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Comorbidity in autism spectrum disorder: A literature review.

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Abstract

Comorbidity is defined as the co-occurrence of two or more disorders in the same person (Matson & Nebel-Schwalm, 2007). The current study provides a review of the literature on comorbidity, in relation to comorbid psychiatric and medical disorders in babies and infants, children, adults and across the lifespan. We also examine comorbid conditions such as attention deficit/hyperactivity disorder (AD/HD), epilepsy, gastrointestinal symptoms, sleep problems, feeding problems and toileting problems in individuals with autism spectrum disorder.

Keywords: Comorbidity, Autism Spectrum Disorder, Attention deficit/hyperactivity disorder (AD/HD), Epilepsy, Sleep problems, Gastrointestinal symptoms.

Comorbidity in autism spectrum disorder

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). One of the main difficulties in diagnosing comorbid psychopathology is the lack of diagnostic instruments designed to screen for these disorders in individuals with ASD. Instruments are only recently being developed, piloted and tested for reliability and validity. Instruments designed for assessing comorbid psychopathology in adults with ASD include the Psychopathology in Autism Checklist (PAC) (Helverschou, Bakken & Martinsen, 2009) and the Autism Spectrum Disorders-Comorbidity for Adults (ASD-CA) (Matson, Terlonge & González, 2006).

Instruments designed to screen for comorbid psychopathology in children are a more recent development than the instruments designed for adults. Comorbid disorders often are more difficult to diagnose at a younger age. The Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT), Part II (Matson, Boisjoli & Wilkins, 2007) was developed to screen for comorbid psychopathology in infants aged 16-37 months and has been psychometrically validated (Matson, Fodstad, Mahan & Sevin, 2009). The Autism Spectrum Disorders Comorbidity-Child Version (ASD-CC) (Matson & González, 2007) is another instrument used to diagnose comorbid psychopathology in children. Leyfer, Folstein, Bacalman, Davis, Dinh, Morgan et al., (2006) modified the existing instrument The Kiddie Schedule for Affective Disorders and Schizophrenia for use with children and adolescents with ASD. The modified instrument, the Autism Comorbidity Interview-Present and Lifetime Version (ACI-PL) was used to research prevalence rates of specific disorders.

Comorbid psychiatric and medical conditions

Babies and infants

While there is now a great emphasis on the early diagnosis of ASD and the provision of early intensive behavioral intervention programs, there is a lack of research regarding comorbid conditions in very young children. The Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT), Part II (Matson et al., 2007) is an instrument developed to screen for comorbid psychopathology, and has been used in all of the following studies. Fodstad, Rojahn and Matson (2010) divided participants into the ASD group and atypically developing group. They then divided participants by age groups into 12-18 months, 19-24 months, 25-31 months and 32-39 months. The authors found that those with ASD had more severe comorbid symptoms than atypically developing toddlers. Younger children had fewer problems, and there was an increasing trend as the older age groups displayed the most severe problems across all classes of behaviors.

Kozlowski, Matson, Belva and Rieske (2012) compared feeding and sleeping issues using items on the BISCUIT Part II, in children with Autistic disorder, Pervasive Developmental Disorder-Not otherwise specified (PDD-NOS) and atypically developing children without an ASD. Children with Autistic disorder presented with significantly more feeding and sleeping problems than children with PDD-NOS or atypically developing children. Those with PDD-NOS presented with more feeding and sleeping issues than atypically developing children. When developmental functioning is controlled for, there was a difference between groups in terms of feeding and sleeping issues.

Infants with autistic disorder had higher avoidance and anxiety scores than infants with PDD-NOS or atypically developing infants (Davis, Fodstad, Jenkins, Hess, Moree, Dempsey et al., 2010). Davis, Moree, Dempsey, Hess, Jenkins, Fodstad and Matson (2012) found that as communication scores increased, so did anxiety scores in children with autistic disorder. The authors discussed the importance communication plays in terms of anxiety. Infants and toddlers with ASD need to understand from others what they should be anxious of, and through this lack of understanding, they may be likely to be overly anxious. The authors also commented on the likelihood that children with lower communication ability may be unable to accurately communicate any anxiety experienced, thus appearing that they experience lower levels of anxiety overall. Additionally, females were found to have significantly higher communication scores.

