small but statistically significant correlation was found between mean MPA scores and degree of hyperactivity in the total group of children studied. However, as in Firestone, Lewy, and Douglas (1976), no such correlation was evident within the hyperactive probands. A "ceiling effect" may have made such a relationship difficult to establish.

The previous findings by other research groups of low but significant inverse correlations between IQ and MPA were also evident within the total proband group in the present investigation (Halverson & Victor, 1976; Waldrop & Halverson, 1971; Rosenberg & Weller, 1973). A significant correlation between MPA and IQ within the hyperactive group was not present, nor has it been reported in any other group of hyperactives.

The HA probands evidenced more obstetrical complications than the other probands. Although this has been suggested by other research (Werry, Weiss, & Douglas, 1964; Nichols, 1976), the majority of papers in the area have not been able to demonstrate such differences (Dubey, 1976; Rapoport & Ferguson, 1981). The importance of pre- and perinatal problems is further attenuated by the small differences found, as well as by the lack of significant findings between the groups on the individual factors that make up the pregnancy plus birth complication score.

Although the HA appeared to have more obstetrical complications in their history than their siblings, this was statistically significant only between the hyperactives and their sisters. In addition, there was not a higher incidence of hyperactivity, as reported on the hyperactivity index, in the siblings of hyperactives compared with the siblings of the other groups. Only one child in each sibling group received a hyperactivity index of 15 or higher. This reduces support for the hypothesis that within a family predisposed to hyperactivity, as evidenced by a high number of MPA, obstetrical complications may act as a "releaser" for behaviors associated with hyperactivity. It is not surprising however, that more hyperactive children were not found in the total sibling groups. The prevalence of hyperactivity in school-age children runs between 5% and 10% of the total population (Barkley, 1981). Thus, no more than three or four children would be expected to score 15 or higher on the hyperactivity index, within the sibling population where rating scores were available ($N = 46$).

Abundantly clear is the fact that the probability of a child being hyperactive increases dramatically if both a large number of MPA and obstetrical complications are present. In fact, every child with this combination of features was hyperactive. In contrast, 71% of the nonhyperactives and only 29% of the hyperactive probands had a low number of MPA and few obstetrical complications.

The present study does not support the conclusion that MPA alone are sufficiently accurate to be used as "markers" for children at risk for hyperactivity. However, as suggested by Quinn et al. (1977), high MPA in conjunction with a history of obstetrical problems may well be quite accurate in predicting which children will develop behaviors usually associated with hyperactivity.

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