



## An investigation of anxiety in children and adolescents with autism spectrum disorder<sup>☆</sup>



Sian Williams <sup>a</sup>, Geraldine Leader <sup>a,\*</sup>, Arlene Mannion <sup>a</sup>, June Chen <sup>b</sup>

<sup>a</sup> National University of Ireland, Galway, Ireland

<sup>b</sup> Michigan State University, USA

### ARTICLE INFO

#### Article history:

Received 3 October 2014

Accepted 17 October 2014

Available online 17 November 2014

#### Keywords:

Anxiety

Autism spectrum disorder

Gastrointestinal symptoms

Sleep problems

Challenging behavior

### ABSTRACT

Anxiety-related concerns are among the most common presenting problems for school-age children and adolescents with autism spectrum disorder (ASD) in clinical settings. The current study examined the relationship between anxiety and gastrointestinal (GI) symptoms, sleep problems, and challenging behavior in a sample of children and adolescents with ASD, aged 6–17 years. Parental measures were completed by 109 parents of children and adolescents with ASD. Significant positive correlations were found between anxiety and GI symptoms, and anxiety and sleep problems. A hierarchical linear regression indicated that demographic variables, GI symptoms, sleep problems, and challenging behavior accounted for 34% of the variance in anxiety, with sleep, severity of self-injurious behavior, age, and diagnosis of intellectual disability emerging as significant predictors. The findings suggest that these factors should be considered during clinical practice as they may serve as important alerts for clinicians to consider assessing for anxiety disorders. Future research should investigate these variables further by examining their associations with specific types of anxiety disorders.

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### 1. Introduction

High rates of anxiety have been reported among children and adolescents with autism spectrum disorder (ASD). Research indicates that anxiety is more commonly observed in youth with ASD compared to typically developing peers (Bellini, 2004; Guttmann-Steinmetz, Gadown, DeVincent, & Crowell, 2010; Russell & Sofronoff, 2005) or youth with conduct disorder (Green, Gilchrist, Burton, & Cox, 2000) or attention deficit/hyperactivity disorder (ADHD; Gadown, DeVincent, & Schneider, 2009). Researchers have suggested that anxiety-related concerns are among the most common presenting problems for school-age children and adolescents with ASD in clinical settings (Ghaziuddin, 2002). The most frequently occurring of the anxiety disorders in children and adolescents with ASD appears to be specific phobias, generalized anxiety disorder, separation anxiety disorder, obsessive-compulsive disorder, and social phobia (Evans, Canavera, Kleinpeter, Maccubbin, & Taga, 2005; Matson & Love, 1990; White, Oswald, Ollendick, & Scabill, 2009).

<sup>☆</sup> This research was conducted by the first author under the supervision of the second author in partial fulfillment of the requirements of the MSc in ABA at NUI Galway.

\* Corresponding author at: Irish Centre for Autism and Neurodevelopmental Research, School of Psychology, National University of Ireland, Galway, Ireland. Tel.: +353 49 3434; fax: +353 91 521355.

E-mail address: [geraldine.leader@nuigalway.ie](mailto:geraldine.leader@nuigalway.ie) (G. Leader).

### 1.1. Prevalence of anxiety in ASD

Researchers have reported that in small outpatient samples anywhere from 11% to 84% of children and adolescents with ASD experience some degree of anxiety (Muris, Steerneman, Merckelbach, Holdrinet, & Meesters, 1998; White et al., 2009). In clinical samples, approximately 55% of children with ASD have been found to meet diagnostic criteria for at least one anxiety disorder (de Bruin, Ferdinand, Meester, de Nijs, & Verheij, 2007), while a meta-analysis by van Steensel, Bogels, and Perrin (2011) indicated that 40% of children and adolescents have at least one anxiety disorder. The wide-ranging prevalence of anxiety in children with ASD is likely due to method variance with respect to assessment instrument (interview versus self-report scale), informant (parent versus child), anxiety classification (symptoms versus disorders), and type of anxiety disorder measured (Vasa et al., 2013).

### 1.2. Importance

Although, anxiety symptoms and disorders are highly prevalent in children and adolescents with ASD, they are often unrecognized or misdiagnosed (MacNeil, Lopes & Minnes, 2009). Unfortunately, differentiating between comorbid anxiety and characteristics of ASD can be problematic (Tsai, 2006). It remains unclear whether anxiety difficulties constitute a separate condition or align more closely with core ASD features. For example, social withdrawal in ASD may appear similar to social avoidance in social anxiety disorder. Recognizing the presentation of anxiety symptoms presents a further challenge for practitioners as the appearance of anxiety symptoms may differ in individuals across the range of intellectual functioning and verbal abilities. It is important to identify comorbid anxiety in children and adolescents with ASD because anxiety symptoms can cause considerable distress and interfere with daily functioning (Muris et al., 1998). Comorbid anxiety disorders can cause acute distress, amplify the core symptoms of ASD and trigger behavioral difficulties including tantrums, aggression and self-injury (Canitano, 2006). Anxiety in individuals with ASD has also been shown to be related to various other symptoms including gastrointestinal (GI) issues (Mazurek et al., 2013; Nikolov et al., 2009) and sleep problems (Malow et al., 2006; Rzepecka, McKenzie, McClure, & Murphy, 2011).

