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Higher depressive symptoms in early adolescents with Autism Spectrum Disorder by self- and parent-report compared to typically-developing peers

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Abstract

Background: Depression is more prevalent among male early adolescents with Autism Spectrum Disorder (ASD) than their typically- developing (TD) peers, but findings are limited to two male-only studies. Therefore, a broader understanding of depressive symptoms among both male and female early adolescents with ASD in larger samples is needed. Self- and parent-ratings are frequently used, yet rater differences may emerge and provide unique insights.

Method: Ratings of adolescent depressive symptoms were examined among 230 early adolescents (10:0–13:5 years) with and without ASD using self- (Children's Depression Inventory, Second Edition; CDI-2) and parent- report (Child Behavior Checklist; CBCL) measures. The influence of diagnostic group (ASD vs. TD) and rater (early adolescent vs. parent) on ratings were examined with Full Scale IQ and sex as covariates. Additionally, the reliability and strength of agreement between raters were examined.

Results: Higher depressive symptoms were reported by both raters in the ASD group (Borderline range) compared to the TD group (Average range). The interaction of diagnostic group and rater was nonsignificant, but significant main effects emerged. Sex was a significant covariate, but Full Scale IQ was not. The reliability and strength of agreement between raters in the ASD group only were not significant.

Conclusions: Findings suggest that depressive symptoms may be higher in both male and female early adolescents with ASD across self- and parent- reports. However, measurement of depression in ASD may be complicated by nonsignificant reliability and strength of agreement

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between raters. Results have implications for screening and intervention for early adolescents with ASD.

Keywords

Autism; depression; early adolescence; typically-developing peers; parent ratings

Individuals with Autism Spectrum Disorder (ASD) exhibit deficits in social communication and interaction, with the presence of restricted, repetitive behaviors and interests (APA, 2013). Impairments in social functioning have been associated with various challenges including fewer initiations to peers (Chang & Locke, 2016), less friendships (Nabors, Hawkins, Yockey, Booker, & Tipkemper, 2017), and heightened loneliness (Hedley, Uljarević, Wilmot, Richdale, & Dissanayake, 2018). Social impairments have also been associated with elevations in psychiatric comorbidities common among individuals with ASD (Cederlund, Hagberg, & Gillberg, 2010). Research indicates that 70–95% of individuals with ASD report at least one comorbid psychiatric disorder (Joshi et al., 2010; Lever & Geurts, 2016) and 48–60% with two or more during their lifetime (Lever & Geurts, 2016; Mazefsky, Anderson, Conner, & Minshew, 2011; Simonoff et al., 2008). Among adolescents with ASD, the most common psychiatric comorbidities are anxiety, ADHD, language disorders, and depression (Joshi et al., 2010).

Depression Prevalence

With regards to depression prevalence among typically-developing (TD) adolescents, the 12-month prevalence was estimated at 11.3% (Mojtabai, Olfson, & Han, 2016). Epidemiological studies emphasize the importance of earlier screening for depression in adolescence as 50% of all lifetime cases start at 14 years old and 75% by 24 years old (Kessler et al., 2005). Earlier screening is vital to earlier intervention given that earlier age of onset of depression (i.e., adolescence) affects the course and is associated with greater illness and burden across the lifetime as compared to individuals with onset at later ages (i.e., 24 and older; Zisook et al., 2007).

Findings from a recent meta-analytic review of studies assessing lifetime and current prevalence of unipolar depressive disorders in children, adolescents, and adults with ASD suggest that lifetime and current prevalence was 14.4% and 12.3%, respectively (Hudson, Hall, & Harkness, 2019). Lifetime prevalence rates have been estimated at 11.7% for post-pubertal adolescents with ASD (Merikangas et al., 2010). Based on findings from their meta-analytic review, Hudson, Hall, and Harkness (2019) reported that individuals (children, adolescents, adults) with ASD are 4-times more likely to experience depression in their lifetime than TD peers. The authors suggest that variations between this summary and the lifetime and current prevalence rates in ASD may be accounted for by measurement differences (self-report vs. clinician interview), developmental period, and intellectual functioning (i.e., higher symptoms among individuals with higher intellectual functioning; Hudson, Hall, & Harkness, 2019). Despite these findings, less is known about prevalence and severity of depressive symptoms among early adolescents with ASD (Hudson, Hall, & Harkness, 2019).

Depression: Presentation in Adolescents with and without Autism

Depression is a constellation of core (e.g., depressed mood, anhedonia) and associated (e.g., low self-esteem, suicidal ideation) symptoms that cause distress (APA, 2013) and have been linked to poor long-term outcomes in adulthood (McKenzie, Olsson, Jorm, Romaniuk, & Patton, 2010; McLeod, Horwood, & Fergusson, 2016; Naicker, Galambos, Zeng, Senthilselvan, & Colman, 2013; Vassallo, Edwards, Renda, & Olsson, 2014; Verboom, Sijtsema, Verhulst, Penninx, & Ormel, 2014). Specifically in adolescence, depression may manifest as irritable mood and has been associated with heightened suicide risk (Thapar, Collishaw, Pine, & Thapar, 2012; Windfur et al., 2008), school refusal and/or early termination (Fletcher, 2010; Quiroga, Janosz, Bisset, & Morin, 2013), psychosocial challenges (Auerbach, Bigda-Peyton, Eberhart, Webb, & Ho, 2011; Lee, Hankin, & Mermelstein, 2010), substance use (Gámez-Guadix, Orue, Smith, & Calvete, 2013; Horwitz, Hill, & King, 2011; Keenan-Miller, Hammen, & Brennan, 2007), and other health-related challenges (Hasler et al., 2005; Myrtveit et al., 2014). Despite the necessity for intervention, depression is more often missed in adolescents than adults, which leaves many adolescents undiagnosed and untreated for years (Bertha & Balázs, 2013; Leaf et al., 1996; Thapar, Collishaw, Pine, & Thapar, 2012).

