An analysis of the predictors of comorbid psychopathology, gastrointestinal symptoms and epilepsy in children and adolescents with autism spectrum disorder.

Arlene Mannion

Geraldine Leader

National University of Ireland, Galway.

Corresponding author: Geraldine Leader, Ph.D., Irish Centre for Autism and Neurodevelopmental Research, School of Psychology, National University of Ireland, Galway, Ireland. Tel: 0035391 493434, Fax: 00353 91 521355

An analysis of the predictors of comorbid disorders in ASD.

Abstract

Mannion, Leader and Healy (2013) examined the frequency of comorbid disorders in children and adolescents with autism spectrum disorder and the predictors of sleep problems. This study will examine the predictors of comorbidity in the 89 participants. 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- Comorbid for Children (ASD-CC) was administered to informants to assess symptoms of comorbid psychopathology. The Children's Sleep Habits Questionnaire (CSHQ) and Gastrointestinal symptom inventory were administered to assess sleep problems and gastrointestinal symptoms respectively. Sleep problems predicted gastrointestinal symptoms. Level of intellectual disability predicted gastrointestinal symptoms. Specifically, those with no intellectual disability were more likely to present with gastrointestinal symptoms. Gastrointestinal symptoms in turn predicted total comorbid psychopathology score and the individual subscales of worry/depressed, avoidant behavior, conduct behavior and tantrum behavior on the ASD-CC. Gender and ASD-CC total score predicted an individual having an anxiety disorder. Specifically, being male predicted an anxiety disorder. The ASD-CC subscales of worry/depressed and avoidant behavior predicted an anxiety disorder. The implications of these findings are discussed in the study.

Keywords: Comorbidity, Autism Spectrum Disorder, Comorbid Psychopathology, Sleep Problems, Gastrointestinal Symptoms

An analysis of the predictors of comorbid psychopathology, gastrointestinal symptoms and epilepsy in children and adolescents with autism spectrum disorder.

1. Introduction

Comorbidity is defined as the co-occurrence of two or more disorders in the same person (Matson & Nebel-Schwalm, 2007). Research on comorbidity in autism spectrum disorder (ASD) is a relatively new area in autism research. Little has been studied in terms of predictors of comorbidity. Simonoff, Pickles, Charman, Chandler, Loucas and Baird (2008) examined the risk factors for psychiatric disorders in children with ASD. The presence of epilepsy, past or present was associated with any main psychiatric disorder, and for any behavioral disorder. With regards to contextual characteristics, a relationship was found between family deprivation and any main psychiatric disorders and any behavioral disorder for males only. An association was found between area deprivation and attention deficit/hyperactivity disorder (AD/HD) for the entire sample and for males only. The authors did not find a relationship between IQ and a psychiatric disorder. Simonoff et al. (2008) commented that the absence of associations with putative risk factors may be because the presence of ASD "trumps" other risk factors.

Ming, Brimacombe, Chaaban, Ximmerman-Bier and Wagner (2008) found sleep disorders to be associated with gastrointestinal dysfunction, and with mood disorders. Medical co-occurrence was not a risk factor for psychiatric co-occurrence, and vice versa. The authors found no association between epilepsy and other co-occurrences. Amiet, Gourfinkel-An, Bouzamondo, Tordjman, Baulac, Lechat et al. (2008) conducted a meta-analysis and analysed the risk factors associated with epilepsy in autism. They found that the risk of epilepsy is higher in individuals with autism and an intellectual disability, and the

more severe the intellectual disability, the more prevalent epilepsy is. Amiet et al. (2008) also found that females had a higher risk of epilepsy.

