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Gender Differences in Clinical Profiles of Children and Adolescents Referred for an Autism Spectrum Disorder Evaluation

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GENDER DIFFERENCES IN CLINICAL PROFILES OF CHILDREN AND ADOLESCENTS REFERRED FOR AN AUTISM SPECTRUM DISORDER EVALUATION

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MEDICAL CLINICAL PSYCHOLOGY

ABSTRACT

The current study aimed to examine sex differences in clinical profiles of children and adolescents referred for an ASD evaluation, including ASD symptoms and associated clinical features. Specifically, the study aimed to include females who may be mis- or under-diagnosed by current ASD diagnostic procedures in order to characterize this phenotypically diverse population. Participants included 1,099 children and adolescents who were referred for an ASD evaluation at a tertiary care clinic. In this sample, 276 participants (25.11%) were female, 602 participants (54.8%) were diagnosed with ASD, and the average age was 5.97 years old (SD = 3.60). Independent samples t-tests, two-way factorial ANOVAs, and chi-square tests of independence were used to evaluate group differences in ASD symptom presentation as measured by the ADOS and ADI-R, as well as group differences in cognitive, adaptive, language, and fine motor skills. Results indicated that females exhibited a greater gap between age of first concern and age at evaluation, and males were more likely to be diagnosed with ASD at the time of evaluation. Females exhibited lower RRB and Social Affect severity scores on the ADOS as well as lower likelihood of reaching or exceeding the diagnostic cut-off for the RRB domain on the ADI-R compared to males. No sex differences were identified for associated clinical features. These findings suggest that there are quantifiable sex differences in ASD clinical presentation among individuals referred for an ASD evaluation, even when the

sample is expanded to include those who may otherwise be missed by potentially male-biased diagnostic instruments. Future research should continue to examine sex differences in clinical presentation to elucidate characteristics of the female autism phenotype and promote early and accurate referral and evaluation.

Keywords: autism spectrum disorder, ASD, sex

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INTRODUCTION

Autism Spectrum Disorder (ASD) is diagnosed at a substantially lower rate in females compared to males, with an estimated female to male ratio of 1:3 (Loomes et al., 2017). Although this sex discrepancy has decreased over the years (Fombonne, 2009), it remains one of the greatest sex gaps among neurodevelopmental disorders.[1] ASD diagnosis is based on two primary clusters of criteria—social communication deficits and the presence of restricted interests and repetitive behaviors (RRBs)—that were developed based on research using predominantly male populations (Kirkovski et al., 2013; Kopp & Gillberg, 2011; Mattila et al., 2011; Hull et al., 2017). As a result, females are often excluded from the research that is used to define the ASD phenotype, leading to a predominantly male description of ASD (Ratto et al., 2018). Despite this male-centered research basis for diagnosis, researchers have started to investigate the remarkable sex discrepancy in ASD diagnosis rates. Theories supported by research over the years include the female protective effect, male vulnerability, expression and perception hypotheses, and camouflage theory, which suggests sex differences in female presentation of ASD.

[1] Although the established thesis title uses the term "gender", recent developments in the literature since thesis proposal have reinforced the distinction between "sex" and "gender" (Strang, 2020). For the purposes of the current study, "sex" is the construct of interest, as it refers to sex assigned at birth.

Theories on Sex Differences

Many researchers have claimed that there are genuine sex differences in the likelihood of developing ASD which leads to differences in the prevalence and presentation of ASD. One prevailing theory concerning sex-discrepant diagnosis rates is the female protective effect (FPE) theory, or the notion that there is a characteristic inherent in females that reduces the likelihood of developing ASD symptoms (Hull et al., 2020). There are several theoretical and empirical underpinnings of this theory. The variability model suggests that males exhibit greater genetic variability, allowing for a greater incidence of ASD, albeit with less severity (Kreiser & White, 2014; Ferri et al., 2018). The liability-threshold model draws on genetic studies to claim that females require higher mutational load to reach the ASD diagnostic threshold (Chakraborti et al., 2020; Tsai et al., 1981; Ferri et al., 2018). Neurobiological findings have aligned with this threshold theory, as pronounced connectivity alterations in sensorimotor and limbic networks within females suggest a greater etiological load for ASD diagnosis, especially considering the negative link between connectivity and ASD symptoms among girls but not boys (Alaerts et al., 2016; Olson et al., 2020). A recent review of sex differences in gut microbiomes among individuals with ASD suggests that differences in autistic phenotype rates could be attributed to excitotoxicity, the diversity and frequency of probiotics in females, and the protective effect of estrogen, among other potential causes (El-Ansary et al., 2020).

The inverse to female protection has also been argued: that males are more susceptible to ASD than females. There is research to support this claim, as fetal testosterone has been linked to many aspects of development and could therefore relate to male vulnerability (Ferri et al., 2018). Other sources of male vulnerability and female protection

include sex hormone involvement, sex chromosomes, and unique neurobiological pathways (Ferri et al., 2018; Westeinde et al., 2020). Indeed, research has suggested that there are neurobiological sex differences unique to individuals with ASD, including differences in cortical thickness (Bedford et al., 2020), larger amygdala in males (Baron-Cohen, Knickmeyer, & Belmonte, 2005), and other brain characteristics (Lai et al., 2017).

Despite these genetic, hormonal, and neurobiological underpinnings of the FPE, recent research has suggested that the current sex ratio is underestimating the true number of females with ASD, as females with ASD are often not identified in the diagnostic process (Loomes et al., 2017). Two hypotheses could explain this claim: the expression hypothesis and the perception hypothesis. The expression hypothesis claims that females express less severe ASD traits, whereas the perception hypothesis claims that females' expressions of ASD traits are perceived to be less severe than males' expressions (Chen et al., 2020). Either hypothesis would result in lower rates of diagnosis and both hypotheses have been supported by research. Baron-Cohen et al.'s (2005) theory of the "extreme male brain" supports the expression hypothesis, claiming that the male ASD brain is characterized by a systemizing cognitive/affective style, compared to the female empathizing cognitive/affective style. Supporting the perception hypothesis, research has shown that girls with ASD are rated more positively by conversation partners when compared to boys, despite comparable ASD symptom severity as rated by expert clinicians (Cola et al., 2020). This finding supports the notion that female trait expression is perceived to be less severe than male trait expression. Differential expectations of the sexes may also play a role, as social communication deficits in girls may be viewed as "shyness" during childhood (Micai et al., 2019). Interestingly, sex plays a role in predicted

future perception as well, as when rated at the age of five, boys with ASD are rated as more likely to be perceived as atypical at the age of 15 than girls with ASD (Geelhand et al., 2019). One recent meta-analysis on 103,958 historical assessment scores found evidence for both the expression and perception hypotheses (Chen et al., 2020).

Camouflage theory borrows aspects of both the expression and perception hypotheses and suggests that individuals with ASD mask their symptoms through social reciprocity (behavioral camouflaging), theory of mind (compensatory camouflaging), and other social behaviors that ultimately camouflage ASD traits (Wood-Downie et al., 2020). As it pertains to sex differences in ASD diagnosis rates, the theory is that females with ASD participate in camouflaging behavior more frequently and successfully than males with ASD (Hull et al., 2020). Research has supported this claim, as camouflaging is more common in females with ASD compared to males with ASD (Cook et al., 2021; Schuck et al., 2019), whether operationalized by the discrepancy between external behavior and internal status (Lai et al., 2016) or the Camouflaging Autistic Traits Questionnaire (CATQ; Hull et al., 2019). Similar to findings regarding compensatory patterns of behavior in females with ADHD (Young et al., 2020), research has found significant sex differences in camouflaging among individuals with ASD, whereas there is no significant sex difference in camouflaging among neurotypical individuals (Hull et al., 2019).

Specifically, females with ASD have been shown to endorse and participate in behaviors such as social imitation, maintaining proximity to peers, and weaving in and out of activities (Dean, et al., 2017). In terms of social reciprocity, females with ASD exhibit higher social reciprocity than males with ASD, even with both groups exhibiting similar levels of ASD traits; this sex trend holds for compensatory camouflaging, such as theory

of mind (Wood-Downie et al., 2020). As for social relationships, "protective same-age friendships" may help play an inclusive social role supporting camouflage; these types of friendships are more common in females compared to males (Micai et al., 2019) and girls with ASD are predicted to have stronger best-friendships than boys with ASD (Sedgewick et al., 2018). Females tend to camouflage their symptoms in a variety of social environments, including in front of teachers and parents (Tubío-Fungueiriño et al., 2021). Sex differences in camouflaging may have a neural basis, as neural self-representation has been shown to be uniquely associated with camouflaging behavior in females with ASD (Lai et al., 2018).

The notion that females could be camouflaging their symptoms suggests that they may present with a different symptom profile, which could contribute to better understanding of the reported discrepancy between sexes in ASD diagnosis rate (Bitsika & Sharpley, 2019). However, identifying the difference between symptom presentation and inner experience among females with ASD can be particularly complex (Egerton & Carpenter, 2016; Suckle, 2020). Not only does camouflage produce burden that increases stress, anxiety, and desire for social withdrawal (Allely, 2019b), it may also be a core cause of female underdiagnosis.

The camouflage theory as it pertains to ASD suggests that females express ASD symptoms differently than males, and therefore that the underestimation of ASD among females may be a result of this phenotypic difference, as gold-standard diagnostic measures for ASD are developed using predominantly male samples that best capture classically male ASD traits (Ratto et al., 2018; Young et al., 2018). Indeed, boys are more likely than girls to meet diagnostic criteria for ASD despite exhibiting similar levels of

ASD traits (Dworzynski et al., 2012). These findings suggest that there must be something unique about females that results in underdiagnosis.

