

# CHARACTERISTICS OF CHILDREN WHO HAVE FULL OR INCOMPLETE FETAL ALCOHOL SYNDROME

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**Objective** To describe the clinical features and hospitalization rates of American Indian children with full or incomplete fetal alcohol syndrome (FAS).

**Study design** Two retrospective case-control studies were conducted of Northern Plains American Indian children with presumed FAS identified from 1981 to 1993 by using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), code 760.71. Children who had full or incomplete FAS were compared with each other and with children who did not have FAS.

**Results** Compared with the control children, the 43 children with FAS and the 35 children with incomplete FAS had more facial dysmorphism, growth deficiency, central nervous system dysfunction, and muscular problems and were hospitalized more frequently with otitis media, pneumonia, FAS, dehydration, and anemia. Case children were hospitalized more days than were control children. Case children were removed from their homes and placed in foster care more often than were control children.

**Conclusions** Children with full or incomplete FAS had many health, learning, and social needs. Health care providers and community programs should identify the needs of these children and offer optimal services to meet those needs. (*J Pediatr* 2004;145:635-40)

Fetal alcohol syndrome (FAS) is the most common cause of preventable mental retardation in the United States.<sup>1</sup> The prevalence of FAS in the Northern Plains American Indians is estimated at 8.5 children per 1000 live births.<sup>2</sup> The characteristics of mothers who have children with FAS or some characteristics of it (incomplete FAS) have been described.<sup>3</sup> The purpose of this study was to describe the clinical features and hospitalization rates of American Indian children with full or incomplete FAS, thereby raising clinician awareness of the need to evaluate children with prenatal alcohol exposure and to intervene appropriately.

## STUDY DESIGN

The protocol was reviewed and approved by the Aberdeen Area Indian Health Service (IHS) and the national IHS Institutional Review Boards and by four Northern Plains Tribes. At four Northern Plains IHS hospitals or clinics, children with full or incomplete FAS were identified from 1981 to 1993 by using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), code 760.71.<sup>4</sup> This code includes noxious influences (specifically alcohol) affecting the fetus or newborn infant through the placenta or breast milk and includes FAS.

FAS cases were defined as children who met all 5 of the following criteria, based on documentation in their medical records: (1) prenatal alcohol exposure or maternal history of alcohol consumption, (2) FAS diagnosed or noted as a suspected diagnosis by a physician, (3) one or more facial features characteristic of FAS, (4) growth deficiency (any measurement of height, weight, or head circumference  $\leq$ 10th percentile for age), and (5)

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CNS	Central nervous system	IHS	Indian Health Service
FAS	Fetal alcohol syndrome		

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**Table I. Pregnancy outcomes and growth deficiency for cases and control children**

Neonatal outcome	Study 1: FAS			Study 2: Incomplete FAS		
	Cases n = 43	Control children n = 86	OR <sup>†</sup> or P value	Cases n = 35	Control children n = 70	OR <sup>†</sup> or P value
Mean gestational age (wk)	38.5	39.4	.02	38.0	39.3	.01
Low birth weight <2500 g	31.7%	4.0%	11.14 (2.67–53.72)	12.9%	4.8%	2.96 (0.51–18.22)
Mean birth weight (g) <sup>*</sup>	2686	3423	.001	2923	3440	.001
Mean birth length (cm)	48.0	51.9	.001	49.6	51.6	.01
Mean head circumference (cm)	32.7	34.9	.001	34.0	34.7	.07
Mean Apgar (1 min)	7.03	8.02	.001	7.18	7.96	.03
Mean Apgar (5 min)	8.55	8.95	.03	8.46	8.84	.24
Postnatal growth deficiency						
Failure to thrive <sup>*</sup>	55.8%	1.2%	107.4 (13.65–2303)	20.0%	0.0%	.001
Growth deficiency <sup>‡</sup> (<10th percentile) <sup>*</sup>	100.0%	8.8%	.001	47.1%	6.8%	17.67 (2.30–135.49)
Height <sup>*</sup>	78.6%	3.9%	89.2 (19.86–469.0)	37.5%	6.9%	12.33 (1.56–97.63)
Weight <sup>*</sup>	81.0%	5.1%	63.0 (8.41–471.8)	41.2%	3.4%	19.95 (3.73–142.0)
Head circumference <sup>*</sup>	85.4%	7.4%	55.0 (7.29–415.0)	35.5%	3.8%	13.75 (2.47–100.68)

\*Differences between study 1 and study 2 cases are statistically significant.

