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Adaptive Functioning and Autism Spectrum Disorder Symptom Severity in Childhood: Parent Perception vs Clinician Rating

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Adaptive Functioning and Autism Spectrum Disorder Symptom Severity in Childhood: Parent Perception vs Clinician Rating

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Approval Page

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Statement of Original Work

I declare the following:

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ADAPTIVE FUNCTIONING AND AUTISM SPECTRUM DISORDER SYMPTOM SEVERITY IN CHILDHOOD: PARENT PERCEPTION VS CLINICIAN RATING

by

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ABSTRACT

Autism Spectrum Disorder (ASD) is a neurocognitive developmental disorder that impacts over one percent of the population. As of 2016, one in 64 children were diagnosed with ASD by four years of age, with males receiving the diagnosis 3.5 times more often than females (Shaw et al. 2020). Research also indicates that ASD prevalence varies by socioeconomic status (SES) and race/ethnicity (Diguiseppi et al., 2016). These differences may be a result of differential access to resources, a connection between SES and race/ethnicity, measure sensitivity to child sex, cultural differences in sensitivity to symptomatology, or a true difference in ASD presentation. Some of the most commonly used tools in assessing children for ASD are parent report forms or clinical interviews with the child's parent (such as the Vineland Adaptive Behavior Scales, Second Edition; VABS-II) and clinician assessment and observation, frequently using the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Gadow et al., 2016). Effectively interpreting parent ratings of their child's ASD symptom severity can make a difference in how a clinician diagnoses a child and, in turn, what steps are taken to help the child moving forward. The purpose of this dissertation is to examine the association between parent and clinician ratings of a child's ASD symptomatology. Utilizing two commonly used assessment measures, the VABS-II and the ADOS-2, the association between parent ratings of adaptive functioning and clinician ratings of ASD symptom severity were analyzed. A logistic regression, linear regression, and receiver operating characteristic (ROC) curve were estimated to evaluate the association and the predictive power of the VABS-II for ASD diagnosis based on the ADOS-2. Findings suggested that the VABS-II Adaptive Behavior Composite and the ADOS-2 are inversely related, as hypothesized, but that the association is not moderated by demographic factors. Additionally, the ROC curve showed that the VABS-II can be used to predict ASD diagnosis based on ADOS-2 cut-off scores. These findings and their implications are further discussed in the dissertation.

Keywords: ASD, symptoms, severity, parental report

Chapter 1: Statement of the Problem

Autism Spectrum Disorder (ASD) is a neurocognitive developmental disorder that impacts over one percent of the population. Specific criteria for what constitutes ASD have changed in the Diagnostic and Statistical Manual for Mental Disorders, fifth edition (DSM-5) from the DSM-IV, and the diagnosis of ASD is rapidly increasing among both children and adults (American Psychiatric Association [APA], 2013). In 2016, over 1.5% (one in 64) of children four years of age were diagnosed with ASD, with males receiving the diagnosis 3.5 times more often than females (Shaw et al., 2020). Later diagnoses are associated with increased levels of parental stress, and they delay early intervention, which is known to be key to improving the efficacy of the interventions (Elder, 2014).

Some of the most frequently used tools in assessing children for ASD are parent report forms or clinical interviews with the child's parent (Gadow et al., 2016). These measures rely on the parents to report accurately the symptoms and their severity. Clinicians interact with and observe the child while administering the Autism Diagnostic Observation Schedule-Second Edition (ADOS-2; Elder, 2014). They must also rely on the parent ratings and descriptions of the child's developmental history, as well as on their description of how the child functions in day-to-day life, to make a valid diagnosis and to inform treatment recommendations.

Having various raters provide information about a child when completing an evaluation can provide a more in-depth and well-rounded view of the child's symptoms and behavior in various settings (Goulardins et al., 2018). Despite the potential benefits of employing multiple raters, there are mixed findings regarding rater agreement of symptom severity (Azad et al., 2016). One key issue seen with parent reports is the potential for disagreement between raters (i.e., parents, teachers, and clinicians) regarding symptoms, severity, and their meanings. Parents frequently conceptualize symptom severity in a more subjective manner than clinicians or clinical assessments (Zaboltsky et al., 2015). Parents have been found to be more influenced by how their child's symptoms affect the family when providing ratings of symptom severity, rather than how the symptoms compare to developmental norms or expectations (Zaboltsky et al., 2015).

When both parents and teachers complete rating forms for a child, some findings demonstrate agreement on the level of impairment seen in the children (Azad et al., 2016). Others have found the opposite. For instance, when using the Behavior Assessment System for Children, Second Edition (BASC-2), parents consistently rate the children as having less severe internalizing and externalizing behaviors relative to teachers' ratings (Nicpon et al., 2010; Ellison et al., 2016). In addition, while using the Vineland Adaptive Behavior Scales, Second Edition (VABS-II) parents consistently rated the children as having lower levels of functioning in activities of daily living relative to teachers' ratings (Dickson et al., 2018). When parents and teachers show significant levels of disagreement on rating forms, it can be difficult for clinicians to move forward with identifying appropriate interventions and treatment goals (Azad et al., 2016). Although there is a growing body of literature concerning parent and teacher rating discrepancies for children with ASD, there is little to no research focused on the relationship between parent and clinician ratings of symptom severity for ASD.

The literature regarding influences on parent ratings of their child's ASD symptom severity is sparce but does exist. Factors such as race and ethnicity have been associated with differences in parents' ratings of ASD severity, with Anglo mothers rating their children as having more developmental concerns than Latino mothers (Blacher et al., 2014). In addition, parents who were English Language Learners (ELL) were more likely to rate their child's symptoms as severe (Dovgan et al., 2019). Financial variables have also been associated with ratings of severity in some cases (Dovgan et al., 2019) but not in others (Zablotsky et al., 2015). In addition, child sex has been shown to play a significant role in differences between parent and clinician ratings of ASD severity, with girls being rated as less severe by clinicians than by parents (Navarro-Pardo et al., 2021). These disparities are likely attributable to standardization differences, where measures such as the ADOS-2 are not standardized by child sex, but the VABS-II are (Navarro-Pardo et al., 2021). These discrepancies are mirrored by the same inconsistency in findings regarding the influence of parental education. One study reported that parents with higher levels of education report lower symptom impairment in their children (Gadow et all., 2016), while another study described a lack of a relationship between parental education and ratings of ASD severity (Zablotsky et al., 2015).

The majority of the studies on ASD symptom ratings included large samples, but diversity of participants was often lacking, with most studies focusing primarily on white male children diagnosed with ASD and only identifying mothers as the parent. Even though ASD is more common in males than in females (Shaw et al., 2020), these samples are not representative of the total ASD population. In addition, the study designs relied mostly on parent reports of severity in order to diagnose ASD or to determine symptom severity, rather than obtaining an independent evaluation by a clinician. Utilizing parent reports of severity as the determinant of the child's ASD severity makes it difficult to evaluate the impact of various parental factors on those ratings. In clinical settings, the clinician would be comparing the parents' rating forms to their own observations, making it more applicable to use this same design in the research as well (i.e., research comparing parent ratings to clinical observations, rather than relying solely on parent ratings of severity).