Sex Differences in ASD Symptom Domains

The findings on sex differences in ASD symptom presentation are varied. Many studies have suggested that there are little to no differences in ASD symptomatology between sexes (Fulton et al., 2017; Mandic-Maravic et al., 2015; Mussey et al., 2017; Reinhardt et al., 2015). This is especially true when sex groups are matched on cognitive functioning, in which case researchers find no difference in symptom severity or symptom domains between IQ-matched sex groups (Matheis et al., 2019). Further research has corroborated this finding that there are no significant differences in ASD symptom severity between females and males, regardless of IQ-matching (Bitsika & Sharpley, 2019; Tillmann et al., 2018). However, other research findings have identified sex differences in key aspects of ASD (Schuck et al., 2019), suggesting that boys are more likely to be diagnosed with ASD than girls when symptom severity is held constant (Russell, Steer, & Golding, 2011).

Sex differences in specific domains of ASD symptoms have been identified, including the core symptom cluster of RRBs. A recent PRISMA review identified five studies showing no significant difference in RRBs between sexes, 12 studies showing significantly more RRBs in males compared to females, and one study showing some features of RRBs significantly higher in females compared to males (Allely, 2019a). Indeed, there are mixed findings on sex differences in RRBs, but the preponderance of the

literature suggests that males exhibit significantly more RRBs than females, holding across cultures (Frazier et al., 2014; Kaat et al., 2021; Supekar & Menon, 2015; Tillmann et al., 2018; Uljarević et al., 2020; van Wijngaarden-Cremers et al., 2014; Wang et al., 2017). Specifically, research has suggested that females exhibit fewer restricted interests (Antezana et al., 2018; McFayden et al., 2020) and stereotyped behaviors (Antezana et al., 2018) than males. Even when matched on IQ, females exhibit fewer "unusually repetitive/excessive stereotyped behaviors" compared to males as measured by the Autism Diagnostic Observation Schedule (ADOS-2*;* Knutsen et al., 2018). However, a closer look at specific characteristics of RRBs reveals complexity, as although males may commonly exhibit more restricted interests and repetitive behaviors, females have also been found to exhibit more compulsive behaviors and insistence on sameness (Antezana et al., 2018; McFayden et al., 2020). Despite these mixed findings, a recent meta-analysis concluded that female presentations of RRBs are "quantitatively and qualitatively unique," as restricted interests fall along sex lines and repetitive behaviors can take different forms by sex (McFayden et al., 2020; Sutherland et al., 2017).

The research on the symptom cluster of social communication has been similarly complex. One meta-analysis found no significant sex differences in social communication function despite the presence of heterogeneity in symptom presentation (Mahendiran et al., 2019a). A recent multisite study found mixed results, ranging from no sex differences to greater severity for either sex depending on the type of social communication measure and participant age (Kaat et al., 2021). One meta-analysis on individuals with high autistic traits suggested fewer social autistic behaviors in females compared to males (Cook et al., 2021). Similarly, another study found less severe communication

impairment in female toddlers with ASD compared to male toddlers with ASD, as measured by the Battelle Developmental Inventory-2 (BDI-2; Matheis et al., 2019). This finding was in contrast with higher endorsements of language impairments for females on the Baby and Infant Screen for Children with Autism Traits-Part 1 (BISCUIT-Part 1) in the same study. This discrepancy may suggest that expectations of females are higher when it comes to social communication, as the BISCUIT-Part 1 asks for comparison to same-aged peers, whereas the BDI-2 is an observational measure of the individual.

Indeed, other research has suggested that social communication is more greatly affected for females diagnosed with ASD compared to males diagnosed with ASD (Frazier et al., 2014; Mahendiran, 2019b). Specifically, parents report that high-functioning females with ASD exhibit worse communication skills, experience more social problems, struggle more with making friends, and have more social anxiety than males (Micai et al., 2019). When differences in verbal skills are accounted for, females with ASD still exhibit poorer social skills than males with ASD (Howe et al., 2015). In line with camouflage theory, females with ASD exhibit higher social reciprocity and better social affect than males with ASD (Craig et al., 2020; van Ommeren et al., 2016; Wang et al., 2017; Wood-Downie et al., 2020).

Sex Differences in Associated Features of ASD

There are a number of associated features of ASD, or other areas of functioning and behavior involved in identifying and diagnosing ASD, that reflect sex differences in presentation, including language, cognitive, and adaptive functioning. Language delays

are the most commonly reported first concern among parents of children with ASD (Chawarska et al., 2007). Females with ASD have been found to exhibit stronger verbal fluency, use of gestures, and detailed emotional autobiographical memories, particularly among high-functioning individuals with ASD, in comparison to males with ASD (Micai et al., 2019). Females with ASD also tend to perform better than males with ASD in terms of pragmatic skills, with a higher occurrence of typical pragmatic language markers in female speech (Parish-Morris et al., 2017; Sturrock et al., 2020). In addition, females exhibit better complex phrase speech (Salomone et al., 2015), greater internalized state language (Kauschke et al., 2016), and superior use of non-verbal gestures compared to their male counterparts (Rynkiewicz et al., 2016). However, a recent review has indicated more mixed findings regarding sex differences in language skills (Estrin et al., 2021).

Research has also suggested that diagnosed females typically present with lower cognitive and adaptive functioning compared to diagnosed males (Frazier et al., 2014; Howe et al., 2015). In terms of adaptive behavior, females with ASD obtain lower scores in communication, leisure, and social skills compared to males with ASD, with females struggling more with daily living skills (Mahendiran, 2019b; White et al., 2017). This finding on daily living skills has been corroborated in other research, with one study also finding that parents of females with ASD reported more challenges in socialization than parents of males with ASD (Ratto et al., 2018). Regarding cognitive functioning, risk of underdiagnosis is especially high for females without intellectual disability (i.e., with an IQ above 70; Micai et al., 2019). It has been argued that higher cognitive functioning may be linked to an improved ability to camouflage ASD traits (Wood-Downie et al., 2020). Indeed, diagnosed females with higher IQ are less likely to meet diagnostic criteria on the

Autism Diagnostic Interview-Revised (ADI-R), a semi-structured interview measure of ASD symptoms, suggesting that IQ might have a positive impact on scores on diagnostic measures for girls (Ratto et al., 2018).

Motor skills and sensory processing may also play a role in early caregiver concern, referral, and clinical presentation at the point of ASD evaluation. In terms of motor skills, research suggests that male children with ASD typically perform better than females with ASD on both fine and gross motor skills tasks (Carter et al., 2007; Matheis et al., 2019). These differences appear to occur in adults as well as children (Moseley et al., 2018), although one study found that age may play a role, as researchers found no sex differences in motor skills before the age of four, but also found that females performed significantly worse than boys above the age of four (Wang et al., 2016). Interestingly, one study found fine motor skills to be predictive of social affect differences (typically better in females) among male preschoolers with ASD, but not females (Craig et al., 2020). This finding may establish motor skills as a possible core feature for sex differences in ASD. Research on sensory sensitivities and processing is rather sparse and inconclusive. However, one study found that females with ASD experience more difficulty with sensory processing related to endurance/tone (specifically movement flexibility) compared to boys with ASD (Bitsika et al., 2018); notably, this was only one of the 18 areas assessed by this measure.

Taken together, these findings on ASD traits and behavioral indicators support the presence of a possible female-typical ASD phenotype (FAP; Hull et al., 2020). Moreover, this FAP appears to be characterized by factors (e.g., higher IQ and adaptive skill) that support the masking of social impairments, potentially improving performance on

diagnostic measures and resulting in mis- or under-diagnosis (Ratto et al., 2018). Considering how gold-standard diagnostic measures were developed using predominantly male samples, and thus defining and characterizing the male ASD phenotype, current diagnostic procedures may be inadequate for capturing the FAP and may therefore underestimate female prevalence rates (Loomes et al., 2017). If males and females do present differently, then this predominantly male research population may create bias in the conception of ASD. This conception of ASD informs the diagnostic criteria and assessments that determine the research samples used to further explore ASD, resulting in circularity. Sex differences must be elucidated to inform understanding of ASD and take this understanding into account for diagnostic considerations.

However, most studies use the existing ASD gold-standard measures as inclusion criteria for their research on sex differences in ASD symptoms; this excludes the population that is not identified in the diagnostic process**.** It is crucial that research on ASD sex differences include all those referred for ASD evaluation, as they compose a group likely to be missed by existing sex-based issues in diagnosis (Ratto et al., 2018). In addition, much of the extant literature is conducted with research-recruited samples comprised of individuals already diagnosed with ASD (Kaat et al., 2021). Drawing from a community sample of children and adolescents referred for clinical ASD evaluation, the present study aimed to address this gap in ASD phenotype research, examining sex differences in comprehensive diagnostic profiles.

Current Study

Sex differences in symptom expression at the point of diagnostic assessment may lead to underdiagnosis of ASD among females, which may be a core factor leading to sex disparities in ASD diagnosis. The present study aimed to examine sex differences in clinical presentation of children and adolescents referred for an ASD evaluation at a community clinic. Specifically, this study aimed to investigate sex differences in ASD traits, language, cognitive and adaptive functioning, motor skills, and sensory processing among children referred for ASD evaluation, both regardless of and accounting for ASD diagnosis. By exploring data gathered at ASD diagnostic visits, a clearer picture of those referred for ASD diagnosis could be obtained, illuminating gaps in diagnosis related to sex differences in clinical presentation. A community sample from an existing clinic not only provides access to a population excluded in research samples, but it also ensures ecological validity in a clinical setting.

