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Aggression in Children and Adolescents with ASD: Prevalence and Risk Factors

Stephen M. Kanne · Micah O. Mazurek

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Abstract The prevalence of and risk factors for aggression were examined in 1,380 children and adolescents with autism spectrum disorders (ASD). Prevalence was high, with parents reporting that 68% had demonstrated aggression to a caregiver and 49% to non-caregivers. Overall, aggression was not associated with clinician observed severity of ASD symptoms, intellectual functioning, gender, marital status, parental educational level, or aspects of communication. Individuals who are younger, come from a higher income family, have more parent reported social/communication problems, or engage in repetitive behaviors were more likely to demonstrate aggression. Given the significant impact of aggression on individual and family outcomes, it is hoped that this knowledge will inform more targeted intervention efforts.

Keywords Autism · Autism spectrum disorder · Aggression · Disruptive behaviors

Introduction

Although aggression is generally understood to be a common problem among individuals with autism spectrum disorders (ASD), there have been no studies, to date, examining the prevalence of and risk factors for such problems among children and adolescents with a diagnosis of an ASD.

S. M. Kanne (✉) · M. O. Mazurek
Department of Health Psychology and Thompson Center for Autism and Neurodevelopmental Disorders, University of Missouri, 205 Portland Street, Suite 110, Columbia, MO 65211, USA
e-mail: kannest@missouri.edu

Significance of the Problem

Aggression is a major concern for a number of reasons, not least of which involves the potential for physical harm. Research has consistently demonstrated that childhood aggression has serious negative outcomes for both the aggressor and the victim (Card and Little 2006; Coie et al. 1998; Prinstein et al. 2001). Among the general population, these outcomes can include adolescent and adult antisocial behavior, conduct problems, substance use, and depression (Fite et al. 2008; Lochman and Wayland 1994; Zahn-Waxler et al. 2005). Among individuals with developmental disabilities, aggression is one of the strongest predictors of crisis intervention re-referrals (Shoham-Vardi et al. 1996), admission and readmission to residential facilities (Lakin 1983), use of psychotropic medication (Stone et al. 1989; Tsakanikos et al. 2007), and overall quality of life (Gardner and Moffatt 1990).

At the family level, aggressive and disruptive behaviors are the strongest predictors of stress among parents of children with developmental disabilities (Baker et al. 2002) and autism above and beyond other child and caregiver factors (Lecavalier et al. 2006; Tomanik et al. 2004). In addition, aggressive behavior is a significant predictor of out of home placements among children and young adults with intellectual disabilities (Bromley and Blacher 1991; McIntyre et al. 2002). Also, aggression is associated with an increased risk of physical abuse from caregivers, including parents (Stith et al. 2009) and residential staff (Stormshak et al. 1999).

Aggressive behaviors also have negative effects on teacher's instructional efforts (Chalfant et al. 2007), thereby reducing opportunities for learning a variety of skills even when educational and other interventions are in place. Aggression in children with autism and intellectual

disability (ID) has been found to be significantly associated with burnout and emotional exhaustion among teachers and special education support staff (Rubin et al. 2002). Thus, aggressive behaviors can interfere with instruction and progress in a variety of interventions, thereby hindering improvement across a range of developmental domains.

The serious outcomes associated with aggressive behavior highlight the importance of better understanding the scope of the problem among children and adolescents with ASD. Unfortunately, few studies have specifically examined this issue.

Rates of Aggression

Research has shown that aggressive behavior is relatively common among individuals with intellectual disability. For example, in a population study conducted in England, Emerson and colleagues found that 7% of individuals with ID exhibited aggression toward others (Emerson et al. 2001). Aggression was associated with less severe disability (e.g., higher expressive communication skills and better self-care abilities) among the sample investigated. Although this information is somewhat relevant to ASD (given that many individuals with ASD also have intellectual impairment), individuals with ASD present with different, although sometimes overlapping, deficits.

Some studies examining the issue among populations with ID have also included sub-samples of individuals with co-occurring autism. For example, among a Norwegian sample of over 900 individuals with ID, 11% of the sample engaged in challenging behavior (Holden and Gitlesen 2006). Of that, 6.4% engaged in attacking others. Interestingly, this was more common among those with mild ID than among those with severe or profound ID; whereas, the reverse was true for self-injurious behavior. Among a subsample ($n = 53$) who were also diagnosed with autism, rates of challenging behavior were much higher (35.8% of this group displayed challenging behavior). Similarly, a 2003 meta-analysis found that among individuals with intellectual disability, a diagnosis of autism was associated with greater levels of aggression, self-injury, and property destruction (McClintock et al. 2003). A recent study examined rates of problem behaviors among a sample of 298 adults with intellectual disability and ASD (Matson and Rivet 2008). Among participants with high ASD symptom severity, 7% engaged in throwing objects at others, 15% engaged in aggression toward others, and 14% engaged in property destruction. Percentages were as follows for the mild ASD symptom severity group: 8, 18, and 11%.