Matson and Tureck (2012) conducted a literature review about the current status of BISCUIT-Parts 1, 2 and 3. While Part 2 is used to determine comorbid psychopathology, Part 1 is used as a diagnostic tool for ASD, and Part 3 is a measure of challenging behavior. The article gives an overview of all the research conducted using the BISCUIT as well as research that is currently underway, such as a 15 nation study using the BISCUIT.

---Insert Table 1 about here---

Children

Investigation of co-occurrences of medical and psychiatric conditions, such as sleep disorders, epilepsy, food intolerance, gastrointestinal dysfunction, mood disorder, aggressive and self-injurious behaviors were examined in a study (Ming, Brimacombe, Chaaban, Ximmerman-Bier & Wagner, 2008). Sleep disorders were found to be associated with gastrointestinal dysfunction and with mood disorders (Ming et al., 2008). No association was found between epilepsy and any of the co-occurring conditions. Individuals with a pervasive developmental disorder (PDD) diagnosis were more likely to have a medical disorder, while participants with Asperger syndrome were more likely to have psychiatric comorbidities (Ming et al., 2008).

Hess, Matson and Dixon (2010) used the Autism Spectrum Disorder Comorbidity-Child Version (ASD-CC) (Matson & González, 2007) to compare symptoms in children and adolescents with and without autism spectrum disorder. Differences lay between children and adolescents with autism spectrum disorder and typically developing children in symptoms of worry/depressed behavior, under-eating, avoidant behavior and repetitive behavior. There was no significant difference between the two groups in conduct and tantrum behaviors. Matson, Fodstad & Dempsey (2009) used the under and over eating subscale of the ASD-CC to investigate feeding difficulties among four groups; autism, pervasive developmental disorder-not otherwise specified (PDD-NOS), atypically developing children and typically developing children. Individuals with autism and PDD-NOS had higher rates of feeding difficulties than typically or atypically developing children.

Davis, Moree, Dempsey, Reuther, Fodstad, Hess et al. (2011) compared anxiety symptoms and communication scores among children with autistic disorder (AD), Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS) and those with no diagnosis. Anxiety decreased as communication deficits increased for those with AD compared to those with PDD-NOS or no diagnosis. In contrast, anxiety increased as communication deficits increased, compared to those with no diagnosis. The authors interpreted the findings of lower anxiety scores as communication deficits increased in AD in two ways. Firstly, those with AS may reflect a severe presentation overall across areas of functioning and a decreased ability to be anxious. Secondly, increased communication deficits may impair children from being able to express symptoms of anxiety, as they are currently defined in the ASD-CC.

Mannion, Leader and Healy (2013) also used the ASD-CC to investigate comorbid psychopathology in children and adolescents with ASD. The mean ASD-CC subscale scores were all no/minimal impairment. Mannion et al. (2013) found that 46.1% of children and adolescents had a comorbid disorder. When intellectual disability was included, this number rose to 78.7%. It was found that 15.7% of individuals presented with an anxiety disorder.

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The ASD-CC subscales of avoidant behavior and under-eating were found to be significant predictors of sleep problems in those with ASD.

Joshi, Petty, Wozniak, Henin, Fried, Galdo et al. (2010) used the Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS-E) (Orvaschel, 1994; Orvaschel and Puig-Antch, 1987). Compared to an age-matched and sex-matched control group, youth with ASD suffered from a significantly higher number of comorbid conditions than youth without ASD. Ninety five percent of those with ASD had three or more comorbid psychiatric diagnoses, while 74% had five or more comorbid disorders. Those with ASD had more anxiety disorders, including specific phobia and agoraphobia, than controls. Those without ASD were more likely to have substance use disorders than those with ASD. Leyfer et al., (2006) modified the K-SADS-E to create the Autism Comorbidity Interview-Present and Lifetime Version (ACI-PL).

Leyfer et al., (2006) found specific phobia to be the most common comorbid diagnosis among children with ASD, followed by obsessive compulsive disorder (OCD). While 37% of children with autism had a diagnosis of OCD in Leyfer et al.'s study, only 8% of children had a diagnosis in Simonoff, Pickles, Charman, Chandler, Loucas and Baird's (2008) study. Simonoff et al. (2008) used the Child and Adolescent Psychiatric Assessment, and found social anxiety disorder to be the most common, followed by attention deficit/hyperactivity disorder (AD/HD), and oppositional defiant disorder (ODD). They also found that 70% of children had at least one comorbid disorder and 41% had two or more. The presence of epilepsy was a risk factor for a psychiatric disorder.