†95% confidence limits in parentheses.

‡Height, weight, or head circumference <10th percentile.

central nervous system (CNS) impairment.<sup>5</sup> If children met only 1 to 4 of these criteria, they were defined as cases with incomplete FAS.

Of 142 medical records in the 4 communities that had an ICD-9 code of 760.71, 43 (30%) met 5 FAS case criteria. Of the remaining 99 medical records, 35 that met 1 to 4 FAS case criteria (incomplete FAS) were randomly selected. Thus, this report contains two separate analyses of data: one based on 43 case children who had FAS, compared with 86 control children (study 1), and the second one based on 35 case children who had 1 to 4 characteristics of FAS (incomplete FAS), compared with 70 control children (study 2). In addition, the children who had full FAS were compared with the children who had only 1 to 4 of the FAS criteria. The methods used for both studies were identical and have been previously described.<sup>3</sup>

Days of hospitalization were counted from 3 days after birth to August 1995. Five hospitalizations of case children and 4 hospitalizations of control children were excluded because we could not determine the number of days admitted.

A matched analysis was done by using corrected McNemar  $\chi^2$  and correlated *t* tests to determine statistical significance of differences in categorical and continuous variables.<sup>6,7</sup> The Fisher exact test was used for discrete variables when there were <5 expected observations in 1 or more of the cells of a 2 × 2 table. Odds ratios and 95% confidence limits were calculated to assess the strength of the associations. Values of *P* ≤ .05 and odds ratios whose 95% confidence limits did not overlap 1 were considered to be statistically significant.

## RESULTS

Study 1 case children had all 5 FAS criteria, and study 2 case children had an average of 3.2 FAS criteria. Of the study 2 case children, 65.7% had facial features, 45.7% had growth deficiency, 65.7% had CNS impairment, 60.0% had maternal alcohol history, and 82.9% were diagnosed with FAS by a physician. In study 1, 60.5% of FAS cases were male, whereas in study 2, 45.7% of cases were male (*P* = .46). On July 1, 1996, the mean ages of study 1 and 2 children were 10.0 and 9.8 years, respectively (range, 4 to 21 years in both studies). At that time, only 2 children had died; both were study 1 control children.

### Birth Order

The mean birth order for the index child was 5.0 for the cases (range, 1 to 13) and 3.3 (*P* = .001) for the control children in study 1 and 4.3 for the cases (range, 1 to 12) and 2.9 (*P* = .004) for the control children in study 2. The index child was the last birth for 53.5% of the case mothers and 30.2% of the control mothers in study 1 (*P* = .01) and 37.1% of the case mothers and 24.3% of the control mothers in study 2 (*P* = .17).

### Pregnancy Outcome and Growth Deficiency

The mean gestational ages, birth weights, and lengths of study 1 and 2 children were significantly less than in their control children (Table I). The mean head circumference at birth was significantly less for study 1 cases than their control children, but the difference between mean head circumferences for study 2 cases and control children did not attain statistical significance (Table I). All the study 1 case