Although this information is helpful in understanding the scope of aggression among individuals with ASD who also have intellectual impairment, information appears to be lacking among samples representing the full range of age, cognitive ability, and ASD symptom presentation.

In a sample more representative of the full ASD spectrum, Lecavalier et al. (2006) reported on a sample of over 400 children and adolescents who were receiving educational services for PDD diagnoses. Prevalence of problem and prosocial behaviors was assessed using both parent- and teacher-report on the *Nisonger Child Behavior Rating Form*. With regard to aggressive behaviors in particular, the study found that property destruction was reported to be a moderate to severe problem for 11% (parents) and 12% (teachers) of the sample. Attacking others was observed more often (14.3%) by teachers than by parents (9.9%). Both reporters indicated physical fighting as a moderate to severe problem for 5% of the sample. Finally, threatening people was rated as a moderate to severe problem for 4.5% (parents) and 7.6% (teachers) of the sample. The study also found that lower adaptive skills were associated with greater conduct problems among the sample. Age and gender effects were not found for conduct problems. The nature of the study precluded data regarding the nature, specificity, and severity of ASD diagnoses and symptoms, however.

In a more recent study, Hartley and colleagues (2008) examined a large sample of young children (between the ages of 1 and 5) with an autistic disorder diagnosis. Among this sample, 27% were rated within the clinically significant range on the CBCL Externalizing Problems subscale, and 22% fell within the clinically significant range on the Aggression subscale. The results indicated that externalizing problems (as well as aggressive behaviors, specifically) were significantly correlated with lower nonverbal cognitive functioning, poorer expressive language, and poorer adaptive skills. Given the limited age range in the sample, generalizations to older children and adolescents cannot be made.

Risk Factors for Aggression

The field of developmental psychopathology has provided a rich body of literature examining the roles of various risk and protective factors in predicting aggressive trajectories among children and adolescents. Across studies, several common factors have been shown to increase risk for aggression. These include low IQ (Lahey et al. 1999; Moffitt 1993; Tremblay 2000), early language delays (Dionne et al. 2003; Stevenson et al. 1985), low income, low parental education, early maternal childbearing (Nagin and Tremblay 2001; Tremblay et al. 2004), and coercive or harsh parenting behaviors (Campbell et al. 2010). In addition, rates of aggression have been found to be consistently higher among boys than girls throughout childhood and adolescence

(Lahey et al. 2000; NICHD Early Child Care Research Network 2004).

In contrast, in the autism field, studies have focused more specifically on understanding the function and contextual factors maintaining aggression among individual children (most often using single case study designs using applied behavioral analysis methodology). This approach is important as it provides child-specific information that translates readily into specific interventions. However, information about group-level risk and protective factors would provide an additional level of important knowledge. This data could be used to identify subgroups of children and adolescents who are at highest risk for chronic or severe maladaptive behaviors. Additionally, it may provide important information that would allow for the prevention or remediation of aggression.

In one of the few studies to examine factors associated with aggression in ASD, Dominick and colleagues conducted a preliminary study of atypical behaviors among a sample of 67 children with ASD. Their results indicated that the presence of aggression was associated with lower IQ, poorer expressive and receptive language, and restricted and repetitive behaviors (Dominick et al. 2007). These issues warrant further study among large samples of children and adolescents representing the full range of ASD symptomatology.

Current Study

Identifying prevalence rates of aggression among individuals with ASD is important for a number of reasons. Such information about the extent of the problem has the potential to inform the need for services. Identifying the factors that are associated with aggression among this sample would allow for targeted interventions that may help prevent or address problem behaviors before they worsen. Pinpointing early risk factors may also help identify individuals who are at risk for developing worsening behavior problems, and may help identify the most promising targets or agents for prevention/intervention.

The current study is the first to report prevalence rates of and risk factors for aggressive behaviors among a large, national sample of children and adolescents with well-characterized diagnoses of ASD. Based on previous research on aggression among typically developing children, we were particularly interested in examining whether aggression was related to risk factors observed in non-ASD children (e.g., age, level of income, level of parental education, parental marital status, gender, cognitive and adaptive functioning, language and communication). In addition we were also interested in whether ASD phenotypic variables, such as level of severity and specific ASD symptoms, were predictive of aggression.

Methods

Participants

The total sample included 1,380 children between the ages of 4 and 17 (mean age = 9.1 years, *SD* = 3.5) who participated in the Simons Simplex Collection (SSC), a North American multiple-site, university-based research study that includes families with only one child with an ASD. The majority of the sample was male (86.6%). Full Scale IQ scores ranged from 13 to 167, with a mean of 84.7 (*SD* = 25.6; Median = 87.0).

Phenotypic information from each participant was collected via a number of different measures and raters, and genetic information was collected from both probands and family members. The measures examined in the current study are described in detail below.