Aims and Hypotheses

AIM 1**:** Differences in ASD symptoms have been identified between males and females with an ASD diagnosis. However, few studies have included those who do not receive an ASD diagnosis in their samples. Therefore, the aim was to explore sex differences in ASD traits among all children and adolescents referred for an ASD evaluation, a group that has been understudied.

Hypothesis 1a**:** Based on prior literature indicating that females are diagnosed later than males (Micai et al., 2019), it was predicted that the gap

between age of first concern and age of evaluation would be greater for females compared to males.

Hypothesis 1b: Provided existing literature indicating that females are diagnosed at a lower rate than males, it was predicted that rate of ASD diagnosis among those referred for ASD evaluation would be lower among females compared to males.

Hypothesis 1c: Given existing literature suggesting that males with ASD exhibit more RRBs than females with ASD, it was predicted that females would exhibit fewer RRBs than males.

Hypothesis 1d: Based on previous literature indicating that females with ASD exhibit more social communication deficits than males with ASD, it was predicted that females would perform worse on measures of social communication compared to males.

AIM 2: Differences in other clinical characteristics have been identified between males and females with ASD. To paint a clearer picture of the FAP, the aim was to explore sex differences in a comprehensive set of clinical data among children and adolescents referred for an ASD evaluation.

Hypothesis 2a: Provided existing literature indicating that females with ASD have stronger language skills than males, it was predicted that female performance on language measures would be better than male performance.

Hypothesis 2b: Based on previous literature suggesting that both adaptive and cognitive functioning are typically lower among females with ASD compared to males, it was predicted that females would exhibit lower levels of functioning in both areas than males at the point of diagnosis.

Hypothesis 2c: Given existing literature suggesting that motor skills are worse among females with ASD compared to males, it was predicted that females would perform worse on measures of fine motor skills compared to males.

Hypothesis 2d: Considering the paucity of research on sex differences in sensory processing, it was predicted that there may be no sex differences in a measure of sensory processing.

AIM 3: Few studies have examined the interaction between sex and diagnosis in a sample of individuals referred for an ASD evaluation. The aim was to examine patterns of phenotypic difference across these two dimensions among children and adolescents referred for ASD evaluation.

Hypothesis 3a: Given existing literature suggesting that boys are more likely to be diagnosed with ASD than girls even when severity of symptoms is held constant, it was predicted that females with ASD would have higher ASD symptom severity than males with ASD. Specifically, it was hypothesized that females referred for evaluation who receive a diagnosis of ASD would have a higher symptom severity than boys who were referred and received a diagnosis.

Hypothesis 3b: Provided prior literature on sex differences in RRBs, it was predicted that there would be a main effect of diagnosis and sex on RRB scores, such that individuals with ASD would exhibit higher RRB scores than individuals not diagnosed, and females with ASD would exhibit fewer RRB scores than males with ASD.

Hypothesis 3c: Considering the role of social communication in camouflage, as well as prior research on camouflage comparisons between ASD and neurotypical groups (Hull et al., 2020), it was predicted that there would be an interaction between sex and diagnosis for social communication, such that females with ASD would present with worse social communication skills than males with ASD, whereas there would be no difference among those not diagnosed with ASD.

Hypothesis 3d: Based on the role of language in camouflage, as well as differences identified in prior research on individuals with ASD, it was predicted that there would be a main effect of sex on language skills, such that there would be greater language difficulties in males with and without ASD compared to females with and without ASD.

Hypothesis 3e: Given existing literature on sex differences in level of functioning, as well as the role of adaptive and cognitive functioning in camouflage, it was predicted that there would be an interaction of sex and level of functioning, such that females with ASD would present with lower levels of functioning than males with ASD, whereas females not

diagnosed with ASD would present with higher levels of functioning than males not diagnosed with ASD.

METHOD

Participants

Participants included all individuals with data in the Alabama Center for Developmental Disabilities Education, Research, and Service: Database (UAB IRB X080117004). This database is comprised of children and adolescents who were referred and clinically evaluated for an ASD diagnosis at UAB Civitan-Sparks Clinics between 2006-2020. The age range of the database participants is from one year to late adolescence. Participants over the age of 18 were excluded. Data collected include a range of diagnoses, sex, ASD severity, and sensory sensitivities, as well as cognitive, adaptive, language, and motor skills. Everyone referred for an ASD evaluation (defined as having been administered an ADOS) was included in the sample, regardless of outcome diagnosis.

Measures

A summary of measures, items, variables, and their involvement in data analysis can be found in Tables 1 and 2. Table 1 pertains to ASD symptoms and level of functioning. Table 2 pertains to language, motor skills, and sensory processing.

Demographic Variables

Demographic information including age, sex, and race were collected during the retrospective chart review process based on caregiver report. Race was subjectively collected through clinician report.

ASD Diagnosis and Symptoms

Diagnosis was determined by clinical judgement from licensed clinicians using the DSM-IV/DSM-5 criteria in use at the time of evaluation and based on the information gathered during the evaluation process. For the current study, an ASD diagnosis included ASD, Autism, Asperger's, and PDD-NOS; other diagnoses fell under the non-ASD category, including ADHD, Developmental Delay, and Language Disorder. Rule-Out ASD was also included in the non-ASD category, as although these participants represent individuals for whom a diagnosis has not yet been determined, they represent an important portion of this sample for whom there remains a question regarding ASD diagnosis, but for whom a diagnosis has not yet been provided with clinical certainty.

Autism Diagnostic Observation Schedule, Generic or Second Edition (ADOS-G/ADOS-2). The ADOS-G/ADOS-2 is a standardized semi-structured play-based measure utilized in diagnosing ASD (Lord et al., 2012). The ADOS-2 is considered one of the gold-standard measures for the assessment and diagnosis of ASD (Kanne et al., 2008).

The ADOS-2 is a revision of the ADOS-G, which was the first commercially-available version of the ADOS. Five modules have been developed for individuals across age levels and communicative ability. ADOS-2 scores are based on observations of skills and behaviors of the individual in a variety of play-based circumstances, and scores based on these observations are compiled to yield scores for Social Affect, RRBs, Overall score, and overall Comparison Scores of autism-related symptoms relative to others at the same age and language level (scores from 1 to 10, with higher scores indicating greater severity) that can be used as a measure of symptom severity. The ADOS-G scores can also be used to calculate severity scores on the same scale across modules (Gotham et al., 2009) in this manner. Interrater reliability is excellent for the Social Affect domain (.92-.98), substantial to excellent for the RRB domain (.79-.91), and excellent for Overall score (.94-.97). Test-retest reliability combined across modules is good for Social Affect (ICC = .89), moderate for RRB (ICC = .74), and excellent for Overall score (ICC = .90). Internal consistency for Modules 1-3 is good to excellent for Social Affect (.87-.92) but poor for RRB (.51-.66). However, this poor internal consistency is expected for the RRB domain considering the heterogeneity of the construct (Lord et al., 2012). Specifically, RRB symptoms are less explicitly elicited during ADOS-2 tasks compared to Social Affect symptoms and are therefore more incidental in their occurrence. Furthermore, DSM-5 criteria only require two of four symptoms from the RRB cluster for diagnosis, whereas all social communication deficits must be present for diagnosis; it may be common for autistic individuals to score highly on one item of the RRB domain and low on another. For the current study, Comparison Scores were used as a measure of overall ASD symptom severity observed during the ADOS. In addition, domain-level calibrated severity

scores were calculated based on raw scores for Social Affect and RRBs to measure ASD symptom domain severity, accounting for child characteristics such as age and communicative ability (Hus et al., 2014).

Autism Diagnostic Interview-Revised (ADI-R). The ADI-R is a semi-structured, standardized interview administered by clinicians to caregivers of individuals with ASD (Lord et al.,1994). This tool is considered a gold-standard measure for the assessment and diagnosis of ASD, particularly when used in conjunction with ADOS-2 assessment. ADI-R scores use a rating system of 0-3 for behavior and symptoms factoring into total scores where 0 = no definite behavior of the type specified, 1 = behavior of the type specified probably present but defining criteria not fully met, and 2 = definite abnormal behavior of the type described in the definition and coding, with a code of 3 occasionally used to indicate extremely severe behavior. Content areas for the scores include social interactions, RRBs, and communication and language skills. Raw scores in each content area are then compared to the cut-off algorithm to determine whether or not the individual's scores exceed the cut-off for classification of autism. For the current study, the rate of reaching cut-off scores for each of these content area subscales was analyzed. Additionally, age of first concern was measured via parent-report as part of the ADI-R interview. Interrater reliability is reported for each item that contributes to the algorithm, with intraclass correlations exceeding .75 for rater pairs (Lord et al., 1994). Cronbach's alpha was calculated to assess internal consistency within each domain; internal consistency is excellent in the Social Interaction content area (alpha of .95), poor in the RRB content

area (alpha of .69), and great in the Communication content area (alpha of .84). Test-re-test reliability is excellent (mean of 91% across all items).

Level of Functioning

Level of functioning, alternatively conceptualized as developmental level, was based on the individual's cognitive and adaptive functioning. This information was gathered in clinic according to clinical judgement of assessments needed, with a typical evaluation incorporating at least a cognitive or adaptive assessment, if not both. For the current study, assessments administered in the clinic were prioritized for analyses. However, in instances where the only assessment was administered in school or another clinic and was determined to be valid by the clinician for case conceptualization, the outside assessment score was used, as long as it occurred within three years of the date of evaluation.