Adolescents with and without ASD may experience depression, but an understanding of developmental differences may be vital to accurate diagnosis and treatment. To start to understand these differences, many researchers have examined depressive symptoms in children with and without ASD as rated by parents (Mayes, Calhoun, Murray, Ahuja, & Smith, 2011). Differences in mood disturbance (e.g., greater irritability and anxiety) and heightened sleep problems may be unique depressive symptoms among children with ASD (Hess, Matson, & Dixon, 2010; Mayes, Calhoun, Murray, Ahuja, & Smith, 2011; Mayes, Calhoun, Bixler, & Vgontzas, 2009). Moving into adolescence, heightened social loneliness and poor friendship quality are more closely associated to depressive symptoms in ASD than in TD adolescents (Whitehouse, Durkin, Jaquet, & Ziatas, 2009). Increased self-injury and regression of adaptive skills may be depressive symptoms unique to adolescents with ASD (Magnuson & Constantino, 2011), though continued investigation with larger comparative samples is warranted.

With regards to sex-based differences in depression, a strong evidence base supports a higher depression prevalence among adolescent females than males in TD cohorts (Avenevoli, Swendsen, He, Burstein, & Merikangas, 2015; Breslau et al., 2017; Essau, Lewinsohn, Seeley, & Sasagawa, 2010). This pattern in adolescence is a continuation of sex-based differences observed in childhood (i.e., higher prevalence among females; Maughan, Collishaw, & Stringaris, 2013; Parker, & Brotchie, 2010) that extend into adulthood (Albert, 2015; Altemus, Sarvaiya, & Epperson, 2014). With regards to older adolescents with ASD, the majority of studies suggest no significant differences between males and females in depression (Cassidy, Bradley, Shaw, & Baron-Cohen, 2018; Hurtig et al., 2009; Rosenberg, Kaufman, Law, & Law, 2011; Worley & Matson, 2011). However in older cohorts, some studies have reported higher prevalence among females (Oswald et al., 2016) or males with ASD (Mayes, Gorman, Hillwig-Garcia, & Syed, 2013; Matson & Williams, 2014). Specifically in early adolescence, many studies indicate higher prevalence and severity of

depressive symptoms among TD females as compared to their male peers (Avenevoli, Swendsen, He, Burstein, & Merikangas, 2015; Breslau et al., 2017; Essau, Lewinsohn, Seeley, & Sasagawa, 2010); however, less is known about symptoms in early adolescence among males and females with ASD. The present study focused on rater bias, reliability, and agreement among early adolescents with and without ASD and their parents; however, sex-based differences in the literature suggest that controlling for sex as a covariate in the present study is warranted.

Measurement of Depression in Autism

Screening for depression among children with and without ASD is reliant upon parental report (Kendall, Cantwell, & Kazdin, 1989; Moretti, Fine, Haley, & Marriage, 1985); over the course of development, self-reported measures of depression and other psychiatric symptoms are more frequently used. In early adolescence (i.e., prior to puberty), both self- and parent-rated measures of depressive symptoms are utilized and studies of self-reports among TD early adolescents are robust (Bertha & Balázs, 2013; Thapar, Collishaw, Pine, & Thapar, 2012); however, there are fewer studies of self-reports among early adolescents with ASD (Gotham, Brunwasser, & Lord, 2015; Pezzimenti, Han, Vasa, & Gotham, 2019). Therefore, a greater understanding of depressive symptoms among early adolescents with ASD using self-reports is warranted and may provide insights into prevalence during this critical developmental period.

For adolescents with ASD, accurate screening and diagnosing depression may be further hindered by diagnostic overshadowing as several symptoms of depression (e.g., constricted affect, social withdrawal; APA, 2013) are also symptoms in ASD (Pezzimenti, Han, Vasa, & Gotham, 2019). Diagnostic overshadowing is particularly problematic in ASD given pre-existing deficits in social functioning (Pezzimenti, Han, Vasa, & Gotham, 2019; Taylor & Gotham, 2016). Preexisting social difficulties among youth with ASD may also contribute to the emergence and phenotype of depression in this population (Hollocks et al., 2014; Strang et al., 2012) and specifically, social comparison to peers (i.e., one’s perceived self-other disparity) may be a salient factor of depressive symptoms among adolescents with ASD (Hedley & Young, 2006). Elevated vulnerability to depression among adolescents with ASD presents as a prominent safety concern due to increased risk of suicidality (Chen et al., 2017; Pezzimenti, Han, Vasa, & Gotham, 2019) and self-injurious behaviors (Taylor & Gotham, 2016). Comorbid depression in adolescents with ASD has also been associated with decreased functioning in adulthood including higher rates of unemployment, loneliness, family strain, as well as reduced friendships and adaptive skills (Williams, O’Connor, Eder, & Whitlock, 2009; Mazefsky, Conner, & Oswald, 2010). These findings are concerning for adolescents as depressive symptoms often persist and worsen over time without intervention (Gadke, McKinney, & Oliveros, 2016).

