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Affective problems, gastrointestinal symptoms, sleep problems, and challenging behaviour in children and adolescents with autism spectrum disorder

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ABSTRACT

Background: People with autism spectrum disorder (ASD) can experience affective problems, gastrointestinal (GI) symptoms, sleep problems, and challenging behaviour. This study identified the frequency of affective problems and explored how they related to co-occurring conditions in children and adolescents with ASD.

Method: Participants were children and adolescents diagnosed with ASD using DSM-IV-TR criteria (n = 95), 40 % (n = 38) of whom also had a diagnosis of intellectual disability (ID). The following scales were completed by the participants' parents or guardians: Child Behaviour Checklist (CBCL), Gastrointestinal Symptoms Inventory, Children's Sleep Habits Questionnaire (CSHQ), and the Behaviour Problems Inventory-Short Form (BPI-S). Pearson's correlations and independent sample t-tests were used to examine the relationships between variables. Two hierarchical multiple regressions examined predictors for affective problems in preschool and school-aged children with ASD.

Results: Participants scored in the clinical range (69.5 %) and borderline range (10.5 %) for affective problems. Significant positive relationships were found between affective problems and sleep problems, GI symptoms, and challenging behaviour. ID and gender predicted affective problems in preschool aged children. In school-aged children, affective problems were predicted by ID, sleep problems, and aggressive/destructive behaviour severity. However, only 25 % of the variance in affective problems was accounted for.

Conclusions: Future research is needed to understand how affective problems are impacted by co-occurring conditions in children and adolescents with ASD. Affective problems are prevalent in this population and the quality of life for individuals may be improved if practitioners consider co-occurring conditions during clinical practice.

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1. Introduction

1.1. Co-occurring conditions in autism

Autism spectrum disorder (ASD) is characterised by having atypical differences in social communication and social interaction, repetitive patterns of behaviour, interests, or activities (American Psychiatric Association, 2013). Co-occurring conditions are present when two or more conditions occur concurrently within the same individual (Hossain et al., 2020; Matson & Nebel-Schwalm, 2007). Individuals with ASD frequently experience at least one co-occurring condition (DeFilippis, 2018; Mannion, Brahm, & Leader, 2014; Matson & Shoemaker, 2009). For example, children with ASD can also be diagnosed with social anxiety disorder, attention-deficit/hyperactivity disorder (AD/HD), epilepsy, behaviour problems, feeding problems, mood disorders, oppositional defiant disorder and gastrointestinal problems (Devlin, Healy, Leader, & Reed, 2008; Francis, Mannion, & Leader, 2017; Leader & Mannion, 2016b; Leyfer et al., 2006; Mannion & Leader, 2014a, 2014b; Matson & Nebel-Schwalm, 2007; Simonoff et al., 2008). Having co-occurring conditions can have serious implications for the individual, as it is associated with poorer health outcomes, increased health care costs, and more complex clinical management (Howlin & Magiati, 2017; Valderas, Starfield, Sibbald, Salisbury, & Roland, 2009).

1.2. Affective problems in ASD

Affective problems and mood disorders are among the most common conditions that co-occur with ASD (Bergman et al., 2020; Hollocks, Lerh, Magiati, Meiser-Stedman, & Brugha, 2019). Prevalence rates of mood disorders in people with ASD can range from 4 % to 38 % (Hudson, Hall, & Harkness, 2018; Stewart, Barnard, Pearson, Hasan, & O'Brien, 2006), which is higher than in people without autism. However, rates of affective problems in ASD have been found to vary widely. This may be because data about affective problems are obtained from caregivers and people with ASD can struggle to identify and talk about complex emotions, which makes it difficult to accurately affective problems (Capps, Yirmiya, & Sigman, 1992; Weiss, Thomson, & Chan, 2014). Assessment can be further compounded and potentially yield unreliable results, if a person with ASD is non-verbal, because many assessment tools rely heavily on an individual's description of their own subjective experiences (Bradley, Summers, Wood, & Bryson, 2004). One solution is to rely on cues from directly observable behaviours. Ghaziuddin, Ghaziuddin, and Greden (2002) suggest that signs such as changes in function or regression of skills may be indicators of affective problems in individuals with ASD.

An additional challenge in detecting co-occurring conditions is the difficulty distinguishing between the symptoms of psychopathology and the core features of ASD. A review by Stewart et al. (2006) found that depression in people with ASD can present with a decrease in repetitive and restricted behaviours. However, individuals with ASD may be taking part in therapies or treatments that aim to reduce such behaviours (Green et al., 2006). A reduction in repetitive behaviours may, therefore, be erroneously attributed to the success of these treatments, while symptoms of affective problems are overlooked. Additionally, the presence of ASD can mask the symptoms of psychiatric conditions (Mazzone, Ruta, & Reale, 2012).

In addition to affective disorders, previous research has shown correlations between ASD and other co-occurring conditions such as gastrointestinal (GI) symptoms, sleep disorders, and challenging behaviour (Mannion & Leader, 2013, 2016; Williams, Christofi, Clemmons, Rosenberg, & Fuchs, 2012; Williams, Leader, Mannion, & Chen, 2015). However, less research has examined the relationships between co-occurring conditions such as affective problems and mood disorders and their biological and behavioural symptoms. Matson and Goldin (2013) found that many studies involving individuals with ASD tended to examine just a single co-occurring condition. Because multiple co-occurring conditions are common research is needed to explore how they relate and interact with one another and the implications this may have for both people with ASD, caregivers and clinicians.

1.3. Affective problems and gastrointestinal symptoms

GI symptoms are common in children with ASD, with prevalence rates ranging from 9 to 91 % (Coury et al., 2012; Leader & Mannion, 2016a; Ming, Brimacombe, Chaaban, Zimmerman-Bier, & Wagner, 2008; Nikolov et al., 2009). In typically developing individuals, research investigating the correlation between GI symptoms and affective problems has found that rates of affective problems are nearly five times greater in individuals who experience severe GI symptoms than people who do not experience GI symptoms (Mussell et al., 2008).

There is little research to date that has explored the relationship between GI symptoms and affective problems in people with ASD. One study of the limited available research, a study conducted by Ferguson, Dovgan, Takahashi, and Beversdorf (2019), found that externalising behaviours were correlated with GI symptoms in preschool-aged children with ASD, and internalising behaviours were correlated with GI symptoms in school-aged children with ASD. Such findings indicate a link between affective problems and GI symptoms in people with ASD.

