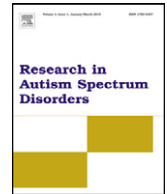




ELSEVIER

Contents lists available at [SciVerse ScienceDirect](http://www.sciencedirect.com)

Research in Autism Spectrum Disorders

Journal homepage: <http://ees.elsevier.com/RASD/default.asp>

An investigation of comorbid psychological disorders, sleep problems, gastrointestinal symptoms and epilepsy in children and adolescents with Autism Spectrum Disorder[☆]

Arlene Mannion, Geraldine Leader^{*}, Olive Healy

National University of Ireland, Galway, Ireland

ARTICLE INFO

Article history:

Received 30 April 2012
Accepted 2 May 2012

Keywords:

Comorbidity
Autism Spectrum Disorder
ASD-CC
CSHQ
GI symptom inventory

ABSTRACT

The current study investigated comorbidity in eighty-nine children and adolescents with Autism Spectrum Disorder in Ireland. Comorbidity is the presence of one or more disorders in addition to a primary disorder. The prevalence of comorbid psychological disorders, behaviours associated with comorbid psychopathology, epilepsy, gastrointestinal symptoms and sleep problems were examined. Age, gender, level of intellectual disability, presence of epilepsy, attention deficit/hyperactivity disorder (AD/HD) and an anxiety disorder were determined using a self-constructed demographic questionnaire. The Autism Spectrum Disorder-Comorbidity-Child (ASD-CC) was administered to informants to assess symptoms of psychopathology and emotional difficulties. The Children's Sleep Habits Questionnaire (CSHQ) and Gastrointestinal Symptom Inventory were administered to assess sleep problems and gastrointestinal symptoms respectively. Forty-six percent of participants had a comorbid disorder, with this number increasing to 78.7% if intellectual disability was included. The prevalence of epilepsy was 10.1%, AD/HD was 18% and an anxiety disorder was 15.7%. Prevalence rates of gastrointestinal symptoms and sleep problems are discussed in the study.

© 2012 Elsevier Ltd. All rights reserved.

1. Introduction

Comorbidity is defined as the co-occurrence of two or more disorders in the same person (Matson & Nebel-Schwalm, 2007). A comorbid condition is a second order diagnosis which offers core symptoms that differ from the first disorder. Comorbidity in the assessment of Autism Spectrum Disorder (ASD) is a topic that has infrequently been addressed (Matson & Nebel-Schwalm, 2007). It is extremely important to be aware of comorbid diagnoses in individuals with Autism Spectrum Disorder for several reasons. The use of psychotropic medication for children with ASD provides a justification for investigating comorbidity. Drug administration is often likely to be for challenging behaviour, or comorbid psychopathology, versus core symptoms of ASD (Matson & Nebel-Schwalm, 2007). If psychotropic medication is necessary, accurately diagnosed comorbid conditions could significantly assist medical doctors in providing the best possible medication regimens for children while minimising possible side effects (Thorson & Matson, 2012).

[☆] This research was conducted by the first author under the supervision of the second author in partial fulfilment of the requirements for her MSc degree 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 (G. Leader).

Matson and Nebel-Schwalm (2007) also discussed the importance of designating one disorder as primary and another as secondary. This is important in terms of priority of intervention, as well as determining the long term prognosis of a disorder. An individual may be given a more successful prognosis by a clinician, given the absence of other co-occurring disorders. Multiple disorders present in the same person result in more frequent mental health referrals compared to children who have a diagnosis of only one disorder (Mash & Barkley, 2003; Matson & Nebel-Schwalm, 2007). It is also necessary to determine a primary diagnosis for the allocation of resources and for the child's ability to cope with intervention on multiple target behaviours (Matson & Nebel-Schwalm, 2007).

Despite the necessity for research on comorbid conditions in ASD, there are many difficulties associated with diagnosing comorbid disorders. Matson and Nebel-Schwalm (2007) discussed these in their review on comorbid psychopathology in children with ASD. The first difficulty in diagnosis of comorbidity is that there is often an overlap in ASD and intellectual disability (ID). Seventy five percent of individuals with ASD show some level of ID (Croen, Grether, & Selvin, 2002; Matson & Nebel-Schwalm, 2007). It was even questioned until recently whether individuals with ID were able to develop mental health disorders (Matson & Barrett, 1982; Matson & Nebel-Schwalm, 2007). Secondly, symptoms of comorbid disorders may vary in individuals with ASD from symptoms seen in the general population. Thirdly, there is considerable heterogeneity in symptoms of ASD which leads to complications regarding what constitutes core symptoms of ASD. Finally, symptoms of comorbid conditions can change over time. This is especially true in the case of mood disorders, in particular bipolar disorder (Matson et al., 2006).

Simonoff et al. (2008) found that 70% of children with ASD had at least one comorbid disorder, with 41% having two or more. Prevalence rates of specific comorbid disorders have been shown to vary considerably within different studies. Simonoff et al. (2008) found social anxiety disorder to be the most common comorbid disorder in children with ASD, with 29% of participants presenting with the disorder. In contrast, Leyfer et al. (2006) found that only 7.5% of children with ASD presented with social anxiety disorder. Leyfer et al. (2006) found specific phobia to be the most common comorbid diagnosis, with 44% of children with ASD meeting diagnostic criteria, while Simonoff et al. (2008) found only 8.5% of children presented with a specific phobia. Oppositional defiant disorder was found in 28% (Simonoff et al., 2008) and 7% (Leyfer et al., 2006) of children with ASD respectively. Ten percent of children presented with at least one episode of major depression (Leyfer et al., 2006), compared to less than 1% (0.9%) in Simonoff et al.'s (2008) study.

