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Self-injurious behaviors in children with autism spectrum disorder enrolled in the Study to Explore Early Development

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Abstract

We assessed potential factors associated with “current” or “ever” self-injurious behaviors, reported in the Autism Diagnostic Interview–Revised, among children with autism spectrum disorder (n = 692) from the Study to Explore Early Development. Data on factors examined were obtained from questionnaires, standardized clinical instruments, and birth certificates. We employed a log-binomial regression to assess these associations. Although most associations were quite similar for currently and ever exhibiting self-injurious behaviors, a few differences were noted. We documented previously unreported associations of current self-injurious behaviors with maternal age and cesarean delivery, and ever self-injurious behaviors with maternal age, child sex, gestational age, and maternal race. We also confirmed previously reported associations with adaptive skills, somatic conditions (sleep, gastrointestinal, and sensory abnormalities), and other behavioral problems. These findings are informative for clinical practice and future research.

Keywords

autism; autism spectrum disorder; challenging behaviors; developmental disabilities; self-injurious behaviors

Autism spectrum disorder (ASD) is a pervasive neurodevelopmental condition characterized by impairments in social communication and interaction, and the presence of restricted and repetitive patterns of behaviors, interests, or activities (American Psychiatric Association (APA), 2013). Self-injurious behaviors (SIB) are reported in ASD (Baghdadli et al., 2003; Duerden et al., 2012; Minshawi et al., 2014a; Rattaz et al., 2015; Soke et al., 2016; Weiss, 2002). SIB include various repetitive and rhythmic behaviors, such as arm biting, head banging, and hair pulling, that occur without an apparent intent of willful self-harm but may pose significant risk of harm to self (Dempsey et al., 2016; Fee and Matson, 1992).

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Individual consequences of SIB may include injuries (e.g. lacerations, contusions, concussions, bleeding) and infections that can result in emergency room visits and hospitalizations (Devine, 2014; Ianuzzi et al., 2015; Minshawi et al., 2014b). Those with SIB are more likely to be excluded from educational and vocational activities and placed in residential facilities (Devine, 2014; Ianuzzi et al., 2015; Minshawi et al., 2014b). SIB can affect the entire family (e.g. high medical expenditures and stress) (Ianuzzi et al., 2015), and increase the societal costs of care in those with ASD (Minshawi et al., 2014b). The etiology of SIB is not completely understood, and most likely results from interactions between biological (e.g. genetic and somatic conditions) and environmental factors (e.g. inability to communicate and interact with others). Furthermore, in those with developmental disabilities, SIB may serve different functions, such as communication, social interaction, and self-regulation (Carr, 1977; Devine, 2014; Guess and Carr, 1991; Kurtz et al., 2012; Soke et al., 2017).

There are few large epidemiological studies that examine SIB in ASD (Matson and Goldin, 2013). This limits the ability to fully delineate risk factors for SIB and to develop targeted interventions (Soke et al., 2017). Risk factors for SIB examined in past studies varied depending on the study. In general, no significant associations were reported between SIB and race/ethnicity or sex (Baghdadli et al., 2003; Horovitz et al., 2011; Kozlowski et al., 2012; Sell et al., 2012). In contrast, low cognitive and adaptive skills, presence of other challenging behaviors, and somatic conditions, including sleep and sensory problems, were associated with SIB (Baghdadli et al., 2003; Carroll et al., 2014; Duerden et al., 2012; Goldman et al., 2011; Kanne and Mazurek, 2011; Schroeder et al., 2014). Inconsistent results were reported concerning associations of SIB with child chronological age (Baghdadli et al., 2003; Duerden et al., 2012; Esbensen et al., 2009; Murphy et al., 2009), autism severity (Baghdadli et al., 2003; Duerden et al., 2012; Rattaz et al., 2015), gastrointestinal problems (Buie et al., 2010; Christensen et al., 2009; Kang et al., 2014; Kennedy and Thompson, 2000, as cited by Thompson and Caruso, 2002; Maenner et al., 2012), and developmental regression (Lance et al., 2014; Soke et al., 2017; Wiggins et al., 2009).

Lack of power due to small sample sizes, selection bias that may have resulted from inclusion of children from clinical samples, and limited external validity of the findings are some of the limitations of past studies (Duerden et al., 2012). In addition, the diversity of instruments used to assess SIB, including both non-standardized and standardized questionnaires, such as the Autism Diagnostic Interview–Revised (ADI-R) (Lord et al., 1994) and the Childhood Autism Rating Scale (CARS; Schopler et al., 1986), impedes the ability to combine findings meta-analytically to increase power. Large studies that examine SIB in children with ASD recruited from educational as well as clinical settings are needed. Furthermore, to our knowledge, no study has compared the factors associated with currently observed SIB (“current SIB”) versus ever having exhibited SIB (“ever SIB”). The purpose of this study is to enhance our knowledge of factors influencing SIB by assessing potential associations with current and ever SIB, reported in the ADI-R, in a community-based sample of children with ASD. In addition, this study evaluates the concordance between parental report of SIB on the ADI-R and clinician’s observations of SIB during the Autism Diagnostic Observation Schedule (ADOS) (Lord et al., 2000).

Methods

Study design

We employed a cross-sectional design using data from the Study to Explore Early Development (SEED), a multi-site case–control study that enrolled children aged 30–68 months from six sites in the United States: California, Colorado, Georgia, Maryland, North Carolina, and Pennsylvania (Schendel et al., 2012). These analyses were authorized by the SEED Data Sharing Committee and all data were collected under the original SEED protocol, approved by the institutional review boards of the Centers for Disease Control and Prevention and each participating site.

Participants

SEED participants were recruited from multiple sources, including specialized ASD diagnostic and treatment centers, early intervention providers, and vital records. After clinical evaluation by trained clinicians using standardized instruments, enrolled children were classified into the ASD case group or one of two control groups (Schendel et al., 2012). For the current study, we included only children who met study criteria for ASD case classification. Details on the methodology used to classify children as "ASD" in SEED have been provided by others (Schendel et al., 2012; Wiggins et al., 2015a, 2015b). In brief, eligible children aged 30–68 months (born between 1 September 2003 and 31 August 2006), with a knowledgeable caregiver who was fluent in English or, at two sites, English or Spanish, were enrolled and underwent a comprehensive assessment by clinicians with expertise in assessment and diagnosis of children with ASD, using standardized instruments, including ADOS, ADI-R, Mullen Scales of Early Learning (MSEL; Mullen, 1995), and Vineland Adaptive Behavior Skills (VABS-2; Sparrow et al., 2005). ASD cases included in this study met the *Diagnostic and Statistical Manual for Mental Disorders* (4th ed., text rev., DSM-IV-TR; APA, 2000) criteria for ASD and the cut-offs for ASD classification on the ADOS and the ADI-R, based on an algorithm developed by SEED clinicians (Wiggins et al., 2015a).