1.4. Affective problems and sleep problems

Sleep problems are a common disorder associated with ASD. Parental reports suggest that sleep problems among children with ASD can range from 50 to 80 percent, compared with nine to 50 percent reported for non-autistic peers (Allik, Larsson, & Smedje, 2006; Cohen, Conduit, Lockley, Rajaratnam, & Cornish, 2014). People with ASD have been found to display higher levels of dysomnia, including problems in initiating or maintaining sleep, excessive sleepiness, and parasomnias; including night terrors, sleepwalking,

and sleep apnea (Schreck & Mulick, 2000; Surtees et al., 2019). Sleep problems can also persist throughout the lifetime, with one sleep disorder often predicting the development of further secondary or tertiary sleep problems (Cohen et al., 2014).

Sleep problems are exacerbated by mood disorders in children with ASD and higher levels of depressive symptoms have been associated with increased sleep disturbance and atypical sleep patterns (Hollway & Aman, 2011). Studies have found that sleep problems are significantly correlated with levels of affective problems in children with ASD (Mayes & Calhoun, 2009; Zaidman-Zait et al., 2020). Clinicians have also suggested that sleep disturbances may serve as an indication of affective problems in individuals with intellectual disability and ASD (Ghaziuddin et al., 2002).

1.5. Affective problems and challenging behaviours

Challenging behaviours, such as self-injury, aggressive or destructive behaviour and stereotyped behaviour, are common in individuals with ASD and intellectual disabilities, and they can be associated with poor language skills, in particular expressive language, as well as poor quality of social interaction (Chiang, 2008; Murphy et al., 2005). The presence of co-occurring conditions can impact challenging behaviours in people with ASD and they can be linked to psychiatric conditions (Brereton, Tonge, & Einfeld, 2006; Hemmings, Gravestock, Pickard, & Bouras, 2006; Meyer, Mundy, Van Hecke, & Durocher, 2006).

1.6. Current study

The present study identified the frequency of affective problems in children and adolescents with ASD. It also explored the relationship between affective problems and sleep problems, GI symptoms, and challenging behaviour such as self-injurious, aggressive, destructive, and stereotypical behaviour. Then, it examined factors that potentially may predict the occurrence of affective problems in children and adolescents with ASD.

2. Method

2.1. Participants

The study sample comprised children and adolescents ($n = 95$) with a diagnosis of ASD under DSM-IV-TR criteria (American Psychiatric Association, 2000). The participants received their diagnosis as a result of the formal diagnostic protocol that employed multiple diagnostic measures, from licenced psychologists, or paediatricians, independent of the study. Participants ranged in age from two to 18 years ($M = 9.47$; $SD = 4.09$). Seventy-six participants in the sample were male, while 19 were female. Forty percent of participants ($n = 38$) had a co-occurring diagnosis of intellectual disability. Of people with an intellectual disability, the severity ranged from mild intellectual disability (37 %), moderate intellectual disability (53 %), and severe intellectual disability (11 %).

2.2. Procedure and informants

Ethical approval for this study was obtained through the National University of Ireland ethical committee. Informants in the study were the parents and guardians of children and adolescents diagnosed with ASD. Informants were made aware of the study through advertising in parent support groups and special schools. If parents/guardians wished to participate in the study, they were given the opportunity to ask questions and they were provided with a participant information sheet and a consent form. Once informed consent was obtained, the informants were provided with the battery of questionnaires that are describe below. Informants completed the questionnaires independently in their own time, according to the instructions printed on top of each questionnaire.

2.3. Measures

2.3.1. Demographic information

A bespoke questionnaire was devised to obtain demographic information on the participant's age and gender. This also gathered information about whether participants had an intellectual disability and the level of intellectual disability.

2.3.2. Child Behaviour Checklist (CBCL)

The Child Behaviour Checklist (CBCL) (Achenbach & Rescorla, 2001) is a parental report measure designed to detect emotional and behavioural problems in children and adolescents. Informants were parents of children and adolescents diagnosed with ASD. The preschool version is designed for use with children aged 18 months to five years and the school age version is designed for use with children from six to 18 years of age. The school age version consists of 113 items, scored on a three-point Likert scale (0 = the behaviour is absent, 1 = the behaviour occurs sometimes, 2 = the behaviour occurs often). The time frame for item responses is the past six months. The preschool version has 99 items that are scored similarly to the school age version. The CBCL has been shown to have good reliability (range .71–.89) and excellent validity (Nakamura, Ebesutani, Bernstein, & Chorpita, 2009). Affective problems were measured using the DSM-Oriented Affective Problems scale within the CBCL.

2.3.3. Gastrointestinal Symptom Inventory

The Gastrointestinal Symptom Inventory (Autism Treatment Network, 2005) was used to assess the GI symptoms of the

participants. The GI symptoms measured were abdominal pain, nausea, bloating, diarrhoea, constipation, or other GI symptoms. The inventory consists of 35 initial questions. Questions are scored according to the presence or absence of each GI symptom. Additional items are completed, and scores created, if a participant exhibited a symptom. The inventory includes 77 items in total. The Inventory was developed from previous questionnaires and clinical assessments of children with ASD who had identified GI conditions. The inventory is frequently administered in ASD Treatment Network centres across the United States and Canada, and it has been employed in published research (Leader, Francis, Mannion, & Chen, 2018; Mannion & Leader, 2016; Mazefsky, Schreiber, Olino, & Minshew, 2014; Mazurek et al., 2013; Williams, Fuchs, Furuta, Marcon, & Coury, 2010; Williams et al., 2012a; Williams, Christofi, Clemmons, Rosenberg, & Fuchs, 2012, 2015).

2.3.4. Children's Sleep Habits Questionnaire (CSHQ)

The Children's Sleep Habits Questionnaire (CSHQ) (Owens, Spirito, & McGuinn, 2000) is a 45-item parental-report questionnaire. Although it was designed for use with typically developing children aged 4–10 years, it has been used with both younger and older children with ASD (Hoffman et al., 2008; Rzepecka, McKenzie, McClure, & Murphy, 2011). The CSHQ is has eight subscales. Responses using the CSHQ are assessed using a three-point Likert scale, and participants are asked to rate whether a behaviour occurs "usually" (i.e. if it occurs 5 or more times in a week), "sometimes" (i.e. if it occurs 2–4 times in a week), or "rarely" (i.e. if it occurs never or 1 time during a week). Test–retest reliability was found to be acceptable (range .62–.79), and validity was also supported as the total score and subscales differentiated between a community sleep sample ($n = 469$) and a clinic sample of problem sleepers ($n = 154$) (Owens et al., 2000). Results of a receiver operator characteristics analysis suggested that a total score of 41 was considered the optimal clinical cut-off for sleep problems (Owens et al., 2000).