Measures

Core Symptoms of ASD

The *Autism Diagnostic Interview—Revised* (*ADI-R*; Rutter et al. 2003) was conducted with the parents of all study participants to provide diagnostic information. The *ADI-R* is a 93 item semi-structured diagnostic interview which focuses on developmental history and current presentation of core symptoms of autism spectrum disorders. The *ADI-R* provides scores in the areas of reciprocal social interaction, language/communication, and restricted, repetitive, and stereotyped patterns of behavior. Scores are also provided with regard to both current and past symptoms. Specific coding conventions include "0" (i.e., behavior of type specified in the coding is/was not present) through "3" (i.e., severe manifestation of the abnormality specified) with additional categories for "abnormality in the general areas of the coding, but not of the type specified, not applicable, and not known." The diagnostic algorithm (based on ICD-10 and DSM-IV guidelines) also provides clinical cutoff scores. The *ADI-R* has been shown to have good inter-rater reliability, high intraclass correlations, and good internal consistency (Catherine Lord and Rutter 1994).

The *Autism Diagnostic Observation Schedule* (*ADOS*) was also administered to each participant (Lord et al. 2002). The *ADOS* is a semi-structured, standardized observational assessment, which focuses on the core symptoms of ASD (including the areas of communication, reciprocal social interaction, imagination/creativity, and stereotyped behaviors and restricted interests). An individual is administered one of four different modules (which are selected based on the age and level of speech of the participant). The *ADOS* is scored via a diagnostic algorithm that provides cutoff values for diagnoses of Autistic Disorder and Autism Spectrum

Disorders. The number and nature of items differs across modules, as does the diagnostic algorithm. The *ADOS* also has good psychometric properties, including inter-rater reliability (Lord et al. 2002).

Given the different number of items across ADOS modules, and the differences in the items used, it is not possible to directly compare raw scores across modules. More specifically, when comparing two individuals who both have received an ADOS, a greater raw score for one individual may indicate greater ASD severity if both received the same module; however, one cannot compare the raw scores of the two individuals to judge severity if they have received different modules (e.g., one a Module 1 and the other a Module 2) due to the differences across modules. To allow for comparisons across modules, a calibrated severity score (CSS) was computed based on each participant's *ADOS* results through a technique developed by Gotham and colleagues (2009). The CSS transforms *ADOS* scores into a metric used to gauge autism severity, accounting for age and language variables. In their study of 1,118 individuals, Gotham and colleagues (2009) found the CSS to be less influenced by the participant demographics than raw *ADOS* total scores.

The *Social Responsiveness Scale* (*SRS*; Constantino et al. 2003) was administered to parents of all participants. The *SRS* is a parent-report measure of specific behaviors that are associated with the full range of ASD symptomatology (including social interaction, communication, and restricted/repetitive patterns of behavior). The quantitative approach of this measure allows for dimensional understanding of traits that range from typical to clinical. The questionnaire includes 65 items that assess the child's engagement in reciprocal social interactions, understanding of emotional and social cues, and motivation to engage with others. Psychometric studies of the *SRS* indicate that scores are continuously distributed across the general population, and that the *SRS* shows good test–retest reliability, inter-rater reliability, discriminant validity, and concurrent validity (Constantino et al. 2003; Constantino and Todd 2003).

The *Repetitive Behavior Scale—Revised* (*RBS-R*; Lam and Aman 2007) was also administered to parents of all participants. The *RBS-R* is a questionnaire allowing parents to report on specific repetitive behaviors often observed in individuals with ASD. Factor analysis on the *RBS-R* responses led to 5 subscales: Rituals/Sameness, Self-injurious behaviors, Stereotypic behaviors, Compulsive behaviors, and Restricted Interests. Item-total correlations for these subscales ranged from 0.54 to 0.65 and internal consistency ranged from 0.78 to 0.91.Inter-rater reliability ranged from 0.57 to 0.73 in one sample (Lam and Aman 2007).

Aggression

Four individual item scores from the *ADI-R* were used to assess both current and historical aggression directed toward both caregivers and non-caregivers. These scores were derived from Item #81 "Aggression Toward Caregivers or Family Members" (current and ever) and Item #82 "Aggression Toward Non-caregivers or Nonfamily Members" (current and ever). Possible scores on these items range from zero to three, as follows:

0. No aggression or only very rare episodes
1. Mild aggressiveness (threatening, rough play, or provoked lashing out)
2. Definite physical aggression involving hitting or biting
3. Violence including the use of implements

For the purposes of several subsequent analyses, a single dichotomous variable was created to clearly delineate between those exhibiting definite aggressive behaviors and those exhibiting none. Thus, the sample was divided into those who were *not* currently demonstrating aggression to either caregivers or to non-caregivers (a score of "0" on both questions regarding aggression to caregivers and non-caregivers) and those who were currently demonstrating *definite* aggression to either a caregiver or non-caregiver (a score of "2" or "3"on either questions regarding aggression to caregivers and non-caregivers). The large overall sample size allowed this division while retaining a large number of individuals in the resultant sample. This resulted in 549 (39.8%) individuals in the No Aggression group, and 489 (35.4%) in the Definite Aggression group, with a total of 1,038 showing either no aggression or definite aggression. Demographic information for the total sample, the Definite and No Aggression groups, and these two groups combined is presented in Table 1.