Strang, Kenworthy, Daniolos, Case, Wills, Martin et al. (2012) used the Child Behavior Checklist to examine anxiety and depression symptoms in children with ASD. Fifty-six percent of individuals were in the clinical range of anxiety symptoms, while 24% 7

were in the borderline range for depression. In contrast to previous research, higher IQ or fewer ASD symptoms did not predict anxiety and depression symptoms in ASD. In support, Amr, Raddad, El-Mehesh, Bakr, Sallam and Amin (2012) found that children with comorbid psychiatric disorders had significantly lower IQ than those without comorbid psychiatric disorders. Sixty-three percent of children were diagnosed with at least one comorbid psychiatric disorder, which is supported by previous literature (Simonoff et al., 2008).

---Insert Table 2. about here---

Adults

While a number of studies have used structured clinical interviews to diagnose psychiatric disorders in adults with ASD (Lugnegard, Unenge Hallerback & Gillberg, 2011; McCarthy, Hemmings, Kravariti, Dworynksi, Holt, Bouras et al., 2010; Hofvander, Delorme, Chaste, Nydén, Wentz, Ståhlberg et al., 2009), others used measures especially designed for ASD (e.g. the Psychopathology in Autism Checklist, PAC; Helverschou et al., 2009; Autism Spectrum Disorders-Comorbidity for Adults, ASD-CA; Matson et al., 2006), and intellectual disability (e.g. Diagnostic Assessment for the Severely Handicapped-revised, DASH-II; Matson, 1995a).

The Autism Spectrum Disorders-Comorbidity for Adults (ASD-CA) (Matson et al., 2006) is a 37 item scale, which includes five subscales: Anxiety/repetitive behaviors; Conduct problems; Irritability/ Behavioral excesses; Attention/Hyperactivity/Impulsivity and Depressive symptoms. The scale's reliability was established by Matson & Boisjoli (2008). LoVullo & Matson (2009) developed cut-off scores for the subscales of the ASD-CA. They compared the frequency of symptoms across three groups; individuals with intellectual disability (ID), individuals with ID and ASD, and individuals with ID, ASD and additional psychopathology. The ID and ASD group scored significantly higher than the ID group on most subscales, except for conduct problems. It was suspected that individuals with ID, ASD and additional psychopathology would score highest, however this was not the case. The authors suggested that this may be due to the differences between the groups in terms of usage of psychotropic medication. Over 71% of the ID, ASD and additional psychopathology group were on psychotropic medication, compared to 15.8% of those in the ID and ASD group. The authors commented on the overall suppressive effect on behavior that psychotropic medication can have (LoVullo & Matson, 2009).

The Psychopathology in Autism Checklist (PAC) (Helverschou et al., 2009) is a 42 item scale, with five subscales; Psychosis, Depression; Anxiety disorders; Obsessive Compulsive Disorder (OCD) and General Adjustment Problems. Helverschou et al. (2009) piloted the scale, tested its reliability and found acceptable psychometric properties. It was found that the scale discriminated between adults with autism and ID with and without psychiatric disorders, and partially between individuals diagnosed with different psychiatric disorders.

Bakken, Helverschou, Eilertsen, Heggelund, Myrbakk and Martinsen, (2010) used the PAC to assess the prevalence of psychiatric disorders in individuals with intellectual disability only and those with a combination of ID and autism. Over fifty-three percent of those with autism and ID combined had high psychiatric disorders scores and severe general adjustment problems, compared to 17.4% of the ID only group. Anxiety symptoms were present in 64% of those who had a psychiatric disorder and autism and ID, compared to 52% in those who had a psychiatric disorder and ID. The majority of individuals in both groups had more than one psychiatric disorder.

Bradley, Summers, Wood and Bryson (2004) used the Diagnostic Assessment for the Severely Handicapped-revised (DASH-II) (Matson, 1995a), and compared individuals with severe intellectual disability with and without ASD. Individuals with ASD showed four times more psychiatric comorbidity than those without ASD. Those with ASD showed significantly more anxiety, mood disorders, sleep disorders and organic syndromes than those without ASD. La Malfa, Lassi, Salvini, Giganti, Bertelli and Albertini (2007) also used the DASH-II (Matson, 1995). Participants were compared in terms of whether screened positive for a Pervasive developmental disorders (PDD) or not, and if they were in the 'clinical significance' or 'no clinical diagnosis' groups, based on their scores on the DASH-II. PDD was correlated with an increased presence of psychiatric disorders. A relationship was also observed between PDD and mood, mania and depression.