2.3.5. Behaviour Problems Inventory Short Form (BPI-S)

The Behaviour Problems Inventory Short Form (Rojahn et al., 2012) is an informant-based behaviour rating instrument with 33 items and three sub-scales: Self-injurious Behaviour, Stereotyped Behaviour, and Aggressive/Destructive Behaviour. It is based on the Behaviour Problems Inventory-01 (BPI-01; Rojahn, Matson, Lott, Esbensen, & Smalls, 2001), which was developed specifically for use among individuals with developmental disabilities. Rojahn et al. (2013) found that test–retest reliability of the three BPI-01 subscales ranged from .68 to .77 for frequency ratings and from .65 to .80 for severity ratings, indicating moderate reliability. Evidence for strong convergent and discriminant validity was also found. It has been used in several published studies on children with ASD and other developmental disabilities (Leader, Tuohy, Chen, Mannion, & Gilroy, 2020; Newman, Leader, Chen, & Mannion, 2015).

2.4. Statistical analyses

Descriptive statistics including frequencies, means, and standard deviations were generated for the variables. Pearson's r correlations were used to examine whether or not a relationship existed between affective problems, and sleep problems, challenging behaviour, and GI symptoms. Independent sample t -tests were used to further explore the relationship between affective problems and

Table 1

Means and Standard Deviations for the Subscales of the Child Behavior Checklist (CBCL) DSM-Oriented Affective Problems Scale, the Children's Sleep Habits Questionnaires (CSHQ), the Behavior Problems Inventory Short Form (BPI-S), and the frequency and percentages of gastrointestinal symptoms.

		<i>M</i>	<i>SD</i>
CBCL Range	Normal	55.79	13.92
	Borderline	68.50	2.68
	Clinical	72.42	6.35
CSHQ Subscales	Bedtime resistance	10.00	3.83
	Sleep Onset Delay	2.53	1.21
	Sleep duration	6.25	2.02
	Sleep anxiety	7.36	2.59
	Night wakings	5.40	1.70
	Parasomnias	11.91	3.23
	Sleep disordered breathing	4.31	1.49
	Daytime sleepiness	15.13	3.98
BPI-S Subscales	SIB Frequency	4.64	4.27
	SIB Severity	3.15	3.28
	Aggressive/Destructive Behavior Frequency	9.83	8.56
	Aggressive/Destructive Behavior Severity	8.12	7.34
	Stereotyped Behavior Frequency	17.61	11.37
Number of Gastrointestinal Symptoms		Frequency	Percentage
No Symptoms		14	14.7
One		18	18.9
Two		19	20.0
Three		17	17.9
Four		15	15.8
Five or more		12	12.6

specific GI symptoms, such as abdominal pain, constipation, bloating, diarrhoea, and nausea. Finally, two hierarchical multiple regressions were conducted to examine whether age, gender, intellectual disability, GI symptoms, sleep problems, or challenging behaviour significantly predicted affective problems for both preschool-aged and school-aged children with ASD.

3. Results

3.1. Affective problems

It was found that 69.5 % ($n = 66$) participants scored in the clinical range for affective problems, and a further 10.5 % ($n = 10$) scoring in the borderline range. Twenty percent of participants ($n = 19$) scored within the normal range. The means and standard deviations obtained from the DSM-Oriented Affective Problems scale are presented in [Table 1](#).

3.2. Sleep problems

Ninety-two participants (96.84 %) scored above the cut-off score of 41 on the CSHQ, that indicated the presence of sleep problems. The mean score on the CSHQ was 60 ($SD = 10.28$). The means and standard deviations for each of the CSHQ subscales are presented in [Table 1](#).

3.3. Gastrointestinal symptoms

Eighty-five percent of participants ($n = 81$) experienced at least one GI symptom within the previous 3 months, while 66 % of participants ($n = 63$) had experienced more than one (see [Table 1](#)). The most commonly reported symptom was constipation. This was experienced by 53 % of participants within the preceding three months. The next most common symptom was diarrhoea (45 %), followed by abdominal pain (43 %), nausea (38 %), and bloating (34 %). Seventeen percent of participants reported experiencing other GI symptoms, including indigestion, and acid reflux. Of the participants who experienced constipation, 22 reported receiving treatment for this symptom (44 %), while of people who experienced abdominal pain, 20 had received treatment (37 %). Seven participants who experienced nausea (19 %), four who experienced diarrhoea (9 %), and two who experienced bloating (6 %) were treated for these symptoms. The frequency and percentage of the number of GI symptoms experienced by participants is presented in [Table 1](#).

3.4. Challenging behaviour

The mean scores and standard deviations were calculated for the three subscales of the BPI-S. [Table 1](#) presents the frequency and severity of self-injury, aggressive or destructive behaviour and the frequency of stereotyped behaviour. These subscales do not have specific cut-off points.

3.5. Affective problems and sleep problems

A Pearson's r correlation was conducted to determine the relationship between scores on the Affective Problems scale of the CBCL and the total scores on the CSHQ. A moderate positive correlation was found, $r(95) = .45, p < .001$, indicating that children with affective problems are more likely to experience sleep problems. Further analysis of the subscales of the CSHQ found that affective problems correlated significantly with daytime sleepiness, $r(95) = .41, p < .001$, with a medium effect size. Affective problems and sleep duration also positively correlated, $r(95) = .35, p < .001$, with a medium effect size. A small positive correlation was found for affective problems and sleep anxiety, $r(95) = .21, p < .05$. A correlation matrix of all subscales of the CSHQ and the CBCL scores are presented in [Table 2](#).

Table 2

Correlation matrix between subscales of the CSHQ and CBCL Affective Problems.

	1	2	3	4	5	6	7	8	9
1 Bedtime resistance									
2 Sleep onset delay	.14								
3 Sleep duration	.26*	.29**							
4 Sleep anxiety	.76**	.21*	.17						
5 Night wakings	.25*	.1	.42**	.17					
6 Parasomnias	.18	.14	.26**	.26**	.34**				
7 Sleep disordered breathing	.	.13	-.04	.01	.07	.38**			
8 Daytime sleepiness	.07	.22*	.12	.09	.05	.04	.05		
9 CBCL Affective Problems	.08	.17	.35**	.21*	.17	.19	.18	.41**	

Note. * $p < .05$, ** $p < .001$.

3.6. Affective problems and gastrointestinal symptoms

A Pearson's r correlation was computed to assess the relationship between scores on the Affective Problems scale of the CBCL and the GI Symptoms Inventory. The results suggested a moderate positive correlation, $r(95) = .34, p < .01$, with a moderate effect size. The effects of five different GI symptoms on affective problems were examined using independent samples t -tests. For each test, the assumption of homogeneity of variance was met (i.e. $p > .05$). A significant difference was found in the affective problem scores between people who experienced abdominal pain ($t(76) = 4.73, p < .001$), nausea ($t(76) = 3.59, p < .01$), and constipation ($t(87) = 2.42, p < .05$), with people experiencing these GI symptoms presenting with higher scores on the Affective Problems scale than people who did not experience these GI symptoms.

