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ABSTRACT

This study explored relationships between intelligence and visual motor ability and patterns of impairment of visual motor ability in children prenatally affected by alcohol. Fourteen children (mean age 8.2 years) diagnosed with fetal alcohol syndrome (FAS) and 50 children with possible fetal alcohol effects (FAE) were assessed with the Bender Visual Motor Test and a Wechsler IQ test. The group exhibited impaired performance (using Koppitz's emotional and developmental scores) relative to norms. Higher IQ predicted better visual motor performance. Performance IQ was marginally related to emotional indicators. Despite significantly lower IQs in the FAS group, both FAS and FAE groups performed equally poorly on the Bender. Examination of the types of errors made revealed distortion of shape to be the most frequently occurring error. The two diagnostic groups did not differ in types of errors made. (Contains 11 references.) (DB)

CHILDREN WITH FETAL ALCOHOL SYNDROME AND FETAL ALCOHOL EFFECTS:

PATTERNS OF PERFORMANCE ON IQ AND VISUAL MOTOR ABILITY

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Abstract

The Bender Visual Motor Test has not been employed with children diagnosed as fetal alcohol-affected in spite of evidence suggesting visual spatial deficits and cognitive impairment. Sixty-four children (M age = 8.2 years) diagnosed FAS (n = 14) or described as possible FAE (n = 50) were assessed with the Bender and a Wechsler IQ test. Half were male and 64% were Caucasian. The group exhibited impaired performance (using Koppitz's emotional and developmental scores) relative to norms. Higher IQ predicted better visual motor performance; performance IQ was marginally related to emotional indicators. Despite significantly lower IQs in the FAS group, both groups performed equally poorly on the Bender. Additionally, examination of the types of errors made, e.g. distortion of shape, integration, rotation, and perseveration on the drawings revealed distortion of shape to be the most frequently occurring error, and the two diagnostic groups did not differ in types of errors made. These data identify visual motor and emotional domains as specifically impacted in fetal alcohol-affected children.

Introduction

Fetal Alcohol Syndrome (FAS) is a birth defect diagnosed when patients have a positive history of prenatal alcohol exposure and three defining characteristics:

1) Evidence of growth retardation including height, weight, and head size.

2) Specific physical anomalies, including a characteristic facies, e.g., short palpebral fissures, flat midface, indistinct philtrum, thin upper lip and abnormalities of the limbs and joints (see Figure 1).

3) Evidence of central nervous system dysfunction including manifestations of hyperactivity, motor incoordination, learning or attentional difficulties, or mental retardation.

Patients with a positive history of prenatal alcohol exposure and some, but not all of the above criteria are identified as having possible Fetal Alcohol Effects (FAE).

Prenatal alcohol exposure causes learning problems and deficits in higher order processes such as abstraction and judgment. In recent years, both clinical case studies and large, epidemiologic studies have found alcohol-affected individuals to exhibit deficits in visual sequencing, visual spatial reasoning, and attention and memory (Nanson & Hiscock, 1990; Mattson et al., 1992; Carmichael Olson et al., 1993; Streissguth et al., In press).

Despite these deficits, alcohol-affected individuals exhibit a wide range of intellectual functioning as assessed on standardized, traditional IQ tests (Streissguth et al., 1991). Sole reliance on intellectual assessment may lead to inappropriate conclusions about the extent of impairment among this group. Additional assessments of other cognitive processes, e.g., visual motor functioning are particularly useful in examining other areas of impairment.

The Bender Gestalt Visual Motor Test has widespread utility with children at risk. Yet, no study to date has examined Bender performance in a clinical sample of children diagnosed as FAS or FAE despite evidence suggesting notable visual spatial deficits and cognitive impairment within this group.

Aims of the study

The study had several objectives:

1) To explore the association between intelligence and visual motor ability among a group of alcohol-affected children.

2) To test for differential patterns of impairment on visual motor ability and intelligence among the two subgroups of alcohol-affected children (those with FAS versus FAE).

3) To examine the specific types of errors made on the Bender Gestalt Test of Visual Motor Ability by the two groups of alcohol-affected children.

Method

Subjects:

The sample consisted of 64 children aged 5 to 12 years (M = 8.2 years) enrolled in the Northwest sample of the Fetal Alcohol Follow-up Project being conducted at the University of Washington Fetal Alcohol and Drug Unit. All children were prenatally exposed to alcohol and evaluated by a dysmorphologist. Fourteen were diagnosed as having Fetal Alcohol Syndrome (FAS), while 50 were described as possible Fetal Alcohol Effects (FAE). Sample characteristics are displayed in Table 1. Patients were primarily Caucasian, roughly equal in terms of gender, and ranged in educational attainment from zero to six years (M = 2 years).

