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Correspondence of parent report and laboratory measures of inattention and hyperactivity in children with heavy prenatal alcohol exposure

Leila Glass [a], Diana M. Graham [a], Benjamin N. Deweese [a], Kenneth Lyons Jones [b], Edward P. Riley [a], Sarah N. Mattson [a,*]

[a] Center for Behavioral Teratology, Department of Psychology, San Diego State University, 6330 Alvarado Court, Suite 100, San Diego, CA 92120, USA
[b] University of California, San Diego, School of Medicine, Department of Pediatrics, San Diego, CA 92093, USA

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ABSTRACT

Clinical research and practice support a multi-method approach to validating behavioral problems in children. We examined whether parent-reported symptoms of hyperactivity and inattention (using the Disruptive Behavior Disorder Rating Scale) were substantiated by objective laboratory measures [hyperactivity measured by wrist-worn actigraphy (ACT) and inattention assessed using a 20-minute continuous performance task (CPT)] in three age- and demographically-matched groups of school-age children: children with prenatal alcohol exposure (AE), non-exposed children with idiopathic ADHD (ADHD), and controls (CON). Results indicated that the clinical groups (AE, ADHD) had significantly higher parent-reported levels for both domains compared to the CON group, and did not differ from each other. On the laboratory measures, the clinical groups were more inattentive than controls on the CPT, but did not differ from each other. In contrast, the ADHD group had higher objective activity on the ACT than AE and CON, which did not differ from each other. Thus, laboratory measures differentially validated parent reports in a group-dependent manner. Actigraphy substantiated parent-reported hyperactivity for children in the ADHD group but not for children in the AE group, while the CPT validated parent-reported inattention for both clinical groups. Although the majority of children in the AE group met the criteria for ADHD, objective activity levels were not different from controls, indicating that hyperactivity may be a less prominent feature in the AE group. Thus, while there is considerable overlap between the effects of prenatal alcohol exposure and ADHD, differences in behavioral profiles may be clinically useful in differential diagnosis. Further, these data indicate that objective measures should be used to validate parent reports.

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1. Introduction

Fetal alcohol spectrum disorders (FASD) affect approximately 2–5% of younger school children in the United States (May et al., 2009) and affected children are at risk for a constellation of cognitive, behavioral, and motor impairments (see Mattson et al., 2011). These impairments occur across the lifespan (Spohr et al., 2007; Streissguth, 1992) and to varying degrees of severity (Mattson et al., 2011). Children with FASD often meet the diagnostic criteria for a variety of disruptive disorders (Ware et al., 2013), including high rates of attention-deficit/hyperactivity disorder (ADHD; Fryer et al., 2007; Landgren et al., 2010). Conversely, children with ADHD are 2.5 times more likely to be alcohol-exposed than those without ADHD (Mick et al., 2002). Shared characteristics between children with FASD and non-exposed children with ADHD make it difficult to accurately differentiate these two groups (Halperin et al., 1992; Mattson and Riley, 2011). For example, attention deficits are common among children with FASD (Coles et al., 1997; Kooistra et al., 2011; Mattson et al., 2006) and children with idiopathic ADHD (Doig et al., 2008; Herman et al., 2008; LaDue et al., 1992). Another core feature of ADHD, the presence of hyperactivity (Barkley and Murphy, 1998), has only been described using parent report, either anecdotally or qualitatively in children with FASD (Landesman-Dwyer et al., 1981; Shaywitz et al., 1980), and has yet to be examined directly.

The identification of inattention and hyperactivity in children with ADHD or FASD relies primarily upon parent/guardian evaluations (Biederman et al., 2004; McGrath et al., 2004), as they are easy to administer, require minimal interpretation, and provide information from those most experienced and invested in the child. While beneficial, these reports are subjective and may be influenced by motivation for receiving medication or other services. To increase accuracy, multi-method evaluation of hyperactivity and inattention has been employed to incorporate information from both parents and teachers, in addition to objective measures (McGrath et al., 2004; Sims and Lonigan, 2012).

