Children With Fetal Alcohol Spectrum Disorders: Problem Behaviors and Sensory Processing

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KEY WORDS
- fetal alcohol spectrum disorders
- pediatrics
- prenatal alcohol exposure
- sensory integration

OBJECTIVE. This study describes the sensory-processing and behavior profiles of a clinic-referred sample of children with fetal alcohol spectrum disorders (FASD) and examines the relationship between sensory processing and behavior.

METHODS. Outcomes on the Short Sensory Profile (SSP) and Child Behavior Checklist (CBCL) for 44 children, ages 5 to 10 years, were assessed and compared using retrospective data analysis.

RESULTS. A high proportion of the children demonstrated deficits in sensory processing and problem behaviors as measured by the SSP and the CBCL. Moreover, the correlation between the SSP and CBCL total scores ($r = -.72$) was significant.

CONCLUSION. Results provide evidence that children with FASD demonstrate problem behaviors and sensory-processing impairments as reported by parents and that sensory-processing deficits co-occur with problem behaviors at a high rate in this population. This finding suggests that deficits in sensory processing may affect the ability of children with FASD to respond adaptively to their environments.

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Fetal alcohol syndrome (FAS) is a permanent birth defect syndrome caused by maternal consumption of alcohol during pregnancy (Jones & Smith, 1973). FAS is characterized by growth deficiency, a specific cluster of minor facial anomalies, and central nervous system damage and dysfunction (Astley & Clarren, 2000). Not all children subjected to prenatal alcohol exposure have FAS. The adverse impact of prenatal alcohol exposure presents along a continuum called *fetal alcohol spectrum disorders* (*FASD;* Bertrand et al., 2004). Clinical diagnoses that fall under the umbrella of FASD include FAS, partial FAS, static encephalopathy–alcohol exposed, and neurobehavioral disorder–alcohol exposed. The teratogenic impact of alcohol on the developing brain can lead to deficiencies in cognitive functioning, attention, memory, learning, language, auditory processing, motor skills, and problem solving (Connor & Streissguth, 1996; Mattson & Riley, 1998). Secondary disabilities affecting work, school, and social functioning may also result, which may include deficits in adaptive behavior, social competence, communication, and daily living skills (Roebuck, Mattson, & Riley, 1999; Streissguth et al., 2004; Whaley, O'Connor, & Gunderson, 2001).

Although cognitive and behavioral deficits associated with FASD have been extensively reported in the literature, sensory-processing deficits have received less attention. *Sensory processing* is a general term based on Dunn's (1999) conceptual model, which hypothesizes that a continuum of interaction exists between neurological processing of sensory input and behavioral responses. Daily activities and skills are believed to be negatively affected by sensory-processing deficits (Ayres, 1979). Sensory-processing impairments have been theoretically linked to a wide range of neurobehavioral difficulties, including problems with motor coordination, language, visual–perceptual skills, behavior, attention, learning, and emotional regulation (Ayres, 1972, 1979). Some of the documented manifestations of sensory-processing deficits include hyperactivity, distractibility, social difficulties, learning difficulties, poor organizational skills, and behavioral difficulties (Ayres, 1979). These characteristics also have been consistently reported in children with FASD (Mattson, Goodman, Caine, Delis, & Riley, 1999; Mattson & Riley, 1998).

Unfortunately, little research examines the relationship between sensory-processing and behavioral impairments in children with FASD. Findings from two studies that explored sensory processing in children with prenatal alcohol exposure suggest that children with FASD do present with sensory-processing difficulties and that these deficits co-occur with other behavioral and adaptive deficits (Jirikowic, Olson, & Kartin, in press; Morse, Miller, & Cermak, 1995). Although both studies found significantly more sensory-processing problems in children with FASD compared with typically developing children, findings were considered preliminary with limitations in instrumentation, sample size, and the depth of concurrent problem behaviors examined. More investigation of the impact prenatal alcohol exposure has on a child's ability to process and respond to sensory stimuli in his or her environment and how this relates to the child's behavioral responses to the environment is an important step that may lead to more effective intervention.