There are similarities in prevalence rates between diagnoses of comorbid attention-deficit/hyperactivity disorder (AD/HD), with rates varying from 28% (Simonoff et al., 2008) to 31% (Leyfer et al., 2006). Due to the variability of prevalence rates of comorbidity in children with autism, one of the aims of the current study is to determine the prevalence of current comorbid disorders as well as behaviours that are associated with comorbid disorders. These behaviours include tantrum behaviours, repetitive behaviours, worry/depressive behaviours, avoidant behaviours, under-eating, over-eating and conduct behaviours and are measured using the Autism Spectrum Disorder Comorbidity-Child Version (ASD-CC) (Matson & González, 2007). In relation to gender differences, Worley and Matson (2011) found that there was no difference between males and females with ASD in terms of total psychiatric symptoms or on any of the specific factors of psychiatric symptoms examined, using the ASD-CC. The current study also aims to determine prevalence rates of other comorbid disorders, such as epilepsy, gastrointestinal symptoms and sleep problems.

Reports of the frequency of epilepsy in autism range from 5% to 38.3% (Giovanardi-Rossi, Posar, & Parmeggiani, 2000; Mouridsen, Rich, & Isager, 1999; Olsson, Steffenburg, & Gillberg, 1988; Rossi, Parmeggiani, Bach, Santucci, & Visconti, 1995; Tuchman & Rapin, 1997, 2002; Tuchman, Rapin, & Shinnar, 1991; Volkmar & Nelson, 1990; Wong, 1993). The prevalence of epilepsy among all children is estimated at 2–3% (Tuchman & Rapin, 2002). Volkmar and Nelson (1990) found that seizures occur most frequently in infancy before 5 years of age and in adolescence after 10 years of age. Clinical epilepsy develops by adolescence in more than a third of children with Autistic Disorder, while the likelihood for those with Asperger's syndrome of developing epilepsy is 5–10% in early childhood (Tuchman et al., 1991).

In their meta-analysis, Amiet et al. (2008) found that ID was found to be a risk factor for epilepsy where the prevalence of epilepsy was 21.4% in individuals with autism and ID versus 8% in individuals with autism without ID. The more severe the ID, the more prevalent epilepsy is and the greater part of statistical association between epilepsy and ID in autism relates to moderate and severe ID (Amiet et al., 2008). Amiet et al. (2008) also found that more females than males with autism had a diagnosis of epilepsy, where the prevalence of epilepsy was 34.5% in females versus 18.5% in males. Furthermore, Tuchman et al. (1991) found that girls with autism had lower cognitive ability than boys.

It is important to consider comorbid psychopathology alongside epilepsy as people with epilepsy are at an increased risk of experiencing suicidal ideation, displaying suicidal behaviour and committing suicide than the general population (Hecimovic, Salpekar, Kanner, & Barry, 2011). In this study, the researchers also commented that depressive disorders in paediatric patients remain under-recognised and untreated in this age group, highlighting the need for the development of more sensitive and specific screening instruments to identify depressive disorders in children (Hecimovic et al., 2011).

Reports from paediatric gastroenterologists have described gastrointestinal (GI) symptoms in 46–84% of children with autism (Horvath et al., 2000; Horvath & Perman, 2002a, 2002b; Kuddo & Nelson, 2003; Melmed, Schneider, Fabes Philips, & Reichelt, 2000). Other studies found smaller prevalence rates of GI symptoms in children with ASD, from 22.7% (Nikolov et al., 2009) to 24% (Molloy & Manning-Courtney, 2003).

Kuddo and Nelson (2003) commented on the features of autism that complicate interpretation of GI symptoms. Deficits in language can lead to difficulties in parental perception of pain in children with ASD. The insistence on sameness can lead children to demand stereotyped diets that may result in an inadequate intake of fibre, fluids and other food constituents,

which can cause gastrointestinal problems. If medication is administered to children with ASD, it can influence gut function, for example stimulants can cause abdominal pain and beta blockers can cause diarrhoea, constipation and gastric irritation (Kuddo & Nelson, 2003).

Despite high prevalence rates of gastrointestinal symptoms being found in some studies, others have found that gastrointestinal symptoms are no more common in children with ASD than typically developing children (Ibrahim Voigt, Katusic, Weaver, & Barbaresi, 2009; Kuddo & Nelson, 2003). Using matched control participants, Ibrahim et al. (2009) found no significant association between autism and overall incidence of gastrointestinal symptoms or any other gastrointestinal symptom category, except constipation and feeding issues. Constipation and feeding issues were found to have a behavioural aetiology (Ibrahim et al., 2009).

Children with ASD with GI symptoms were no different from children without GI symptoms in demographic characteristics, measures of adaptive functioning or autism symptom severity (Nikolov et al., 2009). However, children with GI symptoms showed greater symptom severity on measures of irritability, anxiety and social withdrawal and were less likely to respond to treatment (Nikolov et al., 2009). Valicenti-McDermott, McVicar, Cohen, Wershil, and Shinnar (2008) compared gastrointestinal problems in children with ASD with and without language regression. An association was observed between children with language regression, a family history of autoimmune disease and gastrointestinal symptoms.