Correlations between parent and teacher ratings of ADHD symptoms are generally lower than expected, ranging between .40 and .59 on several well-respected questionnaires for ADHD populations (Dupaul,

* Corresponding author at: 6330 Alvarado Court, Suite 100, San Diego, CA 92120, USA. Tel.: +1 619 594 7228; fax: +1 619 594 1895.
E-mail addresses: lglass@mail.sdsu.edu (L. Glass), dgraham@mail.sdsu.edu (D.M. Graham), bdeweese@mail.sdsu.edu (B.N. Deweese), klyons@ucsd.edu (K.L. Jones), eriley@mail.sdsu.edu (E.P. Riley), sarah.mattson@sdsu.edu (S.N. Mattson).

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1991; Sprafkin et al., 2002). For the Disruptive Behavior Rating Scale (Barkley and Murphy, 1998), parent and teacher ratings of ADHD symptoms of inattention and hyperactivity were not significantly correlated (Hartman et al., 2007), even though parent and teacher ratings were significantly correlated on other behavioral scales including oppositional defiant disorder symptomology (Antrop et al., 2002). Parents and teachers observe children in different environments, and while we would expect differences in behavioral ratings for a variety of reasons, an objective measure of hyperactivity to support these ratings would facilitate valid identification of behavioral issues.

In addition to parent questionnaires, objective child performance measures have been used to supplement clinical judgment of diagnosis and identification (Sims and Lonigan, 2012). Research studies have used a variety of performance measures to assess behavioral symptomology such as computerized continuous performance tasks (CPT) to assess inattention and portable electronic activity monitors (actigraphy) to assess hyperactivity (Sims and Lonigan, 2012). Continuous performance tasks are a well-validated measure of inattention utilized in a variety of populations including ADHD (e.g., Letz et al., 1996b) and FASD (e.g., Kooistra et al., 2010). Actigraphy is an objective, non-invasive, quantitative method of measuring activity levels and has been used to confirm the presence of hyperactivity as a core deficit of ADHD (Halperin et al., 1992; Porrino et al., 1983). Early use of actigraphy demonstrated that children with ADHD are approximately 25–30% more active during academic classroom activities (Porrino et al., 1983) and laboratory-based attention tasks (Halperin et al., 1992) compared to control children. In the past twenty years, the combination of CPT and physical observation tools (e.g., actigraphy and infrared motion tracking systems) has enabled objective differentiation of children with ADHD from typically developing children (Teicher et al., 1996; Teicher et al., 2004).

While these measures have been successfully utilized to assess locomotor activity in children with ADHD, hyperactivity in FASD has yet to be assessed using objective measures, instead relying exclusively upon caregiver report and qualitative observations. Actigraphy has only been used once in the FASD population to assess sleep disturbances (Wengel et al., 2011), but not during waking hours. To our knowledge, the current study is the first to use actigraphy to objectively assess the presence of hyperactivity in the FASD population.

While there are parental, qualitative, and anecdotal reports that substantiate hyperactivity and inattention as characteristics shared by both ADHD and FASD (Barkley and Murphy, 1998; Landesman-Dwyer et al., 1981; Shaywitz et al., 1980), understanding the precise nature of these impairments may help facilitate the identification of children with FASD and inform the development of targeted interventions for this population. To this end, we examined: (1) whether laboratory measures of hyperactivity and inattention were consistent with primary caregiver reports for three groups of children (children with histories of heavy prenatal alcohol exposure, children with idiopathic ADHD, and controls); and (2) whether deficits noted in subjects with prenatal alcohol exposure were specific to this condition. We hypothesized that parents in both clinical groups would report hyperactivity and inattention and that objective laboratory measures would support these subjective measures.

2. Methods

2.1. General methods

Children and their caregivers were recruited as part of an ongoing multi-site study supported by the Collaborative Initiative on Fetal Alcohol Spectrum Disorders (CIFASD; see, Mattson et al., 2010a). Recruitment for this CIFASD phase (Phase 1) occurred between 2003 and 2007 and recruitment methods for all children included word of mouth, clinician referral, and advertisements. Actigraphy was only used at one CIFASD site, and thus all subjects for this study were from the Center for Behavioral Teratology at San Diego State University.