3.7. Affective problems and challenging behaviour

A Pearson's r correlation revealed significant correlations between scores on the DSM-Oriented Affective Problems scale of the CBCL and the Self-Injurious Behaviour and Aggressive/Destructive Behaviour frequency and severity subscales of the BPI-S. No significant correlation between affective problems and Stereotyped Behaviour was observed. The results are summarised in [Table 3](#).

3.8. Hierarchical linear regression analyses

Hierarchical multiple regressions were carried out to explore which of the variables predicted the observed variance in the CBCL Affective Problems scores. Two regressions were conducted to analyse preschool-aged children and school-aged children separately, because the items on the CSHQ differ between the age groups. Both regressions contained identical steps. The age and gender of participants and the presence of intellectual disability were added during the first step. CSHQ total score was added in the second step, while total GI symptoms were added in the third step. The five subscales of the BPI-S; self-injurious behaviour frequency, self-injurious behaviour severity, aggressive/destructive behaviour frequency, and aggressive/destructive behaviour severity, and stereotyped behaviour frequency were added during the final step.

For the regression analysis on preschool children, the first step was significant, accounting for 25.6 % of the variance in scores of the DSM-Oriented Affective Problems scale, $F(3,17) = 3.30, p = .046$. Gender, specifically being male, and the presence of intellectual disability were found to significantly predict affective problems. Step two was also found to be significant, $F(4,16) = 3.61, p = .028$, where sleep problems were added, explained 8.7 % of the variance in scores on the CBCL Affective Problems scale, in which intellectual disability significantly predicted affective problems. The third and the fourth step with total GI symptoms and BPI-S subscales were both found to be non-significant. The results are summarised in [Table 4](#).

For the regression analysis on school-aged children, the first step was not significant. The second step significantly predicted affective problems, $F(4, 69) = 7.31, p < .001$, accounting for 24.6 % of the variance in CBCL scores, with intellectual disability and the CSHQ total score accountable for this. The third block, to which GI symptoms were added, was significant, $F(5,68) = 6.69, p < .001$, accounting for 2.3 % of the overall model, in which the presence of an intellectual disability and the CSHQ total score were predictive of affective problems. The fourth block where BPI-S subscales were added was also significant, $F(10,63) = 4.41, p < .001$, accounting for 3.8 % of the variance in scores on the CBCL Affective Problem scale, in which the presence of an intellectual disability, the CSHQ total score, and the BPI-S Aggressive/Destructive Behaviour Severity subscale were predictive of affective problems. See [Table 5](#) for a summary of the results.

4. Discussion

This study examined the relationship between affective problems and GI symptoms, challenging behaviour, and sleep problems in children and adolescents with ASD. It found that 69.5 % of children were within the clinical range for affective problems, and a further 10.5 % were in the borderline range. This suggests that affective problems are common in children and young people with ASD. They also appear more prevalent than among typically developing peers where prevalence rates of major depressive condition are between 1 % and 5 %, and 14 %–25 % of young people experience at least one episode of major depression before adulthood ([Kessler & Walters, 1998](#); [Fleming & Offord, 1990](#); [Lewinsohn, Rohde, & Seeley, 1998](#)). Some researchers have suggested factors such as poor social functioning and a lack of self-perceived social skills may contribute to the relatively higher prevalence of depression and affective

Table 3
Correlation matrix between the subscales of the BPI-S and CBCL Affective Problems.

		1	2	3	4	5	6
1	BPI-S SIB Frequency						
2	BPI-S SIB Severity	.87**					
3	BPI-S Aggressive/Destructive Behavior Frequency	.21*	.23*				
4	BPI-S Aggressive/Destructive Behavior Severity	.21*	.24*	.93**			
5	BPI-S Stereotyped Behavior Frequency	.46**	.41**	.14	.03		
6	CBCL Affective Problems	.26*	.28**	.27**	.30**	.13	

Note. * $p < 0.05$, ** $p < 0.01$.

Table 4
Summary of Hierarchical Regression Analysis for Variables Predicting Affective Problems in Preschool Aged Children.

Variable	B	SE B	β	ΔR^2
Block 1				.37*
Age	1.31	2.00	.13	
Gender (Male)	10.85	4.33	.55*	
Presence of Intellectual Disability	10.18	3.73	.60*	
Block 2				.12
Age	1.26	1.88	.12	
Gender (Male)	7.80	4.41	.40	
Presence of Intellectual Disability	9.57	3.52	.57*	
CSHQ Total	.31	.17	.36	
Block 3				.01
Age	1.65	2.20	.16	
Gender (Male)	7.31	4.71	.37	
Presence of Intellectual Disability	9.55	3.62	.57*	
CSHQ Total	.29	.19	.33	
GI Total	.47	1.25	.09	
Block 4				.20
Age	.64	2.30	.06	
Gender (Male)	4.53	5.00	.23	
Presence of Intellectual Disability	8.69	3.94	.51	
CSHQ Total	.37	.37	.43	
GI Total	-.50	1.40	-.10	
BPI-S SIB Frequency	.89	1.08	.48	
BPI-S SIB Severity	-.19	1.40	-.08	
BPI-S Aggressive/Destructive Behavior Frequency	.34	.64	.36	
BPI-S Aggressive/Destructive Behavior Severity	-.27	.88	-.25	
BPI-S Stereotyped Behavior Frequency	.06	.19	.08	

Note. * $p < .05$, ** $p < .001$.

Table 5
Summary of Hierarchical Regression Analysis for Variables Predicting Affective Problems in School Aged Children.

Variable	B	SE B	β	ΔR^2
Block 1				.05
Age	.38	.46	.10	
Gender (Male)	3.05	3.92	.09	
Presence of intellectual disability	4.42	3.17	.16	
Block 2				.25**
Age	.72	.40	.19	
Gender (Male)	.79	3.43	.02	
Presence of intellectual disability	6.62	2.78	.24*	
CSHQ Total	.63	.13	.51**	
Block 3				.03
Age	.63	.40	.17	
Gender (Male)	-.32	3.43	-.01	
Presence of intellectual disability	6.20	2.75	.23*	
CSHQ Total	.55	.13	.45**	
GI total	1.48	.82	.20	
Block 4				.08
Age	.72	.42	.19	
Gender (Male)	.86	3.43	.03	
Presence of intellectual disability	6.04	2.75	.22*	
CSHQ Total	.56	.13	.35**	
GI total	1.28	.84	.17	
BPI-S SIB Frequency	-.49	.63	-.15	
BPI-S SIB Severity	.85	.77	.21	
BPI-S Aggressive/Destructive Behavior Frequency	-.63	.43	-.42	
BPI-S Aggressive/Destructive Behavior Severity	1.01	.50	.57*	
BPI-S Stereotyped Behavior Frequency	.12	.14	.10	

Note. * $p < .05$, ** $p < .001$.

problems in autistic people (Pouw, Rieffe, Stockmann, & Gadov, 2013; Sterling, Dawson, Estes, & Greenon, 2008; Vickerstaff, Heriot, Wong, Lopes, & Dossetor, 2007). But, considering the high prevalence of affective problems in ASD more research in this area is warranted.