Two assessments typically administered to children in the Fetal Alcohol Syndrome Diagnostic and Prevention Network (FAS DPN) at the University of Washington are the Short Sensory Profile (SSP; Dunn, 1999), which is used to measure sensory-processing impairments, and the Child Behavior Checklist (CBCL; Achenbach, 1991; Achenbach & Rescorla, 2001), which is used to measure problem behaviors. Children's total and section scores on the SSP are classified into three categories (definite difference, probable difference, and typical performance) on the basis of parent-reported sensory-processing behaviors. Similarly, parent-reported problem behaviors on the CBCL syndrome scales, internalizing scale, externalizing scale, and total problems scores are classified into three categories (clinical, borderline, and normal).

Because of the paucity of research related to sensory processing and potential association with problem behaviors in children with FASD, this study had two purposes. The first purpose was to describe the sensory-processing characteristics and problem behaviors of 5- through 10-year-old children with FASD. The second was to explore the relationship between sensory-processing deficits and problem behaviors in children with FASD by testing the following hypotheses.

1. A significant negative correlation will exist between the CBCL total score (high scores document impaired outcome) and the SSP total score (low scores document impaired outcome).

2. Children with FASD in the SSP definite or probable group will score significantly different from children with FASD in the SSP typical group on the CBCL in the following areas: two of the syndrome scales (attention problems and social problems), the total problems score, and the externalizing problem score.

3. Children with FASD in the CBCL clinical or borderline group will score significantly different than children with FASD in the CBCL normal group on the SSP total score and five of the seven section scores (i.e., tactile sensitivity, movement sensitivity, underresponsive/seeks sensation, auditory filtering, and visual/auditory sensitivity).

4. Children with FASD who have scores that fall within the categories of definite or probable differences on the SSP will be more likely to demonstrate borderline or clinical ranges on the CBCL than children who demonstrate SSP scores within the typical performance category.

Methods

Research Design

A retrospective study was conducted using data from the Washington State FAS DPN clinical database. This database contains more than 2,000 fields of exposure and outcome data on each child with prenatal alcohol exposure who received FASD diagnostic evaluations at one of the six network clinics. Approximately half of the children are seen at the University of Washington FAS DPN clinic. Although the FAS DPN database is a clinic-referred sample, the only requirement for obtaining a FASD diagnostic evaluation at a FAS DPN clinic is a confirmed prenatal alcohol exposure at any quantity, frequency, or duration.

All children in this database received an interdisciplinary FASD diagnostic evaluation (Clarren, Carmichael Olson, Clarren, & Astley, 2000) using the FASD 4-Digit Diagnostic Code developed by Astley and Clarren (1997, 2000). The four digits of the code reflect the magnitude of expression of the four key diagnostic features of FASD in the following order: (1) growth deficiency, (2) FAS facial features, (3) central nervous system damage–dysfunction, and (4) prenatal alcohol exposure. The magnitude of expression of each feature is ranked independently on a 4-point Likert scale with 1 reflecting complete absence of the FAS feature and 4 reflecting strong presence of the FAS feature. Diagnoses were updated and coded according to the 2004 version of the 4-Digit Diagnostic Code (Astley, 2004).

Data were used in this study from all children in the FAS DPN database who met the following inclusion criteria: (1) being 5 through 10 years of age at the time of diagnosis, (2) being male or female of any race or ethnicity, (3) having one of the FASD diagnoses using the 2004 FASD 4-Digit Diagnostic Code (FAS, partial FAS, static encephalopathy–alcohol exposed, or neurobehavioral disorder–alcohol exposed); and (4) having complete data available in the database for the SSP and the CBCL. The CBCL has been administered at the FAS DPN since it first opened in 1993. The SSP was not available until 1999; thus, it was not administered in the FAS DPN until 2000. Because administration of both the CBCL and the SSP was an inclusion criterion for this study, the study population was restricted to only those diagnosed since 2000 who had data for both measures.