Clinicians rely on having an accurate understanding of a child’s symptom severity and adaptive functioning to provide appropriate psychoeducation, interventions, and/or recommendations to parents. The purpose of this dissertation is to examine the association between parent and clinician ratings of a child’s ASD symptomatology. Utilizing two commonly used assessment measures, the VABS-II and the ADOS-2, the association between parent ratings of adaptive functioning and clinician ratings of ASD symptom severity were be analyzed. By shedding light on this connection, this study will inform future diagnostic assessments and aid clinicians in determining the necessity of further evaluation of those suspected of having ASD. Understanding the influence of potential demographic moderators will also assist clinicians in effectively interpreting parent ratings of their child’s ASD symptom severity and can make a difference in how clinicians diagnose and treat children diagnosed with ASD moving forward.

Chapter 2: Review of the Literature

A systematic literature review was conducted searching peer-reviewed articles in the *PsychInfo* and *ERIC* databases using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines, as established by Moher and colleagues (2009). The search was conducted during the Fall of 2020 and Winter of 2021 utilizing various combinations of the following key terms: *autism, parent rating, severity, parent education, education, parent age, factors, pathology,* and *not ADHD*. Inclusion criteria consisted of peer reviewed research articles from peer reviewed journals that addressed the topic of this paper. Articles were included if they were published in English in 2010 or later. Articles were excluded from the literature review if they did not relate to parent ratings of their child's symptom severity in comparison to clinician ratings of that child's symptom severity. Due to the limited research in this area specific to ASD, articles were also included if they appeared in the search results and related to broader developmental disabilities rather than exclusively ASD. In addition, articles that evaluated the association between parent and teacher ratings were included in the study if they appeared in the initial search, as a result of the paucity of studies focused on the connection between parent and clinician ratings. Articles that appeared as duplicates or were not available in full text were also eliminated.

The initial search yielded 285 articles. After removing duplicate articles, 228 were for review. Examining the abstracts and titles of these articles eliminated 195 from consideration and left 33 for full-text review. Eighteen were eliminated using the exclusion criteria, resulting in 15 articles included in this literature review. These articles will be further discussed and referenced throughout the paper.

Autism Spectrum Disorder

Definition

ASD is a neurocognitive developmental disorder that impacts over one percent of the population (American Psychiatric Association [APA], 2013). The DSM-5 has established two key categories for ASD symptoms: persistent social and communication deficits and the presence of restricted, repetitive patterns of behaviors and/or interests as well as sensory sensitivities. Severity of these symptoms is also taken into account and included in the diagnosis (APA, 2013). A hallmark of ASD is that symptoms must be apparent during the early developmental period of the individual and cause clinically significant impairment (APA, 2013).

The diagnosis of ASD includes various specifiers for severity as well as the presence of intellectual and/or language impairments. Severity of social communication deficits as well as of restricted, repetitive patterns of behavior are broken down into three levels: level 1 (requiring support), level 2 (requiring substantial support), and level 3 (requiring very substantial support) (APA, 2013). Guidelines for each of these levels are provided in the DSM-5. A specifier for with or without accompanying intellectual impairment should also be included in the diagnosis based on an evaluation of both verbal and nonverbal functioning. The specifier for with or without accompanying language impairment should be utilized to reflect the individual's current level of verbal functioning at the time of the evaluation (APA, 2013).

ASD symptoms typically present as developmental delays or as a loss of social or language skills around the second year of life (12-24 months). The more severe the symptoms are, the earlier they will be observable, and those that do not present until later than 24 months tend to be more subtle (APA, 2013). ASD is not considered degenerative, and learning is expected to continue as the individual ages. The learning may occur at a slower pace than in typically developing peers. Although an individual's level of impairment cannot be predicted based on risk factors, some general factors impacting the prevalence of ASD are known. Parental age is positively correlated with increased risk for ASD (Rieske & Matson, 2020), as is fetal exposure to valproate (a drug commonly used to treat epilepsy and bipolar disorder as well as to prevent migraines (APA, 2013). Birth weight is correlated with increased risk for ASD, with lower birth weight being associated with a higher risk (APA, 2013). Estimates of heritability range from 37% to over 90%, (APA, 2013). The wide range of variability in heritability estimates of ASD reflects the limited understanding researchers have regarding ASD etiology and, in turn, treatment.

Prevalence

While specific criteria for what constitute ASD have changed in DSM-5 from the DSM-IV, its prevalence is rapidly increasing among both children and adults (APA, 2013). Despite the apparent increase in diagnoses, Maenner and colleagues (2014) suggested that the change in diagnostic criteria in the DSM-5 would decrease prevalence estimates. Yet, in 2016, over 1.5% (one in 64) of children by four years of age were diagnosed with ASD with males receiving the diagnosis 3.5 times more often than females (Shaw et al. 2020). Shaw and colleagues (2020) found that the number of children diagnosed with ASD by the age of four years old was significantly higher than the number of children diagnosed with ASD at eight years old, demonstrating higher frequency of early evaluation and diagnosis.

Research also indicates that ASD prevalence varies by socioeconomic status (SES) and race/ethnicity. In the United States, ASD diagnoses are more prevalent in families of higher SES (Diguiseppi et al., 2016). In addition, lower incidences of ASD are reported of children in families identifying as Hispanic or Black non-Hispanic than of children in families identifying as

White non-Hispanic (Diguiseppi et al. 2016). These differences may be a result of differential access to resources, a relationship between SES and race/ethnicity, cultural differences in sensitivity to symptomatology, or a true difference in ASD prevalence. Further research is needed to determine why these differences are seen.

Evaluation

Some of the most commonly used tools in assessing children for ASD are parent report forms or clinical interviews with the child's parent (Gadow et al., 2016). According to Elder and colleagues (2017) the most frequently used parent report forms include the Ages and Stages Questionnaire-Third Edition (ASQ-3), Modified Checklist for Autism in Toddlers-Revised Follow-up (M-CHAT-R/F), Social Communication Questionnaire (SCQ), and Gilliam Autism Rating Scale-Third Edition (GARS-3). Elder and colleagues also reference frequent use of the Autism Diagnosis Interview-Revised (ADI-R), a structured interview of the child's parents completed with the clinician. All these measures rely on the parents to report accurately the symptoms and severity of their child's symptoms.

The ADOS-2, an evaluation tool requiring an interactive observation by the clinician with the child, is considered the gold-standard for assessing ASD (Elder et al. 2017). Findings from the ADOS-2 are then interpreted in combination with those from the parental reports, interviews by the clinician, and other data sources to determine the appropriateness of an ASD diagnosis and the related severity levels. While the clinicians have the opportunity to interact with and to observe the child, they still must rely on the parent ratings and descriptions of the child's developmental history as well as how the child functions in day-to-day life in order to inform diagnosis and recommendations.

Some research has suggested that individuals diagnosed with less severe symptoms have symptom trajectories that improve over time while those with more severe symptoms have stable symptom trajectories (Szatmari, 2015). The same study also examined adaptive functioning and found a similar pattern, with lower adaptive functioning being associated with worsening functioning, moderate level severity being associated with a stable trajectory, and higher levels of adaptive functioning being associated with improved functioning over time (Szatmari, 2015). Later diagnoses are also associated with increased levels of parental stress and delay early intervention, which is known to be key to improving the efficacy of the interventions (Elder et al., 2017).