Two-thirds of children and adolescents with ASD have a sleep problem at some point in childhood (Richdale, 2001; Richdale & Schreck, 2009). Contrasting this to typically developing children, up to 50% of children in the age range 0–6 years may have a sleep problem, and an average of 25% of all children will experience sleep difficulties at some time (Richdale & Schreck, 2009; Sheldon, Ferber, & Kryger, 2005). Similarly to epilepsy, intellectual disability has been found to be a risk factor for sleep problems. When an intellectual disability is present, sleep problems may be found in up to 80% of children (Richdale & Schreck, 2009; Sheldon et al., 2005).

Relationships have been found between sleep problems in children with ASD and increased rates of overactivity (Hoshino, Watanabe, Yashima, Kaneko, & Kumashiro, 1984), disruptive behaviour (Patzold, Richdale, & Tonge, 1998), communication difficulties (Segawa, Katoh, Katoh, & Nomura, 1992), social difficulties (Segawa et al., 1992) and difficulties with breaking routines (Segawa et al., 1992) as cited in Schreck, Mulick, and Smith (2004). Schreck et al. (2004) found that fewer hours of sleep per night predicted overall autism severity scores and social skills deficits. Similarly, stereotypic behaviour was predicted by fewer hours of sleep per night and screaming during the night (Schreck et al., 2004). Poor sleepers with ASD have a higher percentage of behavioural problems than good sleepers with ASD (Goldman et al., 2011).

The current study aims to investigate whether comorbid symptoms and disorders predict sleep problems in children and adolescents with ASD. Behaviours commonly reported as comorbid with ASD, such as sensory issues, eating habits, hyperactivity, and anxiety were more common in poor sleepers (Goldman et al., 2011). The most powerful predictors of sleep disturbance were parents' ratings of autism severity, followed by hyperactivity, mood variability, and aggression, which combined one third of the variance in sleep problems (Mayes & Calhoun, 2009). Other significant factors predicting sleep disturbance included parental ratings of oppositional behaviour, explosiveness, attention deficit, impulsivity and anxiety (Mayes & Calhoun, 2009). Higher levels of sleep problems are associated with higher levels of anxiety in children with ID and/or ASD (Rzepecka, McKenzie, McClure, & Murphy, 2011).

The aim of this study is to investigate the prevalence of current comorbid psychological disorders and behaviours that are associated with these disorders, as well as investigating the prevalence of intellectual disability, epilepsy, gastrointestinal symptoms and sleep problems in a sample of children and adolescents aged 3–16 years with ASD in Ireland. This study will also investigate if the presence of current comorbid psychological disorders, behaviours associated with psychological disorders, intellectual disability, epilepsy or gastrointestinal symptoms predict sleep problems in children and adolescents with ASD.

2. Method

2.1. Participants

Participants were 89 children and adolescents with a diagnosis of Autism Spectrum Disorder (in accordance with DSM-IV-TR criteria). Participants were recruited through schools, ASD service providers, parent support groups and online forums. The mean age of the sample was 9 years ($S.D = 39.53$), ranging from 3 to 16 years. Eighty three percent ($n = 74$) were males and 17 percent ($n = 15$) were female. Fifty nine percent ($n = 53$) of participants had an intellectual disability. A mild intellectual disability was reported for 25 percent of males ($n = 19$) and for 33 percent of females ($n = 5$). A moderate intellectual disability was reported for 27 percent of males ($n = 20$) and for 26 percent of females ($n = 4$). A severe intellectual disability was reported for 4 percent of males ($n = 3$) and for 13 percent of females ($n = 2$).

2.2. Measures

2.2.1. Demographic information

A self-constructed questionnaire provided information on the participants' age, gender, whether they had an intellectual disability and what level of intellectual disability. Presence or absence of epilepsy, attention deficit/hyperactivity disorder (AD/HD) and an anxiety disorder were reported, as well as any other current comorbid diagnosis.

2.2.2. The Autism Spectrum Disorder–Comorbid for Children (ASD-CC)

The ASD-CC (Matson & González, 2007), is a 39-item, informant-based rating scale designed to assess symptoms of psychopathology and emotional difficulties which commonly occur with ASD. Items are included to address conditions such as AD/HD, depression, conduct disorder, eating disorders/difficulties, OCD, specific phobias, and tic disorders. Caregivers rate each item to the extent it has been a recent problem as either 0 = “not a problem or impairment; not at all”, 1 = “mild problem or impairment”, 2 = “severe problem or impairment”, or X = “does not apply or don’t know”. Inter-rater and test–retest reliability for the ASD-CC has been found to be moderately good ($k = .46$ and $k = .51$, respectively) with very good internal consistency ($\alpha = .91$) reported (Matson & Dempsey, 2008). Factor analysis yielded seven subscales for the ASD-CC: (1) Tantrum Behaviour, (2) Repetitive Behaviour, (3) Worry/Depressed, (4) Avoidant Behaviour, (5) Under-Eating, (6) Conduct and (7) Over Eating. Construct validity was established for Tantrum Behaviour, Worry/Depressed, Repetitive Behaviour, Conduct, and Over-Eating factors.

2.2.3. Children's Sleep Habits Questionnaire (CSHQ)

The CSHQ (Owens, Nobile, McGuinn, & Spirito, 2000) is a 52-item parental-report, sleep-screening instrument designed for typically developing children ages 4–10 years. However, it has been used with younger children with Autism Spectrum Disorders (Goodlin-Jones, Sitnick, Tang, Liu, & Anders, 2008), as well as with an older population of children with ASD (Goldman et al., 2011). Forty-two of the items are rated on a three-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. There are 8 subscales of the CSHQ, including bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, parasomnias, day-time sleepiness and sleep disordered breathing. The CSHQ is not intended to be used to diagnose specific sleep disorders, but rather to identify sleep problems and the possible need for further evaluation. 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).