**Table II. Facial features and central nervous system dysfunction of cases and control children**

	Study 1: FAS			Study 2: Incomplete FAS		
	Cases n = 43 (%)	Control children n = 86 (%)	OR <sup>†</sup> or P value	Cases n = 35 (%)	Control children n = 70 (%)	OR <sup>†</sup> or P value
<b>Dysmorphic facial features</b>						
Any facial features*	100	2.3	.001	65.7	1.4	132.25 (15.81–2933.80)
Facial features present but not specified*	37.2	0.0	.001	2.9	0.0	.72
Philtrum	48.8	0.0	.001	42.9	1.4	51.75 (6.33–1134.17)
Low nasal bridge	34.9	1.2	30.0 (4.62–1263)	31.4	0.0	.001
Palpebral fissures	32.6	0.0	.001	22.9	0.0	.001
Thin upper lip	30.2	0.0	.001	20.0	0.0	.001
Ear malformation	30.2	0.0	.001	22.9	0.0	.001
Hearing loss	20.9	0.0	.001	5.7	1.4	4.00 (0.36–44.11)
Flattened maxilla	18.6	0.0	.001	14.3	0.0	.007
Short, upturned nose	18.6	0.0	.001	11.4	1.4	8.00 (0.89–71.58)
Epicanthal folds	14.0	1.2	12.0 (1.44–99.68)	14.3	0.0	.007
<b>CNS dysfunction</b>						
Behavior problems*	90.7	12.8	66.48 (17.64–277.79)	65.7	11.4	10.5 (3.21–34.31)
Developmental delay*	74.4	2.3	122.1 (22.97–872.53)	40.0	2.9	14.0 (3.18–61.60)
Speech/language delay*	69.8	5.8	37.38 (10.98–136.87)	42.9	4.3	14.5 (3.27–64.26)
Microcephaly*	55.8	1.2	48.0 (6.49–354.82)	8.6	0.0	.066
Seizures	30.2	5.8	11.5 (2.47–53.60)	17.1	4.3	4.00 (1.00–15.99)
Irritability in infancy	20.9	0.0	.001	8.6	0.0	.066
Attention deficit disorder	20.9	3.5	8.5 (1.39–51.85)	31.4	2.9	21.00 (2.64–166.81)
Hyperactivity	20.9	2.3	8.0 (1.94–41.66)	22.9	0.0	.001
Short attention span	18.6	0.0	.001	14.3	0.0	.007
Learning disabilities	23.3	4.7	9.0 (1.89–42.95)	20.0	1.4	14.00 (1.72–113.79)
School failures	16.3	4.7	11.0 (1.17–103.3)	11.4	1.4	8.00 (0.89–71.58)
Mental retardation	14.0	1.2	12.0 (1.44–99.68)	22.9	0.0	.001
Conduct/behavior disorder	11.6	3.5	3.33 (0.8–13.95)	14.3	2.9	9.00 (0.99–82.06)
EEG abnormality	5.7	0.0	.21	17.1	0.0	.002
Ptosis	9.3	0.0	.022	0.0	0.0	.99
Microphthalmia	9.3	0.0	.022	0.0	0.0	.99

\*Differences between study 1 and study 2 cases are statistically significant.

†95% confidence limits in parentheses.

children and about half of study 2 case children had postnatal growth deficiency defined by any measurement of height, weight, or head circumference below the 10th percentile for age, significantly higher than the rates of growth deficiency for control children (Table I). Postnatal growth deficiency and documentation of failure to thrive by medical providers occurred significantly more often for study 1 case children than study 2 case children.

### Dysmorphic Facial Features

The most common dysmorphic facial features reported in both studies were long, flat philtrum, low nasal bridge, short palpebral fissures, thin upper lip, ear malformations, flattened maxilla, and epicanthal folds (Table II). Of the 9 case children

in study 1 and the 2 case children in study 2 who had hearing loss, 36.4% (4/11) had ear malformations.

### Central Nervous System Dysfunction

The most common CNS problems were behavior problems, developmental delays, and speech and language delays (Table II). These were documented significantly more often in case children's records than their control children's records, and in study 1 case children's records than study 2 case children's records. Microcephaly was diagnosed significantly more often in study 1 case children than in their control children and study 2 case children. Case children were more likely to have seizures than were their control children.