Influences on Parent Report

Parent Characteristics

Parent ratings of their child's ASD symptom severity is likely to be influenced by the parents' individual characteristics as well as the child's actual symptom severity. Researchers have examined the relationship between some of these characteristics and ratings of symptom severity to determine associations and to identify moderators to severity ratings. The data indicating that ASD has a basis in parental age at conception lends itself to the question of the influence of parental age on ASD severity ratings. A study consisting of the ratings of 252 children (ages two to 17) by their parents evaluated this question utilizing the Autism Spectrum Disorder-Diagnostic Child Version (ASD-DC; Rieske & Matson, 2020). Parent's ratings on the ASD-DC were used as the outcome variable to represent ASD severity. It is important to note that this instrument is actually measuring the parent's perception of their child's ASD severity. Paternal age at conception, not maternal age, was found to be a significant predictor of ASD severity over and above the child's age and sex (Rieske & Matson, 2020). This demonstrates that fathers who were older at the time of conception rated their child's ASD severity as more severe. It is possible that these children would have also been rated as more severe by an independent clinician, but Rieske & Matson (2020) did not include this information for reference. Conversely, mothers in this study tended to report more ASD symptoms than fathers indicated (Dovgan et al., 2019). Unobservable symptoms, such as emotional competence and nonverbal comprehension, make up the majority of disagreements between mothers' and fathers' reports, as they typically agree more on the observable behaviors (Dovgan et al., 2019).

Parental education level and SES are frequently related, as advanced levels of education tend to result in higher salaries and greater SES also makes it easier for individuals to pursue higher levels of education. For these reasons, it can be difficult to isolate the two phenomena from each other. Dovgan and colleagues (2019) examined familial factors such as these to determine the influence they have on how parents perceive their child's ASD severity. This study utilized parent reports of children ages two to 17 (N=3,055) and was completed via a telephone survey. Parents were asked about child factors such as age and sex as well as family variables such as the highest level of education in the household and income levels. Child variables explained 4.8% of the variance in parent ratings of ASD severity and family factors explained 1.4% of additional variance, both of which were found to be significant. When Dovgan and associates examined the familial factors more closely, it was revealed that the financial contributors (including education level) explained 3% of variance, an amount which was also significant. Comparatively, Zablotsky and colleagues (2015) found no association between SES or parental education and ratings of ASD severity within a sample of 967 parents of children diagnosed with ASD.

Maternal level of education has also been found to influence perception of the child’s symptom severity (Gadow et al., 2016; Selin et al., 2018). Parent and teacher ratings of ASD symptoms as well as overall impairment for 221 children six to 18 years old demonstrated this impact (Gadow et al., 2016). While maternal education was not correlated with ASD symptoms, it was a predictor of total impairment as reported by both parents and teachers. Parents with higher levels of education (advanced college degrees) reported the lowest rates of impairment due to ASD symptoms among their children. This again raises the question of whether education level influences perception, if parental education actually impacts symptom severity in children, or if access to services supersedes the influence of education on its own. Comparing parental ratings to those of a clinician aid in answering this question, as they would provide a rating of symptom severity that is not impacted by the parents’ education. Selin and colleagues (2018) compared parent ratings of their child’s language disorders to those of speech language pathologists (SLPs). On the average, parents’ ratings were less severe than those of the SLPs, but this relationship was not influenced by the maternal education level. This suggests that the difference in severity, at least for language disorders, may be the result of differences in perception rather than actual differences based on education.

Racial/Ethnic Differences

The rating forms used to assess ASD are typically normed emphasizing the majority population and, as a result, are susceptible to being culturally insensitive/biased. This may result in parent ratings that are less than reflective of a child’s true symptomatology due to ignoring cultural differences or nuances (Dovgan et al., 2019). It is also possible, of course, that the rating forms are appropriately reflecting the parent’s intended ratings and that cultural differences are actually influencing the parent’s perceptions, rather than the survey’s ability to capture those perceptions validly. Various cultural groups have their own values and beliefs about child development and, therefore, disability status (Blacher et al., 2014). For example, Puerto Rican families appear to have lower expectations of their children with disabilities than Anglo families, while Latino parents in general, not just those of Puerto Rican origin, appear to have higher expectations (Blacher et al., 2014). However, the findings surrounding how these differences influence parent ratings of child ASD symptom severity are mixed, with some finding divisions (e.g., Blacher et al., 2014; Dovgan et al., 2019) and others not (e.g., Rieske & Matson, 2020).

The distinction between these two potential explanations would be difficult to make, but Dovgan and colleagues (2019) did note differences between parents' ratings of ASD symptom severity as a function of race, ethnicity, and primary language spoken in the home. Families in which the parents were ELL were more likely to rate their child's ASD symptoms as severe rather than mild or moderate (Dovgan et al., 2019). On the other hand, Blacher and colleagues (2014), in a study of 83 Anglo and Latino mothers of children with ASD, found that Anglo mothers rated their children as having significantly more developmental concerns than Latino mothers did on the ADI-R. Despite this difference in parent reporting of symptoms, the Latino children actually had higher scores on the ADOS-2 administered by a clinician, reflecting more ASD symptomatology, than the Anglo children (Blacher et al., 2014).

In line with the parental characteristics discussed previously, ELL families were more likely than other families to have lower levels of education (less than high school) and lower household incomes (Dovgan et al., 2019). These demographic characteristics all relate to one another, and families from various races and ethnicities likely perceive their child's ASD symptoms differently as a result of the varying experiences, acculturation levels, and stress they all experience.

Impact on the Family

Another factor that may influence parental ratings of ASD severity is how the child's diagnosis impacts the family. A parent's perception of their child's ASD severity may be more swayed by impact of the child's diagnosis and symptoms on the family, and less by their impact on the child or the objective severity of the symptomatology. Zablotsky and colleagues (2015) evaluated this phenomenon in 967 parents of children across the United States who were between six and 17 years old. Parents completed multiple surveys and provided demographic information, all of which were used to create profiles of the extent to which the child's ASD impacted the family and the child, the symptomatology, and how the parents would describe the severity of the child's ASD. Parents who rated the family impact factor higher were significantly more likely to rate their child's ASD as the most severe. The child impact factor and the reported symptomatology had smaller influences on the parent's ratings. An availability heuristic may account for some of these differences, as parents are more likely to recall and be influenced by how they or their family are negatively affected by something than they are to recall the objective symptom presentation of their child.

Parent vs Teacher Ratings

Utilizing multiple raters when collecting information about a child, particularly parents and teachers, can provide a more in-depth and well-rounded view of the child's symptoms and presentation in various settings (Goulardins et al., 2018). Despite the potential benefits of employing multiple raters, there are mixed findings regarding rater agreement on symptom severity (Azad et al., 2016). Teacher reports appeared to have more significant associations with child clinical correlates, such as age, IQ, ethnicity, hospitalization, and diagnosis, than parent reports (Gadow et al., 2016). Assessing the agreement among 123 parent teacher dyads on the

Social Responsiveness Scale (SRS) revealed that parents and teachers significantly agreed on the level of impairment seen in children with ASD when the impairment was more severe but not when it was considered mild or moderate (Azad et al., 2016). On the other hand, evaluating social difficulties for children with ADHD, parent and teacher ratings demonstrated no significant concordance regardless of ADHD severity (Goulardins et al., 2018). Overall, teacher's ratings of social behavior correlated with clinical observations of symptom severity, while the parent's ratings did not for children with ASD (Azad et al., 2016).