2.2.4. 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. The ATN is the first network of hospitals and physicians dedicated to developing a model of comprehensive medical care for children and adolescents with autism through seventeen participating institutions in the U.S. and Canada. This tool has not been validated. It was based on previous questionnaires and on clinical symptom assessment for children with autism and identified gastrointestinal disorders. 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. These branches will allow determination of rates of these categories as well.

2.3. Informants

Informants were parents of children and adolescents diagnosed with Autism Spectrum Disorder. Rating scales were completed by parents independently according to the instructions printed on top of the questionnaires.

3. Results

3.1. Current comorbid diagnoses

The prevalence of a comorbid disorder (excluding an intellectual disability) was 46.1% ($n = 41$) in the sample. When intellectual disability is included as a comorbid disorder, 78.7% of ($n = 70$) individuals had a comorbid disorder. The prevalence of attention deficit/hyperactivity disorder (AD/HD) was 18 percent ($n = 16$). The majority of those with AD/HD were male with 87.5% ($n = 14$) of those with AD/HD being male, and only 12.5% ($n = 2$) of those with AD/HD being female. Fifteen percent of children ($n = 14$) had a diagnosis of an anxiety disorder with the majority with the diagnoses being male ($n = 9$), while 5 females had the diagnosis. The prevalence of epilepsy in the current sample was 10.1% ($n = 9$). Of those with epilepsy, 66.6% were males ($n = 6$), while 33.3% were female ($n = 3$). A diagnosis of oppositional defiant disorder (ODD) was present in 4.5% ($n = 4$) of participants (Table 1).

3.2. Comorbid psychopathology

The means and standard deviations were calculated for behaviours associated with psychopathology in the Autism Spectrum Disorder–Comorbid for Children (ASD-CC). The mean score for the ASD-CC was 28.56 ($SD = 12.35$). Although there is no cut-off for the total score, there are cut-offs for the seven subscales. They are divided into no/minimal impairment,

Table 1
Current comorbid diagnoses.

Characteristic	Percentage of participants
Intellectual disability	69.6% (<i>n</i> = 53)
Comorbid disorder (including intellectual disability)	80.7% (<i>n</i> = 70)
Comorbid disorder (excluding intellectual disability)	46.1% (<i>n</i> = 41)
Epilepsy	10.1% (<i>n</i> = 9)
Attention deficit/hyperactivity disorder (AD/HD)	17.9% (<i>n</i> = 16)
Anxiety disorder	15.7% (<i>n</i> = 14)
Oppositional defiant disorder (ODD)	4.5% (<i>n</i> = 4)

Table 2
ASD-CC subscale means, standard deviations and level of impairment.

Factor	Mean	Standard deviation	Level of impairment
Tantrum behaviours	8.66	4.22	No/minimal impairment
Repetitive behaviours	7.00	3.71	No/minimal impairment
Worry/depressed	3.08	2.70	No/minimal impairment
Avoidant behaviours	5.63	2.92	No/minimal impairment
Under-eating	1.01	1.70	No/minimal impairment
Conduct behaviours	1.81	1.96	No/minimal impairment
Over-eating	1.35	1.85	No/minimal impairment

moderate impairment and severe impairment, depending on how far the score falls from the mean. All of the mean scores in the study were determined to have no or minimal impairment, when means were compared to established cut-offs. A summary of the scores for each factor and its level of impairment are provided in Table 2.

3.3. Gastrointestinal symptoms

A gastrointestinal Symptom Inventory was missing for two of the participants. Of the 87 completed questionnaires, 79.3% (*n* = 69) of participants presented with at least one gastrointestinal symptom within the last 3 months. 20.7% (*n* = 18) presented with one symptom only, while 23% (*n* = 20) had two symptoms. 13.8% (*n* = 12) and 14.9% (*n* = 13) presented with three and four symptoms respectively. Only 6.9% (*n* = 6) had five gastrointestinal symptoms within the last three months. The most common gastrointestinal symptoms were abdominal pain and constipation, with each affecting 51.7% (*n* = 45) and 49.4% (*n* = 43) of participants respectively. Following these, diarrhoea was the next most common symptom with 45.9% (*n* = 40) of participants experiencing it, while 29.9% (*n* = 26) of participants had experienced symptoms of nausea within the last 3 months. The least common gastrointestinal symptom was bloating, where 25.3% (*n* = 22) presented with this symptom (Table 3).

3.4. Sleep problems

The prevalence of sleep problems in this sample was 80.9% (*n* = 72), whereby a sleep problem was classified if a child presented with a score of 41 or more on the CSHQ. The mean score on the CSHQ was 53.53 (*SD* = 14.15). 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 4.

3.5. Hierarchical regression analysis

A hierarchical linear regression was conducted to examine if age, gender, comorbid disorders (including intellectual disability), behaviours associated with psychopathology and gastrointestinal symptoms predicted sleep problems in children and adolescents with ASD. Age of participants, gender, presence of intellectual disability, presence of epilepsy, presence of AD/HD, presence of anxiety disorder and presence of other comorbid disorders were entered in the first step of

Table 3
Frequency and percentage of gastrointestinal symptoms.