Cognitive Functioning

With regard to the IQ measure, the *Differential Ability Scales, 2nd Edition* (*DAS-II*) was the primary scale administered to 89.6% of the participants (Elliot 2007). In a small subset, either the *Mullen Scales of Early Learning* (Mullen 1995) (4.2%), *Wechsler Intelligence Scale for Children, 4th Edition* (*WISC-IV*; 2.7%) (Wechsler 2003), or *Wechsler Abbreviated Scale of Intelligence* (*WASI*; 3.5%) (Wechsler 1999) was used depending on the child's age or ability to complete the other measures. A standard, deviation IQ was computed for all of the measures when appropriate normative data was available; however, in a small number of cases wherein raw scores were outside of standard ranges for deviation scores (16.1%), a ratio IQ was computed by taking the average of the age equivalents

Table 1 Demographic variable means and *SD*s for the total sample ($N = 1{,}380$), No Aggression group ($N = 549$), definite aggression group ($N = 489$), and the two groups combined ($N = 1{,}038$)

Variable	Total sample mean (*SD*)	No aggression mean (*SD*)	Definite aggression mean (*SD*)	Combined groups mean (*SD*)
Age	9.1 (3.5)	9.7 (3.7)	8.6 (3.1)	9.2 (3.5)
Autism diagnosis (%)				
Autistic disorder	69	67	73	70
Asperger syndrome	21	23	19	21
PDD-NOS	10	10	8	9
Race				
White	80	82	79	81
Black	4	3	3	3
Asian	4	5	4	4
Other	12	10	14	12
Gender (% male)	87	88	85	87
Marital status (% married)	93	93	93	93
Maternal educational level (%)				
Less than 9 years	0.2	0.0	0.5	0.3
Some high school	1.1	0.5	1.4	0.9
GED	0.9	1.5	0.8	1.2
High school	7.6	7.5	7.7	7.6
Some college	21.0	21.8	20.5	21.1
Associates degree	8.0	8.5	6.3	7.4
Bachelors degree	36.4	38.8	34.7	36.8
Graduate degree	24.8	21.5	28.1	24.7
Paternal educational level (%)				
Less than 9 years	0.2	0.2	0.2	0.2
Some high school	1.7	1.8	1.4	1.6
GED	1.6	1.8	1.2	1.5
High school	9.8	11.2	9.1	10.2
Some college	18.2	18.5	16.7	17.7
Associates degree	6.0	5.9	6.5	6.2
Bachelors degree	32.8	29.9	35.1	32.4
Graduate degree	29.8	30.5	29.8	30.2
Income (per year) (%)				
Less than $20k	3.2	3.7	2.3	3.0
$21k–35k	4.5	5.3	4.3	4.8
$36k–50k	8.7	9.6	8.0	8.8
$51k–65k	10.6	12.3	10.0	11.2
$66k–80k	12.3	12.8	11.7	12.3
$81k–100k	17.4	17.6	15.7	16.7
$100k–130k	15.3	14.1	16.9	15.4
$131k–160k	10.0	7.7	12.0	9.8
More than $160k	18.0	16.8	19.1	17.9
CSS	7.4 (1.8)	7.3 (1.8)	7.4 (1.7)	7.3 (1.8)
IQ[a]	84.7 (25.6)	86.5 (25.4)	82.4 (25.3)	84.6 (25.9)
RBS-R total score[b]	26.4 (17.0)	22.2 (15.4)	31.2 (17.5)	26.4 (17.0)
Vineland-II adaptive behavior composite	74.5 (11.5)	75.2 (11.7)	72.6 (11.1)	74.0 (11.5)
PPVT-4[c]	86.4 (28.7)	88.4 (27.8)	84.0 (30.0)	86.3 (28.9)
SRS total score[d]	81.9 (13.3)	79.0 (13.1)	85.0 (12.8)	81.8 (13.3)

CSS calibrated severity score

[a] Based on the DAS-II (89%), Mullen (4%), WISC-IV (3%), or the WASI (4%)

[b] Repetitive Behavior Scale—Revised

[c] Peabody Picture Vocabulary Test, 4th Edition

[d] Social Responsiveness Scale

across the subtest scales and dividing by chronological age in months, and then multiplying by 100.

Adaptive Skills

The *Vineland Adaptive Behavior Scales, 2nd Edition—Survey Form* (Sparrow et al. 2005) was administered to the parents of all participants. The *Vineland-II* is a semi-structured interview that assesses adaptive functioning across a range of domains, including Communication, Socialization, and Daily Living. Standard scores are derived for each domain, and an overall Adaptive Behavior Composite standard score is provided. The *Vineland-II* has been widely used among individuals with ASD (Gillham et al. 2000), and has strong psychometric properties.