The majority (96.84 %) of participants presented with sleep problems. A strong correlational relationship was found between affective problems and sleep problems in children and adolescents with ASD. Correlational relationships were also found between

affective problems and daytime sleepiness, sleep duration, and sleep anxiety. These findings concur with previous research where sleep problems in ASD are well documented and they have previously been shown to have strong links to psychological conditions such as anxiety (Paavonen et al., 2008; Williams et al., 2015). Sleep problems are also common in typically developing children and adolescents with affective problems (Ivanenko, Crabtree, & Gozal, 2005), with a range of dysomnias and parasomnias associated, including longer sleep latency, night waking, early morning waking, and a decrease in sleep efficiency (Gregory & Sadeh, 2012). Although the current study found no associations between age and affective problems in children and adolescents, studies of typically developing children have suggested age may influence rates of affective problems. For example, in a comparison of children and adolescents with major depressive disorder, hypersomnia was over two times more common in adolescents than in children (Gregory & Sadeh, 2012).

Sleep problems were found to positively predict affective problems in school-aged children with ASD. Though this relationship is extremely under researched, the available studies suggest that the assessment of affective problems in people with ASD relies on symptoms, such as sleep disturbances or fatigue, rather than presenting with a depressed mood (Ghaziuddin et al., 2002), suggesting an important link between sleep and affective problems. A greater understanding of the relationship between affective problems and sleep problems in people with ASD could improve diagnosis and treatment procedures.

The majority of participants (85 %) of participants experienced GI symptoms, with constipation and diarrhoea being reported as the most common. This high prevalence is in line with previous research (Mannion & Leader, 2013, 2016). Significant differences were found between individuals who experienced abdominal pain, nausea, and constipation in comparison to people who did not experience symptoms. Furthermore, individuals with GI symptoms experienced more affective problems. Previous research examining GI symptoms and co-occurring psychopathology in children with ASD, has also found anxiety to be positively correlated with GI problems (Ferguson et al., 2019; Williams et al., 2015). Anxiety has been related to an 11 % increase in the presence of constipation symptoms, and affective problems were correlated with an 11 % increase in stomach aches, but a 9 % decrease in constipation (Ferguson et al., 2019). This suggests that affective problems and anxiety is associated with the GI health of people with ASD in different ways.

The current study found positive relationships between affective problems and self-injurious behaviour and aggressive/destructive behaviours in children and adolescents with ASD. Research has shown that instances of self-injurious behaviour have been found to decrease following treatment with antidepressant medication (Ricketts et al., 1993; Sovner, Fox, Lowry, & Lowry, 1993). Evidence of behaviour changes associated with affective problems in ASD have caused some researchers to suggest such changes may be an appropriate method of measuring affective problems in individuals with ASD, which may prove especially useful when diagnosing people who may have difficulty communicating their experiences (Stewart et al., 2006). However, using behavioural markers in assessing affective problems in ASD is problematic, as these behaviours are not specific to affective problems, nor are they a diagnostic criterion for affective problems in ASD. Changes in behaviours may occur for numerous reasons, including changes in diet, sleeping patterns, or medication, as well as through the introduction of a new treatment plan or intervention (Stewart et al., 2006; Tsiouris, Cohen, Patti, & Korosh, 2003). Therefore, the behaviour change may not be attributed to the onset of affective problems. Caution should be taken in interpreting such observable behaviours as symptoms of co-occurring psychiatric conditions.

Intellectual disability was found to be a positive predictor of affective problems in children and adolescents with ASD. This is interesting, as previous research has suggested that depressive symptoms are associated with higher IQ in individuals with ASD. For example, Sterling et al. (2008) found that adults who displayed significant depressive symptoms had higher cognitive abilities as well as less impaired social functioning. In a study of children with ASD, Vickerstaff et al. (2007) found that higher age and IQ predicted lower levels of self-perceived social competence, and low self-perceived social competence predicted higher levels of depressive symptoms.

The strengths of this study included its good statistical power and that it involved a representative sample of children and adolescents with ASD. The use of parental reports may be a limitation, especially in the measurement of affective problems, as parents may be unaware of some of the internal symptoms of the affective problems being experienced by their children, including feelings of worthlessness or suicidal thoughts. However, due to the age of the participants, as well as possible co-occurring diagnoses of intellectual disabilities, the use of self-reports were not deemed appropriate. Both parent and child reports have been used previously in several studies (Oswald et al., 2015; Ozsivadjian, Hibberd, & Hollocks, 2014). Parental reports were also relied upon for information on intellectual disability status. Another limitation is that the CBCL Affective Problems scale contains items regarding sleep, overlapping with items on the CSHQ, which may bring into question the relationship found between the two.

Future research needs to replicate the findings of the current study. Ideally this should include a measure of intellectual functioning, and it should aim to identify other significant predictors of affective problems. The present study found that 25 % of the variance in affective problems was accounted for by the variables examined, including sleep problems, GI symptoms, and challenging behaviour. This means that three quarters of the variance remains unexplained. In addition, because this study has identified correlational relationships between affective disorders and challenging behaviours, sleep problems and GI disorders, future research needs to determine the causal directionality of these relationships.

5. Implications for practice

This study has highlighted the high prevalence of affective problems amongst children and adolescents with ASD. It is vital to ameliorate suffering and to improve quality of life that affective problems are accurately assessed and treated. This study has contributed greater understanding of the relationship between affective problems and co-occurring conditions in children and adolescents with ASD. This knowledge can help clinicians to improve their awareness about co-occurring conditions and the potential relationships between them. Awareness of these could potentially inform diagnostic and treatment monitoring procedures.

Furthermore, the main treatments for affective problems are currently pharmacological, including the use of antidepressants such as tricyclics and selective serotonin reuptake inhibitors (SSRIs), mood stabilizers, antipsychotics, and hypnotics. In highlighting significant positive relationships between affective problems, sleep, behaviour, and GI symptoms, this research suggests there are opportunities for further research that could inform the development of alternative holistic treatment strategies.