Hermans, van der Pas and Evenhuis (2011) conducted a literature review of instruments assessing anxiety in adults with intellectual disability. Self-report measures, informant-report measures and diagnostic instruments were reviewed. The most promising self-report instrument was the Glasgow Anxiety Scale for people with an Intellectual Disability (GAS-ID) (Mindham & Espie, 2003), while the Anxiety, Depression and Mood Scale (ADAMS) (Methot & Morin, 2004) is the most promising informant-report measure. Hermans et al. (2011) included the PAC in their review, and found the pilot study to be of good methodological quality, while the anxiety subscale of the PAC had moderate reliability but did not differentiate between different psychiatric diagnoses.

A number of studies used structured clinical interviews. Lugnegard et al., (2011) examined psychiatric comorbidity in individuals with Asperger syndrome, and found that 70% of individuals had at least one episode of major depression, while 50% had suffered from recurrent depressive disorders. Fifty six percent of individuals had an anxiety disorder. Hofvander et al. (2009) compared the frequency of psychiatric disorders among three groups; individuals with Autistic disorder, those with Asperger syndrome and those with pervasive developmental disorder-not otherwise specified (PDD-NOS). Forty-three percent of individuals were diagnosed with attention deficit/hyperactivity disorder (AD/HD). Fourteen percent had a diagnosis of dyslexia. The most common comorbid condition was mood disorder, with 53% of individuals having a diagnosis, followed by anxiety disorder, whereby 50% had a diagnosis. One third of individuals had been treated with an antidepressant at least once in their lives. The frequency of comorbid diagnoses did not differ between the ASD subgroups or between males and females.

McCarthy et al. (2010) used interviews also, but they additionally examined the association between challenging behavior and comorbid psychopathology. They compared those with ID and ASD, and those with ID only. There were significant differences in comorbid psychopathology between those with and without ASD. Those with ASD and challenging behavior were not more likely to receive a psychiatric diagnosis than those with ASD without challenging behavior. However, those with ASD and challenging behavior were less likely to receive a diagnosis of schizophrenia. The authors suggested that the presence of challenging behavior in an individual with ASD may make the diagnosis of psychotic symptoms more difficult. There was no association between challenging behavior when age, level of ID and gender was controlled for. A diagnosis of ASD predicted challenging behavior, but a diagnosis of a psychiatric disorder did not.

Morgan, Roy and Chance (2003) collected data using medical records and psychiatric case notes. Thirty-five percent of those with autism had another comorbid psychiatric condition. The most common psychiatric diagnosis was depression, whereby 20% had a diagnosis. Eleven percent of individuals with ASD had a diagnosis of bipolar affective disorder, while 5% had a diagnosis of schizophrenia. Thirty four percent of individuals had a diagnosis of epilepsy, while 6% had a diagnosis of hypothyroidism. Similar to LoVullo and Matson (2009), a high percentage (50%) of individuals were on at least one psychotropic

medication. Forty percent of those on neuroleptics did not have an additional psychiatric diagnosis.

Munesue, Ono, Mutoh, Shimoda, Nakatani and Kikuchi (2008) assessed individuals with ASD for mood disorders in an outpatient clinic. Thirty-six percent of individuals were diagnosed with mood disorder. In those with mood disorders, bipolar disorder accounted for 75% of the cases. None of the individuals with autistic disorder had mood disorders. The majority (75%) of those with mood disorders had a diagnosis of Asperger syndrome.

Lifespan

Davis, Hess, Moree, Fodstad, Dempsey, Jenkins and Matson (2011) examined the developmental trajectory of anxiety symptoms across the lifespan in individuals with ASD. The study examined anxiety in toddlers, children, young adults and older adults, using three different measures; the BISCUIT Part 2 (Matson et al., 2007), ASD-CC (Matson & González, 2007), and the ASD-CA (Matson et al., 2006). Anxiety rose from toddler-hood, peaked in childhood, decreased through young adulthood and began to rise again in older aged individuals. Future research should examine how other comorbid symptoms change throughout the lifespan.