Valicenti-McDermott, McVicar, Cohen, Wershil and Shinnar (2008) investigated the relationship between gastrointestinal (GI) symptoms and language regression in children with ASD. Those with a history of regression had more gastrointestinal symptoms and were more likely to have a family history of an autoimmune disease. No association was found between gastrointestinal symptoms and the use of medication, being toilet trained or a history of food selectivity. There was also no association found between GI symptoms and the Childhood Autism Rating Scale scores. In support, Nikolov, Bearss, Lettinga, Erickson, Rodowski, Aman et al. (2009) found that those with gastrointestinal problems were no different from those without gastrointestinal problems in terms of autism symptom severity. Similarly, Molloy and Manning-Courtney (2003) found that frequency of gastrointestinal symptoms did not vary by age, gender, race or severity of autism. In contrast, Wang, Tancredi and Thomas (2011) found that increased autism severity is associated with increased odds of having GI problems. Nikolov et al. (2009) also found no difference between those with and without GI problems, based on demographic characteristics or measures of adaptive functioning.

Gorrindo, Williams, Lee, Walker, McGrew and Levitt (2012) investigated gastrointestinal symptoms by both clinical evaluation and parental report. They also compared children with GI dysfunction and ASD, children with ASD only and children with GI dysfunction only. Gorrindo et al. (2012) found that more children were non-verbal in the GI dysfunction and ASD group than those with ASD alone. Supporting the evidence of Valicenti-McDermott et al. (2008), there were no significant association between medication usage and GI dysfunction. The authors also found no association between GI dysfunction and diet. The most common gastrointestinal symptom was constipation, and the risk factors were analysed for it. Younger, more socially impaired and non-verbal children with ASD

had increased odds of constipation. Agreement between parental report and physician diagnosis was high, being 92.1% in the ASD and GI dysfunction group, and was no different than that of the GI dysfunction only group.

Mannion, Leader and Healy (2013) reported prevalence data on comorbid disorders in children and adolescents with autism spectrum disorder. In a sample of 89 participants, Mannion et al. (2013) examined the frequency of current comorbid diagnosis, comorbid psychopathology, gastrointestinal symptoms, sleep problems and epilepsy. It was found that 46.1% of children and adolescents with autism spectrum disorder had a comorbid diagnosis. When intellectual disability was included, 78.7% had a comorbid diagnosis. The authors found that 80.9% had a sleep problem. The avoidant behavior and under-eating subscales of the Autism Spectrum Disorder-Comorbid for Children (ASD-CC) and total gastrointestinal symptoms predicted sleep problems. Specifically, abdominal pain predicted sleep anxiety. Avoidant behavior, under-eating and gastrointestinal symptoms predicted parasomnias and daytime sleepiness. While the study looked at the prevalence of a variety of comorbid disorders, predictor variables were only analysed for sleep problems. The majority of children (79.3%) in the study had at least one gastrointestinal symptom and one of the aims of the current study is to examine the predictors of gastrointestinal symptoms. Williams, Fuchs, Furuta, Marcon and Coury (2010) found that children with GI symptoms had lower quality of life scores, when compared to children without GI symptoms. Therefore, this is an area of importance in research. Mannion et al. (2013) found that the prevalence of attention-deficit hyperactivity disorder was 18%, 15.7% of individuals had an anxiety disorder and 10.1% had epilepsy. The current study aims to examine the predictors of these comorbid disorders, as well as the predictors of comorbid psychopathology.

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. 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.

2.2.3. Autism Spectrum Disorder – Comorbid for Children (ASD-CC). The ASD-CC (Matson & Gonzalez, 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 (α= .91) reported (Matson & Dempsey, 2008). Factor analysis yielded seven subscales for the ASD-CC: 1) Tantrum Behavior, 2) Repetitive Behavior, 3) Worry/Depressed, 4) Avoidant Behavior, 5) Under-Eating, 6) Conduct and 7) Over Eating. Construct validity was established for Tantrum Behavior, Worry/Depressed, Repetitive Behavior, Conduct, and Over-Eating factors.

2.2.4. 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 to 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, McGrew, Johnson, Richdale, Clemons & Malow, 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 to 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).

