

GENDER AND ATTENTION DEFICITS IN CHILDREN DIAGNOSED WITH A FETAL ALCOHOL SPECTRUM DISORDER

Lisa E Herman¹, Michelle C Acosta^{1,2}, Pi-Nian Chang³

¹St. Luke's-Roosevelt Hospital Center, Dept. of Psychiatry, New York, New York;

²Columbia University College of Physicians and Surgeons, New York, New York;

³University of Minnesota, Dept. of Pediatrics

ABSTRACT

Background

A portion of children are born with Fetal Alcohol Spectrum Disorders (FASD). Most present with significant difficulties in attention, with attention-deficit/hyperactivity disorder (ADHD) being the most common psychiatric co-morbidity.

Objectives

The current study will describe behavioral and executive functioning (EF) deficits in attention in a group of children with FASD. Effects of gender and ADHD diagnosis will be explored.

Methods

Existing data from the University of Minnesota's Pediatric Psychology clinic was utilized. Of 191 children with FASD in the database, 36 children (ages 6-16) had complete scores on measures of behavioral and EF attention deficits. Multivariate Analyses of Variance (MANOVA) were used to examine the impact of gender and ADHD diagnosis on behavioral checklist scores and on a variety of EF measures.

Results

FASD males were significantly more likely to be diagnosed with ADHD (68%) than FASD females (29%). No impact of gender or diagnosis was found for behavioral measures of attention, but an interaction of gender and diagnosis emerged for EF. Females with ADHD evidenced deficits in EF compared to females without ADHD. However, males with ADHD performed better on measures of EF than their non-ADHD counterparts.

Conclusion

An ADHD diagnosis in FASD children needs to be reconsidered, especially for males.

Key Words: *Fetal Alcohol Syndrome (FAS); Fetal Alcohol Spectrum Disorders (FASD); Attention-Deficit/Hyperactivity Disorder (ADHD); Gender; Executive Functioning (EF)*

Drinking alcohol while pregnant can cause abnormal brain tissue and organ development in a growing fetus.¹ As a result, many children are born with multiple physical and neurological abnormalities. Medical professionals² first coined the term Fetal Alcohol Syndrome in

children with features such as growth deficiencies (e.g., small stature, microcephaly), facial anomalies (e.g., flattened upper lip, small palpebral fissures), and central nervous system dysfunction (i.e., brain damage). Interestingly, not all children born to mothers who consume alcohol

while pregnant present with classic FAS features. The individual differences seen in children prenatally exposed to alcohol necessitated professionals to create the current nondiagnostic umbrella term Fetal Alcohol Spectrum Disorders (FASD). National prevalence rates estimate that children with FASD are diagnosed at a rate of 10 cases per 1,000 births.³

While presentation of FASD symptoms vary, most children exhibit low intelligence^{4,5,6} learning disorders^{7,8,9} memory difficulties¹⁰ and deficits in independent living skills.^{8,9} However, attention deficits are most prevalent, with attention-deficit/hyperactivity disorder (ADHD) being the most common psychiatric comorbidity in children with FASD.^{11,12,13} There are two widely-used methods to assess attention deficits in children, behavioral observation and neuropsychological testing. Behavioral observation consists of parent and/or teacher reports of a child's behaviors, including hyperactivity, impulsivity, and inattention. Neuropsychological testing includes administration of measures sensitive to deficits in executive functioning (EF), a core aspect of ADHD.^{14,15,10}

EF is comprised of five factors: the ability to focus attention (e.g., selectively attend to information), the ability to shift attention (e.g., easily change attention from one thing to another), the ability to sustain attention (e.g., maintain alertness), the ability to encode information (e.g., keep information in working memory), and the ability to stabilize attention (e.g., consistently respond to a target stimulus on a continuous performance test).^{16,17} Examining these factors allows for a fine-grained examination of attention.