Instruments

SSP. Sensory-processing behaviors were measured using the SSP. The SSP is a 38-item, judgment-based caregiver questionnaire that serves as a tool for identifying a child's sensory-processing behaviors; it links these behaviors with the child's functional performance in daily activities (Dunn, 1999). The SSP, a shorter version of the Sensory Profile, was developed as a screening tool to identify children with sensory difficulties more quickly and for use as a sensory-processing measure for research purposes. The SSP is a standardized behavioral checklist with normative data. A 5-point Likert scale ranging from *always* to *never* is used to record caregiver responses. Low raw scores reflect sensory-processing problems. Moreover, the SSP includes a classification system made up of three categories (normal, probable difference, and definite difference). Psychometric properties, including reliability and validity, for the SSP are generally strong (Dunn, 1999; Dunn & Brown, 1997; Dunn & Westman, 1997; Ermer & Dunn, 1998; Watling, Deitz, & White, 2001). Internal reliability of the section scores, for a sample of 117 children, ages 3 to 17, ranged from .82 to .89 (Cronbach's alphas; Dunn, 1999). Internal reliability for the total score was .96 (Cronbach's alpha; Dunn, 1999). Intercorrelations among the SSP sections scores ranged from .25 to .76 ($p < .01$; Dunn, 1999). This finding implies that the sections are measuring differing but overlapping constructs.

Achenbach CBCL. Functional behaviors were measured using the CBCL (Achenbach, 1991) for ages 4 to 18 years and the Achenbach System of Empirically Based Assessment CBCL for ages 6 to 18 years (Achenbach & Rescorla, 2001). These are standardized tools used to assess behavioral and emotional problems that have occurred during the past 6 months.

Both versions of the CBCL are questionnaires on which a caregiver rates a child's problem behaviors. The response format is 0 (*not true*), 1 (*somewhat or sometimes true*), or 2 (*very true or often true*). Scoring provides eight syndrome scales that measure behavioral and emotional problems. These scales are anxious/depressed, withdrawn/depressed, somatic complaints, social problems, thought problems, attention problems, rule-breaking behavior, and aggressive behavior. The eight syndrome scales are summarized into three broader scales: internalizing (anxious/depressed, withdrawn/depressed, somatic complaints), externalizing (rule-breaking behavior, aggressive behavior), and total problems score. Moreover, the CBCL includes a classification system made up of three categories (normal, borderline, and clinical ranges). High T scores reflect the presence of problem behaviors. Both versions of the Achenbach CBCL are based on a careful review of the literature and empirical studies. Test–retest reliabilities and the majority of the internal consistency reliabilities were adequate to excellent for both the 1991 and 2001 CBCL scales used in this study. For the 1991 CBCL scales reported in this study, using a mean Pearson r, test–retest reliabilities ranged from .82 to .95, and internal consistency reliabilities (coefficient alphas) for males ranged from .62 to .96 and for females ranged from .66 to .96 (Achenbach, 1991). For the 2001 CBCL scales reported in this study, using the Pearson r, test–retest reliabilities ranged from .82 to .94 and internal consistency reliabilities (coefficient alphas) ranged from .82 to .97 (Achenbach & Rescorla, 2001). For both versions of the CBCL (Achenbach, 1991; Achenbach & Rescorla, 2001), content validity, criterion-related validity, and construct validity were studied extensively with one of the key findings being that both of these measures discriminate significantly between children who are referred for evaluation and those who are not referred.

Data Analysis

Descriptive statistics (e.g., means, standard deviations) were used to summarize the sociodemographic profile of the study population and outcomes from the SSP and CBCL. Because the data met the assumptions for the use of parametric statistics, the Pearson r correlation coefficient was used to address Hypothesis 1 regarding the linear associations between sensory processing and functional behaviors, and t tests were used to compare mean outcomes between the two groups. The chi-square and the Fisher exact tests were used to test for significant contrasts in proportions between groups for the test classification categories. The alpha level was set at $p \leq .05$. Because of the increased risk of Type I errors with multiple comparisons, specific hypotheses were declared a priori. The p values across the CBCL and SSP subtests should be interpreted with caution and regarded as exploratory.

Results

Child Demographic and Child Development Information

Forty-four children met the study's inclusion criteria. A summary of the sociodemographic and clinical profiles of the study population is presented in Table 1. The diagnostic classifications of these 44 children spanned the full continuum under the umbrella of FASD. Eighteen children reportedly had concomitant mental health or psychiatric diagnoses, including oppositional defiant disorder (n = 6), posttraumatic stress disorder (n = 5), adjustment disorder (n = 4), conduct disorder (n = 2), and bipolar disorder (n = 1). In addition, 23 children were reported to have a diagnosis of attention deficit disorder (ADD) or attention deficit/hyperactivity disorder (ADHD).