Cognitive Functioning. A variety of measures of cognitive functioning were used in clinic depending on the clinician's judgement: Bayley Scales of Infant and Toddler Development-III, Differential Ability Scales-II, Stanford-Binet Intelligence Scales-5, Wechsler Intelligence Scale for Children (IV/V), and Wechsler Abbreviated Scale of Intelligence-II. For the current study, a single cognitive assessment standard score (M = 100, SD = 15) per child was selected as a measure of the referred child's cognitive skills.

Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III). The Bayley-III is a performance-based tool designed to identify developmental concerns in early childhood (Bayley, 2005). It is designed to assess children from 1 to 42 months

of age. This tool includes measures of cognitive, language, motor, adaptive, and social-emotional skills. For the current study, the Cognitive Scale standard score was used as a measure of the referred child's cognitive functioning. Average internal consistency of the Cognitive Scale across age ranges has been shown to be excellent (.91) and test-retest reliability for the Cognitive Scale has been shown to be good (.81; Bayley, 2006).

Differential Ability Scales, Second Edition (DAS-II). The DAS-II is a measure designed to assess the cognitive skills of children and adolescents aged 2:6-17:11 (Elliott, 2007a). In addition to Verbal and Nonverbal cluster standard scores, the DAS-II produces a General Conceptual Ability (GCA) score that was used in the current study as a measure of the referred child's cognitive functioning. Internal consistency of the GCA (.90-.94) has been shown to be excellent, and test-retest reliability (.79-.94) has been shown to be generally good. In addition, correlations with the Wechsler Intelligence Scale for Children Full-Scale IQ and the Stanford-Binet 4th edition have been shown to be strong (Elliott, 2007b).

Stanford-Binet Intelligence Scales, Fifth Edition (SB-5). The SB-5 is a measure used to assess the cognitive skills of individuals aged 2-85 years (Madaus et al., 2008). It can be used to assess individuals with varying abilities, including individuals with developmental or intellectual disabilities as well as those who are typically developing. For the current study, the Full Scale Intelligence Quotient (FSIQ) standard score was used as a measure of the referred child's cognitive functioning. Internal consistency for the FSIQ is excellent (Cronbach's alpha = .97-.98), test-retest reliability for the FSIQ is strong (.93-.95 across age groups), and interrater agreement is generally good (.74-.97; Madaus et al., 2008).

Wechsler Intelligence Scale for Children- Fourth or Fifth Edition (WISC-IV/V). The WISC-IV/V is a performance-based assessment designed to assess specific and general cognitive skills among children and adolescents ages 6:0-16:11 (Wechsler, 2014a). For the current study, standard scores of Full Scale Intelligence Quotient (FSIQ) were used to quantify overall cognitive functioning. The split-half reliability of the FSIQ (.96), its test-retest reliability (.92), and interscorer agreement for a subset of subtests (.98-.99) are all excellent (Wechsler, 2014b).

Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II). The WASI-II is a performance-based assessment designed to measure specific and general cognitive skills and can be administered to children, adolescents, and adults ages 6-89. This is a briefer format compared to other Wechsler intelligence assessments. For the current study, standard scores of FSIQ based on the 4-subtest battery were used to quantify overall cognitive functioning. The WASI-II has good to excellent internal consistency (.87-.91), acceptable to excellent test-retest reliability (.79-.90), and excellent interrater reliability (.94-.99; McCrimmon & Smith, 2013).

Adaptive Functioning. Adaptive functioning is used to describe independent functioning in everyday life, including communication skills, self-help skills, and socialization, among other domains (Perry et al., 2009). Two different measures of adaptive functioning were used in this clinic depending on the clinician's judgement: Vineland Adaptive Behavior Scales-Second/Third Edition or the Adaptive Behavior Assessment Scale-Second/Third Edition. One adaptive standard score (M = 100, SD = 15) per child

was used as a measure of the referred child's level functioning, with higher scores indicating greater adaptive functioning.

Vineland Adaptive Behavior Scales, Second/Third Edition (II/Vineland-3). The Vineland Adaptive Behavior Scales is a semi-structed interview or caregiver questionnaire designed to assess personal skills needed in everyday life, including communication, socialization, daily living skills, and motor skills (Sparrow et al., 2016a). For the current study, standard scores of the Adaptive Behavior Composite (ABC) from the Vineland were used to quantify level of functioning. Test-retest reliability for the Vineland-3 has been shown to be acceptable to good, with corrected *r* values from .62 to .94 across adaptive domains and ABCs. Internal consistency has been shown to be excellent (.86-.99). Interrater reliability has been shown to be moderate to perfect (.46-.93) (Sparrow et al., 2016b).

Adaptive Behavior Assessment Scale, II or Third Edition (ABAS-II/3). The Adaptive Behavior Assessment Scale is a caregiver questionnaire designed to assess adaptive skills across the lifespan, with an emphasis on individuals with neurodevelopmental disorders such as ASD (Harrison & Oakland, 2015a). Specific areas assessed using the ABAS include communication, functional academics, leisure, and health and safety, among others. For the current study, the standard score of General Adaptive Composite (GAC) was used to quantify level of functioning. Test-retest reliability for the Parent Form is 0.96 for GAC, and a correlation of 0.82 was calculated between the Vineland and ABAS (Harrison & Oakland, 2015b).

Language Skills

Only one of the following language skill measures was administered to each participant by a speech/language pathologist. Therefore, for the current study one language assessment standard score (M = 100, SD = 15) per child was used as a measure of the referred child's language skills, depending on the language measure they were administered. Higher scores indicate stronger language skills. Separate scores for receptive and expressive language were also explored.

Preschool Language Scales 3rd, 4th, or 5th Edition (PLS-3/4/5). The Preschool Language Scales is a play-based assessment designed to measure language skills across a range of pre-verbal and early literacy levels (Zimmerman et al., 2011a). Commonly used with individuals with ASD, this scale can be administered to children from birth through 7:11 years. Norm-referenced standard scores from the PLS-4/5 were used to measure language skills. Specifically, the Total Language Score was used to quantify general language skills, and Auditory Comprehension and Expressive Communication scale scores were considered to examine receptive and expressive language skills, respectively. Test-retest reliability (.69) has been shown to be good, and both interrater reliability (.50) and internal consistency (.50) have been shown to be fair for the PLS (Zimmerman et al., 2011b).

Clinical Evaluation of Language Fundamentals, 3rd Edition, 4th Edition, Preschool 2nd Edition (3/4, P-2). The CELF-3/4/P-2 is a performance- and observation-

based assessment tool designed to screen for and diagnose language disorders or delay among children. The Preschool 2nd edition can be administered to children ages 3-6, and the 3rd and 4th Editions can be administered to children and adolescents ages 5:0 to 21:11 (Semel et al., 2003; Semel et al., 2004a). This measure produces scores for five specific language indices, including Receptive Language and Expressive Language. For the current study, the Core Language Index was used to quantify overall language skills, and the Receptive Language and Expressive Language indices were also used to provide further detail in language skill profiles. Test-retest reliability (.83-.90) has been shown to be good to excellent, and both internal consistency (.95.-.96) and interrater reliability (ICC = .91-.99) have been shown to be excellent (Semel et al., 2004b).

Oral and Written Language Scales, Second Edition (OWLS-II). The OWLS-II is a performance-based assessment tool designed to measure language skills using a global approach (Carrow-Woolfolk, 2011a). It can be administered to individuals ages 3:0-21:11 years. This measure produces scores on four scales: Listening Comprehension, Oral Expression, Reading Comprehension, and Written Expression. For the current study, Listening Comprehension was used to quantity receptive language skills, Oral Expression was used to quantify expressive language skills, and the Oral Composite score was used to quantify overall language skills. The quality of the measure has been supported by the psychometric properties of the composite scores, as test-retest reliability (.85-.90) has been shown to be good to excellent, and both internal consistency (.92-.98) and interrater reliability ($\geq$ .93) have been shown to be excellent (Carrow-Woolfolk, 2011b).

Motor Skills

Only one of the following motor skill measures was administered to each participant by an occupational therapist. However, each measure produces scores on a different standard scale, thereby preventing direct score substitution. Therefore, for the current study one motor skill assessment z-score (M = 0, SD = 1) was calculated from each measure's standard score for each child as a measure of the referred individual's fine motor skills, thus enabling direct comparison. Higher scores indicate better developed motor skills for each measure.

Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2). The BOT-2 is an activity-based assessment designed to measure a wide array of motor skills among individuals ages 4:0-21:11 years (Bruininks & Bruininks, 2010). In the clinic, this measure was typically used to assess fine motor skills among participants above the age of 6. The BOT-2 produces scores in the areas of Response Speed, Visual Motor Control, and Upper Limb Speed and Dexterity, as well as a Fine Motor Control composite standard score. The Fine Motor Control composite score is derived from scores on the Fine Motor Precision and Fine Motor Integration subtests, and it can range between 20 and 80, with higher scores indicating better motor skills. Scores are classified as follows: 20-30 = 'well below average,' 31-40 = 'below average,' 41-59 = 'average,' 60-69 = 'above average,' and 70-80 = 'well-above average.' Test-retest reliability (ICC = .97-.99), internal consistency, (.86-.95), and interrater reliability (.98) have all been shown to be excellent (Griffiths et al., 2018). For the current study, the Fine Motor Control composite scores

were used to calculate the motor skill z-score to be included in analyses as a measure of the child's fine motor skills.