Measures

We assessed two primary outcomes: current SIB and ever SIB, categorized as "yes" or "no." Data for both outcomes were obtained from question 83 on the ADI-R. Parents are asked about the presence of current or ever SIB (e.g. biting the wrist, banging the head that resulted in tissue damage), with a duration of at least 3 months. If the parents' answer was coded as "2" (self-injury definitely present) or "3" (definite self-injury with serious damage), the child was considered as having current SIB. When the answer was coded as "0 (none) or 1 (slight self-injury e.g. occasionally bites own had/arm when annoyed … no substantial tissue damage)," the child was classified as not having current SIB. To assess ever SIB, parents were asked whether SIB occurred in the past, and we categorized their answers in the same way as for current SIB.

A secondary outcome, observed SIB from the ADOS, categorized as "yes" or "no," was also evaluated. ADOS question D3 assesses whether the clinician notices SIB during the assessment ("observed SIB"). If the clinician assessment of SIB was coded as "1" (dubious

or possible self-injury, and/or rare but clear self-injury) or "2" (more than one clear example of self-injury), the child was classified as having observed SIB. If the observation of SIB was coded as "0," the child was categorized as not having observed SIB.

Factors examined for potential relation to SIB included sociodemographic characteristics, development, autism severity, somatic conditions, behavioral issues, child comorbid diagnoses, maternal medical and psychiatric conditions during pregnancy, labor complications, and child perinatal conditions (see Table 1 for complete listing). Data on these factors were collected from standardized instruments (MSEL, VABS-2, ADI-R, Child Sleep Habit Questionnaire (CSHQ), Gastrointestinal Symptom Inventory (GSI)); SEED-specific instruments (caregiver interview, maternal medical history); and birth certificates. We used ADOS calibrated scores, derived from ADOS raw scores, to assess autism severity (Gotham et al., 2009). The presence of gastrointestinal problems was derived by combining parent's responses to GSI question 14, 15, 16, 17, and 18. Sleep scores represented the total scores from the five individual sleep domain scores in the CSHQ. We analyzed adaptive behaviors skills scores, intelligence quotient (IQ), and sleep scores as continuous variables, since the plots of these variables versus SIB did not show specific cut-points. Other child comorbid diagnoses were grouped as follows: child neurologic conditions (cerebral palsy, seizure disorder); child developmental conditions (attention-deficit/hyperactivity disorder, learning disability, vision and hearing impairments); and child genetic conditions (Down syndrome, fragile X syndrome, tuberous sclerosis). Neonatal complications included major (any condition leading to admission into the intensive care unit) and minor (jaundice, fetal distress). Labor complications were categorized as major (uterus rupture, general anesthesia) and minor (fever, bleeding). The following maternal medical conditions during pregnancy were examined: eclampsia, diabetes, anemia, and high blood pressure.

Analytical strategy

We used a two-step approach to assess the factors associated with current and ever SIB. First, bivariate associations were evaluated between each factor and parent-reported current and ever SIB, respectively, using a log-binomial regression. Variables associated with current or ever SIB at $p \leq 0.20$ were included in the second step (multivariable analyses). Sex, IQ scores, and enrollment site were selected a priori for inclusion in all models. We tested separate models for current and ever SIB using PROC GENMOD (SAS© version 9.3, Cary, NC, USA) and reported unadjusted and adjusted estimates at the significance level of 0.05. We examined possible effect modification by IQ through inclusion of interaction terms in the models. As a secondary analysis, we explored whether associations identified with current or ever SIB were also present with observed SIB.

We examined concordance between parent-reported current and ever SIB with observed SIB using McNemar's test and reported the level of agreement (Kappa statistic) with 95% confidence intervals.

Results

This study involved 692 children with ASD. In Table 1, we presented the attributes of children with current and ever SIB. The prevalence of parent-reported current SIB was 28% and ever SIB was 47% on the ADI-R.

Among the 31 variables tested in bivariate analyses, 21 variables for current SIB and 20 variables for ever SIB were examined in multivariable analyses. Five variables (lower child adaptive skills, child sleep, gastrointestinal and behavioral problems/issues, and younger maternal age) were significantly associated with both current and ever SIB in multivariable models (Tables 2 and 3). Significant independent associations were also found between current SIB alone and higher cognitive skills, child genetic conditions, sensory problems, cesarean birth, and major neonatal complications (Table 2). Additional variables significantly associated only with ever SIB included lower gestational age, male sex, and non-Hispanic white race; sensory problems approached statistical significance for ever SIB (Table 3). None of these relationships were modified by IQ. Although none of the identified associations with current or ever SIB were found with observed SIB, the directionality of their relationships was similar in current or ever SIB compared to observed SIB for most variables analyzed (Supplemental Tables).

The comparisons of the proportions of children with parent-reported current SIB and ever SIB, respectively, to the proportions with observed SIB and the corresponding Kappa statistics are presented in Tables 4 and 5. Parents were more likely to report current SIB (28%) and ever SIB (47%) compared to clinician observation of SIB (6%). The concordance of responses from parents (SIB; yes/no) and clinician observation (yes/no) was 72. 25% for current SIB (i.e. 3.32% for yes and 68.93% for no) and 55.49% for ever SIB (i.e. 4.77% for yes and 50.72% for no).

Discussion

We found five factors—adaptive behaviors scores, gastrointestinal, sleep and behavioral problems, and younger maternal age—to be associated with both current and ever SIB. We also documented that parents reported SIB far more often than clinicians observed SIB.

Our findings were similar to those reported by Soke et al. (2017) concerning the association between SIB and low adaptive scores, sleep and behavioral problems, and abnormalities in sensory processing. These authors examined the potential factors associated with SIB in a study that included large samples of children with ASD from two national databases in the United States and discussed possible mechanisms explaining the associations between SIB and the above factors (see Soke et al., 2017 for details). In line with reports from past studies (Devine, 2014; Duerden et al., 2012; Kurtz et al., 2003; Soke et al., 2017), the associations between SIB and the above factors may indicate that, in some children with ASD, SIB may have specific functions, including communication (e.g. expression of pain or discomfort), social interaction (e.g. attention), and self-regulation.