Additionally, diagnostic overshadowing may be further complicated by the limited research into the reliability and validity of gold standard depression measures as applied to adolescents and adults with ASD (Pezzimenti, Han, Vasa, & Gotham, 2019). A study (Gotham, Unruh, & Lord, 2015) reported acceptable to strong internal reliability for several gold standard depression measures when completed by 50 adolescents and adults with ASD

(16–31 years) including the Beck Depression Inventory, Second Edition (BDI-II: Beck et al., 1996), Self-Report Depression Questionnaire (SRDQ; Reynolds & Baker, 1988), Children's Depression Inventory, Parent-Rated Version (CDI-P; Kovacs, 1992), and the Children's Depression Rating Scale (CDRS; Poznanski & Mokros, 1996). Another study of the CDI, Child-Rated Version (Kovacs, 1992) as completed by 38 adolescents with ASD reported comparable reliability coefficients to the typically-developing literature, but a high rate of false negatives among youth with ASD (Mazefsky, Kao, & Oswald, 2011). Researchers across both studies emphasize the exploratory nature of the findings and importance of large-scale reliability and validity studies of these depression measures in ASD, which remains a gap in the research.

Depression and Early Adolescence

In the general population, depressive symptoms often emerge during adolescence and have been linked to pubertal timing such that increases in depressive and anxious symptoms occur simultaneously with the start of puberty (Angold, Costello, & Worthman, 1998; Costello, Egger, & Angold, 2005; Kaltiala-Heino, Kosunen, & Rimpela, 2003). Early adolescence is a critical developmental window to screen and treat emerging depressive symptoms for all youth and families (Hudson, Hall, & Harkness, 2019). Extensive research has been conducted on pubertal development and accompanying depressive and anxious symptoms in TD cohorts (Conley, Rudolph, & Bryant, 2012; Heim & Binder, 2012; Kaltiala-Heino, Kosunen, & Rimpela, 2003; for a comprehensive review see Negriff & Susman, 2011). Less research has been conducted on depressive symptoms during pubertal development in ASD (Hudson, Hall, & Harkness, 2019; Merikangas et al., 2010).

Complicating this, a reliable and valid measure of depression in ASD has not been developed (Pezzimenti, Han, Vasa, & Gotham, 2019; Strang et al., 2012). To account for this, researchers and clinicians often elicit ratings of depressive symptoms from multiple raters (e.g., adolescents, parents; Pezzimenti, Han, Vasa, & Gotham, 2019). Self- and parent-reports have identified different types of depressive symptoms and degrees of severity, which inform case conceptualization and treatment planning for depression in ASD (Pezzimenti, Han, Vasa, & Gotham, 2019). However, few studies have examined depressive symptoms among early adolescents with ASD per self- and parent-report and how depressive symptoms may or may not differ as compared to TD cohorts.

Depressive Symptoms as Rated by Early Adolescents and/or Parents

In fact, only two studies to date compared self-reported depressive symptoms between early adolescents with and without ASD, and both studies only included males (Ozsivadjian, Hibberd, & Hollocks, 2014; Bitsika & Sharpley, 2015). In the first study by Ozsivadjian and colleagues (2014), 30 early adolescent males with ASD endorsed higher depressive symptoms on the Children's Depression Inventory (CDI; Kovacs, 1992) than 21 TD males. In the Ozsivadjian study (2014), parents of early adolescent males with ASD also rated higher depressive symptoms on the CDI, *Parent Version* (CDI; Kovacs, 1992) than parents of TD males. However, a small sample size and lack of females limited the generalizability of findings. In the second study, Bitsika and Sharpley (2015) included a moderate sample of

adolescent males with ASD (n = 70) who endorsed more depressive symptoms on the depression subscale of the Child and Adolescent Symptoms Inventory (CASI; Gadow & Sprafkin, 1998) than TD males (n = 50). Parent ratings of adolescent depressive symptoms were not examined (Bitsika & Sharpley, 2015).

Across self- and parent-reports, depressive symptoms appear higher among early adolescent males with ASD than their TD peers. However, this conclusion is only supported by two studies and requires continued investigation. Moreover, both studies were limited by small or moderate samples without female participants and multi-informant ratings, which are important elements to understanding depressive symptoms more broadly in early adolescence.

Depressive Symptoms: Rater Differences

Although depressive symptoms were higher at the group level among self- and parent-reports in the ASD group in the Ozsivadjian study (2014), the strength of agreement and reliability between raters were nonsignificant. This finding mirrors the discrepancies between raters on depressive symptoms reported in other studies with post-pubertal adolescents with ASD (White & Roberson-Nay, 2009; Hurtig et al., 2009). Differences across raters may be beneficial in identifying areas of need that may be overlooked by one rater. Simultaneously, discrepant ratings may contribute to diagnostic overshadowing and delayed treatment (Pezzimenti, Han, Vasa, & Gotham, 2019), which likely exacerbate the severity of depressive symptoms in ASD (Gotham, Unruh, & Lord, 2015). In fact, the prevalence rates of depressive symptoms among adolescents and adults with ASD vary widely due to discrepancies between raters, observation challenges, and measurement difficulties (Gotham, Unruh, & Lord, 2015; Mayes, Calhoun, Murray, & Zahid, 2011).