Peabody Developmental Motor Scales, Second Edition (PDMS-2). The PDMS-2 is an activity-based assessment designed to measure both gross and fine motor skills among children from birth through age 6 (Folio & Fewell, 2000). It produces scaled scores in domains including Grasping (e.g., manipulating objects, buttoning) and Visual-Motor Integration (e.g., building a block tower, cutting paper), both of which are used to calculate the Fine Motor Quotient (FMQ) composite score (M = 100, SD = 15). The FMQ is a standard score ranging from 35 to 165, with higher scores indicating more developed fine motor skills. Scores are classified as follows: less than 69 = 'very poor,' 70-79 = 'poor,' 80-89 = 'below average,' 90-110 = 'average,' 111-120 = 'above average,' 121-130 = 'superior,' and greater than 130 = 'very superior.' Interrater reliability (98%) and test-retest reliability (98%) have been shown to be high for the FMQ (Van Hartingsveldt et al., 2005). The internal consistency among subtests ranges from .89 to .96 (Folio & Fewell, 2000). For the current study, Fine Motor Quotient composite scores were used to calculate the motor skill z-score to be included in analyses as a measure of the child's fine motor skills.

Sensory Processing

Only one of the following sensory processing measures was administered to each participant by an occupational therapist. Each measure produces a score on a different

scale. However, percent agreement between the Sensory Profile and the Sensory Processing Measure Home Form has been shown to be 81.8% when scores are collapsed into two categories (Hansen & Jirikowic, 2013). Therefore, for the current study one sensory processing score per child was transformed into Sensory Atypical or Sensory Typical dichotomous categories to allow for valid substitution of any of the following assessment scores as a measure of the referred individual's sensory processing and sensitivities.

Sensory Processing Measure, Home/School/Preschool (SPM). The SPM is a rating-based assessment designed to measure sensory processing difficulties based on teacher or caregiver report (Parham et al., 2007a). This measure can be used for children ages 5 to 12 years. The SPM produces *T*-scores (M = 50, SD = 10) measuring sensory processing, including categories such as Hearing, Touch, and Taste and Smell. These *T*-scores can be placed into three different interpretive ranges: Typical range (*T*-score range of 40 to 59), Some Problems range (*T*-score range of 60 to 69), and Definite Dysfunction range (*T*-score range of 70 to 80). For the current study, the Total sensory *T*-scores in the Some Problems and Definite Dysfunction ranges were classified as Sensory Atypical, and scores in the Typical range were classified as Sensory Typical. Test-retest reliability (ICC = .96-.97) and internal consistency (.93-.94) have been shown to be excellent (Parham, et al., 2007b).

Short Sensory Profile, First/Second Edition (SSP-2). The SSP-2 is a brief rating-based assessment tool designed to measure sensory processing patterns based on

teacher or caregiver report (Dunn, 2014a). This measure can be used for children from birth to 14:11 years. The SSP-2 produces raw scores on 4 quadrants including Seeking, Avoiding, Sensitivity, and Registration, with higher scores indicating greater sensitivity. These raw scores result in a designation of "much less than others"/ "much more than others" (scores past 2 SDs from the mean), "less than others"/ "more than others" (scores between 1 and 2 SDs from the mean), and "just like the majority of others" (scores within 1 SD from the mean). For the present study, the Total sensory scores were collapsed into two categories, with scores in the "much less"/"much more" and "less"/"more" categories classified as Sensory Atypical, and scores in the "just like the majority of others" categories classified as Sensory Typical. Test-retest reliability (ICC = .97), internal consistency (.86), and interrater reliability (.82-.88) are all good to excellent. Correlations between SSP and SSP-2 quadrant scores range from -.80 – -.88 and are all significant, $p < .01$ (Dunn, 2014b).

Procedures

ASD Database

Procedures for the larger Alabama Center for Developmental Disabilities Education, Research, and Service: Database studies were approved by the Institutional Review Board. The information in the database was gathered during routine interdisciplinary clinical evaluations at the UAB Civitan-Sparks Clinics and entered into the database. Specific procedures for the current study were separately approved by the Institutional Review Board (UAB IRB-300005602-005).

For the purposes of the current study, only the information that is relevant was extracted from intake forms and reports. In addition to diagnoses based on clinical judgement, specific assessments and their scores were also utilized for analyses. Children were evaluated by licensed clinicians using a variety of assessments to measure ASD severity, cognitive and adaptive functioning, language skills, motor skills, and other domains of developmental functioning as part of their interdisciplinary assessments. For the purposes of the current study, the standardized assessments that are pertinent to obtaining a view of ASD-related symptoms and functioning were reviewed. ASD measures were administered by independent or site-reliable clinicians with research training using these measures, although the purpose of these assessments was clinical.

Data Analysis

The original combined dataset included 1,100 potential participants. All participants with an ASD or non-ASD diagnosis were included in the final dataset. The data were screened for entry errors, and errors were either corrected or deleted prior to conducting statistical analyses. Main analyses incorporating only variables with complete data were analyzed using the original dataset. However, given expected high rates of missingness across most outcome variables due to clinical procedures, all main analyses incorporating variables with missing data were conducted using multiple imputation with 20 imputed data sets, with age, sex, and ASD diagnosis included as auxiliary variables. Multiple imputation analyzes individual parameters in the generalized linear model, and therefore provides t-test statistics for orthogonal contrasts rather than F-tests for pooled contrasts; ANOVA results reflect this difference. Similarly, chi-square tests of

independence utilized logistic regression for imputed variables and are therefore represented with F-values. Descriptive statistics were analyzed for the whole original sample as well as the diagnostic and sex groups to identify any potential outliers in the data, defined as z-score values exceeding 3.29. Imputed datasets were inspected for violations of ANOVA, chi-square, and t-test assumptions prior to data analysis. Patterns of missingness were examined for all independent variables by sex and ASD diagnosis using chi-square analyses.

Regarding the first aim, an independent samples t-test was conducted to examine sex differences in the amount of time between first concern and evaluation. A chi-square test of independence examined the relation between sex and likelihood of receiving an ASD diagnosis. To explore sex differences in ASD symptoms, an independent samples t-test was conducted to examine sex differences in ADOS RRB domain-level calibrated severity scores, and a chi-square test of independence examined the relation between sex and likelihood of reaching or exceeding diagnostic cut-off scores for the ADI-R Restricted, Repetitive, and Stereotyped Patterns of Behavior (RRB) content areas. Similarly, an independent samples t-test was conducted to examine sex differences in ADOS Social Affect domain-level calibrated severity scores, and a chi-square test of independence examined the relation between sex and likelihood of reaching or exceeding diagnostic cut-off scores for the ADI-R Qualitative Abnormalities in Reciprocal Social Interaction (Social Interaction) content area.

Regarding the second aim, independent samples t-tests were conducted to examine sex differences in language skills, cognitive and adaptive skills, and fine motor skills. Similar analyses exploring sensory processing were contingent on data frequency

meeting the predetermined threshold required for sufficient statistical power, as sensory data were collected in the clinical dataset less frequently than other variables.

Regarding the third aim, two-way factorial ANOVAs were conducted to examine interactions and main effects of sex and ASD diagnosis on ASD symptoms, including ADOS Comparison Scores, ADOS RRB domain-level calibrated severity scores, and ADOS Social Affect domain-level calibrated severity scores. Next, chi-square tests of independence were performed to examine sex and ASD as main effects and interactions as they relate to the rate of reaching or exceeding ADI-R RRB and Social Interaction content area cut-off scores. Finally, two-way factorial ANOVAs were conducted to examine interactions and main effects of sex and ASD diagnosis on associated clinical features, including cognitive functioning, adaptive functioning, and language skills.

RESULTS

Preliminary Analyses

Participants were 1,099 individuals with an average age of 5.49 years (SD=3.33 years). Participants were 25.11% female. The sample was 60.5% White and 85.0% non-Hispanic/Latino (Table 3). Overall, 54.78% of participants were diagnosed with ASD following their evaluation, whereas 31.21% were given another diagnosis, and 14.01% received no diagnosis (Table 4). Means and standard deviations for key outcome and clinical variables by sex can be found in Table 5.

Individual data points were missing at different rates across participants (see Table 5 for frequencies). Chi-square tests of independence indicated that males were more likely to be missing language data ($X^2(1, N = 1099) = 20.67$, $p < .001$), whereas individuals not diagnosed with ASD were more likely to be missing ADI-R data ($X^2(1, N = 1099) = 6.85$, $p = .009$; Total N with ADI-R = 870). This missingness was most likely due to clinician judgement during evaluation based on low perceived likelihood of ASD diagnosis. Missingness on other dependent variables was not related to sex or ASD diagnosis. Given high percentages of missingness across most outcome variables, main analyses were conducted using multiple imputation with 20 imputed data sets, with age, sex, and ASD diagnosis included as auxiliary variables. Analyses examining rate of ASD diagnosis were conducted using the original dataset, as all data were present; all other analyses

were conducted using the imputed data. Those test statistics reflect pooled data across 20 imputations.

One participant was deleted from the dataset due to invalid data. The data were screened for outliers. No values on the primary variables of interest exceeded a z-score of 3.29, indicating there were no outliers. Data were inspected for violations of ANOVA, chi-square, and t-test assumptions prior to data analysis. The assumption of homogeneity of variances across sex was met for each imputed dataset, as measured by Levene's test for equality of variances using $p < .05$. The assumption of normality was also violated for all ADOS measures (RRB, Social Affect, Comparison Score) given the expected binomial distribution that characterizes severity scores in this kind of clinical population that included both ASD and non-ASD participants. Transformations were attempted but unsuccessful without altering interpretation of the data; however, t-tests are often considered robust to violations of normality, so parametric procedures were still used for analyses (Rasch et al., 2007). All other assumptions were met.