2.3. 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 diagnosis

A logistic regression analysis was conducted to determine predictors of a current comorbid diagnosis including epilepsy, attention deficit/hyperactivity disorder (AD/HD), an anxiety disorder or any other comorbid diagnosis, excluding intellectual disability. The predictor variables were age, gender, presence of an intellectual disability, ASD-CC total score, CSHQ total score and GI symptom inventory total score. A test of the full model with all predictors against a constant only model was statistically reliable, χ^2 (df =6, N=89) =19.47,

p =.003, indicating that the predictor variables reliably predicted those with a comorbid diagnosis. The model correctly classified 69% of individuals. While the model itself was significant, examination of the Wald statistics indicated that none of the individual variables were predictors of comorbid disorders. However, gender (i.e. male) was on the verge of significance (p = .056).

3.2. Intellectual disability, Epilepsy and Attention deficit/hyperactivity disorder (AD/HD)

Three logistic regressions were conducted to determine predictors of an intellectual disability, epilepsy and attention deficit/hyperactivity disorder (AD/HD). The predictor variables for the intellectual disability regression were age, gender, current comorbid disorder, AD/HD, an anxiety disorder, epilepsy, ASD-CC total score, CSHQ total score and GI symptom inventory total score. The predictor variables included for epilepsy were as above, except included presence of an intellectual disability, and excluded epilepsy. The predictor variables included for AD/HD were the same but excluded AD/HD. None of the logistic regressions predicted intellectual disability (p =.83), epilepsy (p =.29) or AD/HD (p = .83).

3.3. Gastrointestinal symptoms

Completed gastrointestinal symptom inventories were missing for two of the participants. An analysis of gastrointestinal symptoms was conducted on the remaining 87 participants. A hierarchical linear regression was conducted to examine if age, gender, comorbid disorders (including intellectual disability), comorbid psychopathology and sleep problems predicted gastrointestinal symptoms in children and adolescents with ASD. Age of participants, gender, presence of intellectual disability, epilepsy, AD/HD, an anxiety disorder and presence of other comorbid disorders were entered as control variables in the first step of

the model. These predictor variables were followed by the subscales of the ASD-CC in the second step. Finally, total score on the CSHQ was added in the third step of the model.

The first block, with age, gender and comorbid disorders as predictors was found to significantly predict sleep problems, $F(7, 86)= 5.53$, $p=.<001$, Adjusted $R^2 =.27$. A diagnosis of AD/HD ($p =.04$) and the presence of a comorbid diagnosis ($p =.01$) were significant, while presence of an intellectual disability ($p =.05$) was on the verge of significance. The first block explained 26.9% of the variance in gastrointestinal symptoms. With the addition of the ASD-CC subscales, it was also found to predict gastrointestinal symptoms, $F (14, 86) = 4.64$, $p =.01$, Adjusted $R^2 =.37$. However none of the individual subscales of the ASD-CC predicted gastrointestinal symptoms. A diagnosis of AD/HD ($p =.07$) and the presence of a comorbid diagnosis ($p =.05$) no longer predicted gastrointestinal symptoms in the second block. The presence of an intellectual disability ($p =.01$) was significant in the second block, and the second model explained 37.2% of the variance in gastrointestinal symptoms. Sleep problems were added in the third block, and this model was significant, $F (15, 86) =4.87$, $p=.03$, Adjusted $R^2 =.40$. As can be seen in Table 1., presence of intellectual disability and total CSHQ score were significant predictors in the final model. A diagnosis of AD/HD ($p =.05$) was on the verge of significance. The entire model explained 40.3% of the variance in gastrointestinal symptoms.