### 1.3. Anxiety and gastrointestinal symptoms

Varying results have been reported for the presence of GI symptoms in individuals with ASD. Prevalence rates of 46% to 84% have been reported in some studies (Horvath et al., 2000; Horvath & Perman, 2002a,b; Kuddo & Nelson, 2003; Mannion, Leader, & Healy, 2013; Melmed, Schneider, Fabes Philips, & Reichelt, 2000), while other studies found smaller prevalence rates of GI symptoms in children with ASD, ranging from 22.7% (Nikolov et al., 2009) to 24% (Molloy & Manning-Courtney, 2003). A relatively small body of research has investigated the relationship between anxiety and GI symptoms. Nikolov et al. (2009) reported that in a sample of 172 children with pervasive developmental disorders, 39 (23%) were found to have GI problems. Compared to children without GI problems, those with GI problems showed greater symptom severity on measures of irritability, anxiety and social withdrawal. Similar findings have been reported in studies consisting of a greater sample sizes. Williams, Christofi, Clemons, Rosenberg, and Fuchs (2012) reported that one third of 3122 children (aged 2–18 years) with an ASD diagnosis, experienced at least one chronic GI symptom. The results indicated that clinical anxiety was associated with chronic GI symptoms in children with autism. Chronic GI complaints were greater in children with clinical anxiety compared to those with no anxiety. In a study by Mazurek et al. (2013), a sample of 2973 children and adolescents, participants with chronic constipation, chronic diarrhea, chronic bloating, chronic nausea and chronic abdominal pain had higher anxiety than those without these symptoms. Anxiety contributed to the prediction of chronic constipation, chronic bloating, chronic nausea and chronic abdominal pain, but not to the prediction of chronic diarrhea.

### 1.4. Anxiety and challenging behavior

Challenging behaviors are prominent in the ASD population. The term 'challenging behavior' is used to describe a broad class of unusual behaviors shown by individuals with developmental disabilities including aggression, destructiveness, self-injurious behavior (SIB), and stereotyped behaviors (Emerson, 2001). A study by Murphy, Healy, and Leader (2009), involving 157 children diagnosed with ASD, reported that 82% of the sample displayed some form of challenging behavior. A number of studies have explored the relationship between anxiety and challenging behavior in individuals with ASD. Cervantes, Matson, Tureck, and Adams (2013) utilized the Baby and Infant Screen for Children with aUtlsm Traits (BISCUIT; Matson, Boisjoli, & Wilkins, 2007) to explore the relationship of anxiety/repetitive behavior symptom severity and challenging behaviors in infants and toddlers with ASD. Children with ASD who displayed more severe impairment associated with anxiety/repetitive behavior demonstrated higher rates of overall challenging behavior than those with ASD who evinced no to minimal anxiety impairment. Matson, Mahan, Sipes, and Kozlowski (2010) also used the BISCUIT to investigate the effects of comorbid psychopathology on challenging behavior among atypically developing infants and toddlers, with and without an ASD diagnosis. Greater levels of symptoms of comorbid psychopathology were related to higher rates of challenging behaviors. Specifically, aggressive and destructive behavior, stereotypies, and SIB were particularly pronounced when moderate or severe levels of symptom endorsement were present on the psychopathology factors of anxiety/repetitive behavior.

Similar associations between anxiety and challenging behavior have also been reported for older children and adolescents with ASD, indicating that anxiety may be a prominent feature of ASD throughout the individual's youth. [Farrugia and Hudson \(2006\)](#) examined anxiety symptoms in 29 adolescents with Asperger Syndrome (AS) aged 12–16 years, compared to 30 non-clinical (NC) adolescents and 34 adolescents with anxiety disorders (AD). Self and parental reports revealed significantly higher levels of anxiety in both the AS group and the AD group than in the NC group. Behavioral problems were also significantly higher for the AS group than the two comparison groups. Statistical analyses revealed a positive correlation between levels of anxiety and behavioral problems. In a study by [Rzepecka et al. \(2011\)](#) parental measures of sleep problems, anxiety, and challenging behavior were completed by 187 parents of children (aged 5–18 years) with intellectual disability (ID) and/or ASD. Significant positive associations were found between the three factors. A hierarchical multiple regression showed that medication, sleep problems and anxiety accounted for 42% of the variance in challenging behavior, with a large effect size.