ASD Symptoms and Processes

An independent samples t-test revealed a significant difference between males and females in the amount of time between age of first concern and age at evaluation ($t(254.34) = 3.41$, $p < .001$). Specifically, females referred for an ASD evaluation exhibited significantly greater difference in time between age of first concern and age of evaluation compared to males ($M = 56.09$ months, $SD = 40.28$ vs. $M = 46.94$, $SD = 35.20$), indicating that there was a greater delay from concern to diagnosis for females compared to

males in the current sample. A chi-square test of independence indicated that there was a significant relationship between sex and ASD diagnosis ($X^2(1, N = 1099) = 5.12$, $p = .024$), such that females referred for an ASD evaluation were less likely to be diagnosed with ASD compared to males referred for an ASD evaluation. However, this association was small, $\varphi = .07$, p=.001. Frequencies of ASD diagnosis by sex can be found in Table 4.

A two-way factorial ANOVA indicated a significant main effect of ASD diagnosis on ASD symptom severity ($t(19583) = 29.56$, $p < .001$), such that individuals diagnosed with ASD exhibited more severe ASD symptoms based on the ADOS Comparison Score compared to individuals not diagnosed with ASD. The model indicated no significant main effect of sex on ASD symptom severity ($t(15269) = -0.75$, $p = .456$) or interaction between sex and ASD diagnosis on ASD symptom severity ($t(38562) = 0.11$, $p = .915$).

An independent samples t-test was conducted and revealed a significant difference between males and females on ADOS RRB domain-level calibrated severity scores ($t(5156.5) = -3.59$, $p < .001$). Specifically, females exhibited significantly less severe RRBs compared to males. A chi-square test of independence indicated a significant relation between sex and percentage reaching or exceeding cut-off scores for the ADI-R RRB content area ($F(1,687.31) = 6.60$, $p = .010$). Specifically, females were less likely to reach diagnostic algorithm cut-offs for RRBs than males, suggesting a higher likelihood of clinically significant RRB symptoms reported by parents for males compared to females. This association was small across imputed data sets (Mean $\varphi = 0.085$, Minimum $\varphi = 0.062$, Maximum $\varphi = .110$; $p = .012$).

A two-way factorial ANOVA on RRB symptom severity indicated a significant main effect of ASD diagnosis on ADOS RRB symptom severity, (t(961.99) = 20.72, p < .001), such that individuals diagnosed with ASD exhibited more severe RRB symptoms compared to individuals not diagnosed with ASD. The model indicated a marginally significant main effect of sex on ADOS RRB symptom severity (t(1077.3) = -1.95, p = .051), such that females referred for an ASD evaluation exhibited less severe RRBs than males referred for an ASD evaluation. The model indicated no significant interaction between sex and ASD diagnosis on RRB symptom severity (t(1602) = 0.06, p = .951). A chi-square test of independence indicated that the relation between sex and percentage reaching or exceeding ADI-R RRB cut-off was not significant for participants diagnosed with ASD (F(1,830.53 = 3.30, p = .070) nor participants not diagnosed with ASD (F(1,311.95) = 1.06, p = .305).

An independent samples t-test was conducted and revealed a significant difference between males and females on ADOS Social Affect domain-level calibrated severity scores (t(13517) = -2.02, p = .043). Specifically, females exhibited significantly less severe deficits in social affect compared to males. A chi-square test of independence indicated no significant relation between sex and percentage reaching or exceeding cut-off scores for the ADI-R Social Interaction content area (F(1,474.29) = 0.62, p = .43) or ADI-R Qualitative Abnormalities in Communication content area (F(1,511.41) = 0.76, p = .385.), suggesting that there were no significant sex differences in the presence of parent-reported social communication deficits.

A two-way factorial ANOVA on Social Affect symptom severity indicated a significant main effect of ASD diagnosis on ADOS Social Affect symptom severity

($t(6940.1) = 23.70$, $p < .001$), such that individuals diagnosed with ASD exhibited more severe Social Affect symptoms compared to individuals not diagnosed with ASD. The model indicated no significant main effect of sex on Social Affect symptom severity ($t(10860) = -1.01$, $p = .313$) or interaction between sex and ASD diagnosis on ASD Social Affect symptom severity ($t(12701) = 0.68$, $p = .496$. A chi-square test of independence indicated that the relation between sex and percentage reaching or exceeding ADI-R Social Interaction cut-off was not significant for participants diagnosed with ASD ($F(1,3903.31) = 0.15$, $p = .701$) nor participants not diagnosed with ASD ($F(1,1110.07) = 0.19$, $p = .662$).

Associated Clinical Features

Independent samples t-tests revealed no significant differences in receptive language ($t(417.12) = -0.41$, $p = .681$), expressive language ($t(343.74) = -0.01$, $p = .991$), or total language skills ($t(352.86) = 0.14$, $p = .886$) between males and females. Similarly, independent samples t-tests revealed no significant differences in cognitive skills ($t(190.44) = =1.54$, $p = .125$) or adaptive skills ($t(88.81) = -1.23$, $p = .223$) between males and females. No significant differences in fine motor skills were found between males and females, $t(223.27) = -0.66$, $p = .508$. Sensory data frequency was inadequate to achieve sufficient statistical power to explore sex differences in sensory processing.

DISCUSSION

The present study sought to examine sex differences in the clinical presentation of children and adolescents referred for an ASD evaluation. Participants were evaluated for ASD using standardized measures at the UAB Civitan Sparks Clinics (N=1099). Results indicated higher rates of ASD diagnosis among males compared to females, as well as greater delays in accessing evaluation services following initial parental concerns for females compared to males. Results also indicated greater ASD symptom severity for males compared to females across symptom clusters but did not indicate any significant sex differences in associated clinical features such as language, cognitive and adaptive functioning, and fine motor skills. These patterns of sex differences were identified only for the entire group of children referred for an ASD evaluation; no sex differences were identified among those diagnosed with ASD.

Regarding processes influencing ASD evaluation, the gap in time between age of first concern and age at ASD evaluation was 0.76 years greater for females compared to males, and females were referred for an ASD evaluation 0.64 years later than males, on average. This was expected given research indicating up to one year later age at diagnosis and greater delay in referral to mental health resources for females (Gesi et al., 2021; Micai et al., 2019; McDonnell et al., 2021; Harrop et al., 2021), and further elucidates a delay in obtaining ASD evaluation that is unique to females. The current findings indicated that not only were males referred for an ASD evaluation at a higher rate than females, but

males were also diagnosed with ASD at a higher rate at the point of evaluation. This pattern was expected and is broadly consistent with current sex differences in diagnosis rates, as the female-to-male ratio for all those referred was 1:3.9, and the female-to-male ratio of those diagnosed following evaluation was 1:4.5, compared to the roughly 1:3 female-to-male ratio established in the literature for the general population (Loomes et al., 2017). Boys have been found more likely to receive an ASD diagnosis compared to girls when symptom severity is held constant (Russell et al., 2011), and boys are more likely than girls to meet diagnostic criteria at similar levels of overall autistic-like traits (Dworzynski et al., 2012). Taken together, these findings suggest that there may be something different about males and females in the ASD referral and evaluation process, in line with theories including expectancy biases, sex stereotypes, social camouflaging behavior, or ASD symptom presentation (Cola et al., 2020; Lai & Szatmari, 2020).

ASD Symptoms

A major component of the first aim was to examine sex differences in ASD symptoms using gold standard ASD diagnostic measures. The results indicated no sex differences in overall symptom severity based on ADOS Comparison Scores. This finding is consistent with prior research indicating that there are few to no differences in overall ASD symptomatology between sexes (Fulton et al., 2017; Mandic-Maravic et al., 2015; Mussey et al., 2017; Reinhardt et al., 2015). This similarity in overall symptom severity between sexes is particularly true when groups are matched on cognitive functioning, and there were no significant differences in cognitive functioning between males and females in this study (Matheis et al., 2019; Prosperi et al., 2021).

The results did, however, indicate quantifiable sex differences in specific ASD domains as assessed by gold standard measures. Regarding RRBs, the results were consistent across method of measurement. As measured by the ADOS, females exhibited lower RRB symptom severity than males. Furthermore, as measured by the ADI-R, males referred for an ASD evaluation were more likely to reach or exceed the diagnostic cut-off for the RRB domain, indicating that parents were more likely to report clinically significant RRB symptoms for males compared to females referred for an ASD evaluation. These findings are consistent with the preponderance of literature indicating that females with ASD exhibit fewer RRBs compared to males with ASD (Frazier et al., 2014; Kaat et al., 2021; Supekar & Menon, 2015; Tillmann et al., 2018; Uljarević et al., 2020; van Wijngaarden-Cremers et al., 2014; Wang et al., 2017). Of note, this sex difference on the ADI-R was present for the overall group referred for an ASD evaluation, but not for the ASD or non-ASD groups on their own. Given the nature of this sample, this finding could reflect the referral process more broadly, as research has suggested that the most commonly used ASD screeners may under-identify RRBs among toddler and preschool-aged girls (Ros-Demarize et al., 2020).