---Insert Table 3 about here---

Attention deficit/hyperactivity disorder (AD/HD)

The prevalence of Attention-deficit/hyperactivity disorder (AD/HD) in those with ASD has ranged from 14-78% (Gargaro, Rinehart, Bradshaw, Tonge & Sheppard, 2011). In a recent study, Mannion et al. (2013) found that 18% of children and adolescents with autism spectrum disorder also had a comorbid diagnosis of AD/HD. Mannion et al. (2013) also examined predictors of sleep problems and found that AD/HD was not a significant predictor of sleep problems in children and adolescents with autism spectrum disorder. In their

literature review, Gargaro et al. (2011) provided evidence of the current status of neuroimaging research in autism and ASD. The authors also focused on the theoretical models and neuropsychology of the two disorders as well as treatment strategies. They commented on the importance of considering the social outcome of treatment, as children with autism and AD/HD comorbidity are at increased risk of bullying when compared to children with either autism or AD/HD alone (Montes & Halterman, 2007; Gargaro et al., 2011).

As afore mentioned, Simonoff et al. (2008) found AD/HD to be the second most common comorbid condition in their sample. Keen and Ward (2004) compared the prevalence of ASD and comorbidity in 1997 and 2001. In that time, there was a significant increase in the number of children with ASD AD/HD, from 5.2% to 13.7% (Keen & Ward, 2004). Skokauskas and Gallagher (2012) compared children with ASD to those without. The authors found that almost half (44.78%) of the ASD group met criteria for clinically significant attention deficit/hyperactivity disorder. Borderline clinically significant difficulties were found for the AD/HD subscale for 47% of children with ASD (Skokauskas & Gallagher, 2012).

Goldstein and Schwebach (2004) conducted a retrospective chart review study on children with a diagnosis of either pervasive developmental disorders (PDDs) or AD/HD. It was found that 26% of those with PDDs met DSM-IV criteria for the combined type of AD/HD, while 33% met criteria for the Inattentive type of AD/HD. Forty-one percent of those with PDDs did not have a comorbid diagnosis of AD/HD. Those with PDDs and the combined type of AD/HD did not significantly demonstrate more impairment in daily life functioning than those with a PDD only. However, these children with a comorbid diagnosis were rated by parents and teachers as experiencing more daily living difficulties than those with a PDD alone. Mayes, Calhoun, Mayes and Molitoris (2012) conducted a study to determine what symptoms overlap in ASD and AD/HD and what symptoms are distinct. Mayes et al. (2012) compared children with high functioning autism, low functioning autism, AD/HD combined type and AD/HD inattentive type. The authors also compared the scores to typically developing children whose results had been used in a previous study. The study found that while autism is distinct from AD/HD but the core symptoms of attention deficit, hyperactivity and impulsivity are part of autism. The authors state that autism and AD/HD are "neurobiological disorders with similar underlying neuropsychological deficits" (p.283).

Sinzig, Morsch, Bruning, Schmidt and Lehmkuhl (2008) compared children with ASD and comorbid AD/HD symptoms to children with ASD, but without AD/HD symptoms, and to children with AD/HD and typically developing children. They exhibited executive functioning skills such as inhibition, flexibility, working memory and planning. Children with comorbid AD/HD symptoms showed more problems in inhibitory performance when compared to children with ASD alone. The ASD and comorbid AD/HD group showed similarities to the AD/HD only group with regard to inhibitory performance, but not in working memory deficits. The study also found that individuals with ASD and comorbid AD/HD have more of a speed problem than a comprehension problem in planning, working memory of flexibility tasks.

Nydén, Niklasson, Stahlberg, Anckarsater, Wentz, Rastam and Gillberg (2010) compared adults with ASD to those with AD/HD and those with ASD and comorbid AD/HD. The authors compared groups in terms of intellectual ability, learning and memory, attention/executive function and theory of mind function. As supported by Mayes et al. (2012), there appeared to be an overlap between the three diagnostic categories. There is also distinction between the three groups, as the neurocognitive problems experienced by the ASD and comorbid AD/HD group were not just a summary of the ASD and AD/HD groups. The authors commented that children with neuropsychiatric developmental disorders should be reexamined as adults as 'criteria for diagnosis may not be fulfilled and the neurocognitive functions may have changed over time' (p.1667).