Analyses confirmed that the 44 children included in the study population were a representative subset of all 205 children (5–10 years of age) who received a FASD diagnosis at a FAS DPN clinic since 2000. They were comparable across all variables presented in Table 1. Of the 205 children in the target population, only 44 had both a CBCL and an SSP administered. The primary reason a child did not receive a CBCL or SSP was because he or she was seen at a clinic site that did not routinely administer that assessment. The CBCL and SSP are most routinely administered at the University of Washington FAS DPN clinic site.

Because the effects of multiple home placements and short time durations in foster placement or with current caregivers were factors that also could negatively affect behavioral outcomes in this sample of children, these factors were further examined in a post hoc analysis. Findings revealed no significant correlations between the number of home placements or the duration of home placements and behavioral problems.

Table 1. Child Demographic and Development Information Gathered at Time of FASD Diagnostic Evaluation

Variables	Children With FASD n	%
Age (years, months) at time of diagnosis (n = 44)		
5,0 through 6,11	14	31.8
7,0 through 8,11	17	38.6
9,0 through 10,11	13	29.5
Gender (n = 44)		
Male	30	68.2
Female	14	31.8
Racial/ethnic background (n = 44)		
White	24	54.5
African American	3	6.8
Hispanic/Latino	1	2.3
Native American	4	9.1
Other (other races, mixed races)	10	22.7
Unknown	2	4.5
Diagnostic classification (n = 44)		
FAS	2	4.5
Partial FAS	6	13.6
Static encephalopathy–alcohol exposed	14	31.8
Neurobehavioral disorder–alcohol exposed	22	50.0
Cognition–full scale IQ standard scores from last administered test (n = 39)		
130 to 140	1	2.6
115 to 129	2	5.1
100 to 114	9	23.1
85 to 99	20	51.3
70 to 84	6	15.4
60 to 69	1	2.6
Primary caregiver(s) at time of diagnosis (n = 44)		
Birth parent	10	22.7
Biological family member (not parent)	10	22.7
Foster parent	8	18.2
Adoptive	14	31.8
Caseworker	2	4.5
Total number of home placements at time of diagnosis (n = 43)		
1	9	20.9
2	15	34.9
3	6	14.0
4	5	11.6
>4	8	18.6
Length of time living with current caregiver at time of diagnosis, in years (n = 37)		
0 to 1	13	35.1
2 to 3	5	13.5
4 to 5	7	18.9
>5	12	32.4

Note. The sample sizes vary because data were not available for all variables for all children. Summed percentages may not equal 100 because of rounding error. FASD = fetal alcohol spectrum disorders; FAS = fetal alcohol syndrome.

SSP and CBCL Profiles

The distributions of outcomes for the SSP and the Achenbach CBCL, as reported by the primary caregivers for children with FASD, are presented in Tables 2 and 3.

Correlation Between the SSP and CBCL: Hypothesis 1

A statistically significant negative correlation between SSP and CBCL total scores (r = –.72, $p \le .05$) was found. The relationship is a negative correlation because as the SSP total score becomes lower (indicating more sensory-processing difficulties), the CBCL score becomes higher (indicating more problem behaviors).

Associations Between Clinical Categorizations of the SSP and CBCL

Hypothesis 2. As hypothesized, relative to children with SSP total scores in the typical performance range, children with SSP total scores in the definite or probable difference clinical range had significantly higher mean T scores for the CBCL total problems score, externalizing problem score, and

Table 2. Achenbach Child Behavior Checklist (CBCL) Distributions of *T* Scores and Classification Groups