---Insert Table 1 about here---

In order to examine which types of gastrointestinal symptoms these variables predicted, five stepwise regressions were conducted. In the first regression, abdominal pain was entered as the criterion variable, while presence of an intellectual disability and the eight subscales of the CSHQ were added individually. The same predictor variables were added in the remaining multiple regressions, alongside the remaining types of gastrointestinal

symptoms. Intellectual disability and the subscales of the CSHQ did not predict constipation (p=.06), diarrhea (p=.65) or nausea (p=.24). The model predicted abdominal pain, $F(9,86)=3.50$, p =.001, ΔR^2 =.21., and explained 20.8% of the variance in abdominal pain. Sleep anxiety, sleep disordered breathing and daytime sleepiness specifically predicted abdominal pain, as shown in Table 2. The model also predicted bloating, $F(9,86)=2.05$, p=.045, ΔR^2 =.099., and explained 9.9% of the variance in bloating. Sleep disordered breathing and daytime sleepiness predicted bloating.

---Insert Table 2 about here---

3.3.1. Gastrointestinal symptoms and sleep problems

The association between gastrointestinal symptoms and sleep problems was further examined. Sleep problems occurred in 92.3% (n=24) of those with nausea and in 91.1% (n=41) of those with abdominal pain. Sleep problems occurred in 90.9% (n=20) of those with bloating. Sleep problems occurred in 90% (n=36) of those with diarrhea, and in 83.7% (n=36) of those with constipation. The percentage of participants with both sleep and gastrointestinal symptoms are shown in Table 3.

---Insert Table 3 about here---

3.3.2. Gastrointestinal symptoms and intellectual disability

The association between gastrointestinal symptoms and intellectual disability was further examined. Abdominal pain, constipation, diarrhea and bloating occurred most frequently in those with no intellectual disability, followed by moderate intellectual disability, mild intellectual disability and severe intellectual disability. In contrast, nausea occurred most frequently in those with no intellectual disability, followed by mild intellectual disability, moderate intellectual disability and severe intellectual disability.

---Insert Table 4 about here---

3.4. Anxiety disorders

A logistic regression analysis was conducted to determine predictors of an anxiety disorder. The predictor variables were age, gender, presence of intellectual disability, AD/HD, epilepsy, ASD-CC total score, CSHQ total score and GI symptom inventory total score. A test of the full model with all predictors against a constant only model was statistically reliable, χ^2 (df=8, N=89)=30.43, p <.001, indicating that the predictor variables of age, gender, presence of an intellectual disability, ASD-CC total score, CSHQ total score and GI symptom inventory total score reliably predicted those with an anxiety disorder. The model correctly classified 89.7% of individuals. Examination of the Wald statistics indicated that gender (Wald=5.63, p =.02) and ASD-CC total (Wald=5.41, p =.02) significantly predicted an anxiety disorder. Specifically, being male predicted having an anxiety disorder. A further logistic regression was conducted to determine what subscales of the ASD-CC predicted an anxiety disorder. The seven subscales of the ASD-CC were included as predictor variables. The model was significant χ^2 (df =8, N=89) =32.82, p<.001. The model correctly classified 89.9% of individuals. The worry/depressed behavior (Wald=5.05, p=.025) and avoidant behavior (Wald=5.89, p=.015) predicted having an anxiety disorder.

---Insert Table 5 about here---

3.5. ASD-CC

A hierarchical linear regression was conducted to examine if age, gender, comorbid disorders (including intellectual disability), gastrointestinal symptoms and sleep problems predicted total ASD-CC scores in children and adolescents with ASD. Age of participants, gender, presence of intellectual disability, epilepsy, AD/HD, an anxiety disorder and presence