Like others (Buie et al., 2010; Christensen et al., 2009; Kennedy and Thompson, 2000, as cited by Thompson and Caruso, 2002), we documented an association between

gastrointestinal problems and SIB although this was not found in several other studies (Kang et al., 2014; Maenner et al., 2012; Soke et al., 2017). It is possible that variability in the definition of “gastrointestinal problems” may explain this difference. Nevertheless, this association is consistent with the hypothesis that in children with limited verbal abilities, SIB may be a way to express pain associated with gastrointestinal conditions (e.g. constipation, acid reflux; Kennedy and Thompson, 2000, as cited by Thompson and Caruso, 2002).

The presence of known genetic conditions, higher IQ scores, younger maternal age, and cesarean delivery were significantly related to current SIB; male child sex, non-Hispanic White race and younger age of the mother, and lower gestational age were associated with ever SIB. The association between genetic conditions with current SIB has been reported by others (Moss et al., 2012; Symons et al., 2003) and may be due to biological perturbations (e.g. neurotransmitter activity) found in these genetic conditions. Unlike most studies (e.g. Duerden et al., 2012; Minshawi et al., 2014a), we found a positive relationship between IQ scores and current SIB. Most studies have categorized IQ and did not adjust for numerous child and familial factors, as we did, which may explain the discrepancy. It is also possible that children with low cognitive skills have substantial delays resulting in decreased ability to engage in SIB. The associations of current SIB with lower maternal age and cesarean delivery, and of ever exhibiting SIB with younger maternal age, male child sex, lower gestational age, and non-Hispanic white maternal race, have not been previously identified and require replications in future studies. While these associations may have resulted from chance alone, different hypotheses may also explain these findings. For example, the association between younger maternal age and increased prevalence of both current and ever SIB may be due to the association between maternal younger age and perinatal or post-natal complications, such as preterm birth, low birth weight, and growth retardation (Fall et al., 2015). It is also possible that other factors, such as poverty, high levels of stress, low educational attainment, barriers in access to specialty services, and limited coping skills and knowledge of typical child development, may negatively affect the quality of mother–child interactions and result in the occurrence of SIB, or may instead influence the accuracy of reporting of SIB on the ADI-R. We found a higher prevalence of SIB among children born from cesarean delivery than those born vaginally. It is possible that cesarean mode of delivery is a marker for suboptimal perinatal environment (e.g. placental insufficiency, congenital malformations) that may result in brain insults leading to SIB. Like us, Walker et al. (2015) reported similar associations between developmental delays and perinatal complications.

In contrast to results from most past studies (Horovitz et al., 2011; Jang et al., 2013; Sell et al., 2012), we found that children with parent-reported ever SIB were less likely to have a mother who was of minority race. This discrepancy may be due to differences in the definition of race used between studies, as we examined maternal rather than child race. It is also possible that these findings reveal true racial differences in SIB prevalence, since other studies have documented similar racial differences in the occurrence of attention, anxiety, and lack of or excessive fearfulness (Hartley et al., 2008; Sell et al., 2012). Furthermore, unlike most studies (Baghdadli et al., 2003; Rubenstein et al., 2015), we found a higher prevalence of ever SIB in males compared to females. Past studies may have had insufficient

power to find differences by sex, or our findings may indicate true differences similar to those reported for other challenging behaviors, such as aggression (Giarelli et al., 2010). The prevalence of ever SIB decreased with an increased gestational age. Since prematurity can be associated with developmental delays (Kerstjens et al., 2012), it is possible that brain immaturity may play an important role in the occurrence of SIB.

We found a higher prevalence of SIB reported by parents than was observed by clinicians. The concordance of the presence of SIB between parents and clinicians was low for both current and ever SIB. In most cases, parents reported SIB that were not identified by the clinician. However, in a few instances, clinician observed SIB while parents had not reported it. The discrepancy between parents and clinicians may be due to a number of reasons. Clinicians documented SIB during a 30- to 40-min assessment with the child interacting with an unfamiliar adult in an unfamiliar place. This may not allow sufficient time for the child to display SIB; conversely, this novel environment might elicit SIB as a way for the child to avoid the interaction with the clinician. In contrast, parents' answers on the ADI-R are based on a much longer period of observing the child in a typical environment. It is also possible that parents reported even minor forms of SIB, which may not be considered as SIB by clinicians. On the other hand, some parents may also fail to report SIB during the interview, due to a number of reasons, including lack of awareness or understanding of SIB, embarrassment, or some other factors. The lower proportion of children identified by clinicians as having SIB can also explain why the factors related to SIB reported in the ADI-R were not significantly related to SIB recorded in the ADOS.

There are a number of strengths to the study: (1) the use of a large sample of children with ASD identified through both clinical and educational sources, some of whom were not previously identified, and diagnosed using the current standards; (2) testing of a wide range of predictors, including prenatal and perinatal factors; and (3) use of standardized instruments to assess SIB and other factors. Nevertheless, some limitations are noted. The SEED network included only six sites in the United States and these sites are not representative of all US children with ASD. Thus, these findings may not be generalizable to communities that were not included in this study. We could not infer a temporal relationship between SIB and the factors evaluated, since we used a cross-sectional design. Among children whose SIB were only reported by clinicians and not by parents, it was not possible to assess if these behaviors were only seen during the ADOS, or if they persisted thereafter. The differences in the proportion of children with current versus ever SIB may have resulted from over-reporting of ever SIB, since parents may have reported transient SIB, which has been documented in both children with developmental disabilities and typically developing children at a very young age (Berkson and Tupa, 2000; Symons et al., 2005). It is also important to point out that SIB and associated factors such as sleep, gastrointestinal, behavior issues were all based from parent reports, raising the possibility of method variance. High levels of parental stress may have resulted in over-reporting of both SIB and other factors. As documented above, the observation of the child during the ADOS is of short duration and may limit the possibility for clinicians to detect SIB that may regularly occur in the house and reported by parents. This may explain the large discrepancy between parent-reported SIB and clinician observation.