In contrast, reliability and strength of agreement were significant between TD early adolescents and their parents in that study (Ozsivadjian, Hibberd, & Hollocks, 2014), which matched results from other studies of higher reliability and strength of agreement between raters in TD cohorts (e.g., Youngstrom, Loeber, & Stouthamer-Loeber, 2000). Despite higher agreement among TD raters, the vast majority of studies on self- and parent-rated measures among adolescents report low reliability and poor agreement between raters (Cantwell, Lewinsohn, Rohde, & Seeley, 1997; De Los Reyes, & Kazdin, 2005; Yeh, & Weisz, 2001). Discrepancies between raters in TD cohorts suggests the importance of including both self- and parent-report among adolescents with ASD, particularly for measuring affective states or depression (Mazefsky, Kao, & Oswald, 2011). In a TD cohort, one study reported higher agreement between TD adolescents and their parents on similar indices of depressive symptoms on the self-rated CDI total score and parent-rated Affective Problems subscale of the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001; Nakamura, Ebesutani, Bernstein, & Chorpita, 2008). Researchers concluded that the comparison of CDI-2 total scores and CBCL Affective Problems scores may be an acceptable method to understanding ratings of depressive symptoms from multiple raters, especially when comparison using the same measure across raters may not be feasible and/or available (Nakamura, Ebesutani, Bernstein, & Chorpita, 2008). Given this, an examination of ratings on the CDI and CBCL may be useful with early adolescents with ASD and their parents.

Present Study

The goal of the present study was to examine depressive symptoms among a large sample of male and female early adolescents with ASD as compared to TD peers participating in the first year of a longitudinal study on pubertal development (Corbett, 2017). Measures of depressive symptoms completed by both early adolescents (CDI-2) and their parents (CBCL) were used to understand symptoms from multiple perspectives. The primary goals of this study were to evaluate: (a) the influence of diagnostic group (ASD vs. TD) and rater (early adolescent vs. parent) on ratings of depressive symptoms in this sample, and (b) reliability and strength of agreement between raters. Similar to studies of older cohorts (Hankin et al., 1998; Merikangas et al., 2010), it is likely that more depressive symptoms will be endorsed by early adolescents with ASD and their parents as compared those in the TD cohort. Due to documented discrepancies between raters (De Los Reyes, & Kazdin, 2005; Yeh, & Weisz, 2001), it is likely that rater may emerge as an important factor in assessing adolescent depressive symptoms. Additionally, high reliability and strength of agreement between raters in the ASD cohort is expected given the high reliability and agreement between self-rated CDI and parent-rated CBCL scores in TD populations (Nakamura et al., 2008).

Methods

Participants

The total sample included 230 early adolescents (10:0–13:5 years), 155 males and 75 females, of which 133 had ASD (mean age = 11.4) and 97 were TD peers (mean age = 11.5). Recruitment efforts were aimed at a broad community sample from a 200-mile radius in the southern region of the United States and included participants from research registries, medical health-related network services, well-check and diagnostic clinics, regional autism/disability organizations, schools, and social media platforms. Demographic information for all early adolescents is presented in Table 1.

Inclusion criteria for the total sample included participants: (a) 10:0–13:5 years old, (b) with intellectual functioning at or above 70 on the Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II; Wechsler, 2011) in order to complete self-report measures, and (c) willing to attend a study visit of approximately 3 hours. For early adolescents with ASD, a previous medical diagnosis of ASD was required and diagnostic status was subsequently confirmed via elevated scores ≥ 15 on the Social Communication Questionnaire (SCQ; Rutter et al., 2003) and a score of seven or higher on Module 3 of the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Lord et al., 2012) administered by research-reliable personnel.

Exclusion criteria included: (a) the presence of a neurological or medical condition known to influence pubertal development (e.g., genetic disorder), (b) severe aggression (i.e., unable to complete study protocol safely and/or causing bodily harm to self, others, or property) per parent report and clinical observations during study visits, and (c) low intellectual functioning (FSIQ < 70). For TD early adolescents, exclusion criteria also included scores ≥ 10 on the SCQ (i.e., elevated symptoms characteristic of ASD) and a sibling with ASD. An

additional exclusion criterion for all participants was the use of medications (e.g., GABA agonists, Cortisone) that are known to alter physiological response, such as functions of the hypothalamic-pituitary-adrenal axis (for a full list of medications, see Granger, Hibel, Fortunato, & Kapelewski, 2009). Prior to inclusion in the study, informed written consent was obtained from all parents and assent was collected from all early adolescents. All procedures performed in this study were approved by the University Institutional Review Board and with the 1964 Helsinki declaration and its later amendments.

Procedures

Participant eligibility was assessed during an initial visit (2 hours) at the university-based clinic. Parents of TD participants completed the SCQ during this visit, while early adolescents completed the WASI-II. For early adolescents with ASD, diagnosis was confirmed by review of DSM criteria (American Psychiatric Association, 2013), administration of the ADOS-2, and scores ≥ 15 on the SCQ. In a second study visit (3 hours), all early adolescents completed a series of behavioral experiments and self-report questionnaires (including the CDI-2) as part of the larger longitudinal study (Corbett, 2017). Parents completed questionnaires one week prior to the second study visit, while early adolescents completed their questionnaires during this visit and independently of their parents. Due to time sensitivity of several measures (e.g., CDI-2), parents and early adolescents completed measures within one week of each other to prevent differences in reporting time.

It is important to note that the two measures of depressive symptoms analyzed in this study were not identical across raters (early adolescent vs. parent) due to the nature of the longitudinal study of pubertal development in ASD (Corbett, 2017). Although self- and parent-report versions of the CDI-2 are available, the parent-report version was not included in the original research protocol and thus, was not available for analysis in the present study. Therefore, early adolescents rated depressive symptoms on the CDI-2 in the present study, while parents rated adolescent depressive symptoms on the Affective Problems domain of the parent-report CBCL based on findings in TD cohorts (Nakamura, Ebesutani, Bernstein, & Chorpita, 2008).