Repetitive and restricted behavior has become a variable of particular interest in recent research investigating the association between anxiety and challenging behavior in ASD. [Rodgers, Glod, Connolly, and McConachie \(2012\)](#) examined repetitive behaviors and anxiety in two groups of children with ASD, those with high anxiety and those with lower levels of anxiety. Children with high anxiety had more repetitive behaviors than those without anxiety. Within the anxiety sample, higher levels of insistence on sameness were associated with more anxiety. No association was found between sensory motor repetitive behaviors and anxiety in this group. [Rodgers, Riby, Janes, Connolly, and McConachie \(2012\)](#) compared anxiety levels of 34 children with ASD and 20 children with Williams Syndrome, and examined the relationship between repetitive behaviors and anxiety. Children with autism were found to have higher levels of anxiety. Within the autism sample, higher levels of repetitive behaviors were associated with more anxiety. This was not replicated in the Williams syndrome sample, indicating a differential role for restricted and repetitive behaviors in relation to anxiety. [Stratis and Lecavalier \(2013\)](#) examined the relationship between restrictive and repetitive behaviors and psychiatric symptoms in youth with ASD. Anxiety symptoms were found to be positively associated with the presence of ritualistic and sameness behavior. Anxiety symptoms were reported to be unrelated to the presence of compulsive behaviors. In a sample of 1429 individuals with ASD (aged 5–18 years), [Gotham et al. \(2013\)](#) reported that anxiety and insistence on sameness (IS) continuous variables were minimally, although significantly, associated with each other and with chronological age and verbal IQ. Neither anxiety nor IS were associated with other core autism diagnostic scores. Anxiety was associated with a variety of other psychiatric and behavioral symptoms in ASD, including irritability, attention problems, and aggression, while IS was not. [Gotham et al. \(2013\)](#) concluded that anxiety and IS appear to function as distinct constructs.

### 1.5. Anxiety and sleep problems

Children and adolescents with ASD are vulnerable to sleep difficulties, with approximately two thirds of these children experiencing sleep problems at some point in childhood ([Richdale, 2001](#)). Parent-reported sleep problem rates ranging from 50% to 80% have been reported for children with an ASD, compared with 9 to 50% among comparison groups ([Allik, Larsson, & Smedje, 2006](#); [Couturier et al., 2005](#); [Malow et al., 2006](#); [Polimeni, Richdale, & Francis, 2005](#)). Compared with typically developing children, children with ASD have trouble falling asleep, wake more often during the night, wake earlier in the morning, and sleep less, and they have more sleep walking and talking, nightmares, and bed wetting episodes ([Hering, Epstein, Elroy, Iancu, & Zelnik, 1999](#); [Honomichl, Goodlin-Jones, Burnham, Gaylor, & Anders, 2002](#); [Krakowiak, Goodlin-Jones, Hertz-Pannier, Croen, & Hansen, 2008](#); [Mayes, Calhoun, Bixler, & Vgontzas, 2009](#); [Patzold, Richdale, & Tonge, 1998](#); [Richdale & Prior, 1995](#)).

[Hollway, Aman, and Butter \(2013\)](#) explored possible cognitive, behavioral, emotional, and physiological risk factors for sleep disturbance in children with ASD. In a sample of 1583 children in the Autism Treatment Network, predictors of sleep quality included the core symptoms of autism, developmental regression, ASD subtype (i.e., Asperger's disorder), sensory sensitivities, GI problems, and age. However, anxiety was found to be the strongest predictor of sleep problems in this population. This association between anxiety and sleep has been explored in a number of studies with strong evidence to support a link between the two variables. [Rzepecka et al. \(2011\)](#) found significant positive correlations between sleep problems and anxiety, indicating that higher levels of sleep problems were associated with higher levels of anxiety in children with intellectual disability and/or ASD. [May, Cornish, Conduit, Rajaratnam, and Rinehart \(2013\)](#) conducted a longitudinal study investigating sleep problems in high-functioning children with autism compared with typically developing children. Sleep disturbance was measured at baseline and at a 1-year follow-up, examining change over time and associated behavioral problems. The ASD group had more sleep disturbance than the typically developing group. The findings indicated that sleep disturbance predicted later anxiety difficulties in both typically developing children and children with ASD. This suggests that sleep disturbance may be a risk factor for later anxiety difficulties.

[Mayes and Calhoun \(2009\)](#) reported that sleep disturbance in a sample of 477 children with autism was highly correlated with a number of factors including anxiety. [Malow et al. \(2006\)](#) reported that children with ASD who were categorized as 'poor sleepers' had higher levels of anxiety than children with ASD who did not have sleep problems. In a study by [Mayes, Calhoun, Murray, and Zahid \(2011\)](#), mothers of 627 children with autism completed the Pediatric Behavior Scale. A small correlation between sleep disturbance and anxiety was reported. [Mayes et al. \(2011\)](#) therefore concluded that it does not

appear that sleep problems are further exacerbated by symptoms of anxiety and depression in individuals with autism. Contrary to this finding, Park et al. (2012) reported strong associations between the presence of sleep difficulties and internalizing problems such as anxiety. This study found that children with ASD who presented with sleep problems were more likely to have internalizing problems, including anxiety, than ASD children without sleep problems. Park et al. (2012) stated that these psychological problems, which are common in children with ASD, may exacerbate or be exacerbated by sleep difficulties.