As attention problems are common in the FASD population, examination of the attention deficits in children with FASD versus children with ADHD have been of interest.^{18,19,20,21,22} While overall EF is impaired in FASD^{15,10,23,24,25} and ADHD children,^{14,26} the presentation of weaknesses differs by diagnosis. Specifically, children with FASD have more difficulties encoding information^{19,24} and shifting attention,^{19,27,23,28} and children with ADHD demonstrate more impairment focusing and sustaining attention.¹⁹ No research has examined the differences in ability to stabilize attention.

While patterns of EF deficits differ by diagnosis, studies of behavioral measures of

attention are inconsistent. One study¹⁹ found that ADHD children had significantly higher scores on behavioral checklists than non-ADHD children. However, children with FASD appeared similar to children without FASD or ADHD. In contrast, another study reported that children with ADHD and children with FASD both showed elevated levels of attention problems when compared to children without ADHD or FASD.²⁰ It is unclear whether or not children with FASD have similar attention deficits to children with ADHD when assessed using a behavioral observation checklists.

One factor adding complexity to these findings is the impact of gender on attention; ADHD is diagnosed 2 to 9 times more often in males.²⁹ In addition, qualitative aspects of attention deficits differ between boys and girls with ADHD. One meta-analysis³⁰ of clinically referred children with ADHD found that boys demonstrated higher levels of hyperactivity than girls, but girls were more impaired on inattention. A more recent meta-analysis of children with ADHD³¹ demonstrated that boys displayed higher levels of hyperactivity, inattention, and impulsivity compared to girls. Boys appear to be more hyperactive and impulsive than girls, whereas results regarding inattention are mixed. In contrast to behavioral differences, gender has not been shown to impact EF. In a large study of children with ADHD, neuropsychological tests did not show gender differences in EF (i.e., sustaining attention, shifting attention, encoding information, focusing attention).³² While gender differences may be present in behavioral aspects of attention, there are not gender differences in EF.

Gender differences in attention deficits for children with FASD are less clear. Currently, there are no gender differences in rate of diagnosis of FASD. Two large, population-based studies showed equivalent gender breakdown in FASD children: boys 62.6% (Susan Astley, personal communication, 2005 FASD database) and boys 53.3%.³³ Unfortunately, no studies have examined gender differences in attention deficits for boys versus girls with FASD.

In order for clinicians to correctly diagnose and effectively treat attention deficits in children with FASD, these deficits must be accurately characterized. The current study will describe

behavioral and EF deficits in boys and girls with FASD. Given the scarcity of knowledge regarding gender and diagnostic differences in children with FASD, our current hypotheses are based on what is known about children with ADHD. We hypothesize that:

- 1) FASD boys will be diagnosed with ADHD significantly more often than FASD girls,
- 2) FASD children with ADHD will have significantly higher scores on behavioral measures and show more impairment on measures of EF than FASD children without ADHD,
- 3) FASD boys both with and without ADHD will have significantly higher scores on behavioral deficits in attention, compared to FASD girls, and
- 4) FASD boys and girls both with and without ADHD will not differ on measures of EF.

METHODS

The current study was a retrospective analysis of de-identified archival data from the University of Minnesota's Pediatric Psychology clinic. We were granted exempt status from formal ethical review by our local institutions. Patient information was transformed into specific variables and then compiled onto a statistical software program, Statistical Packages for the Social Sciences, Version 11.0. The database contains demographics, behavioral attention and EF scores, number of living situations, and age at first removal from home environment.

Participants

This study examined 36 (Males=19, Females=17) participants who were taken from a larger database of 191 participants, all diagnosed with FASD. Participants were assessed for FASD by trained physicians and psychologists examining four indicators: 1) central nervous system dysfunction, 2) facial anomalies, 3) growth anomalies, 4) prenatal alcohol history. All participants in the study met criteria for FASD according to the Institute of Medicine Guidelines.³⁴ The reason only 36/191 participants were used for this study was due to missing data, as not all children were administered the full assessment battery. Missing data most commonly consisted of tests of EF (48% missing) and teacher reports of attention problems (40% missing). The 36 participants in our sample were compared to

the remaining 155 participants; no differences were found on demographic, intellectual or attentive functioning. However, the current sample of 36 had a significantly lower score on percentile of category achieved on the Wisconsin Card Sorting Task ($M=5.3\%$, $SD=3.5$) than the remaining sample ($M=9.5\%$, $SD=5.9$, $t=4.1$, $p < .01$). Both groups have significantly lower scores on this test than would be expected, and this difference is not clinically meaningful.