**Table III. Muscular, cardiac, and skeletal problems of cases and control children**

Problem	Study 1: FAS			Study 2: Incomplete FAS		
	Cases n = 43 (%)	Control children n = 86 (%)	OR <sup>†</sup> or P value	Cases n = 35 (%)	Control children n = 70 (%)	OR <sup>†</sup> or P value
Gross motor developmental delays*	46.5	0.0	.001	22.9	1.4	16.00 (2.0–127.93)
Fine motor developmental delays*	46.5	1.2	73.91 (9.43–1583.13)	20.0	1.4	14.00 (1.72–113.79)
Tremulousness*	27.9	0.0	.001	8.6	1.4	6.47 (0.55–171.03)
Feeding difficulties*	27.9	1.2	24.00 (3.12–184.85)	2.9	2.9	1.00 (0.09–11.03)
Hypotonia	23.3	0.0	.001	8.6	0.0	.066
Cardiac	20.9	1.2	18.0 (2.28–142.08)	8.6	8.6	1.00 (0.25–4.00)
Clinodactyly*	18.6	0.0	.001	0.0	0.0	.99
Cleft palate	7.0	0.0	.066	5.7	0.0	.21

\*Differences between study 1 and study 2 cases are statistically significant.

†95% confidence limits in parentheses.

**Table IV. Hospitalization of cases and control children**

	Study 1: FAS			Study 2: Incomplete FAS		
	Cases n = 43	Control children n = 86	OR* or P value	Cases n = 35	Control children n = 70	OR* or P value
Ever hospitalized	90.7%	48.8%	10.68 (3.27–38.62)	77.1%	41.4%	4.77 (1.75–13.37)
Total No. of hospitalizations	135	80		72	54	
Total days	1290	377		470	146	
Total mean days hospitalized	9.56	4.71	.001	6.53	2.70	.001

\*95% confidence limits in parentheses.

## Muscular, Cardiac, and Skeletal Problems

Study 1 case children had significantly more muscular, cardiac, and skeletal malformations than their control children (Table III). Study 2 case children had significantly more gross and fine motor developmental delays than did their control children. Study 1 case children had significantly more gross and fine motor developmental delays, tremulousness, feeding difficulties, and clinodactyly than did the study 2 case children.

## Hospitalizations

Case children in both studies spent significantly more days in hospitals than did control children (Table IV). Study 1 case children were hospitalized more days in their first year of life than were their control children. Compared with the control children, study 1 and 2 case children were hospitalized more often with the following diagnoses: otitis media, pneumonia, FAS, dehydration, and anemia (data not shown). Study 1 children were hospitalized more often than the control children for failure to thrive, neglect, anemia, child sexual abuse, and feeding problems.

## Social Services Involvement

In addition to health complications, study 1 and 2 case children were removed from their home and placed in foster care significantly more frequently than were their control children (Table V).

## DISCUSSION

Because we were not able to interview parents or examine the children, the study was limited to information available in the medical records. Diagnosing FAS is difficult, and information was incomplete in some medical records. The expression “fetal alcohol effects” has been used to describe children who had fetal alcohol exposure but did not meet the FAS case definition; however, no criteria for fetal alcohol effects have been defined.<sup>8</sup> The Institute of Medicine established diagnostic criteria for FAS and alcohol-related effects.<sup>9</sup> The features of children with incomplete FAS have not been reported.

FAS has been identified in boys more frequently than in girls,<sup>10–12</sup> but gender differences in our study were not

**Table V. Social service placement of cases and control children\***

	Study 1: FAS			Study 2: Incomplete FAS		
	Cases n = 43 (%)	Control children n = 86 (%)	OR <sup>‡</sup> or P value	Cases n = 35 (%)	Control children n = 70 (%)	OR <sup>‡</sup> or P value
Children removed from their home <sup>†</sup>	88.4	15.1	64 (8.13–504.0)	68.6	12.9	14 (4.03–48.59)
Foster care <sup>†</sup>	72.1	9.3	28 (6.45–122.0)	40.0	8.6	5.4 (1.92–15.15)
Care by relatives <sup>†</sup>	34.9	5.8	13.5 (2.96–61.60)	8.6	4.3	2.0 (0.4–9.91)

\*Some children received both foster care and care from relatives after removal from their homes.