Dependent Measures

Children's Depression Inventory, Second Edition, Self-Report (CDI-2; Kovacs, 1992).—The CDI-2 contains a self-report questionnaire for children 7–17 years old that measures cognitive, affective, and behavioral depressive symptoms and includes a severity index on a 3-point scale. The total score is comprised of two domains (Emotional Problems, Functional Problems) with two subscales each including Negative Mood and Anhedonia (Emotional Problems) and Interpersonal Problems and Ineffectiveness (Functional Problems). Raw scores are converted to T-scores and youth with T-scores ≤ 59 are in the "Normal" category of depression severity, 60–64 in the "High Average" category, 65–69 in the "Elevated" category, and T-scores ≥ 70 are in the "Very Elevated" category. In the current study, early adolescents who endorsed "I think about killing myself but would not do it" or "I want to kill myself" on Item #8 of the CDI-2 met with study personnel to assess risk and ensure safety.

Child Behavior Checklist, Ages 6–18, Parent Form (CBCL; Achenbach & Rescorla, 2001).—The CBCL is a parent-report questionnaire that measures competencies and problem areas in a variety of domains for youth 6–18 years old. Raw scores are converted to T-scores and youth with T-scores ≤ 64 are in the "Normal" category of severity, 65–69 in the "Borderline" category, and T-scores ≥ 70 are in the "Elevated" category. In the current study, the following subscales of the CBCL were used for analyses: (a) Anxious/Depressed, (b) Affective Problems, and (c) Internalizing Problems. Although distinct measures, the CDI-2 and CBCL possess similarities in the following domains: (1) both use a 3-point Likert scale, (2) raw scores are converted to T-scores, and (3) a clinical cutoff of T ≥ 65 indicates clinically significant scores.

Depressive Symptoms by Diagnostic Group, Rater, and Their Interaction.—Given that previous studies suggest the reliability of comparing CDI-2 Total T-scores and CBCL Affective Problems T-scores in TD cohorts to be adequate (Nakamura, Ebesutani, Bernstein, & Chorpita, 2008), the T-scores from these two domains of separate measures were combined in the present study to examine the influence of diagnostic group (ASD vs. TD), rater (early adolescent vs. parent), and their interaction on ratings of depressive symptoms.

Reliability and Agreement Between Raters.—The CDI-2 Total and CBCL Affective Problems T-scores were also analyzed to identify level of reliability between raters (early adolescent vs. parent). Subsequent analyses were conducted to identify strength of agreement between raters on severity of depressive symptoms (i.e., Average, Borderline, Elevated). However, new ordinal categories of severity were needed for the CDI-2 in order to match those of the CBCL to create consistency across the two measures. To do this, the severity categories of the CDI-2 (i.e., Average, High Average, Elevated, Very Elevated) were assigned new ordinal categories to match the ordinal severity categories of the CBCL (Average, Borderline, Elevated). This was feasible given that the CDI-2 and CBCL utilize T-scores and similar cutoff scores to identify individuals with clinically elevated symptoms. First, the T-scores of the CDI-2 in the "Average" (T ≤ 59) and "High Average" (T ≤ 64) categories were combined and ranked as "Average" given that this same T-score range is categorized as "Normal" on the CBCL. Second, the T-scores of the CDI-2 in the "Elevated" (65–69T) category were ranked as "Borderline" given that this same T-score range is categorized as "Borderline" on the CBCL. Lastly, T-scores of the CDI-2 in the "Very Elevated" (T ≥ 70) category were ranked as "Elevated" given that this same T-score range is categorized as "Elevated" on the CBCL.

Statistical Analyses

Analyses were conducted using SPSS software (version 25; IBM SPSS Statistics, IBM Corporation) and statistical significance was determined at $p \leq 0.05$, two-tailed tests. Descriptive statistics were calculated using means and standard deviations for continuous variables and numbers and proportions for categorical variables. Independent samples t-tests were employed to examine differences between groups on demographic variables and to screen for any potential covariates that may influence the dependent variables (CDI-2, CBCL). The Full Scale IQ (WASI-II) and SCQ scores were significantly different between

groups (see Results section). The FSIQ scores were included as a covariate in analyses given evidence suggesting a relationship between IQ score and depressive symptoms in the ASD literature (Hudson, Hall, & Harkness, 2019). However, SCQ scores were not included as covariates in analyses in order to examine the potential effect of autism symptomology on group differences. Additionally, sex was included as a covariate given robust evidence of higher prevalence among females than males among TD adolescents and adults with ASD. A chi-square test for association was conducted between biological sex and diagnostic group (ASD vs. TD).

To test the first hypothesis, the two covariates (FSIQ, sex) underwent additional screening to determine if they met the analysis of covariance (ANCOVA) assumptions: linearity, homogeneity of regression slopes, and independence of covariates (Field, 2005). The T-scores from the CDI-2 Total and CBCL Affective Problems were analyzed using a composite two-way ANCOVA to examine effects of diagnostic group (ASD vs. TD), rater (early adolescent vs. parent), and their interaction on depressive symptoms. In this two-way ANCOVA, the two covariates were accounted for, ratings of adolescent depressive symptoms were the within-subjects factor, and diagnostic group and rater were the between-subjects factors. Bonferroni corrections were applied to correct for multiple comparisons. To test the second hypothesis, the reliability between raters was calculated using intraclass correlation coefficients (ICC) with T-scores from the CDI-2 Total and CBCL Affective Problems in the total sample and within the ASD and TD groups. Strength of reliability for ICC was interpreted as: (a) poor, ICC < 0.5, (b) moderate, ICC = 0.50–0.75, (c) good, ICC = 0.75–0.90, and (d) excellent, ICC > 0.90 (Koo & Li, 2016). Given the ordinal nature of the severity categories (i.e., Average, Borderline, Elevated), Cohen's κ was calculated to estimate strength of agreement between raters on the severity categories from the CDI-2 Total Severity and CBCL Affective Problems. Strength of agreement for Cohen's κ was interpreted as: (a) poor agreement < 0.00, (b) slight agreement 0.00–0.20, (c) fair agreement 0.21–0.40, (d) moderate agreement 0.41–0.60, (e) substantial agreement 0.61–0.80, and (f) almost perfect agreement > 0.80 (Landis & Koch, 1977).