### 1.6. Current study

There is strong evidence to suggest that anxiety is associated with a number of other difficulties for children and adolescents with ASD including behavioral problems, sleep disturbances, and GI symptoms. Given the impact that these problems can have on the individual with ASD, it is important for research to further explore the relationship between anxiety and these variables. Many studies have investigated the link between anxiety and GI symptoms, sleep problems, and challenging behavior in isolation, but few studies have examined the relationship between these four variables within the same sample. The current study aims to investigate the occurrence of anxiety in children and adolescents with ASD, specifically in terms of the prevalence and the effect of anxiety symptoms. The study intends to examine the relationship between anxiety and sleep problems, GI issues, and challenging behavior in young people with ASD, aged 6–17 years.

## 2. Method

### 2.1. Participants

Participants were 109 children and adolescents with a diagnosis of ASD. Participants were recruited through online forums including online parent support groups, social media websites, and special needs discussion forums. The mean age of the sample was 9.74 years ( $SD = 3.17$ ) ranging from 6 to 17 years. Seventy-three percent ( $n = 80$ ) of the sample were male and 27% ( $n = 29$ ) were female. Forty-two percent ( $n = 46$ ) of participants had an intellectual disability. Mild intellectual disability was reported for 23% of participants ( $n = 25$ ), moderate intellectual disability was reported for 17% of participants ( $n = 18$ ), and severe intellectual disability was reported for 4% of participants ( $n = 4$ ). Twenty-five percent ( $n = 27$ ) of the sample had a diagnosis of an anxiety disorder.

### 2.2. Measures

#### 2.2.1. Demographic information

A self-constructed questionnaire was used to obtain information on the participants' age, gender, whether they had an intellectual disability and what level of intellectual disability. The presence or absence of a diagnosis of an anxiety disorder was also reported.

#### 2.2.2. Child Behavior Checklist (CBCL)

Anxiety symptoms were assessed using the DSM-Oriented Anxiety Problems scale from the Child Behavior Checklist (CBCL) for ages 6–18 years (Achenbach & Rescorla, 2001). The CBCL is a broad-band parent-report questionnaire that assesses current symptoms across a range of areas, including both internalizing and externalizing symptoms. The CBCL has strong psychometric properties and has also been used among samples of children with ASD (Pandolfi, Magyar, & Dill, 2012). Each item is rated on a 3-point scale (ranging from 'Not True' to 'Very True'). The CBCL provides eight empirically derived Syndrome Scales, as well as six DSM-Oriented scales. The CBCL DSM-Oriented Anxiety Problems scale was chosen for the purposes of the current study because it includes items only specific to anxiety. This scale assesses symptoms of generalized anxiety disorder, separation anxiety disorder, and specific phobia. The Anxiety Problems scale also has the advantage of not including symptoms of social phobia and obsessive-compulsive disorder, two disorders that include symptoms that overlap with core ASD symptoms. For prevalence calculations and statistical analyses, raw scores were converted to standardized  $T$ -scores;  $T$ -scores between 65 and 69 are indicative of borderline ('at risk') anxiety, and  $T$ -scores of 70 and above represent clinical anxiety.

#### 2.2.3. Gastrointestinal Symptom Inventory

The Gastrointestinal Symptom Inventory (Autism Treatment Network, 2005) is a 35-item questionnaire that was developed in the early days of the Autism Treatment Network (ATN). There are also additional items should a participant exhibit certain symptomatology, and therefore includes 77 items in total. This measure includes questions about the presence, duration, and nature of various GI symptoms including abdominal (belly) pain, nausea, bloating, constipation, and diarrhea. The inventory is scored initially dichotomously (i.e., whether or not the child has any gastrointestinal symptoms). The inventory also allows branching into specific areas of symptomatology: abdominal pain, abnormal bowel movements, reflux, and food insensitivity. This tool has not been validated. It was based on previous questionnaires and on clinical symptom assessment for children with autism and identified GI disorders.

#### 2.2.4. Children's Sleep Habits Questionnaire (CSHQ)

Sleep problems were measured using the Children's Sleep Habits Questionnaire (CSHQ; [Owens, Nobile, McGuinn, & Spirito, 2000](#)). The CSHQ is a 52-item parental-report, sleep-screening instrument designed to identify sleep problems and the possible need for further evaluation. The CSHQ was not designed specifically for use with individuals with ASD, but has been used in previous studies examining this clinical group (e.g., [Hoffman et al., 2008](#); [Honomichl et al., 2002](#)). The scale was originally designed for typically developing children ages 4–10 years but it has been used with an older population of children with ASD ([Goldman et al., 2011](#)). The CSHQ consists of eight subscales including bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, parasomnias, daytime sleepiness and sleep disordered breathing. Informants are required to respond to 42 items using a 3-point Likert scale, with the responses being 'Rarely' (never or one time a week), 'Sometimes' (2–4 times a week) and 'Usually' (5 or more times a week). Each question was asked in relation to the previous week. The second column of questions is to determine if the item is considered a problem for caregivers. Beside each item, parents can choose 'Yes', 'No', or 'N/A' under the 'Problem?' column. Thirty-three of the items are used in deriving the total sleep disturbance score and the subscales of the questionnaire. While there are no established "norms" for the total subscale scores, a total CSHQ score of 41 has been reported to be a sensitive clinical cut-off for identification of probable sleep problems ([Owens, Spirito, & McGuinn, 2000](#)). Reliability and validity have been shown to be acceptable, including test-retest reliability (range = 0.62–0.79; [Owens et al., 2000b](#)).