Other Measures

Basic receptive language was assessed in the sample using the *Peabody Picture Vocabulary Test, 4th Edition* (*PPVT-4*; Dunn and Dunn 2007). The *PPVT-4* demonstrates good internal consistency and test–retest reliability (both $r >$ 0.90). In the current sample, 94% received Form A of the *PPVT-4* and the remainder received Form B (alternate form reliability $r = 0.89$).

Each parent also participated in an extensive history as part of the SSC project. As part of this history, each was asked their level of income, level of education for each parent, and marital status.

Emotional and behavioral functioning was assessed via the *Child Behavior Checklist* (*CBCL*), which is a parent-report checklist of child and adolescent symptoms occurring within the past 6 months. The CBCL consists of 113 items, which are rated on a scale ranging from "0" (*not true*) to "2" (*very true or often true*) (Achenbach and Rescorla 2001a, b). The *CBCL* provides scores along three summary scales (i.e., Total Problems, Internalizing Problems, and Externalizing Problems) as well as eight Syndrome Scales (i.e., anxious/depressed, withdrawn, somatic complaints, social problems, thought problems, attention problems, rule-breaking behavior, and aggressive behavior). Of particular interest was the Aggressive Behavior syndrome scale from the *CBCL,* which includes 18 items that include physical aggression (e.g., fighting and attacking others, etc.), property destruction, and verbal aggression (arguing, threatening, etc.). The *CBCL* is one of the most widely used rating scales of childhood emotional and behavioral functioning, and has been studied extensively in both clinical and community samples, as well as among samples with ASD.

Results

Prevalence

As detailed in Table 2, in the entire sample of 1,380 individuals, 56% respondents were currently engaging in some form of aggressive actions, ranging from mild to severe, towards caregivers, with fewer (32%) engaging in aggressive behaviors towards non-caregivers. Sixty-eight percent had demonstrated some form of aggression at some point to a caregiver, and 49% to non-caregivers.

Spearman's rank-order correlation coefficient, rho, was used to examine the associations between reported aggression towards caregivers and non-caregivers. The correlation was significant for both current ($r = 0.49$, $p < 0.001$), and ever ($r = 0.54$, $p < 0.001$), suggesting that when a child demonstrated aggression towards a caregiver, he/she was more likely to demonstrate it towards a non-caregiver as well. In the entire sample, 39.8% of participants were not currently demonstrating any aggression to either caregiver or non-caregiver; whereas 35.4% were demonstrating definite aggression. Responses on the *ADI-R* item #81 regarding current aggression towards a caregiver were significantly and positively associated with the *CBCL* Aggression subscale ($r = 0.44$, $p < 0.001$).

Aggression and Relation to Other Variables

As noted above, participants were classified as either (1) having no current aggression towards caregivers or non-caregivers, or (2) currently demonstrating definite aggression to either caregivers or non-caregivers (i.e., No Aggression and Definite Aggression Groups). This dichotomous variable was used in a logistic regression to examine whether specific variables were significantly related to the presence of aggression. Logistic regression transforms the dependent variable into a logit variable,

Table 2 Percentage of individuals in entire sample engaging in aggressive behaviors both currently or at any time in the past (i.e., "ever")

ADI-R#	ADI description	Current caregiver	Ever caregiver	Current non-caregiver	Ever non-caregiver
0	No aggression	43.9	31.9	67.8	51.0
1	Mild aggressiveness	24.3	20.9	14.2	17.4
2	Definite physical aggression	24.3	35.2	15.2	25.8
3	Violence with implements	7.5	12.0	2.8	5.8

which is the natural log of the odds of whether or not an event will occur, and then applies maximum likelihood estimation. By doing this, logistic regression allows one to estimate the odds of a certain event occurring. The dependent variable in logistic regression is typically dichotomous, though the predictor variables can be either categorical or continuous. Backward stepwise logistic regression begins with all of the predictor variables entered into the model. These are then eliminated from the model incrementally based on whether they remain significant at each iteration. When no more variables can be eliminated based on their level of significance, the analysis has been completed.

Six hundred thirty-three participants had complete data on all the measures and were thus used in this initial analysis. Reasons for missing data included age constraints on some measures, and incomplete responses to some items on the history form. Table 3 shows the initial and final steps of the logistic analysis. The final variables included in the model as significant predictors included age, total score from the *RBS-R*, income, and the total score from the *SRS*.