Gastrointestinal symptoms	Frequency	Percentage
At least one symptom	69	79.3%
Two symptoms	20	23%
Three symptoms	12	13.8%
Four symptoms	13	14.9%
All five symptoms	6	6.9%

Table 4

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

Subscale	Mean	Standard deviation
Bedtime resistance	9.15	4.14
Sleep onset delay	2.56	1.16
Sleep duration	5.49	2.77
Sleep anxiety	7.06	3.22
Night wakings	5.02	2.48
Parasomnias	.31	3.54
Sleep disordered breathing	3.61	1.43
Daytime sleepiness	13.49	4.69

Table 5

Summary of significant predictors of total sleep problem scores.

Variable	<i>B</i>	SE <i>B</i>	β
Avoidant behaviour (ASD-CC)	1.37	.67	.28*
Under-eating (ASD-CC)	2.13	.94	.26*
GI symptom inventory total score	2.54	1.18	.28*

* $p < .05$.**Table 6**

Summary of significant predictors of subscales in Children's Sleep Habits Questionnaire (CSHQ).

Variable	<i>B</i>	SE <i>B</i>	β
1. Abdominal pain (GI symptom inventory)	Sleep anxiety 1.63	.80	.25*
2.	Parasomnias		
3.	Daytime sleepiness		

* $p < .05$.

the model. These predictor variables were followed by the subscales of the ASD-CC in the second step. Finally, gastrointestinal symptoms were added in the third step of the model.

The first block, with age, gender and comorbid disorders as predictors were found to significantly predict sleep problems, $F(7, 86) = 2.26$, $p = .038$, $\Delta R^2 = .093$. However, none of the individual variables were significant. The first block explained 9.3% of the variance in sleep problems. With the addition of the behaviours associated with psychopathology, it was also found to predict sleep problems, $F(14, 86) = 2.75$, $p = .003$, $\Delta R^2 = .221$. Both avoidant behaviour was significant in the second model and the model explained 22.1% of the variance in sleep problems. Under-eating was on the verge of significance in the second model. Gastrointestinal symptoms were added in the third block, and this model was significant, $F(15, 86) = 3.01$, $p = .001$, $\Delta R^2 = .259$. As can be seen in Table 5, under-eating, avoidant behaviour and gastrointestinal symptoms were significant predictors in the final model, with the entire model explaining 25.9% of the variance in sleep problems.

3.6. Standard multiple regressions

In order to examine which aspects of sleep problems these variables predicted, eight standard multiple regressions were conducted. In the first multiple regression, bedtime resistance, a subscale of the CSHQ was entered as the criterion variable, while avoidant behaviour, under-eating and the five subscales of the GI inventory questionnaire were added individually. This model was not significant ($p = .086$). The same predictor variables were added in the remaining multiple regressions, alongside the remaining subscales of the CSHQ. Avoidant behaviour, under-eating and the GI inventory subscales did not predict sleep duration ($p = .067$), sleep onset delay ($p = .353$), sleep disordered breathing ($p = .069$) or night wakings ($p = .293$).

The model predicted sleep anxiety, $F(7, 86) = 2.96$, $p = .008$, $\Delta R^2 = .138$, and explained 13.8% of the variance in sleep anxiety. Abdominal pain specifically predicted sleep anxiety, as shown in Table 6. The model also predicted parasomnias, $F(7, 86) = 2.88$, $p = .010$, $\Delta R^2 = .132$, thus predicting 13.2% of the variance in parasomnias. Under-eating was on the verge of significance. Finally, the model was significant as a predictor for daytime sleepiness, $F(7, 86) = 3.83$, $p = .001$, $\Delta R^2 = .187$, explaining 18.7% of the variance. However, none of the individual variables predicted daytime sleepiness.

4. Discussion

In the current study, the prevalence of a comorbid disorder was 46.1% ($n = 41$). This rate increased to 78.7% when intellectual disability is included as a comorbid disorder. This is similar to Simonoff et al. (2008), who found that 70% of

children with ASD had at least one comorbid disorder. The prevalence of epilepsy was 10.1% ($n = 9$). This is supported by Pavone et al. (2004) who found the prevalence to be 6% in children with ASD without additional neurological disorders. More males than females had epilepsy in the current study, which is in contrast to the Amiet et al.'s (2008) study.

Prevalence of AD/HD was 18% ($n = 16$) in children and adolescents with ASD. Simonoff et al. (2008) and Leyfer et al. (2006) found prevalence of AD/HD to be much higher, varying from 28 to 31%. However, Keen and Ward (2004) found AD/HD to have a prevalence of 13.7% in children with ASD. Previous literature found the prevalence of AD/HD to vary between 14 and 78% (Gargaro, Rinehart, Bradshaw, Tonge, & Sheppard, 2011). The prevalence of an anxiety disorder was 15.7% ($n = 14$). This is similar to previous literature, which ranged from 17 to 84% (Leyfer et al., 2006). A diagnoses of oppositional defiant disorder (ODD) was present in 4.5% ($n = 4$) of children with ASD. Other studies found rates to vary, such as 7% (Leyfer et al., 2006) and 28% (Simonoff et al., 2008).

The ASD-CC was used in the current study to investigate behaviours associated with comorbid disorders. When compared to established means (Thorson & Matson, 2012), the present study found similar results. Similar scores were found for worry/depressed, where Thorson and Matson (2012) found a mean of 2.69, while the current study yielded a mean of 3.08. Conduct behaviours were similar also, with the current study score being 1.81, compared to 1.49. Under-eating (1.01) and over-eating (1.35) yielded very similar scores, compared to the established scores of 0.82 and 1.20 respectively. Differences lay between avoidant behaviours (5.63), tantrum behaviours (8.66) and repetitive behaviours (7.00) compared to Thorson & Matson's (2012) scores of 4.23, 6.70 and 4.91. Examining the variance in these results is an area for future research.