Results

Study Population

The total sample included 230 early adolescents with (n = 133) and without (n = 97) ASD ranging from 10:0–13:5 years of age (M = 11.5, SD = 1.1). The total sample included 81.5% Caucasians, 9.7% African Americans, 0.5% Asian, and 8.2% Mixed race. Regarding ethnicity, 5.6% of the sample was Hispanic/Latino. Although no significant differences emerged between groups by age (see Table 1), sex was different between groups with more males in the ASD group (ASD: 99 males and 34 females; TD: 56 males and 42 females), which is attributed to a higher prevalence of ASD in males (Baio, 2012). The larger longitudinal study (Corbett, 2017) actively recruited females with ASD, which afforded data on depressive symptoms among female early adolescents with and without ASD for analysis in the present study. The ratio of male to female early adolescents in the ASD group was not equivalent in the present study, but resembled the 4:1 gender ratio reported in recent prevalence estimates from the Center for Disease Control (Maenner et al., 2020). Continued

recruitment and engagement of females with ASD in research is an ongoing initiative that will provide important insights into pubertal development in this cohort. As expected, there were significant group differences on autism symptomatology on the SCQ with higher values in the ASD group. Additionally, significant group differences emerged on Full Scale IQ scores with higher scores in the TD group. Despite this, IQ scores fell in the average range among early adolescents with ASD and in the above average range for the TD group. Given these differences and findings from the literature (Hudson, Hall, & Harkness, 2019), adolescent sex and FSIQ scores were controlled for as covariates in the composite two-way ANCOVA.

Depressive Symptoms by Diagnostic Group (ASD vs. TD), Rater (Early Adolescent vs. Parent), and Their Interaction

A two-way ANCOVA model was fit on the data with FSIQ and biological sex as covariates, ratings of adolescent depressive symptoms (T-scores from the CDI Total and CBCL Affective Problems) as the within-subjects factor, and diagnostic group (ASD vs. TD) and rater (early adolescent vs. parent) as the between-subjects factors. Table 2 presents the means, adjusted means, standard deviations, and standard errors. The two covariates were screened and met the necessary ANCOVA assumptions to carry out analysis with the combined CDI-2 and CBCL scores. There was not a statistically significant interaction between diagnostic group and rater on depressive symptom T-scores, whilst controlling for FSIQ and biological sex, $F(2,436) = 1.465$, $p = 0.227$, partial $\eta^2 = 0.003$. There was a statistically significant main effect of diagnostic group, $F(1, 436) = 78.906$, $p < 0.001$, $\eta^2 = 0.152$. Adjusted marginal mean of depressive symptom T-scores in the ASD group ($M_{adj} = 62.63$) was higher than the TD group ($M_{adj} = 53.41$), a statistically significant difference of 9.226 T-scores, 95% CI [7.185, 11.267], $p < 0.001$. There was also a statistically significant main effect of rater, $F(1, 436) = 42.332$, $p < 0.001$, $\eta^2 = 0.088$. Adjusted marginal mean of depressive symptom T-scores among parent raters ($M_{adj} = 61.06$) was higher than the early adolescent raters ($M_{adj} = 54.98$), a statistically significant difference of 6.070 T-scores, 95% CI [4.236, 7.903], $p < 0.001$. Lastly, the covariate of sex was significant in the composite two-way ANCOVA, $F(1, 436) = 9.793$, $p = 0.002$, $\eta^2 = 0.022$. However, the covariate of FSIQ was not significant, $F(1, 436) = 0.385$, $p = 0.535$, $\eta^2 = 0.001$.

Agreement Between Raters (Early Adolescent vs. Parent) on Depressive Symptoms

In the total sample, ICC analyses revealed a significant, but “poor” reliability between T-scores from the CDI-2 Total Severity and CBCL Affective Problems (see Table 3). Within the TD group, ICC analyses revealed a significant, but “poor” reliability between raters. In contrast, the reliability between raters in the ASD group was nonsignificant. Given this, it appears that reliability of the total sample was primarily comprised of agreement between raters in the TD group.

For strength of agreement between raters on the CDI-2 and CBCL ordinal categories of severity, Cohen’s κ analyses revealed a significant, “slight” agreement between raters in the total sample (see Table 3). Raters in the TD group exhibited a somewhat stronger agreement on severity than that of the total sample, but still within the range of “slight” agreement. In contrast, raters in the ASD group exhibited a nonsignificant level of agreement on severity of

depressive symptoms. In sum, early adolescents and their parents in the TD group exhibited significant, but poor reliability and slight agreement in ratings of depressive symptoms. In contrast, early adolescents with ASD and their parents consistently differed in their ratings across these measures and ratings between them may be attributed to chance.