Ethical approval

All procedures performed in this study that involved human participants were in accordance with the code of ethics of the world medical association (Declaration of Helsinki).

Author contributions

Geraldine Leader: Supervision, Conceptualisation, Reviewing. Hannah Browne: Writing-Original draft preparation, Methodology, Investigation, Formal Analysis. Sally Whelan: Writing, Reviewing, and Editing. Hannah Cummins: Writing-Original draft preparation, Investigation. Arlene Mannion: Supervision, Conceptualisation, Reviewing, Supervision, Project Administration.

Declaration of Competing Interest

All the authors of this article declare that they have no conflict of interest.

References

- Achenbach, T. M., & Rescorla, L. A. (2001). *The manual for the ASEBA school-age forms & profiles*. Burlington, VT: University of Vermont, Research Center for Children, Youth, and Families.
- Allik, H., Larsson, J. O., & Smedje, H. (2006). Sleep patterns of school-age children with Asperger syndrome or high-functioning autism. *Journal of Autism and Developmental Disorders*, 36(5), 585–595.
- American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders (4th ed.) text revision (DSM-IV-TR)*. Arlington, VA: American Psychiatric Association.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (5th ed.)*. Washington, DC: American Psychiatric Association.
- Autism Treatment Network. (2005). *GI symptom inventory questionnaire, version 3.0*. New York, NY: Autism Speaks.
- Bergman, M., Schene, A., Vissers, C., Vrijzen, J., Kan, C., & van Oostrom, I. (2020). Systematic review of cognitive biases in autism spectrum disorders: A neuropsychological framework towards an understanding of the high prevalence of co-occurring depression. *Research in Autism Spectrum Disorders*, 69, Article 101455.
- Bradley, E. A., Summers, J. A., Wood, H. L., & Bryson, S. E. (2004). Comparing rates of psychiatric and behavior disorders in adolescents and young adults with severe intellectual disability with and without autism. *Journal of Autism and Developmental Disorders*, 34(2), 151–161.
- Brereton, A. V., Tonge, B. J., & Einfeld, S. L. (2006). Psychopathology in children and adolescents with autism compared to young people with intellectual disability. *Journal of Autism and Developmental Disorders*, 36(7), 863–870.
- Capps, L., Yirmiya, N., & Sigman, M. (1992). Understanding of simple and complex emotions in non-retarded children with autism. *Journal of Child Psychology and Psychiatry*, 33(7), 1169–1182.
- Chiang, H. M. (2008). Expressive communication of children with autism: The use of challenging behaviour. *Journal of Intellectual Disability Research*, 52(11), 966–972.
- Cohen, S., Conduit, R., Lockley, S. W., Rajaratnam, S. M., & Cornish, K. M. (2014). The relationship between sleep and behavior in autism spectrum disorder (ASD): A review. *Journal of Neurodevelopmental Disorders*, 6(1), 44.
- Coury, D. L., Ashwood, P., Fasano, A., Fuchs, G., Geraghty, M., Kaul, A., ... Jones, N. E. (2012). Gastrointestinal conditions in children with autism spectrum disorder: Developing a research agenda. *Pediatrics*, 130, S160–S168.
- DeFilippis, M. (2018). Depression in children and adolescents with autism spectrum disorder. *Children*, 5(9), 112.
- Devlin, S., Healy, O., Leader, G., & Reed, P. (2008). The analysis and treatment of problem behavior evoked by auditory stimulation. *Research in Autism Spectrum Disorders*, 2(4), 671–680.
- Ferguson, B., Dovgan, K., Takahashi, N., & Beversdorf, D. (2019). The relationship among gastrointestinal symptoms, problem behaviors, and internalizing symptoms in children and adolescents with autism spectrum disorder. *Frontiers in Psychiatry*, 10, 194.
- Fleming, J. E., & Offord, D. R. (1990). Epidemiology of childhood depressive disorders: A critical review. *Journal of the American Academy of Child & Adolescent Psychiatry*, 29(4), 571–580.
- Francis, K., Mannion, A., & Leader, G. (2017). The assessment and treatment of toileting difficulties in individuals with autism spectrum disorder and other developmental disabilities. *Review Journal of Autism and Developmental Disorders*, 4(3), 190–204.
- Ghaziuddin, M., Ghaziuddin, N., & Greden, J. (2002). Depression in persons with autism: Implications for research and clinical care. *Journal of Autism and Developmental Disorders*, 32(4), 299–306.
- Green, V. A., Pituch, K. A., Itchon, J., Choi, A., O'Reilly, M., & Sigafos, J. (2006). Internet survey of treatments used by parents of children with autism. *Research in Developmental Disabilities*, 27(1), 70–84.
- Gregory, A. M., & Sadeh, A. (2012). Sleep, emotional and behavioral difficulties in children and adolescents. *Sleep Medicine Reviews*, 16(2), 129–136.
- Hemmings, C. P., Gravestock, S., Pickard, M., & Bouras, N. (2006). Psychiatric symptoms and problem behaviours in people with intellectual disabilities. *Journal of Intellectual Disability Research*, 50(4), 269–276.
- Hoffman, C. D., Sweeney, D. P., Lopez-Wagner, M. C., Hodge, D., Nam, C. Y., & Botts, B. H. (2008). Children with autism sleep problems and mothers' stress. *Focus on Autism and Other Developmental Disabilities*, 23(3), 155–165.
- Hollocks, M. J., Lerh, J. W., Magiati, I., Meiser-Stedman, R., & Brugha, T. S. (2019). Anxiety and depression in adults with autism spectrum disorder: A systematic review and meta-analysis. *Psychological Medicine*, 49(4), 559–572.
- Hollway, J. A., & Aman, M. G. (2011). Sleep correlates of pervasive developmental disorders: A review of the literature. *Research in Developmental Disabilities*, 32(5), 1399–1421.
- Hossain, M., Khan, N., Sultana, A., Ma, P., McKyer, E., Ahmed, H., & Purohit, N. (2020). Prevalence of co-occurring psychiatric disorders among people with autism spectrum disorder: An umbrella review of systematic reviews and meta-analyses. *Psychiatry Research*, 287, Article 112922.
- Howlin, P., & Magiati, I. (2017). Autism spectrum disorder. *Current Opinion in Psychiatry*, 30(2), 69–76.
- Hudson, C., Hall, L., & Harkness, K. (2018). Prevalence of depressive disorders in individuals with autism spectrum disorder: A meta-analysis. *Journal of Abnormal Child Psychology*, 47(1), 165–175.
- Ivanenko, A., Crabtree, V. M., & Gozal, D. (2005). Sleep and depression in children and adolescents. *Sleep Medicine Reviews*, 9(2), 115–129.