When evaluating students diagnosed with ASD with the Behavior Assessment System for Children, Second Edition (BASC-2), teachers consistently rate children's symptoms as more severe than their parents rate them (Ellison et al., 2016; Nicpon et al., 2010). For children and adolescents with high functioning ASD, teachers also reported that adolescents demonstrated higher levels of adaptability than younger children (Nicpon et al., 2010). Parents rated adaptability, functional communication, and social skills as significantly more severe than teachers rated them (Ellison et al., 2016). These findings persisted when utilizing the Vineland Adaptive Behavior Scales, Second Edition (VABS-II), with parents providing significantly more severe ratings than teachers for school age children (Dickson et al., 2018). Parents and teachers reportedly had higher levels of agreement regarding communication skills, but this relationship was impacted by the child's ASD severity, as determined by a clinician. Greater severity was associated with higher levels of agreement between parents and teachers (Azad et al., 2016), specifically regarding social approach/withdrawal, but with lower levels of agreement regarding receptive/expressive social communication (Dickson et al., 2016).

Parent and teacher ratings for Attention Deficit/Hyperactivity Disorder (ADHD) symptoms also demonstrate the common disagreement between parent and teacher ratings. For example, parents' reports on the Conners Rating Scale Revised: L (CRS:RL) of 129 children identified 25% of the children as meeting criteria for "clinically significant" ADHD problems while teacher's reports identified only 12% of the children as in that range (Goulardins et al., 2018).

Critique of Literature

The studies reviewed primarily had large sample sizes and evaluated middle to upper class families. However, the few studies that focused on families of lower SES or minority populations had significantly smaller sample sizes. Disparities in representation throughout the studies may reflect real differences among families seeking services due to systematic restraints, such as the high cost of receiving ASD treatment or evaluations. Nevertheless, there is reason to believe that the limitations of diversity within the samples may have skewed results and limited their generalizability. Overall, the literature concerning influences on parental ratings of ASD symptom severity is scarce despite the large role these ratings play in whether or not a child is brought in for an evaluation, diagnosed with ASD, and/or provided with treatment. The few studies that have examined these relationships frequently rely exclusively on parental ratings of ASD symptom severity as the outcome measure, instead of utilizing a clinician's more objective ratings of severity to determine the influence outside factors may have on the parents' ratings. Adding clinician's ratings may provide more information about the correlations identified in the current research (Dovgan et al., 2019).

The current literature review has examined the association among parents' perceptions of their child's ASD symptom severity and various other personal, familial, and environmental factors, such as age, sex, SES, race, ethnicity, and teacher perceptions. Very little research has evaluated to what extent those parental ratings of severity fall in line with clinician ratings of the same child's ASD severity. However, when evaluating ASD symptom severity utilizing the ADOS-2, clinicians reported that Latino children had higher ADOS-2 scores, indicating more ASD symptomatology, than Anglo children while parents' reports indicated the opposite relationship (Blacher et al., 2014). This inconsistency between parent and clinician ratings was also found when evaluating communication difficulties in children without ASD. SLP's rated the children's deficits as more severe than the parents' ratings (Selin et al., 2018). Understanding this connection will aid clinicians in making better informed decisions regarding diagnosis as well as intervention recommendations. It will also likely assist in increasing parental support of the intervention process, as parents would be able to understand better the diagnosis and how their input was utilized.

Parents' perceptions have long been used as a guide for research surrounding the etiology of ASD and the differences among various presentations. An awareness of how parental perception relates to or influences clinician perceptions of ASD severity could better inform etiology research to provide more objective differences in symptom severity that are less influenced by factors such as SES or the impact on the family. Additionally, a recently published theoretical literature review suggested that "any diagnosis that is excessively dependent on the scores of ADOS-2 or ADI-R could be clearly carrying gender bias consequences" (Navarro-Pardo et al., 2021, p. 6). Complementary measures, such as the VABS-II are needed in ASD assessments as an additional measure of severity to provide a more comprehensive and inclusive depiction of the child. Future research should examine the association between parental ratings of ASD severity and clinician ratings of ASD severity as well as whether that connection is moderated by factors such as child age, child sex, parental age, education, SES, race, and/or ethnicity.

Research Objectives

The proposed research project has three objectives:

1. To determine whether there is an association between parent ratings of adaptive functioning on the VABS-II and clinician ratings of ASD symptom severity on the ADOS-2.
2. To determine the degree to which parent ratings of adaptive functioning predict diagnosis of autism based on the ADOS-2. An optimal cut-off score will be examined using sensitivity and specificity statistics.
3. If yes to one, to determine whether the association between parent ratings of child adaptive functioning and clinician ratings of ASD symptom severity is moderated by demographic variables (i.e., ethnicity, and primary language spoken in the home, and socioeconomic status).

Research Hypotheses

H1: Parent ratings of child adaptive functioning on the VABS-II will be inversely related to clinician ratings of ASD symptom severity on the ADOS-2.

H2: Parent ratings of child adaptive functioning on the VABS-II will be able to predict ASD diagnosis based on the ADOS-2 diagnostic cut-off score.

H3: The association between parent ratings of child adaptive functioning and clinician ratings of ASD symptom severity will be moderated by child and family demographic factors in varying degrees.

Chapter 3: Method

The aim of this study is to examine the association between parent rated adaptive functioning on the VABS-II and clinician rated ASD symptom severity on the ADOS-2 for children suspected of having ASD. The predictive potential of the VABS-II Adaptive Behavior Composite for ASD diagnosis based on the ADOS-2 will be examined with the goal of identifying a VABS-II cut-off score for administering the ADOS-2. Additionally, potential moderating factors (i.e., ethnicity, primary language spoken in the home, and socioeconomic status) will also be investigated.

Participants

Participants are those who sought ASD assessments through a community mental health clinic in the Southeastern United States that specializes in ASD evaluations. Families who completed the VABS-II and had a clinician complete the ADOS-2 were included in the study. All families consented to the use of their deidentified data for research and educational purposes and all participant data were de-identified before use in the study. In order to de-identify the data, once a client's evaluation had been completed and a chart had been created, clinicians would enter their demographic information and test scores into a password protected excel file. This de-identified excel file was then converted into an SPSS file and shared with the current researcher. No one involved in the current research was involved in the de-identification. All testing data that did not pertain to the current study (i.e., scores for other assessments administered) were then removed from the SPSS file. Of the 278 participants, six were removed for missing ADOS-2 total scores and/or module information. An additional 11 were removed for missing VABS-II Adaptive Behavior Composite scores. This resulted in a remaining 261 participants, of whom 56 identified as female and 205 identified as male. Thirty-one percent identified as Caucasian, 26.8% as Hispanic, 16.9% as African American/Black, 2.3% as Asian, 13.8% as bi/multiracial, 1.9% as other, and 7.3% chose not to report. Additionally, 82.8% of the participants reported English as their primary language, 11.1% reported Spanish. Regarding parental education, 25.7% of mothers had completed some college (*n* = 67), 20.3% had earned their bachelor's degree (*n* = 53), 16.1% had a masters or graduate degree (*n* = 42), and 15.3% completed high school (*n* = 40). Nineteen and nine-tenths percent of the fathers had completed some college (*n* = 52), 16.5% completed high school (*n* = 43), 16.5% earned their bachelor's degrees (*n* = 43), and 12.3% had masters or graduate degrees (*n* = 32). Participant ages ranged from two to 21 years old (m=5.81 years, SD = 3.67 years). Sixty-nine and three-tenths percent of the participants were diagnosed with ASD following their evaluation (*n* = 181). See Table 1 for parent demographics and Table 2 for child demographics.