The 36 participants were between the ages of 6.3 and 16.5 ($M=10.7$, $SD=3.0$). Participants were Caucasian (41.7%), multi-racial (33.3%), Native-American (13.9%), African-American (8.3%), and other (2.8%). Participants came from unstable living environments; average number of living situations per child was 3.2 ($SD=1.8$) and average age at first removal was 4.0 years old ($SD=4.2$). The average Full Scale IQ fell in the Low Average range ($M=87.9$, $SD=14.9$). The Performance IQ fell in the Average range ($M=92.4$, $SD=13.9$) and was significantly higher than the Verbal IQ ($M=85.5$, $SD=17.0$), which fell in the Low Average range. Half of the sample (50.0%) was diagnosed with ADHD.

Measures

Executive Functioning

EF was assessed with the Wechsler Intelligence Scale for Children, Third Edition (WISC-III), Wisconsin Card Sorting Task (WCST), and the Test of Variables of Attention (TOVA).

Wechsler Intelligence Scale for Children, Third Edition (WISC-III)

The WISC-III³⁵ measures general intelligence in children and adolescents ages 6-16, and yields Verbal, Performance, and a Full Scale intelligence quotient along with four additional index scores. In this study, the Arithmetic, Digit Span, and Coding subtests were used (reliability $r = .78-.85$).³⁶ The Arithmetic subtest requires the participant to listen to a mathematical word problem and then manipulate the answer, measuring one's ability to follow directions and concentrate. The Digit Span subtest consists of a series of numbers read to the participant both forwards and backwards and repeats the numbers back. This task measures auditory memory and attention. The Coding subtest is a timed task that requires a participant to place a symbol in the

bottom half of a box that matches a number in the top of the box. This task primarily examines attention skills and short-term memory.

Wisconsin Card Sorting Task (WCST)

The WCST³⁷ assesses abstract thinking and perseveration; however, this test has become more popular in assessing EF (i.e., planning, goal-directed behavior) for children and adults ages 6.5-89 (test-retest reliability = .57).³⁷ Four stimulus cards are presented to the participant and they are told to match another card to one of the four stimulus cards. For this study, the number of categories achieved percentile and number of perseverative errors standard score will be examined.

Test of Variables of Attention (TOVA)

The TOVA³⁸ is a computerized, visual, continuous performance test is used to assess attention. This test was normed on children 4 to 19 years of age. The participant presses a button if the black box appears at the top of the screen (target stimulus), and not click the button when the black box appears at the bottom of the screen. Standard scores on Omission (measure of inattention; when the subject does not respond to the target stimulus), Commission (impulsivity or disinhibition; the subject responds to the non-target stimulus), and Response Time (measures how consistent the subject is when responding to stimuli) will be used in this study (reliability = .70's to .90's).³⁸

Behavioral Functioning

Behavioral functioning was assessed with the *Achenbach Child Behavior Check List (CBCL) – Parent and Teacher Report Forms*.

Achenbach Child Behavior Check List (CBCL) – Parent and Teacher Report Forms

The CBCL³⁹ assesses attention problems observed in children 6-18 years of age via parent and teacher observation. There are 118 items on both parent and teacher forms that describe specific behavioral problems. This study will only use the parent and teacher Attention Problems T-score. The psychometric properties for both the parent and teacher report forms range from adequate to excellent (.85-.92).⁴⁰

Mirsky's Model of Attention

Consistent with Mirsky's^{16,17} work on attention, the following subscales were used to correspond to each factor:

Focus: WISC-III Coding scaled score;

Shift: WCST number of categories achieved percentile and number of perseverative errors standard score;

Sustain: TOVA Omission, Commission, and Response Time standard scores;

Encode: WISC-III Arithmetic and Digit Span scaled scores; and

Stabilize: TOVA Variability of Response Time.