	Children With FASD (*N* = 44)				
			Classifications		
	T Scores		Clinical	Borderline	Normal
CBCL	*M*	*SD*	*n* (%)	*n* (%)	*n* (%)
Syndrome scales					
Anxious/depressed	65.3	10.5	14 (31.8)	5 (11.4)	25 (56.8)
Withdrawn/depressed	63.9	9.9	10 (22.7)	5 (11.4)	29 (65.9)
Somatic complaints	63.2	9.6	15 (34.1)	4 (9.1)	25 (56.8)
Social problems	70.8	9.9	22 (50.0)	10 (22.7)	12 (27.3)
Thought problems	69.2	9.1	25 (56.8)	8 (18.2)	11 (25.0)
Attention problems	74.7	12.7	25 (56.8)	9 (20.5)	10 (22.7)
Rule-breaking behavior	67.7	8.4	23 (52.3)	4 (9.1)	17 (38.6)
Aggressive behaviors	72.7	11.9	23 (52.3)	9 (20.5)	12 (27.3)
Internalizing syndrome	66.9	8.6	29 (65.9)	6 (13.6)	9 (20.5)
Externalizing syndrome	70.1	9.2	33 (75.0)	4 (9.1)	7 (15.9)
Total problems score	71.9	7.5	38 (86.4)	2 (4.5)	4 (9.1)

Note. FASD = fetal alcohol spectrum disorders.

two syndrome scale scores (attention problems and social problems). In addition, significant differences were found for the syndrome scale scores of rule-breaking behavior and thought problems (Table 4).

Hypothesis 3. Relative to children with normal CBCL total scores, children with clinical or borderline CBCL total scores had significantly lower mean scores for the SSP total score, underresponsive/seeks sensation section score, and auditory filtering section score (Table 5).

Concordance Between CBCL and SSP Category Classifications: Hypothesis 4

Table 6 presents percentages of children falling into each test category. Thirty-seven of the children in this sample (84%) demonstrated deficits in both sensory processing (definite or probable) and problem behaviors (clinical or borderline) on the CBCL. Only 2 children demonstrated no problems on either measure. Children who demonstrated deficits in sensory-processing abilities appeared more likely to also demonstrate problem behaviors. Several analyses document this concordance. When the three clinical classification groups were maintained, a significant linear-by-linear trend was observed ($\chi^2[1, N = 44] = 8.8, p = .003$). Because of the small sample size, some cells had expected counts less than five. When the SSP categories of "definite" and "probable" and the CBCL categories of "clinical" and "borderline" were combined to overcome the small expected cell counts, a near significant association between SSP and CBCL outcomes was observed (Fisher exact test, $p = .057$).

Discussion

This study supports previous findings indicating that sensory-processing dysfunction and problem behaviors co-occur in children with FASD (Jirikowic, Olson, et al., in press; Morse et al., 1995). A high percentage of children in this sample demonstrated both problem behaviors and sensory-processing deficits as indicated by caregiver report. Children who were

Table 3. Short Sensory Profile Distributions of Raw Scores and Classification Groups

	Children With FASD (*N* = 44)				
			Classifications		
	Raw Scores		Definite	Probable	Typical
Short Sensory Profile	*M*	*SD*	*n* (%)	*n* (%)	*n* (%)
Section scores					
Tactile sensitivity	25.2	6.3	23 (52.3)	10 (22.7)	11 (25.0)
Taste/smell sensitivity	14.2	5.9	15 (34.1)	5 (11.4)	24 (54.5)
Movement sensitivity	11.7	3.5	13 (29.5)	10 (22.7)	21 (47.7)
Underresponsive/seeks sensation	17.6	6.0	37 (84.1)	2 (4.5)	5 (11.4)
Auditory filtering	15.0	5.1	37 (84.1)	2 (4.5)	5 (11.4)
Low energy/weak	23.2	6.2	19 (43.2)	6 (13.6)	19 (43.2)
Visual/auditory sensitivity	16.7	5.7	17 (38.6)	8 (18.2)	19 (43.2)
Total score	123.6	28.5	32 (72.7)	7 (15.9)	5 (11.4)

Note. FASD = fetal alcohol spectrum disorders.