Procedure:

The patients were seen in the laboratory for a three-hour period during which time they were administered an age-appropriate Wechsler intelligence test, either a Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R) or Wechsler Intelligence Scale for Children-Revised (WISC-R), and a Bender Gestalt Test of Visual Motor Ability, plus other assessments.

Measures

Intelligence:

Intellectual level of the children was assessed using an age-appropriate Wechsler IQ test. The Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R, Wechsler, 1989) was administered to those under six years of age, and the Wechsler Intelligence Scale for Children-Revised (WISC-R, Wechsler, 1974) was given to those over six years of age. The WPPSI-R and WISC-R yield three measures: Full scale IQ, verbal IQ, and performance IQ; all having a mean of 100 and standard deviation of 15.

Visual motor ability:

Visual motor ability was assessed using the Bender Gestalt Visual Motor Test. The Koppitz (1964) scoring system was employed, which yields two types of error summary scores:

1) Development level. This involves summing the total number of errors across the 9 figure reproductions (range = 0 to 30). Koppitz believes this to be an indicator of maturation of the visual motor perceptual system. For ease of comparison with Wechsler IQ scores, transformed developmental level raw error scores provided by Sattler (1988) were examined (M = 100, SD = 15).

2) Emotional indicator score. Koppitz also presents a set of ten emotional indicators which are scored as presence/absence across the reproductions which allow for detection of emotional disturbances in children. For example, overworked or excessively retraced lines on any of the figures presumably reflects aggression and impulsivity in the child. Range of scores is zero to ten, with a summary score of three or more indicative of presence of greater emotional disturbance relative to normal, non-disturbed children.

Results

Intellectual and visual motor performance among alcohol-affected children:

The intellectual performance range for the total group (n = 64) was broad, with full scale IQ scores ranging from 50 to 142 (M = 90.7). Mean full scale performance for the group fell within the Average range, with performance scale IQ scores (M = 94.5) generally higher than verbal scale IQ scores (M = 88.7, Low Average range).

When compared to published norms available from Sattler (1988), alcohol-affected children exhibited poorer visual motor ability on all Bender measures. On the standard score transformations of the developmental level summary score, visual motor performance of the alcohol-affected children fell within the Low Average range (M = 82.7), with a group mean greater than one standard deviation below the normative mean of 100. The emotional indicator summary scores for the total group ranged from one to eight (M = 3.7), with a total score of three or more indicative of emotional disturbance.

Correlates of visual motor ability:

Since this study utilized the Bender with a new risk group, correlational analysis examined the relationship between Bender performance and IQ and demographic

characteristics for the total group. Older age and higher school grade level (last grade completed) were related to better Bender performance on both developmental level (respective r's = .89 and .44, p's < .001) and emotional indicator summary score (r's = .51, p < .001 and .25, p < .05). Gender was not associated with either Bender score. In terms of intellectual level, higher verbal and performance IQs were significantly related to better visual motor performance (on the developmental level) p's < .001, while performance IQ was only marginally associated with the emotional indicator score, p = .06.

Comparison of intellectual and visual motor performance between groups:

T-test analyses were conducted to test for differential patterns of impairment on IQ and Bender performance among the two groups of alcohol-affected children (FAS versus FAE). T-tests revealed significant group differences between children with FAS versus those with FAE on full scale IQ (t = -2.99, p < .01), verbal IQ (t = -2.44, p < .05) and performance IQ (t = -3.02, p < .01), with the FAS group scoring lower on all IQ measures. See Table 1 for breakdown of mean IQ scores among the two groups.

Despite the children with FAS having lower IQ scores relative to those with FAE, there were no significant group differences on either Bender measure. Non-significant t-tests were obtained on the Bender developmental level error score and the emotional indicator summary score, with both groups having mean emotional indicator scores greater than three, indicating presence of emotional disturbance (see Table 1). While children with FAS had a mean IQ in the Low Average range and children with FAE had a overall Average IQ, both groups exhibited comparable visual motor and emotional deficits.

Types of errors on visual motor performance:

The four types of errors scored on the 9 drawings which comprise the developmental level summary score include: Distortion of shape, rotation, integration, and perseveration. For the total group of alcohol-affected children, distortion of shape was the error most frequented committed, while perseverative errors were the least common. When types of errors for both groups were examined separately, there appeared to be no specific difference in terms of likelihood of committing one type of an error over another; distortion of shape and integration errors remained the most frequently occurring.

Conclusions

Sole reliance on intellectual performance as an indicator of extent of impairment among alcohol-affected children may lead to incomplete conclusions regarding specific cognitive domains impacted by prenatal alcohol exposure. While total group mean intellectual scores were within the Average range (and range of IQ scores was broad), marked visual motor and emotional deficits were found among this group.

The Bender may be a useful tool to allow for a complete picture when examining deficits among this risk group.

Although children with FAS had significantly lower full scale, verbal, and performance IQ scores compared to those with FAE, both groups performed equally poorly (below published norms) on the Bender.