Data Analyses

To address our first hypothesis, a χ^2 was used to examine differences between boys and girls in frequency of ADHD diagnosis. Regarding our second and third hypotheses, a 2x2 between-subjects Multivariate Analysis of Variance (MANOVA) was conducted using gender and diagnosis of ADHD as independent variables and behavioral observation checklist T-scores as dependent variables. To examine our second and fourth hypotheses, we conducted a 2x2 between-subjects MANOVA using gender and diagnosis of ADHD as independent variables and the seven neuropsychological subtest scores of EF as dependent variables.

RESULTS

No significant differences were found for FASD males versus females regarding age, ethnicity, number of living situations, age at first removal from home, or IQ. In addition, there were no significant differences found for FASD children with versus without ADHD regarding age, ethnicity, age at first removal from home, or IQ. However, FASD children with ADHD had significantly more number of living situations (M=3.8, SD=2.0) than did FASD children without ADHD (M=2.6, SD=1.2, $t=-2.2$, $p < .05$). Please refer to Table 1 for behavioral observation and neuropsychological test scores of EF based on gender and ADHD diagnosis.

TABLE 1 Mean (SD) of Behavioral Observation and Neuropsychological Test Scores based on Gender and Diagnosis N=36

| TEST | | (N=18) ADHD | (N=18) no ADHD |
|--------------------------------|--------|--------------------|-----------------------|
| CBCL Parent Attention T-score | Male | 74.2 (9.4) | 79.7 (14.1) |
| | Female | 75.2 (14.0) | 71.4 (13.0) |
| CBCL Teacher Attention T-score | Male | 62.5 (5.4) | 61.3 (7.1) |
| | Female | 64.4 (6.0) | 63.5 (5.9) |
| TOVA Ommission | Male | *80.7 (26.6) | *48.8 (21.6) |
| | Female | **40.4 (0.9) | **70.8 (30.5) |
| TOVA Commission | Male | 102.3 (13.1) | 82.2 (29.8) |
| | Female | 87.4 (22.4) | 78.3 (21.3) |
| TOVA Response Time | Male | 91.2 (21.2) | 74.3 (17.4) |
| | Female | 88.2 (27.8) | 93.7 (16.7) |
| TOVA Variability | Male | 87.1 (25.1) | 67.8 (16.7) |
| | Female | 71.8 (18.1) | 73.8 (25.0) |
| WCST Perseverative | Male | 91.7 (31.3) | 88.0 (19.4) |
| | Female | 85.4 (11.7) | 79.2 (33.2) |
| WCST # Categories (%) | Male | 6.0 (4.5) | 5.3 (5.4) |
| | Female | 4.6 (0.5) | 4.7 (0.4) |
| WISC-III Digit Span | Male | 7.5 (2.8) | 6.8 (3.0) |
| | Female | ***6.4 (2.8) | ***9.3 (3.0) |
| WISC-III Coding | Male | 7.7 (3.9) | 9.3 (5.4) |
| | Female | 7.0 (4.2) | 10.0 (4.2) |
| WISC-III Arithmetic | Male | 6.5 (2.2) | 5.7 (2.9) |
| | Female | 7.4 (2.0) | 8.8 (3.3) |

*significant difference between males with and without ADHD , $p < .01$

**significant difference between females with and without ADHD , $p < .01$

**marginally significant difference between females with and without ADHD, $p < .10$

In order to examine our first hypothesis comparing ADHD diagnoses in FASD boys versus girls, we found that FASD boys were significantly more likely to be diagnosed with ADHD (68.4%) than FASD girls (29.4%; $\chi^2 = 5.5$, $p < .05$). Our second hypothesis was that FASD children with ADHD will have significantly higher scores on behavioral measures and show more impairment on measures of EF than FASD children without ADHD. We found no significant differences between ADHD and non-ADHD children on either CBCL parent and teacher ratings (p 's $> .05$) or EF measures ($p > .10$).