Findings from this study support the need for a comprehensive and multidisciplinary approach for assessing and managing SIB in ASD, as has been suggested by our research group and others (Isaksen et al., 2013; Minshawi et al., 2014b; Soke et al., 2017). In the presence of SIB, comprehensive assessment rather than *a priori* consideration of SIB as behaviorally induced can detect any potential condition that may explain the occurrence of SIB. The co-occurrence of other behavioral problems (e.g. aggression) with SIB may provide an opportunity for clinicians to ask questions about the presence of SIB. Furthermore, as discussed by Soke et al. (2017), our findings suggest that providing interventions that target communication skills, behavioral issues, or sleep or gastrointestinal problems may help prevent SIB in some children and also improve their overall level of function and quality of life. We also identified a number of new associations that merit further evaluation in future studies. Longitudinal etiologic studies, which may collect data on some of the factors identified here and include direct observation of the child for a longer duration and in a number of different settings (e.g. clinic, house, school), are needed in order to establish the temporality of the associations identified and the validity of parent-reported SIB. In summary, SIB is an important public health problem in individuals with ASD, and these findings can be used to inform future research and potentially improve the management of SIB in children with ASD, which will positively affect the quality of life of children with SIB and their families.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

American Psychiatric Association (APA)Diagnostic and Statistical Manual of Mental Disorders4th. Washington, DC: American Psychiatric Publishing; 2000Text revision

American Psychiatric Association (APA)Diagnostic and Statistical Manual of Mental Disorders5th. Arlington, VA: American Psychiatric Publishing; 2013

Baghdadli A, Pascal C, Grisi S, et al. Risk factors for self-injurious behaviors among 222 young children with autistic disorders. Journal of Intellectual Disability Research. 2003; 47:622–627. [PubMed: 14641810]

Berkson G, Tupa M. The early development of stereotyped and self-injurious behaviors. Journal of Early Intervention. 2000; 23:1–19.

Buie T, Campbell D, Fuchs G III, et al. Evaluation, diagnosis, and treatment of gastrointestinal disorders in individuals with ASDs: a consensus report. Pediatrics. 2010; 125:S1–S18. [PubMed: 20048083]

Carr E. The motivation of self-injurious behavior: a review of some hypotheses. Psychological Bulletin. 1977; 84:800–816. [PubMed: 331382]

Carroll D, Hallett V, McDougle C, et al. Examination of aggression and self-injurious in children with autism spectrum disorders and serious behaviors problems. Child and Adolescent Psychiatric Clinics of North America. 2014; 23:57–72. [PubMed: 24231167]

Christensen T, Ringdahl J, Bosch J, et al. Constipation associated with self-injurious and aggressive behavior exhibited by a child diagnosed with autism. Education & Treatment of Children. 2009; 32:89–103.

Dempsey J, Dempsey AG, Guffey D, et al. Brief report: further examination of self-injurious behaviors in children and adolescents with autism spectrum disorders. Journal of Autism and Developmental Disorders. 2016; 46:1872–1879. [PubMed: 26781113]

Devine D. Self-injurious behaviors in autistic children: a neuro-developmental theory of social and environment isolation. Psychopharmacology. 2014; 231:979–997. [PubMed: 24057764]

Duerden E, Oakley H, Mak-Fan K, et al. Risk factors associated with self-injurious behaviors in children and adolescents with autism spectrum disorders. Journal of Autism and Developmental Disorders. 2012; 42:2460–2470. [PubMed: 22422338]

Esbensen A, Seltzer M, Lam K, et al. Age-related differences in restricted repetitive behaviors in autism spectrum disorders. Journal of Autism and Developmental Disorders. 2009; 39:57–66. [PubMed: 18566881]

Fall C, Sachdev H, Osmond C, et al. Association between maternal age at childbirth and child adult outcomes in the offspring: a prospective study in five low-income and middle-income countries (COHORTS collaboration). The Lancet. 2015; 3:e366–e376. [PubMed: 25999096]

Fee, VE., Matson, JL. Definition, classification, and taxonomy. In: Luiselli, JK.Matson, JL., Singh, N., editorsSelf-Injurious Behavior: Analysis, Assessment, and TreatmentNew York: Springer-Verlag; 19923-20

Giarelli E, Wiggins L, Rice C, et al. Sex differences in the evaluation and diagnosis of autism spectrum disorders among children. Disability and Health Journal. 2010; 3:107–116. [PubMed: 21122776]

Goldman S, McGrew S, Johnson K, et al. Sleep is associated with problem behaviors in children and adolescents with autism spectrum disorders. Research in Autism Spectrum Disorders. 2011; 5:1223–1229.

Gotham K, Pickles A, Lord C. Standardizing ADOS-G scores for a measure of severity in autism spectrum disorders. Journal of Autism and Developmental Disorders. 2009; 39:693–705. [PubMed: 19082876]

Guess D, Carr EG. Emergence and maintenance of stereotypy and self-injury. American Journal on Mental Retardation. 1991; 96:299–319. [PubMed: 1756034]

Hartley S, Sikora D, McCoy R. Prevalence and risk factors of maladaptive behavior in young children with autistic disorder. Journal of Intellectual Disability Research. 2008; 52:819–829. [PubMed: 18444989]

Horovitz M, Matson J, Rieske R, et al. The relationship between race and challenging behaviors in infants and toddlers with autistic disorder and pervasive developmental disorder-not otherwise specified. Developmental Neurorehabilitation. 2011; 14:208–214. [PubMed: 21732805]

Ianuzzi D, Cheng E, Broder-Fingert S, et al. Emergency department utilization by individuals with autism. Journal of Autism and Developmental Disorders. 2015; 45:1096–1102. [PubMed: 25261249]

Isaksen J, Bryn V, Diseth T, et al. Children with autism spectrum disorders—the importance of medical investigations. European Journal of Paediatric Neurology. 2013; 17:68–76. [PubMed: 22954514]

Jang J, Matson J, Cervantes P, et al. The relation between race and comorbid symptoms in infants and toddlers with autism spectrum disorders. Research in Autism Spectrum Disorders. 2013; 7:1433–1438.

Kang V, Wagner G, Ming X. Gastrointestinal dysfunction in children with autism spectrum disorders. Autism Research. 2014; 7:501–506. [PubMed: 24753336]

Kanne S, Mazurek M. Aggression in children and adolescents with ASD: prevalence and risk factors. Journal of Autism and Developmental Disorders. 2011; 41:926–937. [PubMed: 20960041]

Kerstjens J, De Winter A, Bocca-Tjeertes I, et al. Risk of developmental delay increases exponentially as gestational age of preterm infants decreases: a cohort study age 4 years. Developmental Medicine and Child Neurology. 2012; 54:1096–1101. [PubMed: 23020259]

Kozlowski A, Matson J, Rieske R. Gender effects on challenging behaviors in children with autism spectrum disorders. Research in Autism Spectrum Disorders. 2012; 6:958–964.