Table 3 Logistic regression for prediction of the presence of aggressive behaviors (0 = no aggression [$N = 325$]; 1 = definite aggression [$N = 308$])

Variable	β	SE	e^{β}
First step			
Non-ASD variables			
Age	−.150**	.030	.860
Gender	.175	.250	1.191
Marital status	−.203	.377	.816
Mother education	−.022	.072	.978
Father education	.010	.068	1.010
Income	.094$^{\Psi}$	.047	1.099
PPVT-4	.005	.007	1.005
IQ	.000	.008	1.000
Vineland composite	−.017	.012	.983
ASD phenotypic variables			
CSS	.043	.050	1.044
RBS-R total	.022**	.006	1.023
SRS total	.024*	.009	1.025
Constant	−1.252	1.305	.286
χ^2 (df = 12)	85.20**		
Final step			
Age	−.136**	.027	.873
Income	.097$^{\Psi}$	.038	1.102
RBS-R total	.022**	.006	1.022
SRS total	−.029**	.008	1.029
Constant	−2.364**	.651	.094
χ^2 (df = 3)	81.48**		

$^{\Psi}$ $p < .05$; * $p < .01$; ** $p < .001$

Significant effects for *RBS-R*, income, and *SRS* were positive, indicating that aggressive behaviors were more likely with increases in repetitive behaviors, higher income, and increasing levels of ASD related social and communicative deficits. As depicted in Fig. 1, the significant effect for age was negative, indicating that with increasing age, aggressive behaviors become less likely.

Subscales of the *RBS-R* were examined more closely to see which types of repetitive behaviors were most predictive of aggression. A backward stepwise method utilizing likelihood ratio was used to determine final variables in the model. Nine hundred ninety-three participants who had complete data on the *RBS-R* were included in this analysis. As indicated in Table 4, final variables that were significant

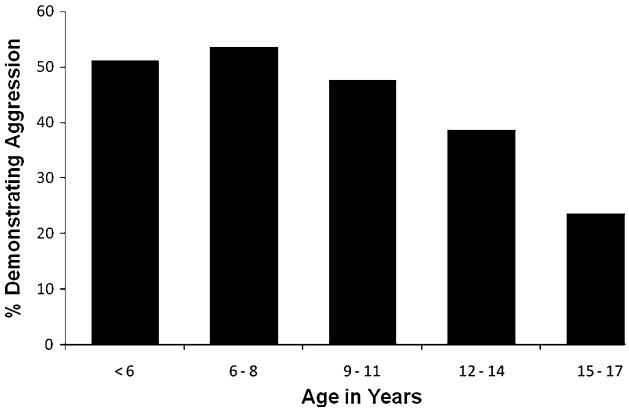

Fig. 1 Percentage of participants demonstrating definite aggression across age groups

Table 4 Logistic regression for prediction of the presence of current aggressive behaviors (0 = no aggression [$N = 527$]; 1 = definite aggression [$N = 466$]) by the *RBS-R*

Variable	β	SE	e^{β}
First step			
Stereotyped behavior	.036	.026	1.036
Self-injurious behavior	.189**	.033	1.208
Compulsive behavior	−.010	.025	.990
Ritualistic behavior	−.066$^{\Psi}$	.028	.936
Sameness behavior	.094**	.018	1.099
Restricted behavior	.003	.132	1.003
Constant	−.992**	.136	.371
χ^2 (df = 6)	118.97**		
Final step			
Self-injurious behavior	.201**	.032	1.223
Ritualistic behavior	−.066$^{\Psi}$	.026	.936
Sameness behavior	.096**	.017	1.101
Constant	−.912**	.121	.213
χ^2 (df = 2)	116.91**		

$^{\Psi}$ $p < .05$; * $p < .01$; ** $p < .001$

predictors and had positive effects were self injurious behaviors, ritualistic behaviors, and resistance to change.

Discussion

In the first study to report on prevalence rates for aggression in a large, well characterized sample of children and adolescents with ASD, aggressive behaviors were reported at an alarmingly high rate. Over two-thirds (68%) of the parents noted that their children had engaged in some form of aggressive behavior towards them at some point, and nearly half (49%) had demonstrated some type of aggressive behavior toward others. Though rates of current aggression were somewhat lower, they remained startlingly high, with 56% of the sample currently aggressing towards caregivers and 32% aggressing towards others. Thirty-five percent of the children and adolescents were currently exhibiting significant aggression (as measured by a score of "2" or "3" on the *ADI-R*) towards either a caregiver or another person. These rates appear to be much higher than rates reported among individuals with intellectual disabilities, which have ranged from 7 to 11% (Emerson et al. 2001; Holden and Gitlesen 2006). The current rates are also higher than rates previously reported among adults with both autism and ID (15–18%) (Matson and Rivet 2008), among young children with autism (22%) (Hartley et al. 2008), and in samples of children meeting educational criteria for PDD, (9–14%) (Lecavalier et al. 2006). Note that part of this increase may be related to how aggression was defined or the time frame encompassed (e.g., "ever") in the ADI-R question.