---Insert Table 4 about here---

Epilepsy

The prevalence of epilepsy among all children is estimated at 2-3% compared to some 30% in autism (Tuchman & Rapin, 2002). Variability in prevalence rates has been attributed to the heterogeneity of samples with respect to age, sex, comorbidity, subtype of pervasive developmental disorder (PDD) or intellectual disability (ID) (Amiet, Gourfinkel-An, Bouzamondo, Tordjman, Baulac, Lechat, et al., 2008). In a retrospective review of electroencephalography (EEG) data and review of medical record charts, 40% of children referred were diagnosed with epilepsy (Gabis, Pomeroy & Andriola, 2005). However, this is not surprising as epilepsy symptoms were present in many of the children, where half presented with convulsions. Mannion et al. (2013) found that 10.1% of children and adolescents with ASD had a comorbid diagnosis of epilepsy. The authors found that epilepsy was not a significant predictor of sleep problems in those with ASD.

Amiet et al. (2008) conducted a meta-analysis of epilepsy in autism. The authors investigated the relationships between epilepsy and intellectual disability (ID), and epilepsy and gender in individuals with autism. It was found that 21.4% of individuals with an intellectual disability had epilepsy, while 8% of those without an intellectual disability had epilepsy. Epilepsy in autism was found to be associated with intellectual disability. The authors found that the more severe the intellectual disability, the more prevalent epilepsy was. The risk for epilepsy was found to be significantly higher for females (Amiet et al., 2008).

Bolton, Carcani-Rathwell, Hutton, Goode, Howlin and Rutter (2011) followed up 150 participants that were diagnosed with ASD in childhood, when they were 21 years of age. They found that 22% of individuals with ASD had epilepsy. More than half of those with epilepsy had seizures occurring weekly or less frequently. The average age of onset of confirmed epilepsy was 13.3 years, and for the majority of participants, seizures first began after the age of 10 years. In support of Amiet et al. (2008), Bolton et al. (2011) found that females were significantly more likely to develop epilepsy, where 30% of female participants developed epilepsy, compared to 18% of male participants. Males had a higher age of onset of seizures than females, and they did not differ in their level of intellectual disability or verbal abilities. Epilepsy was significantly more common in those with a lower overall language ability, where 45% of those with epilepsy had a very limited language ability, compared to 25% of those without epilepsy.

Turk, Bax, Williams, Amin, Eriksson and Gillberg (2009) compared children with ASD who had epilepsy, with those who did not have a diagnosis of epilepsy. A diagnosis of ASD and epilepsy was found to be associated with a later age at diagnosis of autism. The authors suggest that either ASD develops later or diagnostic overshadowing occurred. Having ASD and epilepsy was found to be associated with greater numbers and severities of gross and fine motor problems, incontinence, social impairments and challenging behaviors. Those with ASD and epilepsy showed delayed daily living skills. Those with ASD and epilepsy engaged in staring behavior, where they were found to stare longer and harder than those with ASD only. The ASD only group displayed more brief glances as a means of eye contact and experienced more abnormal fascination with objects than the ASD and epilepsy group.

Seizures are more frequent when intellectual disability is associated with ASD and when neurological signs are evident (Canitano, 2007). Individuals with autism and additional

neurological impairment, such as cerebral palsy are at a higher risk for seizures (Steffenburg, Steffenburg & Gillberg, 2003). A much lower rate of epilepsy, of approximately 6% has been reported in children with autism without additional neurological disorders (Pavone, Incorpora, Fiumara, Parano, Trifiletti, & Ruggieri, 2004). Tuchman, Rapin and Shinnar (1991) also found that type of language dysfunction was a risk factor for seizures, with the highest percentage of seizures occurring in children with the most severe deficits in receptive language. De-Long and Heinz (1997) and Rapin, Mattis, Rowan and Golden (1977) hypothesised that the association of severe receptive language disorders with epilepsy and with autism implicates temporal-lobe dysfunction (Tuchman & Rapin, 2002).

Matson, Neal, Hess, Mahan and Fodstad (2010) investigated adaptive behavior, personal-social behavior, communication, motor and cognitive skills in toddlers who were atypically developing compared to those with ASD, and also compared those with and without seizures. Toddlers with seizure disorders exhibited greater impairments across all domains of functioning when compared to those without seizure disorders. While there was not a significant interaction found between diagnostic group, the general trend showed that those with ASD and seizures exhibited the greatest impairments, followed by those with ASD alone, atypically developing children without seizures and finally, atypically developing children without seizures.