of other comorbid disorders were entered in the first step of the model. These predictor variables were followed by total score on the GI symptom inventory in the second step. Finally, total score on the CSHQ was added in the third step of the model. The first block, with age, gender and comorbid disorders as predictors were found to significantly predict ASD-CC scores, $F(7, 86)= 3.75$, $p=.001$, $\Delta R^2 =.18$. The presence of an anxiety disorder was significant ($p =.02$). The first block explained 18.3% of the variance in comorbid psychopathology. With the addition of GI symptom inventory total score, it was also found to predict comorbid psychopathology, $F(8, 86) =5.38$, $p<.001$, $\Delta R^2 =.29$. Total score on the GI symptom inventory was significant ($p = .001$) in the second block, and the second model explained 28.9% of the variance in comorbid psychopathology. Sleep problems were added in the third block, and this model was significant, $F(9, 86) =5.28$, $p<.001$, $\Delta R^2 =.31$. However, GI symptoms were the only significant predictor of comorbid psychopathology ($p=.005$). The entire model explained 30.9% of the variance in comorbid psychopathology.

---Insert Table 6 about here---

In order to examine which subscales on the ASD-CC that gastrointestinal symptoms predicted, seven stepwise multiple regressions were conducted. In the first multiple regression, tantrum behavior was entered as the criterion variable, while the five types of gastrointestinal symptoms were added individually as predictor variables. The same predictor variables were added in the remaining multiple regressions, alongside the remaining subscales of the ASD-CC. GI symptoms did not predict repetitive behavior ($p=.06$), under-eating ($p=.26$) or over-eating ($p=.07$). GI symptoms predicted tantrum behavior, $F(5,86)=2.37$, $p=.046$, $\Delta R^2 =.074$., and explained 7.4% of the variance in tantrum behavior. Specifically, diarrhea predicted tantrum behavior., as shown in Table 7. GI symptoms also predicted worry/depressed behavior, $F(5,86)=7.23$, $p<.001$, $\Delta R^2 =.266$., and explained 26.6% of the variance in worry/depressed behavior. Specifically, nausea predicted worry/depressed

behavior. GI symptoms predicted avoidant behavior, $F(5,86)=5.14$, $p<.001$, $\Delta R^2 = .194$., and explained 19.4% of the variance in avoidant behavior. Similarly to worry/depressed behavior, nausea predicted avoidant behavior also. GI symptoms also predicted conduct behavior, $F(5,86)=5.88$, $p<.001$, $\Delta R^2 = .221$., and explained 22.1% of the variance in conduct behavior. Abdominal pain, nausea and constipation predicted conduct behavior.

---Insert Table 7 about here---

Although there is no cut-off for the total score on the ASD-CC, there are cut-offs for the seven subscales. They are divided into 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 (Thorson & Matson, 2012). The majority of individuals had no or minimal impairment. However, 27% of individuals showed a moderate impairment in repetitive behavior, 23.6% in tantrum behavior, 21.3% in avoidant behavior, 19.1% in worry/depressed behavior and 16.9% in under-eating behavior. A moderate impairment in over-eating was found in 12.4% of individuals, while 10% of individuals showed a moderate impairment in conduct behavior. A smaller percentage of individuals showed a severe impairment on the subscales of the ASD-CC, with 13.5% displaying a severe impairment in avoidant behavior, 13.5% in conduct behavior, 11.2% in under-eating, 10.1% in tantrum behavior and 9% in over-eating behavior. With regards repetitive behavior, 7.9% of individuals showed a severe impairment in repetitive behavior and 2.2% in worry/depressed behavior.

---Insert Table 8 about here---

A Mann-Whitney *U*-test was carried out to determine if there was a difference between males and females on total ASD-CC score or on the individual subscales. No differences

were found based on gender on total ASD-CC score, U=496.5, p=.52 or on any of the subscales of the ASD-CC. A Mann-Whitney U-test was conducted to investigate if there was a difference between the means of the ASD-CC subscales in the current study, and with the means found in Thorson and Matson (2012). There was no difference found between either study's means of the subscales of the ASD-CC, U=19, p=.48.