- Kessler, R. C., & Walters, E. E. (1998). Epidemiology of DSM-III-R major depression and minor depression among adolescents and young adults in the national comorbidity survey. *Depression and Anxiety*, 7(1), 3–14.
- Leader, G., & Mannion, A. (2016a). Gastrointestinal disorders. In J. L. Matson (Ed.), *Comorbid conditions among children with autism spectrum disorders* (pp. 257–281). Cham: Springer.
- Leader, G., & Mannion, A. (2016b). Challenging behaviors. In J. L. Matson (Ed.), *Handbook of assessment and diagnosis of autism spectrum disorder* (pp. 209–232). Cham: Springer.
- Leader, G., Francis, K., Mannion, A., & Chen, J. (2018). Toileting problems in children and adolescents with parent-reported diagnoses of autism spectrum disorder. *Journal of Developmental and Physical Disabilities*, 30(3), 307–327.
- Leader, G., Tuohy, E., Chen, J. L., Mannion, A., & Gilroy, S. P. (2020). Feeding problems, gastrointestinal symptoms, challenging behavior, and sensory issues in children and adolescents with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 50, 1401–1410.
- Lewinsohn, P. M., Rohde, P., & Seeley, J. R. (1998). Major depressive disorder in older adolescents: Prevalence, risk factors, and clinical implications. *Clinical Psychology Review*, 18(7), 765–794.
- Leyfer, O. T., Folstein, S. E., Bacalman, S., Davis, N. O., Dinh, E., Morgan, J., ... Lainhart, J. E. (2006). Comorbid psychiatric disorders in children with autism: Interview development and rates of disorders. *Journal of Autism and Developmental Disorders*, 36(7), 849–861.
- Mannion, A., & Leader, G. (2013). An analysis of the predictors of comorbid psychopathology, gastrointestinal symptoms and epilepsy in children and adolescents with autism spectrum disorder. *Research in Autism Spectrum Disorders*, 7(12), 1663–1671.
- Mannion, A., & Leader, G. (2016). An investigation of comorbid psychological disorders, sleep problems, gastrointestinal symptoms and epilepsy in children and adolescents with autism spectrum disorder: A two year follow-up. *Research in Autism Spectrum Disorders*, 22, 20–33.
- Mannion, A., & Leader, G. (2014a). Attention-deficit/hyperactivity disorder in autism spectrum disorder. *Research in Autism Spectrum Disorders*, 8(4), 432–439.
- Mannion, A., & Leader, G. (2014b). Epilepsy in autism spectrum disorder. *Research in Autism Spectrum Disorders*, 8(4), 354–361.
- Mannion, A., Brahm, M., & Leader, G. (2014). Comorbid psychopathology in autism spectrum disorder. *Review Journal of Autism and Developmental Disorders*, 1(2), 124–134.
- Matson, J. L., & Goldin, R. L. (2013). Comorbidity and autism: Trends, topics, and future directions. *Research in Autism Spectrum Disorders*, 7(10), 1228–1233.
- Matson, J. L., & Nebel-Schwalm, M. S. (2007). Comorbid psychopathology with autism spectrum disorder in children: An overview. *Research in Developmental Disabilities*, 28(4), 341–352.
- Matson, J. L., & Shoemaker, M. (2009). Intellectual disability and its relationship to autism spectrum disorders. *Research in Developmental Disabilities*, 30(6), 1107–1114.
- Mayer, S. D., & Calhoun, S. L. (2009). Variables related to sleep problems in children with autism. *Research in Autism Spectrum Disorders*, 3(4), 931–941.
- Mazefsky, C. A., Schreiber, D. R., Olino, T. M., & Minshew, N. J. (2014). The association between emotional and behavioral problems and gastrointestinal symptoms among children with high-functioning autism. *Autism*, 18(5), 493–501.
- Mazurek, M. O., Vasa, R. A., Kalb, L. G., Kanne, S. M., Rosenberg, D., Keefer, A., ... Lowery, L. A. (2013). Anxiety, sensory over-responsivity, and gastrointestinal problems in children with autism spectrum disorders. *Journal of Abnormal Child Psychology*, 41(1), 165–176.
- Mazzone, L., Ruta, L., & Reale, L. (2012). Psychiatric comorbidities in Asperger syndrome and high functioning autism: Diagnostic challenges. *Annals of General Psychiatry*, 11(1), 16.
- Meyer, J. A., Mundy, P. C., Van Hecke, A. V., & Durocher, J. S. (2006). Social attribution processes and comorbid psychiatric symptoms in children with Asperger syndrome. *Autism*, 10(4), 383–402.
- Ming, X., Brimacombe, M., Chaaban, J., Zimmerman-Bier, B., & Wagner, G. C. (2008). Autism spectrum disorders: Concurrent clinical disorders. *Journal of Child Neurology*, 23(1), 6–13.
- Murphy, G. H., Beadle-Brown, J., Wing, L., Gould, J., Shah, A., & Holmes, N. (2005). Chronicity of challenging behaviours in people with severe intellectual disabilities and/or autism: A total population sample. *Journal of Autism and Developmental Disorders*, 35(4), 405–418.
- Mussell, M., Kroenke, K., Spitzer, R. L., Williams, J. B., Herzog, W., & Löwe, B. (2008). Gastrointestinal symptoms in primary care: Prevalence and association with depression and anxiety. *Journal of Psychosomatic Research*, 64(6), 605–612.
- Nakamura, B. J., Ebesutani, C., Bernstein, A., & Chorpita, B. F. (2009). A psychometric analysis of the child behavior checklist DSM-oriented scales. *Journal of Psychopathology and Behavioral Assessment*, 31(3), 178–189.
- Newman, I., Leader, G., Chen, J. L., & Mannion, A. (2015). An analysis of challenging behavior, comorbid psychopathology, and Attention-Deficit/Hyperactivity Disorder in Fragile X Syndrome. *Research in Developmental Disabilities*, 38, 7–17.
- Nikolov, R. N., Beauss, K. E., Lettinga, J., Erickson, C., Rodowski, M., Aman, M. G., ... Arnold, L. E. (2009). Gastrointestinal symptoms in a sample of children with pervasive developmental disorders. *Journal of Autism and Developmental Disorders*, 39(3), 405–413.
- Oswald, T. M., Winter-Messiers, M. A., Gibson, B., Schmidt, A. M., Herr, C. M., & Solomon, M. (2015). Sex differences in internalizing problems during adolescence in autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 46(2), 624–636.
- Owens, J. A., Spirito, A., & McGuinn, M. (2000). The Children's Sleep Habits Questionnaire (CSHQ): Psychometric properties of a survey instrument for school-aged children. *Sleep*, 23(8), 1043–1051.
- Ozsvadjan, A., Hibberd, C., & Hollocks, M. J. (2014). Brief report: The use of self-report measures in young people with autism spectrum disorder to access symptoms of anxiety, depression, and negative thoughts. *Journal of Autism and Developmental Disorders*, 44(4), 969–974.
- Paavonen, E. J., Vehkalahti, K., Vanhala, R., von Wendt, L., Nieminen-von Wendt, T., & Aronen, E. T. (2008). Sleep in children with Asperger syndrome. *Journal of Autism and Developmental Disorders*, 38(1), 41–51.
- Pouw, L. B., Rieffe, C., Stockmann, L., & Gadov, K. D. (2013). The link between emotion regulation, social functioning, and depression in boys with ASD. *Research in Autism Spectrum Disorders*, 7(4), 549–556.
- Ricketts, R. W., Goza, A. B., Ellis, C. R., Singh, Y. N., Singh, N. N., & Cooke, J. C. (1993). Fluoxetine treatment of severe self-injury in young adults with mental retardation. *Journal of the American Academy of Child & Adolescent Psychiatry*, 32(4), 865–869.
- Rojahn, J., Matson, J. L., Lott, D., Esbensen, A. J., & Smalls, Y. (2001). The Behavior Problems Inventory: An instrument for the assessment of self-injury, stereotyped behavior, and aggression/destruction in individuals with developmental disabilities. *Journal of Autism and Developmental Disorders*, 31(6), 577–588.
- Rojahn, J., Rowe, E. W., Sharber, A. C., Hastings, R., Matson, J. L., Didden, R., ... Dumont, E. L. M. (2012). The Behavior Problems Inventory-Short Form for individuals with intellectual disabilities: Part I: development and provisional clinical reference data. *Journal of Intellectual Disability Research*, 56(5), 527–545.
- Rojahn, J., Schroeder, S. R., Mayo-Ortega, L., Oyama-Ganiko, R., LeBlanc, J., Marquis, J., & Berke, E. (2013). Validity and reliability of the Behavior Problems Inventory, the Aberrant Behavior Checklist, and the Repetitive Behavior Scale-Revised among infants and toddlers at risk for intellectual or developmental disabilities: A multi-method assessment approach. *Research in Developmental Disabilities*, 34(5), 1804–1814.
- Rzepecka, H., McKenzie, K., McClure, I., & Murphy, S. (2011). Sleep, anxiety, and challenging behaviour in children with intellectual disability and/or autism spectrum disorder. *Research in Developmental Disabilities*, 32(6), 2758–2766.
- Schreck, K. A., & Mulick, J. A. (2000). Parental report of sleep problems in children with autism. *Journal of Autism and Developmental Disorders*, 30(2), 127–135.
- Simonoff, E., Pickles, A., Charman, T., Chandler, S., Loucas, T., & Baird, G. (2008). Psychiatric disorders in children with autism spectrum disorders: Prevalence, comorbidity, and associated factors in a population-derived sample. *Journal of the American Academy of Child & Adolescent Psychiatry*, 47(8), 921–929.
- Sovner, R., Fox, C. J., Lowry, M. J., & Lowry, M. A. (1993). Fluoxetine treatment of depression and associated self-injury in two adults with mental retardation. *Journal of Intellectual Disability Research*, 37(3), 301–311.
- Sterling, L., Dawson, G., Estes, A., & Greenson, J. (2008). Characteristics associated with presence of depressive symptoms in adults with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 38(6), 1011–1018.
- Stewart, M. E., Barnard, L., Pearson, J., Hasan, R., & O'Brien, G. (2006). Presentation of depression in autism and Asperger syndrome: A review. *Autism*, 10(1), 103–116.