#### 2.2.5. Behavior Problems Inventory-Short Form (BPI-S)

The BPI-S ([Rojahn et al., 2011](#)) was used as a measure of challenging behavior. The BPI-S is a shorter version of the Behavior Problems Inventory-01 (BPI-01; [Rojahn, Matson, Lott, Esbensen, & Smalls, 2001](#)). The BPI-S is 30-item informant-based behavior rating instrument designed to assess challenging behaviors in individuals with intellectual disability. The items fall into one of three subscales; Self-injurious Behavior (8 items), Stereotyped Behavior (12 items) and Aggressive/Destructive Behavior (10 items). Informants are asked to rate the frequency of challenging behavior observed in the individual in the prior two months using a 5-point Likert-type rating scale (never = 0, monthly = 1, weekly = 2, daily = 3, hourly = 4). Informants are also required to rate the severity of self-injurious and aggressive/destructive a 4-point severity scale (no problem = 0, a slight problem = 1, a moderate problem = 2, a severe problem = 3). Total scores for each subscale are calculated. The BPI-S has been reported to have psychometrically sound properties but test-retest reliability is yet to be examined ([Rojahn et al., 2012](#)).

### 2.3. Informants

Informants were parents of children and adolescents diagnosed with ASD. Rating scales were completed by parents using an online questionnaire. Instructions from the original paper copies of the rating scales were provided in the online questionnaire.

### 2.4. Statistical analyses

Descriptive statistics including frequencies, means, and standard deviations were generated for the variables. Pearson's correlations were used to investigate the relationship between anxiety and GI symptoms, sleep problems, and challenging behavior. A hierachal linear multiple regression was conducted to determine which variables significantly predicted anxiety scores.

## 3. Results

### 3.1. Anxiety

Raw scores from the DSM-Oriented Anxiety Problems scale of the CBCL were converted into a *T*-score for each participant. A *T*-score of 65–69 placed the participant in the 'borderline' range, while *T*-scores above 69 placed the participant in the 'clinical' range. Fifteen percent ( $n = 16$ ) participants were in the normal range ( $M = 56.94$ ,  $SD = 5.36$ ). Ten percent ( $n = 11$ ) of the sample were in the borderline anxiety range ( $M = 65.82$ ,  $SD = 3.82$ ), while 75% ( $n = 82$ ) obtained *T*-scores which placed them clinical in the range ( $M = 75.09$ ,  $SD = 3.21$ ) for anxiety problems ([Table 1](#)).

**Table 1**  
Child Behavior Checklist (CBCL) DSM-oriented anxiety problems mean *T*-scores and standard deviations.

Range	Mean	Standard deviation
Normal	56.94	5.36
Borderline	65.82	3.82
Clinical	75.09	3.21

**Table 2**

Frequency and percentage of gastrointestinal symptoms.

Gastrointestinal symptoms	Frequency	Percentage
At least one symptom	87	80
One symptom	13	12
Two symptoms	16	15
Three symptoms	32	29
Four symptoms	20	18
All five symptoms	6	6

**Table 3**

Children's Sleep Habits Questionnaire (CSHQ) subscales, total mean scores and standard deviations.

Subscale	Mean	Standard deviation
Bedtime resistance	9.00	3.27
Sleep onset delay	2.41	0.80
Sleep duration	5.55	1.95
Sleep anxiety	7.14	2.49
Night wakings	4.66	1.66
Parasomnias	10.82	2.45
Sleep disordered breathing	4.24	1.37
Daytime sleepiness	14.39	3.86

### 3.2. Gastrointestinal symptoms

Eighty percent ( $n = 87$ ) of the sample presented with at least one GI symptom within the last three months. Twelve percent ( $n = 13$ ) presented with one symptom, 15% ( $n = 16$ ) had two symptoms, 29% ( $n = 32$ ) experienced three GI symptoms, and 18% ( $n = 20$ ) had four symptoms. Only 6% ( $n = 6$ ) of the sample experienced all five GI symptoms within the last three months. The most common GI symptoms were abdominal pain and constipation, with each affecting 60% ( $n = 65$ ) and 48% ( $n = 52$ ) of participants respectively. Following these, diarrhea was the next most common symptom, affecting 44% ( $n = 48$ ) of participants within the last three months, followed by symptoms of nausea experienced by 42% of the sample ( $n = 46$ ). The least common GI symptom was bloating, where 37% ( $n = 40$ ) presented with this symptom (Table 2).