Discussion

This study was the first to compare self- and parent-reported depressive symptoms among a large sample of male and female early adolescents with Autism Spectrum Disorder (ASD) and as compared to ratings among TD peers. It was anticipated that more depressive symptoms would be endorsed by early adolescents and parents in the ASD group, though discrepancies may emerge between raters. Findings revealed that rater discrepancy does not differ by diagnostic group (i.e., the difference between self- and parent-reported adolescent depressive symptoms is similar for the ASD and TD groups). There were significant main effects of diagnostic group (i.e., higher severity in the ASD group) and rater (i.e., higher severity among parent raters) on depressive symptoms, and sex emerged as a significant covariate. In sum, early adolescents and their parents in each diagnostic group perceived similar levels of depressive severity at the group level. However, the reliability and strength of agreement between these raters were significant only in the TD group, with no significance in the ASD group. Results may suggest that raters in the ASD group perceive similar severity of depressive symptoms at the group level, yet nonsignificant reliability and agreement between these raters suggests that the comparison of CDI-2 and CBCL scores may not be a reliable method of understanding adolescent depressive symptoms from multiple raters in ASD. Additionally, future studies should examine sex-based differences in depressive symptoms among adolescents with and without ASD given that sex emerged as a significant covariate in the present study. Further research with larger samples of male and female early adolescents with ASD and objective ratings (e.g., clinician, teacher) completing various depression measures is needed to better understand rater bias.

Higher severity of depressive symptoms endorsed by early adolescents with ASD in this sample mirrors findings in other studies (Ozsivadjian, Hibberd, & Hollocks, 2014; Bitsika & Sharpley, 2015) and among adults with ASD (Chen et al., 2017). Results corroborate that depressive symptoms emerge during early adolescence for both ASD and TD cohorts, but at a higher severity among males and females with ASD. This pattern of elevated severity of depressive symptoms among early adolescents with ASD also emerged in parent ratings on multiple domains of the CBCL with parents of early adolescents with ASD rating adolescent depressive symptoms as more problematic than parents in the TD group. Although early adolescents and their parents completed different measures of depressive symptoms, elevated severity at the group level was reported by both raters in the ASD group and highlights the importance of multiple perspectives. This appears consistent with suggestions proposed by researchers to include multi-informant ratings to best characterize depression in ASD (Gotham, Unruh, & Lord, 2015; Hurtig et al., 2009). Importantly, higher ratings in the ASD group (i.e., approximately one standard deviation) suggests the need for earlier screening and intervention for early adolescents with ASD.

The present study focused on rater bias, reliability, and agreement in the largest sample of male and female early adolescents with and without ASD to date; however, sex emerged as a significant covariate, which highlights the need for a closer examination of sex-based differences in adolescent depressive symptoms among youth with and without ASD. Robust sex-based differences in depression have been documented among TD youth with higher prevalence among females (Avenevoli, Swendsen, He, Burstein, & Merikangas, 2015; Breslau et al., 2017; Essau, Lewinsohn, Seeley, & Sasagawa, 2010), which may provide, in part, an explanation to the emergence of sex as a significant covariate in the present study. However, studies of sex-based differences among early adolescents with ASD remain an outstanding gap in the literature and would be important to investigate. With regards to age, even the youngest participants (i.e., early adolescents 10:0–10:11) with ASD in the current sample exhibited higher severity of depressive symptoms are across self- and parent-reports. This appears consistent with findings of higher depressive severity among children with ASD as compared to peers (Mayes, Calhoun, Murray, Ahuja, & Smith, 2011; Mayes, Calhoun, Bixler, & Vgontzas, 2009) and further emphasizes the need for earlier screening and intervention. Without intervention or proper supports, subclinical depressive symptoms tend to persist and worsen throughout puberty and adolescence, which is concerning given associated safety concerns (e.g., suicidality, self-injurious behaviors; Chen et al., 2017) and long-term maladaptive outcomes (e.g., unemployment, loneliness, reduced friendships; Mazefsky, Conner, & Oswald, 2010). Although screening for depressive symptoms may be a more common practice in post-pubertal adolescents (Merikangas et al., 2010), findings from this study suggest that screening is also needed at earlier ages during puberty to facilitate earlier detection and intervention.

Findings revealed a nonsignificant interaction between diagnostic group and rater, which suggests that parents in both diagnostic groups show a consistent increase in ratings of adolescent depressive symptoms compared to the early adolescents themselves. It appears that parents may not share the same level of insight as early adolescents into depressive symptoms in both the TD and ASD groups. This finding highlights the challenge of rater bias and discrepancies in measuring depressive symptoms in adolescence as mentioned in the literature (White & Roberson-Nay, 2009; Hurtig et al., 2009), especially for those with ASD. Several possibilities may explain the finding that rater discrepancy does not differ by diagnostic group: (a) parents may over-report level of severity, (b) the use of self-reports alone may not be sufficient to capture severity, and/or (c) rater discrepancy in ASD may not be fully explained by lack of adolescent insight into their affective states as a similar discrepancy emerged among TD raters. It is possible that parents may over-report severity as observed in other studies (Cantwell, Lewinsohn, Rohde, & Seeley, 1997; De Los Reyes, & Kazdin, 2005; Yeh, & Weisz, 2001) and/or the use of self-reports alone may not be sufficient to capturing affective states (Hurtig et al., 2009; Ozsivadjian, Hibberd, & Hollocks, 2014; White & Roberson-Nay, 2009); however, a comparison of self and parent ratings to more objective ratings (e.g., clinician, teacher) may provide clarity. Some researchers have cautioned against the sole use of self-reports to measure affective states in ASD due to difficulties in social communication and identifying affective states in this population (Mazefsky & Oswald, 2011). Preliminary findings from the present study corroborate the challenge of relying on self-report alone in ASD, but, may also suggest that difficulties with

insight into affective states may not be unique among early adolescents with ASD as a similar discrepancy was observed between TD adolescents and their parents. Continued investigations of similar measures across adolescents, parents, and clinicians in larger samples are needed to elucidate this possibility.