Our third hypothesis was that FASD boys both with and without ADHD would have higher scores on behavioral deficits in attention, compared to FASD girls. We found no significant difference between FASD boys and girls on the CBCL parent and teacher report forms (p 's $> .05$). Our fourth hypothesis was that FASD boys and girls both with and without ADHD would not differ on neuropsychological measures of EF. A marginally significant main effect of gender on EF was observed [$F(9,24) = 2.0$, $p = .08$]; FASD girls ($M=8.3$, $SD=3.0$) scored marginally higher than FASD boys ($M=6.2$, $SD=2.4$) only on WISC-III Arithmetic [$F(1,32) = 4.1$, $p = .05$].

In order to examine these effects in more detail, we looked at interaction effects of gender by ADHD diagnosis on behavioral measures of attention and EF. No significant interaction effects were found for behavioral measure of attention (p 's $> .05$). However, we did find a marginally significant interaction effect on EF [$F(9,24) = 2.0$, $p = .05$]; significant and marginally significant interactions of gender and ADHD diagnosis were observed on the TOVA Omission score [$F(1,32) = 11.2$, $p < .01$] and the WISC-III Digit Span score [$F(1,32) = 2.9$, $p = .10$]. Post-hoc analyses revealed that on the TOVA Omission score, FASD boys with ADHD ($M=80.7$, $SD=26.7$) performed significantly better than FASD boys without ADHD ($M=48.8$, $SD=21.6$). Conversely, on the TOVA Omission score, FASD girls with ADHD performed significantly worse ($M=40.4$, $SD=.9$) than FASD girls without ADHD ($M=70.8$, $SD=30.6$, p 's $< .05$). A similar pattern emerged on the WISC-III Digit Span score; FASD girls with ADHD performed worse ($M=6.4$, $SD=2.8$) than did FASD girls without ADHD ($M=9.3$, $SD=3.1$) though FASD boys' scores did not differ.

DISCUSSION

The current study examined gender differences on measures of attention in 36 children diagnosed with FASD. The purpose of the study was to better characterize attention deficits in FASD children, taking gender and ADHD diagnosis into consideration. Half of the current sample of FASD children had ADHD diagnoses, which is consistent with another large-scale study of this population (personal communication with Susan Astley). However, this is much higher than the rate of ADHD in the general population (3-7%).¹⁴ This supports the notion that attention difficulties are central for children diagnosed with FASD. Rates of ADHD diagnosis in the current FASD sample (2:1) showed the same gender trends seen in the general population; males are diagnosed with ADHD at a significantly higher ratio than females.²⁹ In addition, our sample showed the same gender trends as another large scale study of children with FASD ($n=631$); males were diagnosed with ADHD (68%) significantly more than their female counterparts (46%; personal communication with Susan Astley). A higher prevalence of ADHD diagnosis in males is documented in both general and FASD populations, indicating that attention problems may be a more significant issue for males regardless of population. In addition, we found that children with ADHD had less stable living environments than those without ADHD. This also is consistent with literature indicating that ADHD is a risk factor for negative family environments.⁴¹

In order to more clearly examine the impact of gender and ADHD diagnosis on attention deficits in children with FASD, we looked at both behavioral attentive functioning and EF. Regarding behavioral attentive functioning, parent ratings indicated clinically significant attention problems across children in our sample, while teacher ratings indicated sub-clinical attention problems. We found no differences on behavioral measures of attentive functioning for children with versus without an ADHD diagnosis. In addition, we found no overall effect of ADHD diagnosis on EF. Similarly, no gender differences in attention were noted by parent or teacher behavior observation or in EF. This is consistent with Seidman et al.³² who found that boys and

girls with ADHD did not differ on measures of EF. Children in our FASD sample showed behavioral deficits in attention and EF, regardless of gender or ADHD diagnosis.

Interestingly, differential gender patterns in our sample of FASD children did emerge based on whether or not a child was diagnosed with ADHD. As expected, girls with ADHD performed significantly worse on measures assessing their ability to sustain attention (TOVA Omission) and encode information (WISC-III Digit Span) than did girls without ADHD. Surprisingly, boys diagnosed with ADHD demonstrated significantly better abilities on a measure of sustained attention than their non-ADHD counterparts. However, this pattern was not evident on other measures of EF. While these findings support the use of the five factor model of EF to measure attention deficits in FASD girls, measurement of EF deficits in FASD boys is less clear. Perhaps these EF measures were not sensitive enough to capture ADHD symptoms in boys with already impaired attentive functioning (i.e., FASD). A second possibility is that ADHD diagnoses in boys are based more on behavioral functioning than EF.