4. Discussion

Sleep problems predicted gastrointestinal symptoms. Sleep disordered breathing and daytime sleepiness predicted both abdominal pain and bloating. Horvath, Papadimitriou, Rabsztyn, Drachenberg and Tyson Tildon (1999) commented that unrecognised gastrointestinal symptoms and disorders may contribute to the behavioral problems of non-verbal children with autism, such as sudden irritability, aggressive behavior and night time awakenings. Sleep anxiety predicted abdominal pain. Mannion et al. (2013) found that abdominal pain predicted sleep anxiety. It may be hypothesised that those with anxiety symptoms may display physiological symptoms, such as abdominal pain. Alternatively, it can be hypothesized that the physiological symptom of abdominal pain causes anxiety symptoms in an individual.

The current study examined gastrointestinal symptoms present in the last three months. Both gastrointestinal symptoms and sleep problems occurred in 67.8% of individuals. Williams, Christofi, Clemmons, Rosenberg and Fuchs (2012a) examined chronic gastrointestinal symptoms lasting more than three months and found that 24.5% of children had both chronic gastrointestinal symptoms and sleep problems. Sleep problems occurred more frequently in children with gastrointestinal symptoms (50%) than those without (37%) (Williams et al., 2010). In support of the relationship found in the current study between gastrointestinal symptoms and sleep problems, Williams et al. (2012a) found that each

chronic gastrointestinal symptom was independently associated with increased sleep dysfunction. The relationship between gastrointestinal symptoms and sleep problems needs to be further examined in future research.

Total GI symptoms predicted comorbid psychopathology total score on the ASD-CC. Nausea predicted worry/depressed behavior and avoidant behavior. It may be hypothesized that if an individual is feeling nauseated, they may appear worried/depressed, or may engage in avoidant behavior. The worry/depressed subscale and the avoidant behavior subscale of the ASD-CC form a measure of anxiety (Davis, Moree, Dempsey, Reuther, Fodstad, Hess et al. 2011). Williams, Christofi, Clemmons, Rosenberg and Fuchs (2012b) found that chronic GI symptoms were more common in children with ASD and clinical anxiety than children with ASD and no anxiety. Williams et al. (2010) found that both children aged 1 to 5 years and those aged 6 to 18 years with ASD and GI symptoms had higher anxious/depressed scores, internalizing problems, affective problems and anxiety problems on the Child Behavior Checklist (CBCL). Nikolov et al. (2009) found that when compared to children without gastrointestinal problems, those with gastrointestinal problems showed greater symptom severity on measures of irritability, anxiety and social withdrawal. The relationship between GI symptoms and anxiety is one that needs to be further examined.

Nausea, abdominal pain and constipation individually predicted conduct behavior. Diarrhea predicted tantrum behavior. It may be hypothesised that individuals may engage in more challenging behavior when GI symptoms are present. Williams et al. (2010) found that children and adolescents with ASD and GI symptoms had higher emotionally reactive scores on the Child Behavior Checklist (CBCL). Myers and Plauché Johnson (2007) commented that in some cases of children with ASD, medical factors may cause or exacerbate maladaptive behaviors, and recognition and treatment of medical conditions may eliminate

the need for psychopharmacologic agents. Investigating the relationship between challenging behavior and GI symptoms is an area of future research.

Level of intellectual disability predicted gastrointestinal symptoms. Those with no intellectual disability were more likely to have GI symptoms, followed by moderate intellectual disability (ID), mild ID and then severe ID, in the case of abdominal pain, diarrhea, constipation and bloating. However with regards to nausea, those with no intellectual disability were more likely to experience it, followed by mild ID, moderate ID and severe ID. This is supported by Williams et al. (2012b) who found that chronic GI symptoms were more likely in children with an IQ greater than 70 compared to those with an IQ less than 70. It can be hypothesized that children and adolescents with no intellectual disability may have better communication abilities, and may be better able to articulate their physiological symptoms than children with an intellectual disability. However, if this were the case, one could hypothesize that those with a mild ID would be the next likely to have GI symptoms. Instead we found that those with a moderate ID were more likely to have GI symptoms. The relationship between ID and gastrointestinal symptoms therefore needs to be examined in future research.