Table 1

Parent Characteristics

	Frequency	Percent
Maternal Education		
<High School	4	1.5%
High School	40	15.3%
Some College	67	25.7%
Associate's	22	8.4%
Bachelor's	53	20.3%
Masters/Graduate	42	16.1%
Professional/Technical	5	1.9%
Doctorate	12	4.6%
Not Reported	16	6.1%
Paternal Education		
<High School	3	1.1%
High School	43	16.5%
Some College	52	19.9%
Associate's	17	6.5%
Bachelor's	43	16.5%
Masters/Graduate	32	12.3%
Professional/Technical	7	2.7%
Doctorate	13	5.0%
Not Reported	51	19.5%

Table 2

Child Demographics

	Frequency	Percent
Sex		
Female	56	21.5%
Male	205	78.5%
Age at Evaluation		
2	26	10.0%
3	51	19.5%
4	54	20.7%
5	25	9.6%
6	28	10.7
7	14	5.4%
8	13	4.9%
9	9	3.5%
10	8	3.1%
11	10	3.8%
12	5	1.9%
13	5	1.9%
14	5	1.9%
15	2	0.8%
16	1	0.4%
18	2	0.8%
20	2	0.8%
21	1	0.4%
Primary Language		
English	216	82.8%
Spanish	29	11.1%
Other	5	1.9%
Not Reported	11	4.2%
Ethnicity		
Caucasian	81	31%
Hispanic	70	26.8%
African American/Black	44	16.9%
Asian	6	2.3%
Bi/Multiracial	36	13.8%
Other	5	1.9%
Not Reported	19	7.3%
Autism Diagnosis		
Yes	181	69.3%
No	80	30.7%

Measures

Adaptive functioning was evaluated utilizing the VABS-II parent/caregiver rating form. A parent/caregiver of individuals being evaluated for ASD completed the VABS-II rating form as part of the ASD evaluation. ASD symptom severity was evaluated via clinician observation and rating on the ADOS-2. A clinician trained in administering the ADOS-2 completed the assessment as a part of the complete ASD evaluation.

VABS-II

The VABS-II is a measure of adaptive behavior for individuals ages birth to 90 years old. The survey has both parent/caregiver and teacher rating forms (Sparrow et al., 2005). The parent/caregiver measure has two versions, interview and rating forms. These versions both produce domains for communication, daily living skills, socialization, and motor skills. An optional maladaptive behavior domain score can also be used to assess problem behaviors (Sparrow et al., 2005). The teacher rating form also measures the four main domains but focuses on behaviors that can be seen in the classroom. For the purposes of this study, the parent/caregiver rating form was be used.

The parent/caregiver rating form is comprised of 433 items used to assess all four adaptive behavior domains as well as the optional maladaptive behavior domain. Internal consistency reliability was evaluated using a split-half analysis. Of 154 reliabilities calculated between the various subdomains, over half were .90 or greater and only six were less than .80 (Sparrow et al., 2005). No systematic differences across age groups or subdomains were found. Sparrow and colleagues (2005) conducted a confirmatory factor analysis which found either a three or four factor model to fit the data better than a one factor model for all age ranges. A moderately high correlation of .70 was found between the VABS-II Adaptive Behavior

Composite score and the ABAS-II General Adaptive Composite score for ages birth to five years, .78 for ages five to 20, and .69 for ages 17 to 74, indicating construct similarity and validity between the measures (Sparrow et al., 2005).

The VABS-II parent rating form indicates starting points based on the child's age, and parents are instructed to start each section with the age-appropriate item. Parents are instructed to answer each item following the indicated starting point by marking the rating that best describes how often their child performs the described behavior without assistance (Sparrow et al., 2005). Each item has four response options: two indicates the child usually performs the behavior, one indicates the child sometimes or partially performs the behaviors, zero indicates the child never performs the behavior, and DK indicates that the parent does not know whether or not the child performs the behavior. Parents are also instructed that if the child has outgrown the behavior to rate it a two (Sparrow et al., 2005). Parent/caregiver questions regarding items can be noted by circling the question mark next to the corresponding item.

To score the VABS-II, basal and ceiling scores must first be identified. Basal items are identified as the highest item after which four consecutive ratings of two were assigned (e.g., item 10 if items seven to 10 were rated two). Ceiling items are the lowest items after which four consecutive ratings of zero were assigned (Sparrow et al., 2005). If no basal item is identified, the first item in the section is the basal, and if no ceiling item is identified, the last item in the section is the ceiling. All items before the basal item are be calculated as having a score of two (Sparrow et al., 2005). The sum of these scores is be marked in the appropriate box for items before basal. All DK and/or missing items per subdomain are also be added up and marked in the box labeled "DK and/or Missing Total." If there are more than two DK and/or missing items in a subdomain then that subdomain cannot be scored (Sparrow et al., 2005). If the subdomain can be scored, the number of zero ratings is then be totaled and marked in the box labeled “N/O Total.” The sum of two and one ratings is also calculated and marked in the box labeled “Sum of 2s and 1s.” The sum of four boxes is then used as the subdomain raw score (Sparrow et al., 2005).

In order to interpret the scores, raw scores are first transferred to the score summary page of the score report. Using tables specific to chronological age ranges in Appendix B of the manual, raw scores are converted to *v*-scale scores for each subdomain (Sparrow et al., 2005). The sums of *v*-scale scores are then calculated by adding together all *v*-scale scores for each domain, respectively, and converted to domain standard scores. For children ages birth to six years and 11 months, all four domain standard scores are then summed, and for individuals ages seven years and older, the sum of the communication, daily living skills, and socialization standard scores is calculated. This sum is then converted to a new standard score for the Adaptive Behavior Composite, using the appropriate table based on chronological age in Appendix B of the manual (Sparrow et al., 2005). Percentile ranks, adaptive levels, and stanine scores can also be found for each domain as well as the composite score. Subdomain adaptive levels and age equivalents can be found in the manual.

ADOS-2

The ADOS-2 is an evaluation tool used to assess individuals with suspected ASD diagnoses. The measure has five separate modules for utilization with children, adolescents, and adults with varying language functioning (Lord et al., 2012). The Toddler Module is intended for children 12 to 30 months old with pre-verbal or single word language. Module 1 is for use with children 31 months old and older, with pre-verbal or single word language. Children using phrase speech should be evaluated using Module 2. Children and young adolescents with fluent speech should be evaluated with Module 3, and older adolescents and adults with fluent speech should be evaluated with Module 4 (Kamp-Becker et al., 2018; Lord et al., 2012). All modules are completed via semi-structured interview and observation between a trained clinician and the client. Inter-rater reliability demonstrated strong to very strong correlations, ranging from .79 to .98 for the various modules (Kamp-Becker et al., 2018; Lord et al., 2012). Comparing the ADOS-2 to another measure of ASD symptomatology, the ADI-R, revealed 75% agreement in diagnoses with most disagreements resulting in false-positive diagnoses (Kamp-Becker et al., 2018). Modules include a variety of play, interactive, and verbal tasks depending on the language level of the individual. Some planned social interactions are created during the observation as well and are referred to as 'presses' to create situations in which interpersonal interactions and communication would be likely (Lord et al., 2012).