Table 4. Achenbach Child Behavior Checklist (CBCL) *T* Scores for Children With FASD Falling Within the Definite or Probable Difference and Typical Classifications on the Short Sensory Profile (SSP)

	CBCL *T* Scores					
	Children With Definite or Probable Difference Total Scores on the SSP (*n* = 39)		Children With Typical Performance Total Scores on the SSP (*n* = 5)		*t*	
CBCL	*M*	*SD*	*M*	*SD*	*t*	*p* (2-tailed)
Syndrome scales						
Anxious/depressed	65.9	10.9	60.6	4.8	1.1	.30
Withdrawn/depressed	64.4	10.3	59.8	5.6	0.9	.34
Somatic complaints	64.0	9.9	57.2	2.5	2.2	.14
Social problems	72.3	9.2	59.0	7.3	9.5	<.01
Thought problems	70.6	8.2	58.6	9.1	9.2	<.01
Attention problems	77.1	11.4	56.2	4.7	16.2	<.01
Rule-breaking behavior	68.6	8.1	60.6	8.0	4.4	.04
Aggressive behaviors	73.8	11.6	64.2	12.0	3.0	.09
Internalizing syndrome	67.7	8.8	60.8	2.5	3.0	.09
Externalizing syndrome	71.3	8.2	61.2	12.6	5.9	.02
Total problems score	73.3	6.2	61.4	8.8	14.6	<.01

Note. n = 44. FASD = fetal alcohol spectrum disorders.

classified in clinically concerning categories on measures of sensory processing or problem behaviors also showed significant differences in specific sensory or behavioral test domains when compared with children in normal classification categories on either measure. A statistically significant correlation between SSP and CBCL total scores ($r = -.72$) was found, indicating that children with FASD who demonstrated sensory-processing deficits were more likely to demonstrate functional behavioral deficits.

The behavioral problems in children with FASD who demonstrated sensory-processing deficits were consistent with those described in previous sensory-processing literature (Ayres, 1972, 1979; Bundy, Lane, & Murray, 2002; Livingston, 1978), as well as those described in other studies on children affected by prenatal alcohol exposure (Jirikowic, Kartin, & Olson, in press; Mattson & Riley, 2000; Whaley et al., 2001). Children with FASD who demonstrated sensory-processing deficits demonstrated significantly more externalizing behavior problems and problems in the specific domains of socialization, attention, rule breaking, and thought problems. More specifically, findings parallel those of Miller, Reisman, McIntosh, and Simon (2001), who compared 46 typically developing children (ages 3 to 13 years) with 32 children with sensory modulation dysfunction (ages 3 to 9 years). They found that children with sensory modulation dysfunction, as measured by the SSP, demonstrated more thought problems, aggressive behaviors, social problems, and attention problems as measured by the CBCL.

Table 5. Short Sensory Profile (SSP) Raw Scores for Children With FASD Falling Within the Clinical or Borderline and Normal Ranges on the Achenbach Child Behavior Checklist (CBCL)

	SSP Raw Scores					
	Clinical or Borderline Ranges on the CBCL Total Score (*n* = 40)		Normal Range on the CBCL Total Score (*n* = 4)		*t*	
SSP	*M*	*SD*	*M*	*SD*	*t*	*p* (2-tailed)
Section scores						
Tactile sensitivity	24.7	6.3	30.3	3.2	3.0	.09
Taste and smell sensitivity	13.9	6.0	17.3	2.5	1.2	.28
Movement sensitivity	11.5	3.5	13.0	2.4	0.7	.42
Underresponsive–seeks sensation	16.8	5.7	25.5	3.5	9.0	<.01
Auditory filtering	14.1	4.3	24.3	3.4	20.7	<.01
Low energy–weak	22.8	6.2	27.3	5.5	1.9	.18
Visual–auditory sensitivity	16.3	5.8	20.5	3.7	2.0	.17
Total score	120.1	27.1	158.0	18.2	7.4	.01

Note. n = 44. FASD = fetal alcohol spectrum disorders.

Table 6. Percentages of Children Falling Into Each Test Category ($N = 44$)

	SSP Categories		
CBCL Categories	Definite	Probable	Typical
Clinical	30 (93.8%)	6 (85.7%)	2 (40.0%)
Borderline	1 (3.1%)	0 (0.0%)	1 (20.0%)
Normal	1 (3.1%)	1 (14.3%)	2 (40.0%)

Note. SSP = Short Sensory Profile; CBCL = Child Behavior Checklist.

Although aggressive behaviors were reported by Miller and colleagues (2001) in children with sensory modulation disorder, as well as by Mattson and Riley (2000) in children with prenatal alcohol exposure, in the current study, significant differences were not found for this domain. However, trends were in the hypothesized direction.