Kurtz P, Chin M, Huete J, et al. Functional analysis and treatment of self-injurious behavior in young children: a summary of 30 cases. Journal of Applied Behavior Analysis. 2003; 36:205–219. [PubMed: 12858985]

Kurtz P, Chin M, Huete J, et al. Identification of emerging self-injurious behaviors in young children: a preliminary study. Journal of Mental Health Research in Intellectual Disabilities. 2012; 1:260–285.

Lance E, York J, Lee LC, et al. Association between regression and self-injurious behaviors among children with ASD. Research in Developmental Disabilities. 2014; 35:408–413. [PubMed: 24342713]

Lord C, Risi S, Lambrecht L, et al. The autism diagnostic observation schedule-generic: a standard measure of social and communication deficits associated with the spectrum of autism. Journal of Autism and Developmental Disorders. 2000; 30:205–223. [PubMed: 11055457]

Lord C, Rutter M, Le Couteur AL. Autism diagnostic interview-revised: a revised version of the diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. Journal of Autism and Developmental Disorders. 1994; 24:659–685. [PubMed: 7814313]

Maenner M, Arneson C, Levy S, et al. Brief report: association between behavioral features and gastrointestinal problems among children with autism spectrum disorder. Journal of Autism and Developmental Disorders. 2012; 42:1520–1525. [PubMed: 22012246]

Matson J, Goldin R. Comorbidity and autism: trends, topics and future directions. Research in Autism Spectrum Disorders. 2013; 7:1228–1233.

Minshawi N, Hurwitz S, Fodstad J, et al. The association between self-injurious behaviors and autism spectrum disorders. Psychology Research and Behavior Management. 2014a; 7:125–136. [PubMed: 24748827]

Minshawi N, Hurwitz S, Morriss D, et al. Multidisciplinary assessment and treatment of self-injurious behaviors in autism spectrum disorders and intellectual disability: integration of psychological and biological theory and approach. Journal of Autism and Developmental Disorders. 2014b; 45:1541–1568.

Moss J, Richards C, Nelson L, et al. Prevalence of autism spectrum disorders symptomatology and related behavioural characteristics in individuals with Down syndrome. Autism. 2012; 17:390–404. [PubMed: 22589453]

Mullen, E. Mullen Scales of Early LearningCircle Pines, MN: American Guidance Service, Inc; 1995

Murphy O, Healy O, Leader G. Risk factors for challenging behaviors among 157 children with autism spectrum disorders in Ireland. Research in Autism Spectrum Disorders. 2009; 3:474–482.

Rattaz C, Michelon C, Baghdadli A. Symptom severity as a risk factor for self-injurious behaviours in adolescents with autism spectrum disorders. Journal of Intellectual Disability Research. 2015; 59:730–740. [PubMed: 25583371]

Rubenstein E, Wiggins L, Lee LC. A review of the differences in developmental, psychiatric, and medical endophenotypes between males and females with autism spectrum disorders. Journal of Developmental and Physical Disabilities. 2015; 27:119–139. [PubMed: 26146472]

Schendel D, DiGuiseppi C, Croen L, et al. The Study to Explore Early Development (SEED): a multisite epidemiologic study of autism by the Centers for Autism and Developmental Disabilities Research and Epidemiology (CADDRE) Network. Journal of Autism and Developmental Disorders. 2012; 42:2121–2140. [PubMed: 22350336]

Schopler, E., Richer, E., Renner, B. The Childhood Autism Rating Scale (CARS)New York: Irvington; 1986

Schroeder S, Marquis JG, Reese RM, et al. Risk factors for self-injurious, aggression, stereotyped behavior among young children at risk for intellectual and developmental disabilities. American Journal on Intellectual and Developmental Disabilities. 2014; 119:351–370. [PubMed: 25007299]

Sell N, Giarelli E, Blum N, et al. A comparison of autism spectrum disorder DSM-IV criteria and associated features among African American and white children in Philadelphia County. Disability and Health Journal. 2012; 5:9–17. [PubMed: 22226293]

Soke GN, Rosenberg SA, Hamman RF, et al. Brief report: prevalence of self-injurious behaviors among children with autism spectrum disorder: a population-based study. Journal of Autism and Developmental Disorders. 2016; 46:3607–3614. [PubMed: 27565654]

Soke GN, Rosenberg SA, Hamman RF, et al. Factors associated with self-injurious behaviors in children with autism spectrum disorder: findings from two national epidemiologic databases. Journal of Autism and Developmental Disorders. 2017; 47:285–296. [PubMed: 27830427]

Sparrow, S., Cicchetti, D., Balla, D. The Vineland Adaptive Behavior Scales-2 (Survey Form)Circle Pines, MN: American Guidance Service, Inc; 2005

Symons FJ, Clark R, Hatton D, et al. Self-injurious behavior in young boys with fragile X syndrome. American Journal of Medical Genetics. 2003; 118:115–121.

Symons FJ, Sperry LA, Dropik PL, et al. The early development of stereotypy and self-injury: a review of research methods. Journal of Intellectual Disability Research. 2005; 49:144–158. [PubMed: 15634323]

Thompson, T., Caruso, M. Self-injury: knowing what we're looking for. In: Schroeder, S.Oster-Granite, M., Thompson, T., editorsSelf-Injurious Behavior: Gene-Brain-Behavior RelationshipsWashington, DC: American Psychological Association; 20023-22

Walker CK, Krakowiak P, Baker A, et al. Preeclampsia, placental insufficiency, and autism spectrum disorder or developmental delay. JAMA Pediatrics. 2015; 169:1–9.

Weiss J. Self-injurious behaviors in autism: a literature review. Journal on Developmental Disabilities. 2002; 9:129–143.

Wiggins L, Levy S, Daniels J, et al. Autism spectrum disorder symptoms among children enrolled in the Study to Explore Early Development (SEED). Journal of Autism and Developmental Disorders. 2015a; 45:3183–3194. [PubMed: 26048040]

Wiggins L, Reynolds A, Rice C, et al. Using standardized diagnostic instruments to classify children with autism in the Study to Explore Early Development. Journal of Autism and Developmental Disorders. 2015b; 45:1271–1280. [PubMed: 25348175]

Wiggins L, Rice C, Baio J. Developmental regression in children with autism spectrum disorders identified by a population-based surveillance system. Autism. 2009; 13:357–374. [PubMed: 19535466]

Table 1

Characteristics of children with autism spectrum disorder in the Study to Explore Early Development (SEED) based on current and ever had self-injurious behaviors.