A second aim of the current study was to identify factors that were associated with aggression among children and adolescents with ASD, and to determine whether those risk factors were similar to those typically reported among children and adolescents without ASD. Surprisingly, the current study found that several factors that have historically been shown to predict aggression in typically developing children were not predictive of aggression in children with ASD. At the family demographic level, we found that parent marital status and level of parental education were not significant predictors of aggression in the current sample (contrary to usual results among samples without ASD). At the individual level, we also found that aggression was equally common among boys than girls. Again, this result is surprising, given the extensive evidence for this gender difference among typically developing children, (the typical finding being that boys are more likely to engage in aggression throughout childhood). Level of intellectual functioning and language ability, also historically associated with an increased risk for aggression in typical populations, were not predictive of aggressive behaviors in the current sample of children with ASD. Past studies linking language ability to aggression have included expressive language. Though the current study used the *PPVT-4* to assess receptive language, the *Vineland-II* includes functional expressive and receptive language domains as part of its composite score. Neither the *PPVT-4* nor the *Vineland II* were significant predictors. Note that when the Vineland subdomains of Daily Living and Communication were included as separate factors in the logistic model, the final predictors remained unchanged and neither emerged as significant predictors.

The current study did reveal some results that were consistent with expectations based on previous work among typically developing samples. For example, consistent with findings from the general population, aggression was reported more often in younger individuals with ASD in the current study. These findings are consistent with studies of aggression among the general population, indicating that physical aggression shows a significant decline across childhood for most children (Hartup 1974; NICHD Early Child Care Research Network 2004; Tremblay 2000). Some developmental researchers have argued that aggression is normative in very early childhood, and that among most children these behaviors decline as emotion regulation, adaptive, and communication skills increase (NICHD Early Child Care Research Network 2004). Indeed, the combination of early language delays and difficulties with impulse control and emotion regulation place typically developing children at heightened risk for aggression (Calkins 1994; Hay 2007; Moffitt 1993). In contrast, among the current sample of children and adolescents with ASD, we did not find an association between language and communication skills (as measured by the *Vineland-II* or the *PPVT-4*) and levels of aggression. Although we did not assess emotion-regulation or impulse control directly, it is possible that these abilities may relate to our findings, and certainly warrant further study given their previous association with aggression among other populations of children. Overall, it appears that age-related factors outside of those measured in the current study are likely at play.

In order to fully investigate these age effects, longitudinal studies will be necessary to provide more information about trajectories of aggressive behavior among children with ASD. General population studies regarding this issue have found that different subgroups of children follow different developmental trajectories with regard to their engagement in physical aggression, including stable patterns of both low and high aggression, declining, and even increasing rates (Broidy et al. 2003; Campbell et al. 2010). Each of these subgroups can be characterized by different risk and protective factors (at the child, family, and community levels). This type of approach provides even more information about potential risk factors for and sequelae of

aggression and would be a highly useful for differentiating subtypes of children with ASD with an eye toward preventing violence or other negative outcomes.

Low family income has historically been identified as a risk factor for aggression in non-ASD populations. Though the current study indicated that level of income was also a significant predictor in ASD, the results were in a direction opposite than expected, with higher income predicting aggression. This result is surprising and not amenable to easy interpretation. Given the high financial cost associated with having a child with ASD (e.g., Ganz 2007), we expected that higher family income would be associated with greater access to resources, supports, and treatments, which would (by extension) result in fewer behavior problems. In light of our current results, however, it is possible that families with higher income are better able to access interventions that challenge (and may be frustrating for) their child with ASD, and in turn may create situations that produce more aggressive behaviors. These speculations clearly warrant further investigation, and studies that include both longitudinal designs may be best able to tease apart these variables.

Another aim of the current study was to examine whether particular ASD phenotypic variables were predictive of aggression. The results indicated that ASD-related severity as assessed by clinician (i.e., *ADOS CSS*) did not significantly predict aggression. In contrast, ASD-related social and communication problems as reported by parents (i.e., *SRS*) were predictive of aggression. In the current total sample, the *ADOS CSS* had a very weak relationship with the *SRS* (Spearman's rank-order correlation coefficient, rho: $r = 0.07$), suggesting that the *SRS* and the *ADOS CSS* are assessing very different constructs. It may be that the *ADOS CSS* reflects core ASD symptoms that contribute to the diagnosis, whereas the *SRS* reflects the functional manifestation of those ASD symptoms. This notion is supported by the strong association between the *SRS* and the *Vineland II* (Spearman's rank-order correlation coefficient, rho; $r = -0.411$, $p < 0.001$), with higher *SRS* total scores associated with lower adaptive skills.

Another ASD phenotypic variable examined was the presence of repetitive behaviors. Our results indicated that repetitive behaviors (as measured by the *RBS-R*) were significantly associated with aggression among children and adolescents with ASD. Specifically, for each point increase in the *RBS-R* total score, the odds of the individual being aggressive increased from 1 to 1.022 (Table 4; $e^{.022}$). An increase of 32 points on the *RBS-R* doubled the odds of the individual being aggressive (i.e., $= e^{32*[.022]}$; 2.02). To place this in context, total *RBS-R* scores in the current sample ranged from 0 to 95. Subscales from the *RBS-R* were then examined to see which were predictive of aggression. The results indicated that self-injurious behaviors, ritualistic behaviors, and resistance to change were predictive of aggression.