- Surtees, A. D., Richards, C., Clarkson, E. L., Heald, M., Trickett, J., Denyer, H., ... Oliver, C. (2019). Sleep problems in autism spectrum disorders: A comparison to sleep in typically developing children using actigraphy, diaries and questionnaires. *Research in Autism Spectrum Disorders*, 67, Article 101439.
- Tsiouris, J., Cohen, I., Patti, P., & Korosh, W. (2003). Treatment of previously undiagnosed psychiatric disorders in persons with developmental disabilities decreased or eliminated self-injurious behavior. *The Journal of Clinical Psychiatry*, 64(9), 1081–1090.
- Valderas, J. M., Starfield, B., Sibbald, B., Salisbury, C., & Roland, M. (2009). Defining comorbidity: Implications for understanding health and health services. *The Annals of Family Medicine*, 7(4), 357–363.
- Vickerstaff, S., Heriot, S., Wong, M., Lopes, A., & Dossetor, D. (2007). Intellectual ability, self-perceived social competence, and depressive symptomatology in children with high-functioning autistic spectrum disorders. *Journal of Autism and Developmental Disorders*, 37(9), 1647–1664.
- Weiss, J., Thomson, K., & Chan, L. (2014). A systematic literature review of emotion regulation measurement in individuals with autism spectrum disorder. *Autism Research*, 7(6), 629–648.
- Williams, K. C., Fuchs, G. J., Furuta, G. T., Marcon, M. A., & Coury, D. L. (2010). Clinical features associated with GI symptoms in Autism Spectrum Disorders (ASD). *Gastroenterology*, 138(5 Suppl. 1), S-74.
- Williams, K. C., Christofi, F. L., Clemmons, T., Rosenberg, D., & Fuchs, G. J. (2012a). Association of chronic gastrointestinal symptoms with sleep problems may help identify distinct subgroups of autism spectrum disorders. *Gastroenterology*, 142(5 Suppl. 1), S-714.
- Williams, K. C., Christofi, F. L., Clemmons, T., Rosenberg, D., & Fuchs, G. J. (2012b). Chronic GI symptoms in children with autism spectrum disorders are associated with clinical anxiety. *Gastroenterology*, 142(5 Suppl. 1), S-79–S-80.
- Williams, S., Leader, G., Mannion, A., & Chen, J. (2015). An investigation of anxiety in children and adolescents with autism spectrum disorder. *Research in Autism Spectrum Disorders*, 10, 30–40.
- Zaidman-Zait, A., Zwaigenbaum, L., Duku, E., Bennett, T., Szatmari, P., Mirenda, P., ... Kerns, C. (2020). Factor analysis of the children's sleep habits questionnaire among preschool children with autism spectrum disorder. *Research in Developmental Disabilities*, 97, Article 103548.