In addition, these findings raise questions about the validity of an ADHD diagnosis in FASD populations. Given that boys and girls with FASD show similar behavioral attention deficits as well as similar patterns on EF subtests sensitive to attention, the significantly higher rate of ADHD diagnosis in boys is puzzling. One possibility for this finding is that children with FASD manifest symptoms of ADHD differently than do children in the general population, and that we were unable to capture these differences using the current measures. A second possibility may be that there exists a gender bias in diagnosis of ADHD. A third possibility is that attention deficits within the FASD population are qualitatively different than seen in ADHD children. The discrepancy found in this FASD population may not only bring into question gender bias diagnosing or qualitative differences in children with FASD, but also the clinical utility of the current ADHD diagnostic system with FASD children. It may be necessary to create and implement a new set of diagnostic criteria to be used specifically with FASD children. In doing so, it may also be beneficial to re-norm specific measures of attention on FASD children in order for clinicians to determine a

population base line of attention deficits as well as determine how much deviation warrants an additional diagnosis of ADHD. A change in diagnostic criteria may help clinicians correctly identify both FASD boys and girls with attention deficits, but this raises yet another question: Is a comorbid diagnosis of ADHD clinically meaningful for children with FASD? Researchers^{18,19,21,22} have found that the attention deficits in FASD children are qualitatively unique, compared to the attention deficits found in non-FASD children. Results from this study, specifically in regards to the lack of gender differences seen on behavioral observation scores, support this notion. Additionally, although limited, researchers have found that using traditional treatment methods, such as the use of stimulant medication with FASD children, produces inconsistent therapeutic response.⁴² Attention deficits, as well as other common mental health diagnoses found in the FASD population (e.g., Oppositional Defiant Disorder), may be a manifestation of the brain damage that occurred prenatally; therefore a different approach to treatment is necessary. Applying additional mental health labels to children who already have a complex medical condition may not prove beneficial for long-term outcomes.

Results must be interpreted with caution due to several limitations. First, our sample size was small ($n = 36$), which may yield lower power making it difficult to detect significant differences between males and females with FASD. However, even with an increased sample size, the effect sizes for our non-significant findings on the two behavioral subscales remain quite low (.01-.05). In addition, the 36 participants in our sample may not have been representative of the larger FASD clinic sample. However, they were similar on demographic, intellectual, and attentive functioning, which increases confidence in the generalizability of our findings. Second, some children came to the clinic with a diagnosis of ADHD while others were given that diagnosis at this clinic based on their evaluation. Therefore, diagnostic strategies may not have been consistent. Additionally, data does not discriminate between ADHD subtypes (e.g., primarily inattentive, primarily hyperactive-impulsive, combined type), nor did we have scales specific to inattention, impulsivity, or

hyperactivity. Therefore, we were unable to determine if there were gender differences based on diagnostic subtype of ADHD. Third, due to the nature of our sample, we were unable to provide a control group of children without ADHD or FASD. It may be beneficial to use such comparison groups in future research. Finally, data regarding current use of stimulant medication were unavailable. We were unable to determine whether children with ADHD were more likely to be treated, which may have impacted performance on EF measures. This may not have had much impact, however, as previous research has indicated that stimulant medication is inconsistently effective at improving attention deficits in children with FASD.

Despite these limitations, the current paper provides the first look at attention deficits in children with FASD, considering both gender and ADHD diagnosis. It remains of vital importance to accurately characterize attention deficits in children with FASD in order to best inform treatment. However, an ADHD diagnosis for a child with FASD may not be productive. Instead, developing a treatment plan based on comprehensive neuropsychological testing may be a more accurate way to characterize attentive strengths and weaknesses in children with FASD. Further research in this area is needed.

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Corresponding Author: leherms@earthlink.net

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