Subjects were children ($N = 82$) between the ages of 7–18 years ($M = 12.24$, SD $= 3.27$). All children were tested individually by a trained examiner blind to subject group. Informed consent and assent were obtained for all subjects and the Institutional Review Board approved all procedures. As part of the larger project, IQ scores were available from the Leiter International Performance Scale — Revised (Leiter-R, see Roid and Miller, 1997), a nonverbal test of intelligence for individuals between the ages of 2 and 20 years old. From the Leiter-R, a composite score of general cognitive ability (IQ) was derived to assess general intellectual functioning. Neuropsychological test results have been published elsewhere (Mattson et al., 2010b).

2.2. Subjects

Three groups of subjects were included in this study: children with a history of prenatal alcohol exposure (AE, $n = 44$), non-exposed children with idiopathic ADHD (ADHD, $n = 16$) and non-exposed control children without ADHD (CON, $n = 22$). Given the high prevalence of ADHD in children with FASD, several recent studies have incorporated ADHD comparison groups (see, Mattson et al., 2011). To receive a diagnosis of ADHD in this study, children had to have at least two of the following indications of this disorder: (1) positive diagnosis of ADHD on the parent-reported Computerized Diagnostic Interview Schedule for Children—Fourth Edition(C-DISC-4.0; Shaffer et al., 2000); (2) clinical ($T \geq 70$) score on the parent-reported Diagnostic and Statistical Manual (DSM)-Oriented ADHD scale from the Child Behavior Checklist (CBCL; Achenbach and Rescorla, 2001); (3) a positive ADHD screen based on a checklist of the DSM-IV criteria for ADHD (American Psychiatric Association, 2000); or (4) the ongoing use of medication prescribed for the treatment of ADHD. A multi-method approach of diagnosing ADHD is a well-accepted clinical practice both in research and in the DSM-5 (American Psychiatric Association, 2013; Lahey et al., 1994).

Children in the AE group had confirmed histories of heavy prenatal alcohol exposure, defined as maternal consumption of more than 4 alcoholic drinks per occasion at least once per week or at least 14 drinks per week (on average) during gestation. Prenatal alcohol exposure was confirmed retrospectively using medical history, birth records, social services records, or maternal report, when available. However, direct maternal report was not common for children with histories of prenatal alcohol exposure, as many of these children no longer resided with their biological families. Thus, precise details about alcohol consumption (i.e., dose and timing) were often unavailable. In these cases, mothers were reported to be "alcoholic" or alcohol abusing or dependent in pregnancy. A diagnosis of FAS was determined by a member of the CIFASD Dysmorphology Core using a standardized assessment following diagnostic criteria, described elsewhere (Jones et al., 2006; Mattson et al., 2010a). Within the AE group, 9 children (20.5%) met these research criteria for FAS. In addition, 34 children (77.3%) in the AE group met the criteria for ADHD given the two method confirmatory strategy, and 2 additional children had subclinical levels of ADHD based on the C-DISC-4.0 (3–5 symptoms positively endorsed within the hyperactivity/impulsivity or inattention sections). Of the remaining subjects in the AE group, 2 had insufficient information upon which to base an ADHD diagnosis, 2 had inconclusive information, and 4 did not meet the clinical or subclinical criteria for ADHD. All 44 children in the AE group were included in analysis to preserve generalizability and capture the heterogeneity of deficits associated with heavy prenatal alcohol exposure, however, exploratory analyses (described below) were conducted including only the 34 children in the AE group who met the criteria for ADHD.

Children in the comparison groups (ADHD, CON) had no prenatal alcohol exposure or minimal exposure (i.e., no more than one drink per week on average and never more than two drinks per occasion during gestation). Children were also excluded from the ADHD and CON groups if they displayed subclinical symptoms of ADHD, defined as having more than minimal symptoms (≥ 3), yet not meeting the clinical

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