### 3.3. Sleep problems

The prevalence of a sleep problem in this sample was 92% ( $n = 100$ ), whereby a score of 41 or more on the CSHQ was indicative of a sleep problem for a participant. The mean score on the CSHQ was 55 ( $SD = 10.36$ ). The CSHQ consists of eight subscales, which do not have specific cut-off points. A summary of the subscale means and standard deviations are included in Table 3.

### 3.4. Challenging behavior

The mean scores and standard deviations for the BPI-S were calculated for three subscales (see Table 4). These subscales do not have specific cut-off points. Ninety-nine percent ( $n = 108$ ) of the sample exhibited at least one form of challenging behavior. Sixty-seven percent ( $n = 73$ ) of participants displayed all three topographies of behavior, 28% ( $n = 30$ ) displayed two behaviors, and 5% ( $n = 5$ ) of the sample displayed one type of challenging behavior.

### 3.5. Correlation analyses

#### 3.5.1. Anxiety and gastrointestinal symptoms

Pearson's correlations were used to test for associations between the variables. In relation to anxiety and GI symptoms, a significant positive correlation was found between total scores on the DSM-Oriented Anxiety Problems subscale of the CBCL

**Table 4**

Behavior Problems Inventory (Short Form; BPI-S) subscales, total mean scores and standard deviations.

Subscale	Mean	Standard deviation
Self-injurious behavior frequency	4.61	4.54
Self-injurious behavior severity	2.96	3.19
Aggressive/destructive behavior frequency	7.05	6.82
Aggressive/destructive behavior severity	5.09	5.29
Stereotyped behavior frequency	16.02	10.30

**Table 5**  
Significant correlations between anxiety and the independent variables.

Variable	r
GI symptom inventory total score	.21*
- Nausea	.19*
- Constipation	.20*
CSHQ total score	.44***
- Sleep onset delay	.23*
- Sleep duration	.19*
- Sleep anxiety	.37***
- Parasomnias	.34***
- Daytime sleepiness	.39***

\*  $p < .05$ .

\*\*\*  $p < .001$ .

and the Gastrointestinal Symptom Inventory ( $r(109) = .21, p < .05$ ), with a small effect size. A small positive correlation between anxiety and nausea was found, ( $r(109) = .19, p < .05$ ). A small positive correlation between anxiety and constipation was also reported, ( $r(109) = .20, p < .05$ ).

### 3.5.2. Anxiety and sleep problems

A significant positive correlation between anxiety and total scores on the CSHQ, was found ( $r(109) = .44, p < .001$ ), with a moderate effect size. Pearson's correlations were conducted for the subscales of the CSHQ. A small positive correlation between anxiety and sleep onset delay was reported, ( $r(109) = .23, p < .05$ ). Likewise, a small positive correlation between anxiety and sleep duration was also reported, ( $r(109) = .19, p < .05$ ). A positive correlation between anxiety scores on the DSM-Oriented Anxiety Problems subscale and the sleep anxiety subscale of the CSHQ was found ( $r(109) = .37, p < .001$ ), with a moderate effect size. A moderate positive correlation was reported for anxiety and parasomnias, ( $r(109) = .34, p < .001$ ). Finally, a positive correlation between anxiety and daytime sleepiness was found ( $r(109) = .39, p < .001$ ), with a moderate effect size.

### 3.5.3. Anxiety and challenging behavior

Pearson's correlations were conducted to determine whether there were correlations between anxiety and challenging behavior, as measured using the BPI-S. Analyses were conducted for each of the three subscales of the BPI-S (Self-Injurious Behavior; Aggressive/Destructive Behavior; Stereotyped Behavior). No significant correlations between anxiety and the subscales of the BPI-S were found (Table 5).

### 3.6. Hierarchical linear regression analyses

A hierarchical linear regression was conducted to examine if age, gender, diagnosis of intellectual disability, sleep problems, GI symptoms, and challenging behavior predicted anxiety in children and adolescents with ASD. Age of participants, gender, and presence of intellectual disability were entered in the first step of the model. These predictor variables were followed by the addition of total score on the CSHQ in the second step. The total score on the GI symptom inventory was added in the third step of the model. Finally, the subscales of the BPI-S were entered in the fourth step of the model. The first block with age, gender, and presence of intellectual disability as predictors was not significant. None of the individual variables were significant. The first block explained 5% of the variance in anxiety scores. The second block, with the addition of total score on the CSHQ, was found to significantly predict anxiety,  $F(4, 104) = 9.45, p < .001, R^2 = .267$ . Both diagnosis of intellectual disability and total score on the CSHQ were significant predictors, with the second model explaining 27% of the variance in anxiety scores. The total score on the GI symptom inventory was added in the third block, and this model was significant,  $F(5, 103) = 7.63, p < .001, R^2 = .270$ . Gastrointestinal symptoms did not emerge as a significant predictor of anxiety. Diagnosis of intellectual disability and total score on the CSHQ again emerged as significant predictors, with the third model explaining 27% of the variance in anxiety scores. The subscales of the BPI-S were added in the final step of the model. This model was significant,  $F(10, 98) = 4.95, p < .001, R^2 = .335$ . As can be seen in Table 6, total score on the CSHQ and age were significant positive predictors in the final model, while diagnosis of intellectual disability and severity of self-injurious behavior were negative predictors, with the entire model explaining 34% of the variance in anxiety.