Previous work may help shed some light on these finding. For example, Reese and colleagues (2005) conducted a functional behavioral interview with the parents of 23 children with autism and 23 children without autism matched for chronological age, developmental age, and gender (Reese et al. 2005). They found that the children without autism engaged in disruptive behavior primarily for social goals, such as to gain attention, obtain items, or escape demands. In contrast, they found that children with autism engaged in disruptive behaviors to escape demands that interfere with a repetitive behavior, to retain access to an item used in a repetitive routine, or to avoid idiosyncratic sensory stimuli. Similar results were reported in a single case study of a woman with intellectual disability and symptoms of autism (Murphy et al. 2000). In assessing the function of aggressive behavior, the authors found that the behavior only occurred when her stereotyped behaviors and rituals were interrupted. Thus, they concluded that the function of her aggression was to escape the termination of her RRB (Murphy et al. 2000).

Although the current study precludes an examination of temporal cause (or function) of aggression, Reese and colleagues' (2005) results may be relevant here. In our sample, the more likely an individual was to engage in repetitive behaviors, the more likely he/she was to respond with aggression toward others. It is quite possible that adults interacting with these children often act to stop or interfere with some repetitive behaviors, which may result in reactive aggression. It seems likely that adult interference would occur most often in the case of self-injury, which we found to have the strongest association with aggression. Alternatively these behaviors may be associated via another variable, such as temperament or poor emotion regulation. Again, this issue warrants further study.

In summary, the current study is the first to report prevalence of and risk factors for aggressive behaviors in very well characterized and large sample of children and adolescents with ASD. The current results reflect a high prevalence of aggressive behaviors in individuals with ASD. Aggression in the current sample was not associated with clinician observed severity of ASD symptoms, level of intellectual, language or communication skills, gender, level of parental education, or parent marital status. Those individuals who were younger, whose parents reported more ASD related social and communication difficulties, who engaged in more severe restricted and repetitive behaviors, and who had higher levels of family income were more likely to demonstrate aggression. Given the significant impact of aggression on individual and family outcomes, it is hoped that this knowledge will inform more targeted intervention efforts.

The current study has several limitations and suggests areas for future research. Though the study uses one of the largest and carefully phenotyped groups of individuals with ASD, there may be biases associated with the sample that limit the generalization of results. For example, the current sample consists only of individuals from simplex families and thus may not represent the same phenotypic expression as individuals from multiplex families. It is possible that the genetic, environmental, behavioral variables that impact the expression of aggressive behaviors are different among individuals from multiplex families. Extending these findings to multiplex families will be an important next step.

Several researchers have investigated behavioral phenotypes associated with specific genetic disorders (Dimitropoulos et al. 2001; Einfeld et al. 2001; Finucane et al. 2001; Holland et al. 2003; Reese et al. 2005). For example, Einfeld and colleagues (2001) examined the behavioral and emotional difficulties in Williams Syndrome. Their results revealed a greater degree of tantrums, food fads, obsessions and preoccupations, wandering, anxiety, preference for adult company, elation, word repetition, excessive affection, avoidance of certain sounds, overactivity, and lower attention span (Einfeld et al. 2001). Individuals with Smith-Magenis Syndrome demonstrate a pattern of characteristic stereotypic and self-injurious behaviors (Finucane et al. 2001). Individuals with Prader-Willi Syndrome have a behavioral phenotype that includes tantrums, skin picking, and compulsive behaviors (Dimitropoulos et al. 2001).

Similarly, ASD researchers have been searching for behavioral phenotypes that may inform the genetic analyses. Autism is one of the most heritable disorders with strong evidence for a genetic basis (Veenstra-Vanderweele et al. 2004). One approach to uncovering behavioral phenotypes has been comparing simplex (i.e., a single ASD affected individual with no other ASD affected family members) to multiplex (i.e., more than one ASD affected individual in the family) families to see if any behavioral differences may associate with genetic variants. However, this line of research has not found significant differences to date in the clinical profiles between simplex and multiplex individuals (Cuccaro et al. 2003), though researchers have noted that locus heterogeneity in ASD (i.e., defects in different loci or genes resulting in the same phenotype) may have differential impact on associated symptoms, including aggression, leading to the recommendation to use large samples and measures that will "allow rational association and linkage approaches given phenotypic heterogeneity" (Veenstra-Vanderweele et al. 2004, p. 396).

The individuals in the current sample were also relatively "high functioning" with the mean IQ score in the current sample within the low average range. Also, two of the four significant predictors of aggression in the current study were assessed via parent report measures, raising the possibility of some type of reporting bias. It will be important to corroborate the current findings with behavioral observations, other objective measures, and multiple informant sources. Using a longitudinal approach would help identify how predictors of aggression may change as a child ages. The current study is also limited in its ability to assess the often complex person-environment interactions that certainly affect the expression of aggression among children. Despite these limitations, the current study provides an important first step toward understanding the scope of the problem of physical aggression among a large sample of individuals with ASD, and offers a first look at factors that may place these individuals at risk for demonstrating aggression.

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