The majority of children (79.3%) presented with at least one gastrointestinal symptom in the last 3 months, with the most common being abdominal pain and constipation. This is similar to rates found in previous studies, varying from 46 to 84% (Kuddo & Nelson, 2003). It is important to remember that gastrointestinal symptoms are also common in typically developing young children (Ibrahim et al., 2009). Horvath, Papadimitriou, Rabszty, Drachenberg, and Tyson Tildon (1999) commented that unrecognised gastrointestinal symptoms and disorders may contribute to the behavioural problems of non-verbal children with autism, such as sudden irritability, aggressive behaviour and night time awakenings. Many parents searching for a biomedical intervention that may help their children with autism have embraced the hypothesis of a "leaky gut" in ASD (Ibrahim et al., 2009). As a result, restrictive diets and other nutritional or gastrointestinal therapies, such as the gluten-free, casein-free diet have become widely popular interventions for children with autism, despite a lack of evidence regarding their safety or efficacy (Ibrahim et al., 2009).

The majority of children (80.9%) also presented with a sleep problem. This is similar to Richdale's (2001) study which found that two-thirds of children and adolescents with ASD will experience a sleep problem at some stage in their lives, and similar to Sheldon et al. (2005), who found that 80% of children with an ID have difficulties with sleep. In order to analyse what factors predicted sleep problems, a hierarchical multiple regression was conducted. It found that avoidant behaviour, under-eating and gastrointestinal symptoms were predictors of the variance in sleep problems. This is supported by Ming, Brimacombe, Chaaban, Ximmerman-Bier, and Wagner (2008), who found sleep disorders to be associated with gastrointestinal dysfunction.

Contrary to previous research, age and intellectual disability did not predict sleep problems in the current study. In order to further investigate how avoidant behaviour, under-eating and gastrointestinal symptoms affected sleep problems, several standard multiple regressions were conducted. The main areas of sleep these factors predicted were sleep anxiety, parasomnias and daytime sleepiness. Abdominal pain was found to be a significant predictor of sleep anxiety. Avoidant behaviour, under-eating and gastrointestinal symptoms predicted parasomnias. With regards to parasomnias, items on the parasomnias subscale of the sleep questionnaire included sleep walking and grinding teeth during sleep. The model also predicted daytime sleepiness. These areas need to be further investigated in order to fully understand the role of avoidant behaviour, under-eating and gastrointestinal symptoms, such as abdominal pain in sleep problems.

In conclusion, this study is the first of its kind investigating comorbid psychopathology in children and adolescents with an Autism Spectrum Disorder in Ireland. Sleep problems and gastrointestinal symptoms were found to be very common among children and adolescents with autism, while epilepsy, AD/HD and anxiety disorders were not as common as the literature suggests. Behaviours associated with comorbid psychopathology were found to be similar with that of previous research. Future research could also examine the role behavioural interventions play in relation to comorbid disorders, including sleep problems.

References

- Amiet, C., Gourfinkel-An, I., Bouzamondo, A., Tordjman, S., Baulac, M., Lechat, P., et al. (2008). Epilepsy in autism is associated with intellectual disability and gender: Evidence from a meta-analysis. *Biological Psychiatry*, 64, 577–582 <http://dx.doi.org/10.1016/j.biopsych.2008.04.030>.
- Autism Treatment Network. (2005). *GI symptom inventory questionnaire, vers. 3.0*. New York, NY: Autism Speaks.
- Croen, L. A., Grether, J. K., & Selvin, S. (2002). Descriptive epidemiology of autism in a California population: Who is at risk? *Journal of Autism and Developmental Disorders*, 32, 217–224 <http://dx.doi.org/10.1023/A:1015405914950>.
- Gargaro, B. A., Rinehart, N. J., Bradshaw, J., Tonge, B. J., & Sheppard, D. M. (2011). Autism and ADHD: How far have we come in the comorbidity debate? *Neuroscience and Biobehavioral Reviews*, 35(5), 1081–1088 <http://dx.doi.org/10.1016/j.neubiorev.2010.11.002>.
- Giovanardi-Rossi, P., Posar, A., & Parmeggiani, A. (2000). Epilepsy in adolescents and young adults with autistic disorder. *Brain and Development*, 22, 102–106.
- Goldman, S. E., McGrew, S., Johnson, K. P., Richdale, A. L., Clemons, T., & Malow, B. A. (2011). Sleep is associated with problem behaviors in children and adolescents with Autism Spectrum Disorders. *Research in Autism Spectrum Disorders*, 5, 1223–1229 <http://dx.doi.org/10.1016/j.rasd.2011.01.010>.
- Goodlin-Jones, B. L., Sitnick, S. L., Tang, K., Liu, J., & Anders, T. F. (2008). The Children's Sleep Habits Questionnaire in toddlers and pre-school children. *Journal of Developmental and Behavioral Paediatrics*, 29, 82–88 <http://dx.doi.org/10.1097/DBP.0b013e318163c39a>.