The respective modules of the ADOS-2 each has a different number of set coding observations and items. The Toddler Module has 11 observations and 41 items; Module 1: 10 observations and 34 items; Module 2: 14 observations 29 items; Module 3: 14 observations and 29 items; Module 4: 15 observations and 29 items (Lord et al., 2012). Each observation opportunity provides a varying level of structure for the presses provided by the clinician to assess the individual's involvement in social interactions. The clinician scores all items directly after completing the module. Some items are rated based on a single observation, but many rely on an overview of behaviors throughout the observation (Kamp-Becker et al., 2018; Lord et al., 2012). When scoring, the clinician rates each item on a scale of how present the abnormal behavior in question is in relation to the individual's chronological age. Most response options range from zero, indicating an absence of abnormality, to three, indicating a clear presence of the abnormal behavior (Kamp-Becker et al., 2018; Lord et al., 2012). For example, a score of zero may indicate that the individual made eye contact in response to hearing their name, while a score of three may indicate that the person did not look toward the clinician at all following a verbal bid for attention. Some items provide ratings of seven and eight as well to provide options for a wider range of behaviors. The response booklets provide specific definitions and descriptions of what behaviors qualify for each rating per item (Lord et al., 2012).

After scoring the items, the clinician converts item scores into algorithm scores, such that ratings of three are converted to two, ratings of seven or eight are converted to zero, and ratings of zero, one, and two remain the same. These new algorithm scores are then summed to create total Social Affect and Restrictive Repetitive Behavior scores. Those two scores together become the Overall Total score (Lord et al., 2012). Overall Total scores on Modules 1 through 4 are converted, using a table on the record form based on chronological age, to Comparison Scores. The Comparison Score is then used to determine level of ASD-related symptoms. Scores of one and two reflect minimal to no evidence of ASD symptoms, three and four reflect low levels, five through seven reflect moderate levels, and eight through 10 reflect high levels of ASD-related symptoms (Lord et al., 2012). For the Toddler Module, scores are calculated in the same way but are not converted to a Comparison Score; instead, the Overall Total score is utilized to indicate level of concern for an ASD diagnosis. The three categories' (little-to-no concern, mild-to-moderate concern, and moderate-to-severe concern) score ranges vary depending on whether the child has few to no words or is older with some words (Lord et al., 2012). Modules 1 to 4 also provide diagnostic cut-off scores based on the Overall Total score. The cut-off scores vary depending on the module but are used to help determine whether the individual does or does not have ASD (Lord et al., 2012).

Procedures

Data Collection

Participants were selected from an existing database of those who sought ASD evaluations from November 2016 to February 2020, prior to the Coronavirus pandemic, at a community health clinic in the Southeastern United States that specializes in ASD evaluations. Those who had one parent complete the VASB-II and a clinician complete the ADOS-2 were be included. Participants provided consent for their de-identified data being used for educational and research purposes prior to the study and their information was de-identified prior to the study. The demographic information was collected from the participants' parent during an initial intake interview. Parents were then asked to complete the VABS-II on their own, and a clinician completed the ADOS-2 with the child.

IRB Requirements

Before any analysis of the data was conducted, approval by the Institutional Review Bord (IRB) at Nova Southeastern University was obtained on October 6, 2021 as an Exempt study (Protocol #: 2021-455).

Statistical Analysis

The data analytic strategy consisted of several steps. First, a simple linear regression model was estimated to determine the degree to which parent ratings on the VABS-II (*independent variable*) are related to clinician ratings on the ADOS-2 (*dependent variable*). Upon examining the assumptions, the data appeared bimodal and therefore a logistic regression was estimated. A receiver operating characteristic (ROC) curve was then conducted to evaluate overall accuracy of prediction along with sensitivity and specificity values associated with cut-off scores.

Next, an additional linear regression model was estimated to assess whether key demographic variables moderate the association between parent ratings on the VABS-II and clinical ratings on the ADOS-2 (i.e., Demographics-BY-VABS-II interaction effects). The number of demographic variables had to be limited due to the sample size, and, as a result, only ethnicity, primary language, socioeconomic status were evaluated. These demographic variables were selected as a result of the stronger support for them within the literature over parent education, and the sample limitation of largely unequal numbers of male and female participants. Assumptions underlying all statistical models were evaluated. All analyses were conducted using IBM SPSS 27.0 (IBM, 2020).

Chapter 4: Results

Hypothesis 1

A linear regression analysis was conducted to predict ADOS-II scores based on VABS-II Adaptive Behavior Composite scores. The underlying assumptions were evaluated, and although the association was relatively linear, a histogram of the residuals revealed a bimodal distribution around the diagnosis cut-off thresholds. As a result, the ADOS-II scores were dichotomized based on ASD diagnosis and a binary logistic regression was estimated to evaluate the probability of diagnosis (based on the ADOS-2 scores). Results from the binary logistic regression indicated that the VABS-II Adaptive Behavior Composite significantly predicted diagnosis as measured by the dichotomous version of the ADOS-2 scores (Odds Ratio = 0.971, p = 0.004). An odds ratio of 0.971 reveals that the odds of accurately diagnosing ASD decreases by 2.9% when VABS-II Adaptive Behavior Composite scores increase by one unit. See Table 3 for further details.

Table 3

Results from Binary Logistic Regression with VABS-II Composite

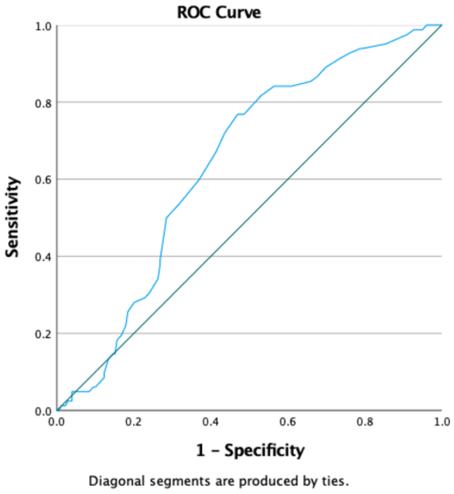
Predictor	B	SE	Wald χ^2	DF	Sig.	Odds Ratio (e^B)
VABS-II Adaptive Behavior Composite	-0.029	0.010	8.123	1	0.004	0.971

Hypothesis 2

VABS-II Adaptive Functioning Composite scores were used in an ROC curve analysis to predict ASD diagnosis based on the ADOS-2. The area under the curve (AUC = 0.641, $p <$ 0.001) reveals that the VABS-II significantly predicts no ASD diagnosis as determined by the ADOS-2. Lower scores on the VABS-II were associated with higher probability of being diagnosed with ASD based on the ADOS-2, as a result of the inverse relationship between adaptive functioning and ASD symptomatology. See Figure 1 for the ROC Curve. A table outlining the sensitivity and specificity of the VABS-II scores for predicting ASD diagnosis is also provided (see Appendix).