The results were mixed regarding sex differences in social affect. It was predicted that females would exhibit more severe deficits in social affect compared to males referred for an ASD evaluation. However, results indicated that females referred for an ASD evaluation exhibited less severe deficits in social affect on the ADOS compared to males referred for an ASD evaluation. Contrary to those findings, ADI-R results indicated no significant sex differences in diagnostic classification for either Social Interaction or Communication ADI-R content areas. These findings were contrary to previous

research indicating that females with ASD have worse social communication skills (Frazier et al., 2014; Mahendiran, 2019b; Micai et al., 2019). However, the extant research remains mixed, as a recent systematic review suggested fewer social autistic behaviors in females with high autistic traits compared to males with high autistic traits (Cook et al., 2021). Similarly, camouflage theory suggests that social communication skills such as social reciprocity and social affect may be better developed in females with ASD, a trend that could apply to this sample (Craig et al., 2020; van Ommeren et al., 2016; Wang et al., 2017; Wood-Downie et al., 2020). More narrow measures of social communication skills outside of gold standard ASD measures (e.g., peer engagement, social motivation, social attention) support these findings, identifying a similar trend to that of sex differences in non-autistic individuals (Wood-Downie et al., 2021). Regarding differences between ADI-R and ADOS findings, research suggesting less severe communication impairment in female toddlers with ASD compared to male toddlers with ASD also indicated higher parent-report of social communication symptoms for females compared to observation of symptoms for females, despite the overall pattern of sex differences (Matheis et al., 2019). This discrepancy between parent-report and observation aligns with the pattern of differences identified in the present study among all those referred for an ASD evaluation. Lastly, recent studies have identified no sex differences in social compensation and negligible differences in social and communicative behaviors among individuals with ASD, in line with the nonsignificant findings on the ADI-R (Kaat et al., 2021; Livingston et al., 2019; Ratto et al., 2018; Tillmann et al., 2018).

Overall, results of the current study identified a mixed pattern of quantifiable differences in the clinical presentation of ASD symptoms among a broad clinical sample of

children and adolescents referred for an ASD evaluation. Although there was no significant difference in overall symptom severity as measured by the ADOS, results indicated less severe RRBs in females compared to males, consistent across observation and parent-report measures. Findings also indicated less severe social communication deficits for females compared to males as measured by the ADOS, but no significant differences in likelihood of clinically significant social communication deficit symptoms reported by parents on the ADI-R. Overall, more consistent differences were identified with the ADOS compared to the ADI-R, consistent with research suggesting that the ADOS better captures sex differences compared to the ADI-R (Lefort-Besnard et al., 2020). There were no changes in the pattern of sex differences between individuals diagnosed with ASD and individuals not diagnosed with ASD; rather, patterns of sex differences were present for the whole sample of individuals referred for an ASD evaluation. This sample is unique, in that it includes those who are not diagnosed but still present with a concern for ASD. In this way, the mixed findings in comparison to existing literature could reflect the inclusion of those who would not typically be diagnosed with ASD based on these gold standard measures, a group of particular interest for investigations of the FAP. Overall, males were more likely to be diagnosed with ASD and females experienced a greater gap between age of first concern and age at evaluation, suggesting a delay in initial access to evaluation services, as well as a difference in diagnostic rate at the point of evaluation. This pattern of sex differences regarding ASD symptoms and clinical processes warrants future investigation of other factors influencing clinical presentation, including associated clinical features.

Associated Features

Another primary aim of the study was to explore other skills and behaviors that may influence clinical presentation between males and females, including cognitive, adaptive, language, and motor skills. Regarding language skills, it was hypothesized that females would exhibit stronger language skills than males, particularly with regard to expressive language. This hypothesis aligned with camouflage theory, as language and expressive communication skills can serve as compensatory mechanisms for "masking" ASD symptoms (Hull et al., 2020). However, the results did not support this hypothesis, as there were no significant differences in language skills, including receptive and expressive language skills, between sexes or diagnoses (i.e., ASD vs. non-ASD). While it has been previously demonstrated that females with ASD demonstrate stronger verbal skills and complex speech production than males with ASD (Micai et al., 2019; Salomone et al., 2015), the current study's findings indicate that language deficits in individuals referred for an ASD evaluation did not differ by sex, regardless of diagnostic outcome. A recent review indicated mixed findings in the literature regarding sex differences in language skills (Estrin et al., 2021). Regarding camouflage theory, language skills should not be conflated with social skills, social communication, or quality of conversation. Females with ASD have been shown to exhibit subtle linguistic differences and communication patterns (e.g., heightened social group focus in speech, different patterns of pronoun use) that are not likely to be captured in typical language measures but may influence perception and camouflage ability (Song et al., 2020).

It was hypothesized that females would exhibit significantly lower cognitive and adaptive skills overall than males, including an interaction between sex and ASD

diagnosis, such that females with ASD would present with lower cognitive and adaptive skills than males with ASD, and females not diagnosed with ASD would present with higher levels of functioning than males not diagnosed with ASD. This hypothesis also aligned with camouflage theory (i.e., higher cognitive functioning linked with greater ability to camouflage ASD traits; Wood-Downie et al., 2020), as well as literature indicating that females diagnosed with ASD typically present with lower cognitive and adaptive functioning compared to males diagnosed with ASD (Frazier et al., 2014; Howe et al., 2015; Mahendiran, 2019b; White et al., 2017). However, there were no significant differences in cognitive or adaptive skills by sex or diagnosis in the current sample. This is consistent with more recent research suggesting that there may be no sex differences in cognitive ability among individuals diagnosed with ASD (Duvall et al., 2020), including the largest multisite study on sex differences to date, which acknowledged negligible differences in early cognitive abilities (Kaat et al., 2021).

It was also hypothesized that females would exhibit worse fine motor skills compared to males, given previous findings that male children with ASD typically perform better than females with ASD on both gross and fine motor tasks (Carter et al., 2007; Matheis et al., 2019). However, there were no significant differences in fine motor skills between sex or diagnosis in the current sample. Of note, no research has investigated sex differences in individuals referred for an ASD evaluation using these clinical measures; in this way, the present study is breaking new ground, and unexpected findings may not be surprising. Given the current study's unique sample, which included individuals not diagnosed with ASD, it is possible that those referred for an ASD evaluation who appropriately received no ASD diagnosis may have influenced these findings, as prior research

has demonstrated no sex differences in motor skills among non-ASD groups (Matheis et al., 2019). Furthermore, effect sizes identified in existing literature have been small, and sex differences in motor skills have been identified primarily for those with cognitive delay, whereas the current sample presents with a range of cognitive functioning. Similarly, age effects have been demonstrated in prior research, such that preschool children with ASD exhibit sex differences in motor skills, whereas older children do not (Wang et al., 2016). Future research should continue to investigate sex differences in motor skills within this population, as the literature remains sparse, particularly regarding a broader sample of individuals referred for an ASD evaluation.

Although no significant sex differences were identified for associated features, these findings reinforce the sex differences identified regarding ASD symptoms, as similarity on other phenotypic variables suggests that sex affects ASD symptom presentation above and beyond other developmental factors influencing clinical presentation (Kaat et al., 2021). Furthermore, extant literature on sex differences in ASD phenotype has largely examined only those diagnosed with ASD, thereby excluding those who may be missed by current diagnostic procedures capturing the characteristically male ASD phenotype. Findings from the current study may reflect this unique sample, as sex differences identified in research samples may not be as clear when examining the phenotype of the broader ASD spectrum. Given findings from this study indicating no sex differences in associated features in this broader sample, future research should continue to investigate clinical presentation for individuals presenting with an ASD concern, regardless of final diagnosis, to more fully account for other factors that may influence an ASD diagnostic evaluation.

Limitations

While the current study utilized a novel sample in comparison to many previous studies, there are several limitations that must be addressed. First, although the current study attempted to account for those who may be falling through the diagnostic cracks and are therefore missed in current research investigating FAP, there is likely still a crucial portion of the female autistic population being missed by the current research; namely, those who are not referred for an ASD evaluation in the first place. Future research should utilize creative recruitment and identification techniques, including prospective data collection among high-risk populations, to include this population of interest in phenotypic research to elucidate the nature of sex differences among all those presenting with autistic symptoms. Furthermore, by including all those referred for an ASD evaluation at this tertiary care clinic, this sample may have also included "neurotypical" individuals, for whom sex differences in ASD symptoms, camouflaging, and associated clinical variables do not apply (Hull et al., 2019).

Additionally, the current study used multiple assessments to measure the same variable, under the assumption that each separate measure and corresponding score represented comparable constructs (e.g., several types of cognitive assessments). This range of measures is a result of the clinical evaluation process, as assessments were administered according to clinical relevance due to factors such as age and referral concern. Using scores from different assessments to represent the same construct is a strategy often used in ASD research due to the nature of retrospective clinical data collection, despite the possibility that different measures are assessing the construct in different ways (Ratto et

al., 2018). Also as a result of retrospective data collection, some measures could not be included in analyses due to low frequency (e.g., sensory sensitivities), and multiple imputation was used to account for patterns in missingness across all clinical measures. Future research should consider additional features influencing clinical presentation such as sensory sensitivities. As a result of the cross-sectional study design, longitudinal data analysis could not be conducted to examine the roles of age, time, and changes in clinical practice in female symptom presentation and measurement, an important area for future research.

Another limitation of the current study was the use of broad categories and scores (e.g., rate of meeting or exceeding ADI-R cut-off; ADOS domain-level calibrated severity scores) to account for ASD symptom presentation. This approach was used due to differences in assessment item administration based on factors such as age and verbal level. However, item-level analysis would be beneficial to elucidate the nuances in observed and reported symptoms, allowing for a more detailed account of sex differences across ADOS and ADI-R measures, particularly given mixed findings across assessment instruments within the current study.