Moreover, results indicated that children with behavioral problems also demonstrated significant differences in their abilities to process sensory stimuli as measured by caregiver report. Children who had impairments in behavior also had specific difficulty processing auditory stimuli and difficulty modulating sensory input from their surroundings as indicated by more sensation-seeking behaviors or underresponsiveness to environmental stimuli. However, the hypothesis that children with impairments in behavior would also have difficulty with tactile, visual/auditory, and movement sensitivities was not supported. These findings suggest that deficits in sensory modulation and auditory processing may result in an increased prevalence of behavioral impairments because of poor adaptive behavioral responses.

Because the majority of children (84%) demonstrating impairments in behaviors also displayed sensory-processing deficits, this study supports the notion that deficits with sensory modulation interfere with the child's abilities to demonstrate adaptive behavioral responses, leading to problem behaviors or impairments in behavioral regulation (Dunn, 1999). The strong correlation between sensory-processing impairments and behavioral problems further supports this relationship. Although concordance between those in clinically concerning categories on the both the CBCL and the SSP only approached significance statistically, possibly because of small numbers in some cells resulting in a reduction of power, the trend was in the hypothesized direction.

Finally, it is of note that children in this study also had a high prevalence of reported mental health and psychiatric diagnoses. Comorbid psychiatric conditions, such as ADD and ADHD or anxiety, mood, conduct, and explosive disorders, also have been reported in previous studies of people with prenatal alcohol exposure (Brown et al., 1991; Coles, 2001; O'Malley & Nanson, 2002). Symptoms associated with prenatal alcohol exposure, sensory-processing deficits, and mental health or psychiatric disorders warrant further exploration in terms of discerning their specific or collective impact on functional behaviors. Further research is warranted to examine the possible effects of other environmental factors (e.g., abuse, neglect) that may influence the relationship between sensory-processing impairments and functional behaviors.

Clinical Implications

This study supports the idea that a link exists between deficits in sensory processing and deficits in problem behaviors in children with FASD. Therefore, occupational therapists working with children with FASD should consider addressing sensory-processing concerns, both in the evaluation process and during intervention. The possibility of decreasing problem behaviors with sensory-based interventions and environmental modifications needs to be considered when serving a child with FASD. Perhaps occupational therapists could intervene for a child with FASD by adapting environments and educating care providers and teachers on how the child's responses to sensory stimuli may negatively influence the child's behavior.

Limitations

The following potential limitations of this study should be considered. First, the study sample was drawn from a clinical population of people referred for diagnostic evaluation. Thus, participants do not necessarily represent all people with FASD. Second, the sample was small, limiting power in some of the analyses, and the possibility of a Type I error is increased for analyses involving multiple comparisons. Third, the SSP and CBCL are standardized measures based on caregiver report. Outcomes can vary depending on which caregiver completes the report.

Direction for Future Research

Further studies should explore and clarify the relationship between sensory processing and problem behaviors in children with FASD. For example, the same hypothesis could be explored using a larger, more diverse sample of children, which would allow examination of subgroups within the population of children with FASD, such as those also diagnosed with ADHD. Gaining a better understanding of the impact prenatal alcohol exposure has on a child's ability to process and respond to sensory stimuli in his or her environment and how this relates to the child's behavioral responses to the environment is an important step in understanding this population of children. With an improved understanding of sensory processing in children with FASD, early intervention and support services could be implemented to assist with problem behaviors, potentially preventing secondary disabilities.

The relationship between problem behaviors and sensory-processing deficits in children with FASD identifies a need for research focused on the effectiveness of interventions for sensory-processing dysfunction and behavioral problems. Future results may help therapists, educators, and caregivers better understand and accommodate these children within their homes, schools, and communities.

Conclusion

Results of this study support previous research that children with FASD demonstrate significant impairments in problem behaviors (Jirikowic, Kartin, et al., in press; Mattson & Riley, 2000) and sensory processing (Jirikowic, Olson, et al., in press; Morse et al., 1995), as reported by parents. Findings further strengthen the idea that deficits in sensory processing co-occur with problem behaviors at a high rate in this population. Deficits in sensory processing, which may contribute to a range of behavioral problems, may thus affect the ability of children with FASD to demonstrate adaptive responses to their environments. ▲

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