Variable	Current self-injurious behavior (n = 692)		Ever self-injurious behaviors (n = 692)	
	Yes (n = 194)	No (n = 498)	Yes (n = 330)	No (n = 362)
Child sex				
Male	158 (81.44)	408 (81.93)	279 (84.55)	287 (79.28)
Female	36 (18.56)	90 (18.07)	51 (15.45)	75 (20.72)
Child enrollment age (months)				
Mean (SD)	55.50 (6.98)	56.15 (6.58)	55.32 (7.44)	56.08 (6.18)
Child gestational age (weeks)				
Mean (SD)	37.84 (3.19)	38.19 (2.96)	37.98 (3.18)	38.20 (2.88)
Child birth weight (g)				
Mean (SD)	3391.58 (1482.18)	3365.15 (1195.96)	3343.18 (1289.31)	3399.33 (1275.73)
Maternal race				
White	126 (64.95)	299 (60.04)	222 (67.27)	203 (56.08)
Non-White	64 (32.99)	191 (38.35)	103 (31.21)	152 (41.99)
Missing	4 (2.06)	8 (1.61)	5 (1.52)	7 (1.93)
Maternal ethnicity				
Hispanic	24 (12.37)	60 (12.05)	41 (12.42)	43 (11.88)
Non-Hispanic	167 (86.08)	431 (86.55)	284 (86.06)	314 (86.74)
Missing	3 (1.55)	7 (1.40)	5 (1.52)	5 (1.38)
Language spoken at home				
English	172 (88.66)	431 (86.55)	294 (89.09)	309 (85.36)
Other	19 (9.79)	61 (12.25)	32 (9.70)	48 (13.26)
Missing	3 (1.55)	6 (1.20)	4 (1.21)	5 (1.38)
Maternal education				
College degree or higher	79 (40.72)	278 (55.82)	144 (43.64)	213 (58.84)
No college	112 (57.73)	212 (42.57)	181 (54.85)	143 (39.50)
Missing	3 (1.55)	8 (1.61)	5 (1.51)	6 (1.66)
Maternal smoking status				
Yes	30 (15.46)	66 (13.25)	54 (16.36)	42 (11.60)
No	164 (84.54)	432 (86.75)	276 (83.64)	320 (88.40)
Maternal age (years)				
Mean (SD)	30.19 (5.69)	32.21 (5.39)	30.74 (5.65)	32.46 (5.32)
Family income (quartiles)				
First (lowest)	71 (36.60)	92 (18.48)	101 (30.61)	62 (17.13)
Second	45 (23.20)	130 (26.10)	81 (24.54)	94 (25.97)
Third	35 (18.04)	128 (25.70)	68 (20.60)	95 (26.24)
Fourth (highest)	34 (17.52)	130 (26.10)	65 (19.70)	99 (27.35)
Missing	9 (4.64)	18 (3.62)	15 (4.55)	12 (3.31)
Developmental regression				

Variable	Current self-injurious behavior (n = 692)		Ever self-injurious behaviors (n = 692)	
	Yes (n = 194)	No (n = 498)	Yes (n = 330)	No (n = 362)
Yes	51 (26.29)	116 (23.29)	83 (25.15)	84 (23.20)
No	143 (73.71)	382 (76.71)	247 (74.85)	278 (76.80)
Missing	0	0	0	0
IQ score				
Mean (SD)	63.18 (19.34)	68.31 (20.04)	65.61 (20.01)	68.03 (19.89)
Adaptive score				
Mean (SD)	67.96 (13.90)	76.12 (18.5)	71.09 (14.52)	76.35 (19.89)
Sleep score				
Mean (SD)	51.51 (11.27)	46.66 (9.18)	50.04 (10.55)	46.16 (9.17)
ADOS-severity score				
Mean (SD)	7.21 (1.62)	7.16 (1.57)	7.20 (1.59)	7.14 (1.58)
Sensory problems				
Yes	162 (83.51)	346 (69.48)	263 (79.70)	245 (67.68)
No	32 (16.49)	152 (30.52)	67 (20.30)	117 (32.32)
Gastrointestinal problems				
Yes	83 (42.78)	139 (27.91)	176 (53.33)	245 (67.68)
No	94 (48.46)	327 (65.66)	124 (37.58)	98 (27.07)
Missing	17 (8.76)	32 (6.43)	30 (9.09)	19 (5.25)
Child behavioral issues				
Yes	99 (51.03)	130 (26.10)	152 (46.06)	77 (21.27)
No	95 (48.97)	368 (73.90)	178 (53.94)	285 (78.73)
Child neurologic conditions				
Yes	21 (10.82)	17 (3.41)	24 (7.27)	14 (3.87)
No	173 (89.18)	481 (96.59)	306 (92.73)	348 (96.13)
Child developmental conditions				
Yes	132 (68.04)	281 (56.43)	215 (65.15)	198 (54.70)
No	62 (31.96)	217 (43.57)	115 (34.85)	164 (45.30)
Child genetic conditions				
Yes	5 (2.58)	7 (1.41)	6 (1.82)	6 (1.66)
No	189 (97.42)	491 (98.59)	324 (98.18)	356 (98.34)
Child other conditions				
Yes	19 (9.79)	45 (9.04)	33 (10.00)	31 (8.56)
No	175 (90.21)	453 (90.96)	297 (90.00)	331 (91.44)
Neonatal complications				
Major	51 (26.29)	94 (18.87)	75 (27.73)	70 (19.34)
Minor	64 (32.99)	182 (36.55)	107 (32.42)	139 (38.40)
None	79 (40.72)	222 (44.58)	148 (44.85)	153 (42.26)
Plurality				
Yes	28 (14.43)	77 (15.56)	51 (15.45)	54 (14.92)
No	166 (85.57)	421 (84.46)	279 (84.54)	308 (85.08)
Mode of delivery				