- Hecimovic, H., Salpekar, J., Kanner, A. M., & Barry, J. J. (2011). Suicidality and epilepsy: A neuropsychobiological perspective. *Epilepsy & Behavior*, 22(1), 77–84 <http://dx.doi.org/10.1016/j.yebeh.2011.04.059>.
- Horvath, K., Medeiros, L., Rabsztyjn, A., Ramer, J., Sewell, T., Zielke, R. H., et al. (2000). High prevalence of gastrointestinal symptoms in children with autistic spectrum disorder. *Journal of Pediatric Gastroenterology and Nutrition*, 31(Suppl. 2), S174.
- Horvath, K., Papadimitriou, J. C., Rabsztyjn, A., Drachenberg, C., & Tyson Tildon, J. (1999). Gastrointestinal abnormalities in children with autistic disorder. *The Journal of Pediatrics*, 135(5), 559–563 [http://dx.doi.org/10.1016/S0022-3476\(99\)70052-1](http://dx.doi.org/10.1016/S0022-3476(99)70052-1).
- Horvath, K., & Perman, J. A. (2002a). Autistic disorder and gastrointestinal disease. *Current Opinion in Pediatrics*, 14, 583–587 <http://dx.doi.org/10.1097/00008480-200210000-00004>.
- Horvath, K., & Perman, J. A. (2002b). Autism and gastrointestinal symptoms. *Current Gastroenterology Reports*, 4, 251–258 <http://dx.doi.org/10.1007/s11894-002-0071-6>.
- Hoshino, Y., Watanabe, K., Yashima, Y., Kaneko, M., & Kumashiro, H. (1984). An investigation of sleep disturbance in autistic children. *Psychiatry and Clinical Neurosciences*, 38, 45–52 <http://dx.doi.org/10.1111/j.1440-1819.1984.tb00353.x>.
- Ibrahim, S. H., Voigt, R. G., Katusic, S. K., Weaver, A. L., & Barbaresi, J. (2009). Incidence of gastrointestinal symptoms in children with autism: A population based study. *Pediatrics*, 124, 680–686 <http://dx.doi.org/10.1542/peds.2008-2933>.
- Keen, D., & Ward, S. (2004). Autism spectrum disorder: A child population profile. *Autism*, 8(1), 39–48 <http://dx.doi.org/10.1177/13623613044040637>.
- Kuddo, T., & Nelson, K. B. (2003). How common are gastrointestinal disorders in children with autism? *Current Opinion in Pediatrics*, 15, 339–343 <http://dx.doi.org/10.1097/00008480-200306000-00020>.
- Leyfer, O. T., Folstein, S. E., Bacalman, S., Davis, N. O., Dinh, E., Morgan, J., et al. (2006). Comorbid psychiatric disorders in children with autism: Interview development and rates of disorders. *Journal of Autism and Developmental Disorders*, 36, 849–861 <http://dx.doi.org/10.1007/s10803-006-0123-0>.
- Mash, E. J., & Barkley, R. A. (2003). *Child psychopathology*. (p. 37). (2nd ed.). New York: Guilford Press.
- Matson, J. L., & Barrett, R. P. (1982). *Psychopathology in the mentally retarded*. (p. 1) New York: Grane and Stratton.
- Matson, J. L., & Dempsey, T. (2008). Stereotypy in adults with autism spectrum disorders: Relationship and diagnostic fidelity. *Journal of Developmental and Physical Disabilities*, 20, 155–165 <http://dx.doi.org/10.1007/s10882-007-9086-0>.
- Matson, J. L., & González, M. L. (2007). *Autism spectrum disorders – Comorbidity – Child version*. Baton Rouge, LA: Disability Consultants, LLC.
- Matson, J. L., González, M. L., Smith, K. R., Terlonge, C., Thorson, R. T., & Dixon, D. R. (2006). Assessing side effects of pharmacotherapy treatment of bipolar disorder: A 20 year review of the literature. *Research in Developmental Disabilities*, 27(5), 467–500 <http://dx.doi.org/10.1016/j.ridd.2005.06.002>.
- 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 <http://dx.doi.org/10.1016/j.ridd.2005.12.004>.
- Mayes, S. D., & Calhoun, S. L. (2009). Variable related to sleep problems in children with autism. *Research in Autism Spectrum Disorders*, 3, 931–941 <http://dx.doi.org/10.1016/j.rasd.2009.04.002>.
- Melmed, R. D., Schneider, C. K., Fabes, R. A., Philips, J., & Reichelt, K. (2000). Metabolic markers and gastrointestinal symptoms in children with autism and related disorders. *Journal of Pediatric Gastroenterology and Nutrition*, 31(Suppl. 2), S31.
- Ming, X., Brimacombe, M., Chaaban, J., Zimmerman-Bier, B., & Wagner, G. C. (2008). Autism spectrum disorders: Concurrent clinical disorders. *Journal of Child Neurology*, 23, 6–13.
- Molloy, & Manning-Courtney, C. A. (2003). Prevalence of chronic gastrointestinal symptoms in children with autism and autistic spectrum disorders. *Autism*, 7, 165–171 <http://dx.doi.org/10.1177/1362361303007002004>.
- Mouridsen, S. E., Rich, B., & Isager, T. (1999). Epilepsy in disintegrative psychosis and infantile autism: A long term validation. *Developmental Medicine & Child Neurology*, 41, 110–114 <http://dx.doi.org/10.1017/S0012162299000213>.