Implications and Future Directions

Given the sex discrepancy in ASD diagnosis rates, an understanding of the factors influencing diagnosis for females is critical in order to ensure accurate and adequate diagnostic processes. Prior research has investigated sex differences in ASD clinical presentation, and although findings suggested quantifiable differences in factors influencing ASD diagnosis, the findings have been mixed. Furthermore, gold standard measures used for

ASD evaluation have been developed based on the predominantly male ASD phenotype, suggesting that females presenting differently may be missed by current diagnostic procedures. By expanding the sample to include all those referred for an ASD evaluation, the current study includes a portion of those missed by extant literature that examines only individuals already diagnosed with ASD. As expected, the finding showed quantifiable sex differences in ASD symptom presentation with females referred for an ASD evaluation exhibiting less severe RRBs and social communication deficits than males referred for an ASD evaluation. Furthermore, there were no sex differences in other associated features such as cognition, adaptive skills, language, and fine motor skills, indicating that sex differences in clinical presentation may be specific to ASD symptoms. Although there may be participants in this sample who are truly not on the autism spectrum, the finding of sex differences in all ASD symptom clusters suggests that future research should continue to investigate those who may be missed by current gold standard diagnostic instruments.

This study's unique sample of individuals referred for an ASD evaluation raises questions regarding sex differences in the factors influencing the referral process as well. Whereas some research has indicated the possibility that girls require more ASD traits than boys to receive an ASD diagnosis (Estrin et al., 2021), it does not appear that this pattern applies to ASD referral. It is possible that many females with ASD who are mis- or under-diagnosed are not referred for an ASD evaluation in the first place. The current study's finding indicating a greater gap between age at initial concern and age at ASD evaluation supports this possibility, and it suggests that further investigation of sex differences in the ASD evaluation referral process is needed. In additional to critical review of

early screening practices, research must continue to investigate the roles of educational personnel, medical providers, and parents in the process of seeking evaluation, as well as the efficacy of interventions aimed at improving knowledge and interpretation of female symptom presentation for children with concern for ASD. Furthermore, among those who are referred for an ASD evaluation, males are still diagnosed at a higher rate compared to females, a possible reflection of a male bias in measures used for diagnosis. In addition to continued research examining sex differences in clinical presentation of individuals with a concern for ASD, investigation of the early identification and referral process for ASD may more clearly elucidate factors influencing current sex differences in referral for evaluation, symptom presentation, and subsequent diagnosis.

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Table 1

Data Analysis Variables: ASD Symptom and Level of Functioning Measures

Measure	*Item*	*Primary Variables*	*Use*
ADOS-G/ADOS-2	Comparison Score	Average Comparison Score	Hypothesis 3a
	RRB calibrated domain-level severity score	Average RRB severity score	Hypothesis 1c, 3b
	Social Affect calibrated domain-level severity score	Average Social Affect severity score	Hypothesis 1d, 3c
ADI-R	Item 2 (Age of First Concern)	Age of First Concern	Hypothesis 1a
	Restricted, Repetitive, and Stereotyped Patterns of Behavior content area	Rate of meeting cut-off score for RRBs	Hypothesis 1c, 3b
	Social Interaction, Qualitative Abnormalities in Communication content area	Rate of meeting cut-off score for Social Interaction, Communication	Hypothesis 1d, 3c
*VABS-I**	Adaptive Behavior Composite Standard Score	Average Adaptive Behavior Composite Standard Score	Hypothesis 2b, 3e
*VABS-II**	Adaptive Behavior Composite	Average Adaptive Behavior Composite Standard Score	Hypothesis 2b, 3e
*Vineland-3**	Adaptive Behavior Composite	Average Adaptive Behavior Composite Standard Score	Hypothesis 2b, 3e
*ABAS-II**	General Conceptual Ability Standard Score	Average Adaptive Behavior Standard Score	Hypothesis 2b, 3e
*ABAS-3**	General Conceptual Ability Standard Score	Average Adaptive Behavior Standard Score	Hypothesis 2b, 3e
*Bayley-III***	Cognitive Scale Standard Score	Average Cognitive Ability Standard Score	Hypothesis 2b, 3e
*DAS-II***	GCA	Average Cognitive Ability Standard Score	Hypothesis 2b, 3e
*SB-5***	FSIQ	Average Cognitive Ability Standard Score	Hypothesis 2b, 3e
*WISC-IV/V***	FSIQ	Average Cognitive Ability Standard Score	Hypothesis 2b, 3e
*WASI-II***	FSIQ	Average Cognitive Ability Standard Score	Hypothesis 2b, 3e

* Indicates that only one Adaptive Functioning assessment was recorded for each participant

**Indicates that only one Cognitive Functioning assessment was recorded for each participant

Table 2

Data Analysis Variables: Language, Motor and Sensory Measures

Measure	*Item*	*Primary Variables*	*Use*
*PLS-4**	Total Standard Score	Average Overall Language Standard Score	Hypothesis 2a, 3d
	Expressive Language Standard Score	Average Expressive Language Standard Score	Hypothesis 2a, 3d
	Receptive Language Standard Score	Average Receptive Language Standard Score	Hypothesis 2a, 3d
*PLS-5**	Total Standard Score	Average Overall Language Standard Score	Hypothesis 2a, 3d
	Expressive Language Standard Score	Average Expressive Language Standard Score	Hypothesis 2a, 3d
	Receptive Language Standard Score	Average Receptive Language Standard Score	Hypothesis 2a, 3d
*CELF**	Core Language Index	Average Overall Language Standard Score	Hypothesis 2a, 3d
	Expressive Language Standard Score	Average Expressive Language Standard Score	Hypothesis 2a, 3d
	Receptive Language Standard Score	Average Receptive Language Standard Score	Hypothesis 2a, 3d
*OWLS**	Oral Composite Standard Score	Average Overall Language Standard Score	Hypothesis 2a, 3d
	Oral Expression Standard Score	Average Expressive Language Standard Score	Hypothesis 2a, 3d
	Listening Comprehension Standard Score	Average Receptive Language Standard Score	Hypothesis 2a, 3d
*Peabody***	Fine Motor Quotient	Average Fine Motor Standard Score	Hypothesis 2c
*BOT-2***	Fine Motor Composite	Average Fine Motor Standard Score	Hypothesis 2c
*SPM-Home****	Total Sensory Systems Standard Score	Average Total Sensory T-Score Classification	Hypothesis 2d

*SPM-School****	Total Sensory Systems Standard Score	Average Total Sensory T-Score Classification	Hypothesis 2d
*SPM-Preschool****	Total Sensory Systems Standard Score	Average Total Sensory T-Score Classification	Hypothesis 2d
*SSP****	Total Standard Score	Average Total Sensory Score Classification	Hypothesis 2d
*SSP2****	Total Standard Score	Average Total Sensory Score Classification	Hypothesis 2d

* Indicates that only one Language Ability assessment was recorded for each participant

**Indicates that only one Motor Skills assessment was recorded for each participant

***Indicates that only one Sensory assessment was recorded for each participant

Table 3

Participant Characteristics by Sex (N = 1,099)

Diagnosis	Female N (% total females)	Male N (% total males)	Total N (% total participants)
Race			
White	153 (55.5)	511 (62.1)	664 (60.5)
Black	68 (24.7)	208 (25.2)	276 (25.1)
Biracial	5 (1.9)	10 (1.3)	15 (1.4)
Other/Unknown	50 (18.1)	94 (11.4)	144 (13.1)
Ethnicity			
Hispanic	50 (18.1)	115 (14.0)	165 (15.0)
Sex			
Female	--	--	276 (25.11)

Table 4

Frequency of Primary Clinical Diagnoses Resulting From ASD Evaluation, by Broad Diagnostic Category

Diagnosis	Female N (% total females)	Male N (% total males)	Total N (% total participants)
ASD	135 (48.9)	467 (56.7)	602 (54.8)
ADHD	15 (5.4)	35 (4.3)	50 (4.5)
Developmental Delay	20 (7.3)	57 (6.9)	77 (7.0)
Intellectual Disability	12 (4.3)	15 (1.8)	27 (2.5)
Neurodevelopmental Disorder	4 (1.4)	21 (2.6)	25 (2.3)
Language Disorder	25 (9.1)	77 (9.4)	102 (9.3)
Mood Disorder	9 (3.3)	15 (1.8)	24 (2.2)
Behavior Disorder	12 (4.4)	17 (2.1)	29 (2.6)
No diagnosis	38 (13.8)	116 (14.1)	154 (14.0)
Other	6 (2.2)	3 (0.4)	9 (0.8)
TOTAL	276	823	1099

Table 5

Means and T-tests Examining Sex Differences in Clinical Measures

		Female	Male	Total		
Measure	N	M (SD)	M (SD)	M (SD)	t	p
Age in years	1099	5.97 (3.60)	5.33 (3.22)	5.49 (3.33)	7.210	.007**
Time between first concern and evaluation in years	721	4.67 (3.36)	3.91 (2.93)	4.11 (3.06)	3.41	<.001***
ADOS						
Comparison Score	1049	5.07 (3.00)	5.49 (2.98)	5.39 (2.99)	-2.30	.021*
RRBs	965	5.16 (3.14)	5.97 (3.00)	5.77 (3.06)	-3.59	<.001***
Social Affect	965	5.19 (2.96)	5.61 (2.84)	5.50 (2.88)	-2.02	.043*
Language	836	67.39 (18.74)	66.90 (18.15)	67.03 (18.30)	0.14	.886
Expressive	814	68.99 (17.59)	69.18 (17.46)	69.13 (17.48)	-0.01	.991
Receptive	807	67.19 (18.97)	67.72 (18.79)	67.58 (18.83)	0.41	.681
Cognitive	542	75.44 (19.16)	77.99 (17.92)	77.30 (18.28)	-1.54	.125
Adaptive	487	68.50 (11.69)	69.58 (12.29)	69.30 (12.13)	-1.23	.223
Fine Motor Z-Score	794	-0.013 (1.022)	0.010 (.990)	0.004 (0.997)	-0.66	.508

*$p < .05$
**$p < .01$
***$p < .001$