Variable	Current self-injurious behavior (n = 692)		Ever self-injurious behaviors (n = 692)	
	Yes (n = 194)	No (n = 498)	Yes (n = 330)	No (n = 362)
Vaginal	103 (53.10)	312 (62.65)	117 (35.45)	142 (39.23)
Cesarean	85 (43.81)	174 (34.94)	201(60.91)	214 (59.12)
Missing	6 (3.09)	12 (2.41)	12 (3.64)	6 (1.66)
Labor complications				
Major	9 (4.64)	23 (4.62)	16 (4.85)	16 (4.42)
Minor	31 (15.98)	55 (11.04)	41 (12.42)	45 (12.43)
None	154 (79.38)	420 (84.34)	273 (82.73)	301 (83.15)
Maternal medical conditions during pregnancy				
Yes	74 (38.14)	161 (32.33)	119 (36.06)	116 (32.04)
No	120 (61.86)	337 (67.67)	211 (63.94)	246 (67.96)
Maternal depression				
Yes	58 (29.90)	121 (24.30)	102 (30.91)	77 (21.27)
No	136 (70.10)	377 (75.70)	228 (69.09)	285 (78.73)
Maternal mental retardation				
Yes	12 (6.19)	18 (3.61)	31 (9.39)	12 (3.31)
No	181 (93.30)	476 (95.58)	299 (90.61)	350 (96.69)
Missing	1 (0.52)	4 (0.80)	0	0
Maternal anxiety				
Yes	26 (13.40)	40 (8.03)	36 (10.91)	30 (18.29)
No	168 (86.60)	458 (91.97)	294 (89.09)	332 (91.71)

SD: standard deviation; IQ: intelligence quotient; ADOS: Autism Diagnostic Observation Schedule.

Table 2

Associations between report of current self-injurious behaviors (SIB) and risk and protective factors in the Study to Explore Early Development (SEED).

Variable	Univariable analyses*		Multivariable analyses**	
	PR and 95% CI	p value	aPR and 95% CI	p value
Child sex (female vs male)	1.02 (0.67, 1.40)	0.88	0.89 (0.65, 1.22)	0.49
Child age (1 month)	1.01 (0.75, 1.03)	0.38	–	–
Gestational age (1 week)	**1.07 (0.98, 1.16)**	**0.11**	1.01 (0.97, 1.05)	0.63
Birth weight (1 g)	1.01 (1.00, 1.00)	0.81	–	–
Non-White vs White maternal race	0.85 (0.64, 1.11)	0.23	–	–
Hispanic vs non-Hispanic maternal ethnicity	1.02 (0.75, 1.39)	0.88	–	–
Language spoken at home (other vs English)	0.83 (0.55, 1.26)	0.38	–	–
Maternal level of education (no college degree vs college)	**1.56 (1.44, 1.69)**	**<0.0001**	0.95 (0.84, 1.07)	0.38
Maternal smoking (yes vs no)	1.13 (0.90, 1.43)	0.28	–	–
Maternal age at birth (1 year)	**0.95 (0.94, 0.96)**	**<0.0001**	**0.97 (0.95, 0.98)**	**<0.0001**
Family income (quartiles)				
First (lowest)	**2.10 (1.59, 2.77)**	**<0.0001**	1.13 (0.64, 2.01)	0.67
Second	**1.24 (0.94, 1.64)**	**0.13**	1.05 (0.76, 1.46)	0.77
Third	1.04 (0.80, 1.35)	0.79	0.98 (0.67, 1.44)	0.93
Fourth (highest)	1.00	1.00	1.00	1.00
Regression (yes vs no)	**1.12 (0.98, 1.28)**	**0.10**	0.85 (0.66, 1.11)	0.23
IQ score (1 unit)	**0.99 (0.98, 0.99)**	**<0.0001**	**1.01 (1.00, 1.02)**	**0.008**
Adaptive score (1 unit)	**0.97 (0.96, 0.98)**	**<0.0001**	**0.98 (0.97, 0.99)**	**<0.0001**
Sleep score (1 unit)	**1.03 (1.02, 1.04)**	**<0.0001**	**1.02 (1.01, 1.03)**	**0.007**
Autism severity scores (1 unit)	1.01 (0.95, 1.08)	0.67	–	–
Sensory problems (yes vs no)	**1.83 (1.60, 2.09)**	**<0.0001**	**1.41 (1.16, 1.71)**	**0.0004**
Gastrointestinal problems (yes vs no)	**1.67 (1.49, 1.88)**	**<0.0001**	**1.39 (1.15, 1.67)**	**0.0006**
Child behavioral issues (yes vs no)	**1.69 (1.33, 2.16)**	**<0.0001**	**1.83 (1.56, 2.14)**	**<0.0001**
Child neurologic conditions (yes vs no)	**2.09 (1.33, 3.27)**	**0.001**	1.31 (0.91, 1.87)	0.14
Child developmental conditions (yes vs no)	**1.44 (1.11, 1.86)**	**0.001**	1.05 (0.72, 1.55)	0.78
Child genetic conditions (yes vs no)	**1.50 (1.16, 1.93)**	**0.002**	**1.33 (1.06, 1.67)**	**0.02**
Child other conditions (yes vs no)	1.06 (0.96, 1.18)	0.23	–	–
Neonatal complications				
Major	1.34 (1.04, 1.73)	**0.02**	1.13 (1.03, 1.25)	**0.008**
Minor	0.99 (0.82, 1.20)	0.93	1.03 (0.83, 1.29)	0.75
None	1.00		1.00	
Labor complications				
Major	1.05 (0.67, 1.65)	0.84	0.89 (0.53, 1.48)	0.64
Minor	**1.34 (0.98, 1.84)**	**0.07**	1.22 (0.89, 1.67)	0.21
None	1.00		1.00	
Plurality (yes vs no)	0.94 (0.74, 1.20)	0.64	–	–
Mode of delivery (C-section vs vaginal)	**1.32 (1.12, 1.56)**	**0.0003**	**1.52 (1.24, 1.86)**	**<0.0001**

Variable	Univariable analyses*		Multivariable analyses**	
	PR and 95% CI	p value	aPR and 95% CI	p value
Maternal medical conditions during pregnancy (yes vs no)	**1.20 (1.01, 1.42)**	**0.03**	1.03 (0.85, 1.11)	0.63
Maternal depression during pregnancy (yes vs no)	**1.22 (0.90, 1.66)**	**0.20**	0.93 (0.64, 1.34)	0.68
Maternal mental retardation during pregnancy (yes vs no)	**1.54 (1.10, 2.16)**	**0.01**	0.91 (0.62, 1.31)	0.60
Maternal anxiety during pregnancy (yes vs no)	**1.47 (1.22, 1.76)**	<**0.0001**	1.34 (0.86, 2.09)	0.19

PR: prevalence ratio; aPR: adjusted prevalence ratio; CI: confidence interval; IQ: intelligence quotient.

*All variables with p values from univariable analysis that are shown in bold were included in the multivariable model.

**All variables with p values from multivariable analysis that are shown in bold were significantly associated with SIB.

Table 3

Associations between report of ever exhibiting self-injurious behaviors (SIB) and risk and protective factors in the Study to Explore Early Development (SEED).