Examination of the types of errors on the drawings made by alcohol-affected children indicated that distortions of shape were the most frequently occurring error, while perseveration was the least. Inspection of types of errors for each group (FAS vs. FAE) revealed no distinct pattern of error among the subgroups. Interestingly, these particular types of errors, e.g, distortion of shape, integration were frequently found in a large epidemiologic study of 7-year old children born to moderate drinking mothers (Streissguth et al., 1989).

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Table 1

Study Variables by Diagnostic Group

	FAS Group (N=14)	FAE Group (N=50)
Demographic Characteristics:		
Age	9.2 (1.9)	7.9 (1.6)
Sex (% Male)	57.0	54.0
Grade Level	2.8 (1.8)	1.8 (1.3)
Race (% Caucasian)	78.6	60.0
Intellectual Functioning:		
Full Scale IQ	79.1 (16.6) *	93.9 (16.4)
Performance IQ	82.4 (19.5) *	97.8 (16.1)
Verbal IQ	79.4 (13.2) *	91.3 (16.9)
Visual Motor Functioning:		
Developmental Error Summary Score [a]	10.2 (6.1)	9.5 (5.3)
Developmental Standard Score [b]	80.0 (14.6)	83.8 (1.4)
Emotional Indicator Error Summary Score [c]	3.4 (1.5)	3.8 (1.4)

Note: Values are means, except where percentages are indicated. Standard deviations are given in parentheses.

[a]Summed total of errors on the 30 developmental indicators.
[b]Standard scores for 30 developmental indicators. Five of the FAS cases and seven of the FAE cases have missing scores only on this measure due to skewness of the distribution above 8 years of age.
[c]Summed total of errors on the 10 emotional indicators.

* $p < .05$

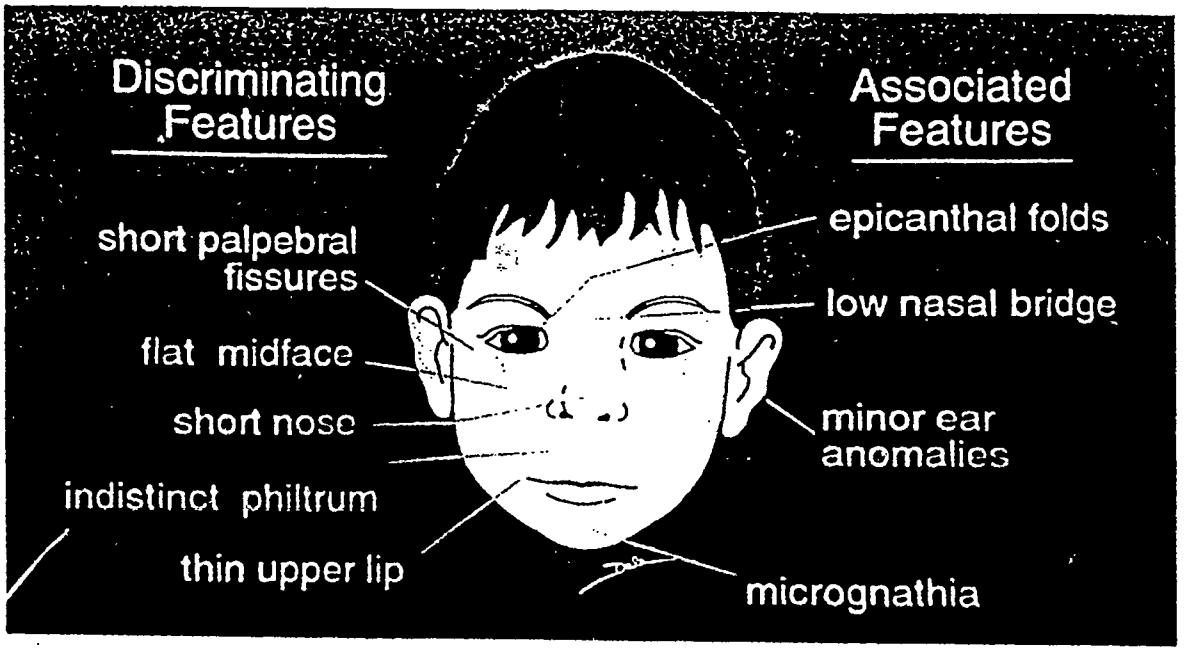

Figure 1 Facies in FAS particularly characteristic of the prepubertal child. Features on the left side are the most definitive. Those on the right side are less differentiating. Microcephaly (small head circumference) is not a facial feature per se, but a central nervous system characteristic. (Epicanthal folds: small fold of skin covering inner corner of the eye; philtrum: zone between nose and mouth; micrognathia: abnormal smallness of the jaws; palpebral fissures: eye openings.)

SOURCE: Streissguth and Little 1994.