Figure 1

ROC Curve for VABS-II Composite Scores Predicting no ASD Diagnosis



Hypothesis 3

A linear regression analysis was conducted to assess whether key demographic variables moderate the association between parent ratings on the VABS-II and clinical ratings on the ADOS-2 (i.e., Demographics-BY-VABS-II interaction effects). The linear regression included the following effects: 1) mean centered VABS-II Adaptive Behavior composite, 2) demographic variables (i.e., ethnicity, primary language, and socioeconomic status), 3) interactions between the mean centered VABS-II Adaptive Behavior Composite and each of the demographic variables.

The key underlying assumptions of multiple linear regression were assessed. The Variance Inflation Factors (VIFs) and a plot of the residuals against the predicted values were examined. They revealed that effects did not have a high degree of multicollinearity, all less than the standard acceptable VIF 10 (Pituch & Stevens, 2015). In addition, the residual against predicted plot revealed a relatively random scattering, suggesting that the linear regression is an accurate representation of the data. The interaction effects were not statistically significant and therefore, the association between VABS-II Adaptive Behavior Composite scores and continuous ADOS-2 scores does not vary significantly based on ethnicity, primary language, or SES. Effect sizes approaching zero (0.002, 0.006, and 0.002 respectively for the interaction terms) taken into account with the sample size reveal that the analysis was adequately powered and not the cause of the lack of significance. Due to the bimodal nature of the ADOS-2 scores in the initial linear regression, a binary logistic regression was also estimated utilizing the dichotomized ADOS-2 scores. The results were consistent, no significant associations, and are therefore not included in this document. See Table 4 for more details.

Table 4

Results from Linear Regression with Interaction Terms

	Unstandardized B	Coefficients Standard Error	Standardized Coefficients Beta	t	P value	Semi-Partial Correlation Squared	VIF
VABS-II Adaptive Behavior Composite	0.360	0.107	0.487	3.355	0.001	0.065	3.650
Ethnicity	0.9923	0.464	0.154	1.991	0.049	0.023	1.045
Primary Language	3.141	1.543	0.164	2.035	0.044	0.024	1.134
SES	-2.091E-6	0.000	-0.012	-0.155	0.877	1.44E-4	1.070
Ethnicity x VABS-II	-0.023	0.037	-0.067	-0.608	0.544	0.002	2.093
Language x VABS-II	-0.131	0.125	-0.088	-1.051	0.295	0.006	1.213
SES – VABS-II	6.030E-7	0.000	0.066	0.609	0.544	0.002	1.056

Notes. $R^2 = 0.274$

Chapter 5 Discussion

When conducting ASD evaluations, clinicians rely heavily on parent ratings of symptomatology and their own clinical observations of the child. The ADOS-2, a clinician based interactive observation tool, is considered the gold standard for assessing children suspected of having ASD, but it is a time-consuming tool that requires specialized training for both administration and interpretation (Elder et al., 2017). The VABS-II is a parent report form that is frequently utilized by clinicians to gain insight into how the child's symptoms are presenting outside of the clinical setting (Gadow et al., 2016). While both of these measures are frequently used in tandem during ASD evaluations, there is a scarcity of literature examining the connection between parent ratings of their child's symptom severity and those of the clinician. The purpose of this study was to examine the association between parent and clinician ratings of a child's ASD symptomatology. Exploring this connection is important due to the frequency of its use in clinical settings and the potential for it to inform future assessments and to increase the accessibility of ASD evaluations. This examination was broken down into three parts: first determining if there was an association between parent ratings of adaptive functioning on the VABS-II and clinician ratings of ASD symptom severity on the ADOS-2, second examining the role of potential moderators of that association, and third determining the predictive power of the VABS-II for ASD diagnosis based on the ADOS-2. Two of the three hypotheses were supported by the findings of this study, all three of which will be examined below.

Although the association between parent and clinician ratings of ASD symptomatology could not be evaluated linearly, due to the bimodal nature of the ADOS-2 data, an association was found. It was hypothesized that parent ratings of child adaptive functioning on the VABS-II would be inversely related to clinician ratings of ASD symptom severity on the ADOS-2. The logistic regression analysis indicated that the hypothesis was correct, parent ratings of child adaptive functioning on the VABS-II were inversely related to ASD diagnosis based on clinician ratings of ASD symptom severity on the ADOS-2. Diagnosis was determined following the ADOS-2 pre-determined cut-off scores per module, and higher VABS-II Adaptive Behavior Composite scores (indicating higher levels of adaptive functioning) were associated with no diagnosis while lower VABS-II Adaptive Behavior Composite scores (indicating lower levels of adaptive functioning) were associated with a diagnosis based on the clinician rated ADOS-2. This is logical, as higher scores on the VABS-II are indicative of better adaptive functioning, which would make an ASD diagnosis less likely, while lower Adaptive Behavior Composite scores would be expected to be associated with ASD diagnoses. Although this inverse association is frequently assumed, due to the nature of the constructs being measured, this finding fills a gap in the literature by specifically evaluating the connection.

After establishing the inverse association between the VABS-II and the ADOS-2, this study aimed to determine the accuracy of parent ratings of adaptive functioning on the VABS-II predicting diagnosis of autism on the ADOS-2 based on pre-existing ADOS-2 cut-off scores, along with sensitivity and specificity. This aimed to fill a gap in the literature and aid clinicians in being able to conduct more cost effective and accessible ASD evaluations. An optimal cut-off score for the VABS-II to predict diagnosis was determined by examining sensitivity and specificity statistics. It was hypothesized that parent ratings on the VABS-II would be able to predict ASD diagnosis accurately based on the ADOS-2 diagnostic cut-off scores. The ROC curve indicated that the hypothesis was correct. Parent ratings were able to predict ASD diagnosis significantly based on the ADOS-2 cut-off score.

In order to determine a VABS-II cut-off score, a balance of sensitivity and specificity was reached to capture individuals who likely would and would not receive an ASD diagnosis best based on ADOS-2 scores. Utilizing a cut-off of 74.50 on the VABS-II Adaptive Behavior Composite would allow for a sensitivity of 0.720 and a specificity of 0.564. Sensitivity refers to the proportion of individuals who are correctly identified as having ASD, based on the ADOS-2. Specificity refers to the proportion of individuals who are correctly identified as not being diagnosed with ASD based on the ADOS-2. A higher sensitivity, and in turn lower specificity, is preferred in this study, as it would be preferable to have more false positives (individuals who do not have ASD but the VABS-II predicts they do) than false negatives (individuals who have ASD but the VABS-II predicts they do not). Individuals who scored at or below the cut-off would be indicated for further ASD evaluation via the ADOS-2, and individuals who scored above the cut-off would not. This break down of sensitivity and specificity would result in more children being evaluated using the ADOS-2 than may be necessary, but would decrease the likelihood of missing a diagnosis. With a base rate of five percent, less than five percent of the population receives a score of 74 or below on the VABS-II Adaptive Behavior Composite, which supports the recommendation that those individuals should be referred for further evaluation via the ADOS-2. Additionally, an Adaptive Behavior Composite score cut-off of 74.5 represents the difference between the fourth and fifth percentile ranks, with a score of 75 corresponding to the fifth percentile and 74 corresponding to the fourth percentile.