- Nikolov, R. N., Bearss, K. E., Lettinga, J., Erickson, C., Rodowski, M., Aman, M. G., et al. (2009). Gastrointestinal symptoms in a sample of children with pervasive developmental disorders. *Journal of Autism and Developmental Disorders*, 30, 405–413 <http://dx.doi.org/10.1007/s10803-008-0637-8>.
- Olsson, I., Steffenburg, S., & Gillberg, C. (1988). Epilepsy in autism and autistic like conditions: A population-based study. *Archives of Neurology*, 45, 666–668.
- Owens, J. A., Nobile, C., McGuinn, M., & Spirito, A. (2000). The Children's Sleep Habits Questionnaire: Construction and validation of a sleep survey for school-aged children. *Sleep*, 23(8), 1043–1051.
- Owens, J. A., Spirito, A., & McGuinn, M. (2000). Sleep habits and sleep disturbance in elementary school-aged children. *Journal of Developmental & Behavioral Pediatrics*, 21, 27–36, <http://dx.doi.org/10.1097.00004703-200002000-00005>.
- Patzold, L. M., Richdale, A. L., & Tonge, B. J. (1998). An investigation in to sleep characteristics of children with autism and Asperger's disorder. *Journal of Paediatric Child Health*, 34, 528–533 <http://dx.doi.org/10.1046/j.1440-1754.1998.00291.x>.
- Pavone, P., Incorpora, G., Fiumara, A., Parano, E., Trifiletti, R. R., & Ruggieri, M. (2004). Epilepsy is not a prominent feature of primary autism. *Neuropediatrics*, 35, 207–210 <http://dx.doi.org/10.1055/s-2004-821079>.
- Richdale, A. (2001). Sleep disorders in autism and Asperger's syndrome. In G. Stores & L. Wiggs (Eds.), *Sleep disturbances in disorders in disorders of development: Its significance and management* (pp. 181–191). London: MacKeith Press.
- Richdale, A. L., & Schreck, K. A. (2009). Sleep problems in autism spectrum disorders: Prevalence, nature, & possible biopsychosocial aetiologies. *Sleep Medicine Reviews*, 13, 403–411 <http://dx.doi.org/10.1016/j.smrv.2009.02.003>.
- Rossi, P. G., Parmeggiani, A., Bach, V., Santucci, M., & Visconti, P. (1995). EEG features and epilepsy in patients with autism. *Brain & Development*, 17, 169–174 [http://dx.doi.org/10.1016/0387-7604\(95\)00019-8](http://dx.doi.org/10.1016/0387-7604(95)00019-8).
- 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*, 2758–2766 <http://dx.doi.org/10.1016/j.ridd.2011.05.034>.
- Schreck, K. A., Mulick, J. A., & Smith, A. F. (2004). Sleep problems as possible predictors of intensified symptoms of autism. *Research in Developmental Disabilities*, 25, 57–66 <http://dx.doi.org/10.1016/j.ridd.2003.04.007>.
- Segawa, M., Katoh, M., Katoh, J., & Nomura, Y. (1992). Early modulation of sleep parameters and its importance in later behavior. *Brain Dysfunction*, 5, 211–223.
- Sheldon, S. H., Ferber, R., & Kryger, M. H. (Eds.). (2005). *Principles and practice of pediatric sleep medicine*. Philadelphia, PA: Elsevier Saunders.
- 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-driven sample. *Journal of the American Academy Child and Adolescent Psychiatry*, 47(8), 921–929 <http://dx.doi.org/10.1097/CHI.0b013e318179964f>.
- Thorson, R. T., & Matson, J. L. (2012). Cutoff scores for the Autism Spectrum Disorder – Comorbid for Children (ASD-CC). *Research in Autism Spectrum Disorders*, 556–559 <http://dx.doi.org/10.1016/j.rasd.2011.07.016>.
- Tuchman, R. F., & Rapin, I. (1997). Regression in pervasive developmental disorders: Seizures and epileptiform electroencephalogram correlates. *Pediatrics*, 99, 560–566 <http://dx.doi.org/10.1542/peds.99.4.560>.
- Tuchman, R. F., & Rapin, I. (2002). Epilepsy in autism. *The Lancet Neurology*, 1, 352–357 [http://dx.doi.org/10.1016/S1474-4422\(02\)00160-6](http://dx.doi.org/10.1016/S1474-4422(02)00160-6).
- Tuchman, R. F., Rapin, I., & Shinnar, S. (1991). Autistic and dysphasic children. II. Epilepsy. *Pediatrics*, 88, 1219–1225.
- Valicenti-McDermott, M. D., McVicar, K., Cohen, H. J., Wershil, B. K., & Shinnar, S. (2008). Gastrointestinal symptoms in children with an autism spectrum disorder and language regression. *Pediatric Neurology*, 39(6), 392–398 <http://dx.doi.org/10.1016/j.pediatrneurol.2008.07.019>.
- Volkmar, F. R., & Nelson, D. S. (1990). Seizure disorders in autism. *Journal of the American Academy Child and Adolescent Psychiatry*, 29, 127–129 <http://dx.doi.org/10.1097/00004583-199001000-00020>.
- Wong, V. (1993). Epilepsy in children with autism spectrum disorder. *Journal of Child Neurology*, 8, 316–322 <http://dx.doi.org/10.1177/08830738900800405>.
- Worley, J. A., & Matson, J. L. (2011). Psychiatric symptoms in children diagnosed with an autism spectrum disorder: An examination of gender differences. *Research in Autism Spectrum Disorders*, 5, 1086–1091 <http://dx.doi.org/10.1016/j.rasd.2010.12.002>.