## 4. Discussion

The current study aimed to examine the relationships between anxiety and gastrointestinal (GI) symptoms, sleep problems, and challenging behavior in children and adolescents with ASD. Consistent with previous research, significant associations between anxiety and both GI symptoms and sleep disturbances were found. Contrary to findings reported in a number of studies, no relationship between anxiety and challenging behavior was detected in the sample. Additionally, the

**Table 6**  
Summary of hierarchical regression analysis for variables predicting anxiety.

Variable	B	SE B	$\beta$	$\Delta R^2$
Block 1				.054
Age of participant	.360	.227	.150	
Gender	-.372	1.648	-.022	
Diagnosis of ID	-2.682	1.475	-.175	
Block 2				.213
Age of participant	.362	.201	.151	
Gender	-.221	1.458	-.013	
Diagnosis of ID	-3.357	1.311	-.220*	
CSHQ total score	.339	.062	.463***	
Block 3				.003
Age of participant	.368	.202	.154	
Gender	-.140	1.466	-.008	
Diagnosis of ID	-3.511	1.330	-.230*	
CSHQ total score	.319	.068	.435***	
GI total score	.337	.462	.069	
Block 4				.065
Age of participant	.422	.210	.176	
Gender	-1.068	1.541	-.063*	
Diagnosis of ID	-2.901	1.449	-.190*	
CSHQ total score	.334	.075	.456***	
GI total score	.079	.467	.016	
SIB frequency	.378	.327	.226	
SIB severity	-1.032	.474	-.435	
Aggressive frequency	.049	.242	.044	
Aggressive severity	.059	.308	.041*	
Stereotypy frequency	.128	.071	.174	

\*  $p < .05$ .

\*\*\*  $p < .001$ .

results of the hierachal linear regression analysis demonstrated that demographic variables, GI symptoms, sleep problems, and challenging behavior predicted 34% of the variance in anxiety, with sleep being the strongest predictor. The current findings highlight the importance of investigating these related problems in future studies.

Within this sample, 10% of participants were found to have borderline clinical anxiety levels, while 75% of participants obtained scores which placed them in the clinical range for anxiety according to the DSM-Oriented Anxiety Problems scale of the Child Behavior Checklist (CBCL). This finding is particularly interesting as a diagnosis of an anxiety disorder was reported for only 25% of the sample. GI symptoms were experienced by 80% of the sample within the last three months. This finding is consistent with the prevalence rate reported by Mannion et al. (2013), however it is higher than the rates reported in other studies (Nikolov et al., 2009; Molloy & Manning-Courtney, 2003; Williams et al., 2012). Sleep problems were reported by 92% of the sample, which is higher than the level of sleep problems found in previous research (Mannion et al., 2013; Rzepecka et al., 2011). Challenging behavior was evident in 99% of the sample. Again, this finding was higher than reported in previous research (Murphy et al., 2009).

The current study reported a significant positive correlation between anxiety and overall GI symptoms, indicating that higher levels of anxiety are associated with higher levels of GI issues. This finding is in line with previous research (Nikolov et al., 2009; Williams et al., 2012). Specifically, nausea and constipation were found to be significantly correlated with anxiety in this sample. This is consistent with research by Mazurek et al. (2013) who reported that participants with chronic nausea and constipation had higher levels of anxiety than those without these GI symptoms.

Consistent with the literature (Malow et al., 2006; Mayes & Calhoun, 2009; Park et al., 2012; Rzepecka et al., 2011) this study found a significant positive correlation between anxiety and sleep problems, indicating that higher levels of anxiety are associated with higher levels of sleep problems in children and adolescents with ASD. Specifically, sleep onset delay, sleep duration, sleep anxiety, parasomnias, and daytime sleepiness were found to be significantly correlated with anxiety levels in this sample.

This study did not find a significant association between anxiety and challenging behavior, despite the high prevalence of challenging behavior reported for the sample. This finding is surprising considering the body of research that has reported contrary findings (Farrugia & Hudson, 2006; Gotham et al., 2013; Rzepecka et al., 2011). For example, Cervantes et al. (2013) and Matson et al. (2010) reported significant associations between anxiety and challenging behavior. These studies used the BISCUIT (Matson et al., 2007) as a measure of challenging behavior. Although the current study used an alternative measure of challenging behavior (BPI-S), both tools consist of similar subscales with items related to self-injurious behavior, aggressive/destructive behavior, and stereotyped behavior. However, it is necessary to note that Cervantes et al. (2013) and Matson et al.'s (2010) findings were representative of a younger population of children with ASD.