In addition, group means may not provide an accurate characterization of depressive symptoms in early adolescence given poor reliability and slight agreement between raters in the TD group and nonsignificant indices in the ASD group. The reliability between raters in the TD group in the current sample is lower than previous reliability estimates between these measures in larger samples of TD adolescents (Nakamura, Ebesutani, Bernstein, & Chorpita, 2008), which may be accounted for by the younger cohort and smaller sample size in the present study. Among raters in the ASD group, nonsignificant ratings suggest that the CDI-2 and CBCL may not be comparable measures to consistently, reliably identify depressive symptoms in this population. This divergence mirrors findings of discrepancy between raters on adolescent social outings (Laugeson et al., 2009) and anxiety (Wood et al., 2015) in other studies, and aligns with the broader challenge of measuring comorbidities in youth with ASD (Brookman-Frazee, Stadnick, Chlebowski, Baker-Ericzen, & Ganger, 2018; Mazzone et al., 2012). The added challenge of measuring depressive symptoms in ASD may be partially accounted for by diagnostic overshadowing (Pezzimenti, Han, Vasa, & Gotham, 2019; Taylor & Gotham, 2016). Collectively, these measurement challenges in ASD are problematic given the maladaptive outcomes associated with elevated, untreated depressive symptoms (e.g., suicidality, self-injurious) and the vital role parents play in the enrollment of adolescents into treatment. Therefore, the development of a reliable, valid measure of depression in individuals with ASD that accounts for pre-existing difficulties with the recognition and communication of affective states is an urgent need. Moreover, a measure of depression in ASD should also include a broad age range to enable screening in early adolescence.

There are several limitations to this study that warrant a discussion. First, early adolescents and their parents completed different measures of depressive symptoms (CDI-2, CBCL) even though this approach has been supported by previous research (Nakamura et al., 2009). It will be important to investigate ratings from different raters using the same measure to better understand multiple perspectives of adolescent depressive symptoms among males and females. Second, the sample did not include equivalent numbers of males and females in the ASD group, which may limit the generalizability of findings. Although the current sample expanded on previous research by including females, it will be essential to include a larger number of females in future investigations to understand the emergence of depressive symptoms in this population and potential predictors. Third, the CDI-2 and CBCL have not been validated for assessing depressive symptoms in the ASD population, which constitutes an important limitation to the present study and reflects measurements challenges in ASD noted by others (Gotham et al., 2015; Magnuson & Constantino, 2011; Mayes et al., 2011). Lastly, Full Scale IQ and biological sex were controlled for in analyses as covariates, yet the participants were not matched on these variables and constitutes a limitation of the present study.

Implications

In summary, this study suggests that depressive symptoms are more severe among early adolescents with ASD as compared to TD peers across both self- and parent-reports. Findings revealed that rater discrepancy does not differ by diagnostic group, which highlights the broader question of rater bias during adolescence, particularly for those with ASD. Despite elevated severity at the group level, reliability and strength of agreement between raters in the ASD group were nonsignificant and suggest that the CDI-2 and CBCL may not be comparable measures for comparison in ASD. It appears that both self-and parent-rated measures are important for early adolescents with ASD as one rater's perspective may not be sufficient to accurately characterize depressive symptoms in ASD. Further research including similar measures across raters, objective ratings (e.g., clinician, teacher), larger samples, and more females with ASD will be necessary to build on these findings and to investigate potential mechanisms of depressive symptoms in early adolescents with ASD.

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Highlights

- Depressive symptoms are higher in male and female early adolescents with ASD than their peers
- Parents of early adolescents with ASD also report higher adolescent depressive symptoms
- Nonsignificant reliability and strength of agreement between raters in ASD group only
- Screening and intervention for depressive symptoms in ASD should occur during early adolescence

Table 1

Participant characteristics

	ASD (n = 133)	**TD (n = 97)**		
	M (SD)	**M (SD)**	**t Statistic**	**p value**
Age	11.4 (0.9)	11.5 (1.1)	1.032	0.306
Sex	99 males	56 males	$X^2 = 7.12$	**0.008**
Full Scale IQ	101.2 (20.9)	117.2 (15.1)	6.341	**0.000**
SCQ[a]	17.2 (8.2)	2.97 (2.9)	15.95	**0.000**
ADOS-2[b] Total	12.6 (4.6)	-	-	-

Bold font indicates significance ($p < 0.05$)

[a]Social Communication Questionnaire

[b]Autism Diagnostic Observation Schedule, Second Edition

Table 2

Means, adjusted means, standard deviations, and standard errors for adolescent depressive symptoms across diagnostic group (ASD vs. TD) and rater (adolescent vs. parent)

Diagnostic Group				
	ASD		**TD**	
Depressive Symptoms	**Early Adolescent**	**Parent**	**Early Adolescent**	**Parent**
M	58.70	65.89	51.43	56.32
(SD)	12.6	8.60	8.75	7.83
M_{adj}	59.04	66.23	50.94	55.87
(SE)	0.88	0.87	1.04	1.03

Note. Depressive symptoms measured by T-scores for the CDI-2 Total and CBCL Affective Problems.

Table 3

Strength of reliability and agreement between raters on depressive symptoms and severity categories

	ICC	Strength of Reliability	*p*		Cohen's K	Strength of Agreement	*p*
Total Sample	0.304	Poor	**<0.001**	Total Sample	0.134	Slight	**0.003**
ASD Group	0.195	Nonsignificant	0.067	ASD Group	0.032	Nonsignificant	0.577
TD Group	0.293	Poor	**<0.001**	TD Group	0.177	Slight	**0.017**

Bold font indicates significance ($p < 0.05$)