Gender and ASD-CC total score predicted an individual having an anxiety disorder diagnosis. Being male predicted having an anxiety disorder. The ASD-CC subscales of worry/depressed behavior and avoidant behavior predicted an individual having an anxiety disorder. This provides validation of the ASD-CC as it measures what it aims to measure. Davis et al. (2011) combined the worry/depressed subscale and avoidant behavior subscale to form a measure of anxiety.

Since gender was a predictor for an individual having a diagnosis of an anxiety disorder, the relationship between comorbid psychopathology and gender was further

examined. There was no difference between males or females on total ASD-CC scores or on any of the subscales of the ASD-CC. Therefore, there is no difference between males and females in tantrum behavior, repetitive behavior, worry/depressed, avoidant behavior, conduct, over-eating or under-eating. This is supported by Worley and Matson (2011) who also found no gender difference in psychiatric symptoms using the ASD-CC. The mean ASD-CC scores found in Thorson and Matson (2012) were compared statistically to the means found in the current study, and there was no difference between the means.

The ASD-CC has cut-off scores for each subscale, which are no/minimal impairment, moderate impairment and severe impairment. The most common moderate impairments were repetitive behavior (27% of individuals), tantrum behavior (23.6%), avoidant behavior (21.3%) and worry/depressed behavior (19.1%). It is not surprising that repetitive behavior is the most common moderate impairment in children and adolescents with ASD, as repetitive behavior is one of the triad of impairments in ASD. McTiernan, Leader, Healy and Mannion (2011) found that 92% of children with ASD displayed stereotyped behavior. Repetitive behavior is a symptom in comorbid psychopathology, such as obsessive compulsive disorder (OCD). Tantrum behavior is the next most common moderate impairment. Ten percent of individuals also displayed moderate conduct behavior. McTiernan et al. (2011) found that 56.3% of children with ASD engaged in aggressive behavior. Avoidant behavior and worry/depressed behavior were also common, a finding which is supported by 15.7% of the sample having an anxiety disorder diagnosis. Moderate impairments in under-eating occurred in 16.9% of individuals and over-eating occurred in 12.4%. Matson, Fodstad and Dempsey (2009) found that children with autism and pervasive developmental disorder-not otherwise specified (PDD-NOS) displayed more eating problems when compared to typically and atypically developing same aged peers.

No predictor variables were found for intellectual disability, epilepsy or attention deficit/hyperactivity disorder (AD/HD). Age, gender, presence of an intellectual disability, ASD-CC total score, CSHQ total score and GI symptom inventory total score as a model predicted an individual having a comorbid diagnosis. However, none of the individual variables predicted a comorbid disorder.

In conclusion, the main finding of the current study is the relationship between gastrointestinal symptoms and comorbid psychopathology, in particular worry/depressed behavior, avoidant behavior, conduct behavior and tantrum behavior. While the author's previous study (Mannion et al., 2013) found a link between sleep problems and gastrointestinal symptoms, the current study examined this relationship further to find that sleep problems predict gastrointestinal symptoms. Gastrointestinal symptoms were predicted by level of intellectual disability, whereby those with no intellectual disability were more likely to present with GI symptoms. It is important for practitioners and researchers to be aware of the prevalence rates of gastrointestinal symptoms in children and adolescents with autism, and also of the link between GI symptoms and comorbid psychopathology. Future research is needed to investigate the relationship between GI symptoms and intellectual disability, language and communication, challenging behavior and comorbid psychopathology.

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Table 1.

Summary of significant predictors of total gastrointestinal symptoms scores.

Variable	*B*	*SE B*	*β*
Intellectual disability	-.76	.29	-.24*
CSHQ total score	.02	.01	.22*

*$p<.05$

Table 2.

Summary of significant predictors of each type of gastrointestinal symptom.