VABS-II Adaptive Behavior Composite scores are whole numbers, and, therefore, the application of the cut-off score would be as follows: clinicians would be recommended (in conjunction with clinical judgement) to utilize the ADOS-2 with individuals with VABS-II scores of 74 or below and not with individuals with VABS-II totals of 75 or above. Both are also within the Moderately Low Adaptive Level, which is a clinically significant category suggestive of meaningful functional impairments, demonstrating not only statistical reasons for utilizing this cut-off but also a clinical one.

Finally, the researcher examined whether the association between the VABS-II and the ADOS-2 was moderated by demographic variables, specifically ethnicity, primary language spoken in the home, and socioeconomic status. Although the literature regarding moderating variables is mixed, it was hypothesized that these demographic characteristics would moderate the association between parent and clinician ratings to varying degrees.

The linear regression indicated that this hypothesis was incorrect. Demographic variables did not significantly moderate the association between parent and clinician ratings and were, in fact, highly correlated. This finding is not particularly surprising, as research regarding the influence of these factors is rather mixed. Some studies have reported significant associations between SES and parent ratings of ASD symptoms (Dovgan et al., 2019), while others found no significant relationship (Zablotsky et al., 2015).

Similar divisions were also found in the literature regarding the influence of racial and ethnic differences on parent ratings of ASD symptomatology, with some studies finding cultural differences (Blacher et al., 2014; Dovgan et al., 2019) and others not (Rieske & Matson, 2020). A potential explanation for the difference in findings regarding race and ethnicity is the language spoken in the home. Despite this, findings regarding the influence of primary language on parent ratings of ASD severity were also mixed within the literature. Some research reports parents who are English Language Learners rate their child's symptoms as more severe, while other research (although with a predominantly English-speaking sample) indicated that mothers who speak English as their first language report more concerns (Dovgan et al., 2019; Blacher et al., 2014).

The lack of consistent findings within the literature is mirrored by the collinearity and lack of significant findings in this study. It is possible that the limitations of the sample (i.e., high levels of similarity due to the use of one clinic and similar geography) may have influenced this analysis. The resulting implications and future recommendations will be discussed in following sections.

Implications

The implications of these findings suggest that the VABS-II can be used as a screening tool for ASD evaluations to aid in determining the utility of administering the ADOS-2. This has the potential of improving ASD evaluations through streamlining, greatly decreasing the time and cost, and, in turn, increasing accessibility. Clinicians would benefit by being able to target their evaluations better, spending time on more appropriate measures for the child's presentation and less time on overall testing per client. Decreasing the barriers to ASD evaluations would also benefit families by increasing their ability to receive an accurate diagnosis quickly and to begin appropriate interventions in a timely manner. The high cost of the ADOS-2, both in time and money, makes it inaccessible for many individuals and clinicians across settings (Colombi et al., 2019; Luallin et al., 2022). The lower cost of VABS-II relative to the ADOS-2, regarding rote cost of materials as well as training required by the clinician, means that use of the VABS-II as a screening tool could greatly increase accessibility. Clinicians would likely be able to lower overall costs of ASD evaluations, resulting in more families being able to afford the evaluations.

Limitations and Future Directions

Although useful, this study does have limitations. One key limitation is that the VABS-II was utilized to collect the parent information, but the VABS-III has been published. Due to availability within the clinic where data were collected, it was not feasible to utilize the newer edition for this particular study, but future studies should confirm the findings with the new edition. In addition, the sample used for the study is a unique sample, limiting the generalizability of the findings. Specifically, participants came from the same geographic area and clinic and had similar socioeconomic statuses. Now that the association and predictive power has been determined in a relatively small sample from a limited area, future research should be conducted with a more representative sample to confirm the findings. It will also be important to expand the scope of the study with a larger sample that is more representative of the general population. Re-examining the potential moderation of demographic variables, and including others, such as child age and sex, may be relevant and impact the generalizability of the findings.

Prior research has found that child factors, such as age and sex, explain a significant amount of variance in parent ratings of ASD symptom severity (Dovgan et al., 2019). The literature also suggests differences in parent and clinician ratings based on the sex of the child, with females being rated as less severe by clinicians than parents (Navarro-Pardo et al., 2021). Further exploring the role these factors play could be vital to the generalizability of the findings. Similarly, the sample was composed of 21.5% female and 78.5% male children. While the prevalence of ASD is also skewed in this direction, it would be beneficial to have a sample that better represents female children as well.

It is also important to note the limitations regarding the sensitivity and specificity of the proposed VABS-II cutoff score. A sensitivity of 0.720 means that 72% of individuals will be accurately identified as having ASD but there would be a false negative rate of 0.280. As a result, the VABS-II would inaccurately recommend not administering the ADOS-2 28% of the time. For this reason, it is vital that clinicians use the VABS-II in conjunction with other measures and as a part of a complete battery.

Future research should also examine the utility of other measures in predicting ASD diagnosis based on the ADOS-2 and increasing predictive power when combined with the VABS-II. Clinicians utilize a variety of measures in conjunction with one another, and some of the most frequently used should be evaluated as well. According to Elder and colleagues (2017), those include the Ages and Stages Questionnaire-Third Edition (ASQ-3), Modified Checklist for Autism in Toddlers-Revised Follow-up (M-CHAT-R/F), Social Communication Questionnaire (SCQ), Gilliam Autism Rating Scale-Third Edition (GARS-3), and the Autism Diagnosis Interview-Revised (ADI-R). Altogether, this study should be viewed as a pilot and, hopefully, the first of many evaluations of ways to increase accessibility of psychological evaluations. Additional studies will be needed to confirm the proposed cut-off score.

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APPENDIX

Sensitivity and Specificity per Predictive Probability

VABS-II Score	Sensitivity	Specificity
40.00	1.000	0
43.00	1.000	.006
46.00	1.000	.011
48.50	1.000	.017
51.00	1.000	.022
52.50	1.000	.028
53.50	1.000	.039
55.00	.988	.05
56.50	.988	.067
57.50	.988	.073
58.50	.976	.089
59.50	.963	.117
60.50	.951	.145
61.50	.939	.207
62.50	.939	.212
63.50	.927	.24
64.50	.915	.263
65.50	.890	.302
66.50	.866	.324
67.50	.854	.341
68.50	.841	.391
69.50	.841	.436
70.50	.817	.469
71.50	.793	.492
72.50	.768	.514
73.50	.768	.531
74.50	.720	.564
75.50	.671	.587
76.50	.598	.631
77.50	.537	.682
78.50	.500	.715
79.50	.390	.732
80.50	.378	.732
81.50	.341	.737
82.50	.305	.76
83.50	.293	.771
84.50	.280	.799
85.50	.256	.816
86.50	.220	.821
87.50	.195	.832
88.50	.184	.844
89.50	.146	.849

90.50	.146	.855
91.50	.134	.866
92.50	.098	.877
93.50	.085	.877
94.50	.061	.899
95.50	.049	.905
96.50	.049	.916
97.50	.049	.933
99.00	.049	.944
101.00	.049	.961
102.50	.024	.961
104.50	.024	.972
106.50	.012	.978
107.50	.012	.983
109.00	.012	.989
116.00	.000	.994
123.00	.000	1.000