†Differences between study 1 and study 2 cases are statistically significant.

‡95% confidence limits in parentheses.

significant. Study 1 and 2 case children had significantly higher birth order than did their control children, a finding consistent with an earlier study.<sup>13</sup>

The facial features recorded in the medical records were characteristic of FAS.<sup>8,9,14</sup> A flat philtrum and low nasal bridge may be more commonly identified because these features are easier to see. Short palpebral fissures may not be as easy to recognize without measurement.<sup>8</sup> Consistent with other studies, hearing loss is common with children who have FAS<sup>13,15–17</sup> but was found in only 6% of study 2 children. Not all the children with malformations of the ear were identified with hearing loss.

Dysmorphic facial features and muscular, cardiac, and skeletal anomalies have been found in other studies of children with FAS.<sup>8,13</sup> Tremulousness and hypotonia in children with FAS were identified in another study.<sup>16</sup> Study 2 children with incomplete FAS had gross and fine motor developmental delays, a finding that has not previously been reported.

Case children manifested prenatal growth retardation by lower birth weight, height, and head circumference than that in their control children. Postnatal growth deficiency occurred in height, weight, and head circumference for the case children and has been previously reported.<sup>8,17</sup> Perhaps due to heavier prenatal alcohol exposure, study 1 children had significantly lower birth weight and more postnatal growth deficiency than did study 2 children.

The case children had numerous CNS difficulties compared with their control children, including behavior problems, developmental delays, speech and language delays, and microcephaly, which have also been found in other FAS studies.<sup>12,17,18</sup> Behavior problems and learning delays cause difficulty for the children and their families, schools, and communities.<sup>19</sup> More research is needed to learn effective teaching strategies in working with children who have FAS or incomplete FAS.

The association of seizures with prenatal alcohol exposure has been known since the late 1800s.<sup>13</sup> The 30% and 17% seizure rates among case children in study 1 and study 2, respectively, are similar to or higher than seizure rates

reported in other studies of children with FAS (range, 3.3% to 21%).<sup>13,18</sup>

Because of the physical anomalies and central nervous system damage, many of the case children were hospitalized. Consistent with other studies, otitis media,<sup>15</sup> pneumonia,<sup>20</sup> failure to thrive,<sup>13</sup> and neglect<sup>17</sup> were more common among the children with FAS. The children with incomplete FAS had some but not all the diagnoses as the children with full FAS. Feeding difficulties, dehydration, anemia, and child sexual abuse have not been reported as common problems among children with FAS.

More than two thirds of study 1 and study 2 case children had been hospitalized, and study 1 case children had significantly more hospitalizations with longer durations than study 2 children. Children with full or incomplete FAS, therefore, have increased medical care costs. Their hospitalizations probably are underreported in this study, because children were often placed with families outside the service area of the clinic or hospital.

In addition to health care, the case children had needs that often required social service intervention. Consistent with another study, a high proportion of children with FAS had been removed from their homes.<sup>10</sup> When children are living in a home in which alcohol is abused, the children are at greater risk for neglect<sup>17</sup> and for being removed from the home; foster care is the most common placement.<sup>21</sup> Children who live in a stable, nurturing environment are less likely to have disrupted school experiences, inappropriate sexual behavior, trouble with the law, and alcohol or other drug problems.<sup>18</sup> Healthcare workers should establish long-term living environments for children with FAS to enable them to maximize their potential.

In summary, children with full or incomplete FAS have numerous health, learning, and social needs. Community programs should be expanded or developed to provide services that will benefit the children throughout their lives. Programs also need to evaluate their current protocols and procedures to determine if there is a better way to provide services for these children. The individual and societal costs of FAS are high.

Additional research is needed to learn how to optimally teach these children.

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