Sleep problems were found to positively predict anxiety in the current study. May et al. (2013) found that sleep disturbance predicted later anxiety difficulties in both typically developing children and children with ASD. A recent review

of anxiety and sleep in typical development over childhood and adolescence suggested that sleep disturbance may act as a “red flag” for the later development of anxiety (Leahy & Gradsar, 2012). The findings of the current study, and previous research, suggest that this too may be the case for the ASD population, highlighting the need for clinicians to be cognisant of this link between anxiety and sleep problems.

Age was found to be a significant positive predictor of anxiety. This finding is consistent with the literature which has found that children with ASD reported an increase in anxiety levels as they grew older (Kuusikko et al., 2008; Mayes et al., 2011). Kuusikko et al. (2008) found that typically developing children showed a different developmental pattern, with levels of anxiety decreasing as they grew older. Kuusikko et al. (2008) concluded that this may be explained by the delayed socio-emotional development of children with ASD and that children with ASD may start to define themselves by evaluating their characteristics and skills at a later developmental stage than their typically developing peers.

The current study also found that diagnosis of intellectual disability was found to negatively predict anxiety. Previous research has suggested that increasing IQ is associated with increased levels of anxiety in ASD (Mayes et al., 2011; Sukhdolsky et al., 2008; Weisbrodt, Gadov, DeVincenzo, & Pomerov, 2005). Mayes et al. (2011) hypothesized that some anxiety symptoms may require levels of cognition, social awareness, and self-perception that are not present in lower functioning populations of ASD, who may be less aware of their disability and its impact and implications.

Severity of self-injurious behavior was found to be a significant negative predictor of anxiety in the current study. The “tension reduction” theory may serve as a potential explanation for such results. This theory was proposed by Brain, Haines, and Williams (1998) and postulates that self-injurious behavior is negatively reinforced as its occurrence reduces internal arousal. Engaging in self-injurious behavior may serve as a coping mechanism to reduce unpleasant symptoms of anxiety in the absence of more appropriate alternative coping strategies. However, interpretation of this finding warrants caution and highlights the need for further investigation.

The present study had a number of methodological strengths including good statistical power and participants who represented a realistic clinical sample of children and adolescents with ASD. In addition, to the authors’ knowledge, this study is the first to investigate all four factors of anxiety, GI symptoms, sleep problems, and challenging behavior within a sample of children and adolescents with ASD.

There were, however, also limitations. In terms of the measures used, the CSHQ and the BPI-S have not been specifically validated for the ASD population. It should be noted that the current study relied on parent-report for the variables of interest. This may serve as a limitation for the current study, particularly in terms of the measurement of anxiety and certain gastrointestinal symptoms such as abdominal pain and nausea. These symptoms may not manifest themselves in observable ways, leading to difficulty in accurate observer report. Although the measurement of internally experienced phenomena presents several methodological challenges for researchers, self-report may not be feasible among children and adolescents with ASD. Even among individuals with functional language skills, children and adolescents with ASD have difficulty with emotional insight and expression (Ben Shalom et al., 2006). Therefore, the use of parent-report for the assessment of anxiety and other psychiatric symptoms has been recommended by researchers (Lopata et al., 2010; Mazefsky, Kao, & Oswald, 2011). Research and clinical practice alike would benefit from the further development of reliable and valid tools for the measurement of these symptoms in individuals with ASD. Further to this, there is a potential response bias, in that it is possible that only those parents who felt their child had anxiety chose to participate. Respondents were invited to participate in the study regardless of whether their child experienced symptoms of anxiety or not. Nonetheless this is a potential limitation that should be considered when interpreting the findings of this study.

This study is an important exploration into how GI symptoms, sleep problems, and challenging behavior interrelate with anxiety symptoms in an ASD sample. Future research may seek to further investigate anxiety in children and adolescents with ASD by examining the different types of anxiety that are related to various problems, particularly GI symptoms and sleep disturbances. Researchers have suggested that individuals with ASD may be vulnerable to different types of anxiety with specific phobias, generalized anxiety disorder, separation anxiety disorder, obsessive-compulsive disorder, and social phobia being the most commonly diagnosed forms of anxiety within this population (Evans et al., 2005; Matson & Love, 1990; White et al., 2009). This may be achieved by selecting an anxiety measure with subscales for the different forms of anxiety disorders. The current study found that age was a significant predictor of anxiety. Given this finding, the literature may also benefit from longitudinal research to document the development of anxiety in ASD across childhood and adolescence.

The current study has important implications for clinical practice. Firstly, these findings support current best practice assessments in ASD, which includes routine assessments of sleep disturbances and health problems. Secondly, the results particularly emphasize the need for clinicians to be aware that GI symptoms and sleep disturbances may be indicative of anxiety problems. Given these findings and the particularly high prevalence of anxiety reported in the current study and previous ASD literature (de Bruin et al., 2007; Muris et al., 1998; van Steensel et al., 2011; White et al., 2009), knowledge that a children or adolescent with ASD is experiencing GI symptoms or sleep disturbances may be an important alert for clinicians to consider in the assessment of and intervention for anxiety.

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