Variable	*B*	*SE B*	*β*
1. Abdominal pain			
Sleep Anxiety (CSHQ)	.07	.03	.47*
Sleep-disordered breathing (CSHQ)	-.09	.04	-.27*
Daytime Sleepiness (CSHQ)	.03	.01	.23*
2. Bloating			
Sleep-disordered breathing (CSHQ)	-.09	.04	-.28*
Daytime Sleepiness (CSHQ)	.03	.01	.29*

*$p<.05$

Table 3.

Frequency and percentage of participants with gastrointestinal symptoms and/or sleep problems.

Variable	Frequency	Percentage
Both Gastrointestinal symptoms and Sleep problem.	59	67.8%
Neither Gastrointestinal symptoms or Sleep problem.	7	8%
Gastrointestinal symptoms only.	10	11.5%
Sleep problem only.	11	12.6%

Table 4.

Level of intellectual disability (ID) with each type of gastrointestinal symptom.

Variable	Frequency	Percentage
1. Abdominal pain		
No ID	25	55.6%
Mild ID	7	15.6%
Moderate ID	12	26.7%
Severe ID	1	2.2%
2. Constipation		
No ID	20	46.5%
Mild ID	9	20.9%
Moderate ID	11	25.6%
Severe ID	3	7%
3. Diarrhea		
No ID	20	50%
Mild ID	7	17.5%
Moderate ID	10	25%
Severe ID	3	7.5%
4. Nausea		
No ID	14	53.8%
Mild ID	6	23.1%

Moderate ID	5	19.2%
Severe ID	1	3.8%

5. Bloating

No ID	11	50%
Mild ID	2	9.1%
Moderate ID	7	31.8%
Severe ID	2	9.1%

Table 5.

Summary of significant predictors of an anxiety disorder.

Predictor Variable	*B*	*Wald*	*95% (CI)*
1. Gender (male)	2.39	5.63	1.52-79.56**
2. ASD-CC total score	.11	5.41	1.02-1.22**
-Worry/Depressed subscale (ASD-CC)	.42	5.05	1.05-2.18**
-Avoidant behavior subscale (ASD-CC)	.48	5.89	1.09-2.24**

*$p<.05$

** $p<.01$

Table 6.

Significant predictor of total ASD-CC scores.

Variable	*B*	*SE B*	*β*
Total GI symptom inventory score.	2.67	.91	.34*

*p<.05

Table 7.

Summary of significant predictors of each subscale of ASD-CC.

Variable	*B*	*SE B*	*β*
1. Tantrum behavior			
Diarrhea	1.93	.91	.23*
2. Worry/Depressed behavior			
Nausea	2.06	.61	.35**
3. Avoidant behavior			
Nausea	2.06	.69	.32**
4. Conduct behavior			
Abdominal pain	1.07	.45	.27*
Nausea	1.27	.46	.29**
Constipation	1.05	.42	.27*

*$p<.05$

** $p<.01$

Table 8.

Frequency, percentage and level of impairment of ASD-CC factor endorsements.

Factor	Level of impairment	Frequency	Percentage
Tantrum behaviors	No/Minimal	59	66.3%
	Moderate	21	23.6%
	Severe	9	10.1%
Repetitive behaviors	No/Minimal	58	65.2%
	Moderate	24	27%
	Severe	7	7.9%
Worry/depressed	No/Minimal	70	78.7%
	Moderate	17	19.1%
	Severe	2	2.2%
Avoidant behaviors	No/Minimal	58	65.2%
	Moderate	19	21.3%
	Severe	12	13.5%
Under-eating	No/Minimal	64	71.9%
	Moderate	15	16.9%

	Severe	10	11.2%
Conduct behaviors	No/Minimal	68	76.4%
	Moderate	9	10.1%
	Severe	12	13.5%
Over-eating	No/Minimal	70	78.7%
	Moderate	11	12.4%
	Severe	8	9%