Variable	Univariable analyses*		Multivariable analyses**	
	PR and 95% CI	p value	aPR and 95% CI	p value
Child sex (female vs male)	**0.82 (0.64, 1.05)**	**0.12**	**0.77 (0.59, 1.00)**	**0.05**
Child age (1 month)	**1.01 (0.99, 1.02)**	**0.20**	1.01 (0.99, 1.02)	0.12
Gestational age (1 week)	**0.99 (0.97, 1.01)**	**0.12**	**0.98 (0.97, 0.99)**	**0.003**
Birth weight (1 gram)	0.98 (0.94, 1.03)	0.41	–	–
Non-White vs White maternal race	**0.77 (0.63, 0.94)**	**0.01**	**0.71 (0.57, 0.88)**	**0.002**
Hispanic vs non-Hispanic Maternal ethnicity	1.03 (0.82, 1.29)	0.81	–	–
Language spoken at home (other vs English)	**0.82 (0.66, 1.02)**	**0.07**	0.91 (0.72, 1.15)	0.41
Maternal level of education (no college degree vs college)	**1.38 (1.24, 1.55)**	**<0.0001**	1.05 (0.93, 1.18)	0.40
Maternal smoking (yes vs no)	**1.21 (1.08, 1.36)**	**0.001**	0.96 (0.85, 1.09)	0.53
Maternal age at birth (years)	**0.94 (0.92, 0.97)**	**<0.0001**	**0.98 (0.97, 0.99)**	**0.0004**
Family income (quartiles)				
Lowest	**1.56 (1.23, 1.99)**	**0.0003**	1.19 (0.91, 1.56)	0.20
Second lowest	**1.17 (1.06, 1.29)**	**0.002**	1.02 (0.95, 1.09)	0.56
Middle	1.05 (0.97, 1.14)	0.22	1.00 (0.88, 1.14)	0.95
Highest	1.00	1.00	1.00	1.00
Regression (yes vs no)	1.06 (0.96, 1.17)	0.28	–	–
IQ score (1 unit)	**0.99 (0.97, 0.99)**	**0.0006**	1.00 (0.99, 1.01)	0.11
Adaptive score (1 unit)	**0.97 (0.96, 0.99)**	**<0.0001**	**0.99 (0.98, 0.99)**	**<0.0001**
Sleep score (1 unit)	**1.02 (1.01, 1.03)**	**<0.0001**	**1.01 (1.00, 1.02)**	**0.02**
Autism severity score (1 unit)	0.99 (0.95, 1.04)	0.80	–	–
Sensory problems (yes vs no)	**1.42 (1.12, 1.81)**	**0.0004**	**1.24 (0.97, 1.59)**	0.08
Gastrointestinal problems (yes vs no)	**1.34 (1.21, 1.47)**	**<0.0001**	**1.21 (1.07, 1.36)**	**0.003**
Child behavioral issues (yes vs no)	**1.73 (1.50, 1.99)**	**<0.0001**	**1.57 (1.35, 1.83)**	**<0.0001**
Child neurologic conditions (yes vs no)	**1.35 (1.11, 1.65)**	**0.003**	1.09 (0.89, 1.35)	0.40
Child developmental conditions (yes vs no)	**1.26 (1.11, 1.43)**	**0.005**	1.01 (0.79, 1.28)	0.97
Child genetic conditions (yes vs no)	1.05 (0.66, 1.66)	0.50	–	–
Child other conditions (yes vs no)	1.09 (0.83, 1.43)	0.53	–	–
Neonatal complications				
Major	1.05 (0.88, 1.25)	0.44	–	
Minor	0.88 (0.70, 1.12)	0.30	–	
None	1.00			
Labor complications				
Major	1.05 (0.88, 1.25)	0.57		
Minor	1.00 (0.82, 1.22)	0.98	–	
None	1.00			
Plurality (yes vs no)	1.02 (0.88, 1.18)	0.78	–	–
Mode of delivery (C-section vs vaginal)	0.93 (0.79, 1.10)	0.41	–	

Variable	Univariable analyses*		Multivariable analyses**	
	PR and 95% CI	p value	aPR and 95% CI	p value
Maternal medical conditions during pregnancy (yes vs no)	1.10 (1.05, 1.27)	0.21		
Maternal depression during pregnancy (yes vs no)	**1.28 (1.14, 1.45)**	<**0.0001**	1.08 (0.90, 1.30)	0.40
Maternal mental retardation during pregnancy (yes vs no)	**1.56 (1.36, 1.80)**	<**0.0001**	1.13 (0.85, 1.50)	0.41
Maternal anxiety during pregnancy (yes vs no)	**1.16 (1.07, 1.26)**	**0.0006**	0.98 (0.84, 1.13)	0.74

PR: prevalence ratio; aPR: adjusted prevalence ratio; CI: confidence interval; IQ: intelligence quotient.

*All variables with p values from univariable analysis that are shown in bold were included in the multivariable model.

**All variables with p values from multivariable analysis that are shown in bold were significantly associated with SIB.

Table 4

Agreement between clinician's documentation of self-injurious behaviors (SIB) and parental report of current SIB in children included in the Study to Explore Early Development (SEED).

	SIB in ADI-R: yes	SIB in ADI-R: no	Total	p value	Kappa and 95% CI
SIB in ADOS: yes	23 (3.32)	21 (3.03)	44 (6.36)		
SIB in ADOS: no	171 (24.71)	477 (68.93)	648 (93.64)	<**0.0001**	0.10 (0.04, 0.16)
Total	194 (28.03)	498 (71.97)	692		

ADI-R: Autism Diagnostic Interview–Revised; ADOS: Autism Diagnostic Observation Schedule; CI: confidence interval.

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Table 5

Agreement between clinician's documentation of self-injurious behaviors (SIB) and parental report of ever had SIB in children included in the Study to Explore Early Development (SEED).

	SIB in ADI-R: yes	SIB in ADI-R: no	Total	p value	Kappa and 95% CI
SIB in ADOS: yes	33 (4.77)	11 (1.59)	44 (6.36)		
SIB in ADOS: no	297 (42.92)	351 (50.72)	648 (93.64)	<**0.0001**	0.07 (0.03, 0.11)
Total	330 (47.69)	362 (52.31)	692		

ADI-R: Autism Diagnostic Interview–Revised; ADOS: Autism Diagnostic Observation Schedule; CI: confidence interval.