As with many other comorbid disorders, there is a lack of research in the area of adults with autism and comorbid epilepsy. Smith and Matson (2010a, 2010b, 2010c) focused on adults with epilepsy and the relationships between epilepsy, challenging behavior, comorbid psychopathology and social skills in three papers. In all three papers, the authors compared four groups: 1) Intellectual disability, 2) Epilepsy, 3) ASD and 4) ASD and epilepsy combined. The first, Smith and Matson (2010a) investigated challenging behavior. It was found that those with comorbid ASD and epilepsy were more impaired than the other groups. Specifically, those with epilepsy and ID showed significantly higher disruptive behavior scores than those with ID only group, ASD only group and epilepsy only group.

The second, Smith and Matson (2010b) investigated comorbid psychopathology, Smith and Matson (2010b) compared ASD-CA scores among four groups; those with ID alone, those with epilepsy alone, those with ASD alone and those with ASD and epilepsy combined. Those with ASD and a comorbid condition (e.g. epilepsy) were more impaired in terms of psychopathology than those with ID, epilepsy or ASD on its own. The ASD and epilepsy group showed higher scores on irritability/behavioral excesses, attention/hyperactivity and depressive symptoms than the ID alone group. Those with combined ASD and epilepsy scored higher on the anxiety/repetitive behavior subscale and on the attention/hyperactivity subscale than those with epilepsy alone.

The third, Smith and Matson (2010c) investigated social skills deficits. Individuals with ID and comorbid ASD and epilepsy were significantly more impaired in social skills than those with ID alone, or those with ASD or epilepsy. Having multiple disorders increased the odds of having diminished social skills. For the positive verbal subscale of the Matson Evaluation of Social Skills for Individuals with sEvere Retardation (MESSIER; Matson, 1995b) individuals with ASD and epilepsy combined were more impaired but epilepsy contributed more to the effect than ASD alone.

Matson and Neal (2009) conducted a literature review about seizures and epilepsy in ASD. The authors examined the prevalence, nosology and etiology. They also looked at the relationship between seizures and epilepsy and regression in ASD. The authors noted that much of the research on regression and epilepsy is correlational and that a causal link between the two has yet to be established. They also commented on the need for clinicians to

be aware of the high co-occurrence between seizures and ASD during assessment and intervention.

---Insert Table 5 about here---

Gastrointestinal symptoms

The published literature is inconsistent regarding the prevalence of gastrointestinal problems in individuals with ASD (Wang, Tancredi & Thomas, 2011). The reported prevalence of gastrointestinal problems in children with ASD has ranged from 9% to 91% (Coury, Ashwood, Fasano, Fuchs, Geraghty, Kaul et al., 2012; Ming, Brimacombe, Chaaban, Ximmerman-Bier & Wagner, 2008; Black, Kaye & Jick, 2002; Fombonne & Chakrabarti, 2001; Ibrahim, Voigt, Katusic, Weaver & Barbaresi, 2009; Molloy & Manning-Courtney, 2003; Mouridsen, Rich & Isager, 2010; Nikolov, Bearss, Lettinga, Erickson, Rodowski, Aman et al., 2009; Taylor, Miller, Lingam, Andrews, Simmons & Stowe, 2002; Valicenti-McDermott et al., 2008; Horvath & Perman, 2002; Wang, Tancredi & Thomas, 2011; Parracho, Bingham, Gibson & McCartney, 2005; Smith, Farnworth, Wright & Allgar, 2009). It has been questioned if gastrointestinal symptoms are more common in those with autism spectrum disorder than in the general population. Kuddo & Nelson (2003) commented on the lack of research using appropriate controls in their review.

Ibrahim et al., (2009) compared children with autism and gastrointestinal symptoms to matched control participants. No significant association found between autism and gastrointestinal symptoms. However, significant differences were found between those with autism and control participants in relation to constipation and feeding issues/ food selectivity. Children with autism had a higher incidence of constipation and feeding issues. The authors suggested that these issues may have a behavioral etiology. Insistence on sameness in children with autism may lead them to demand stereotyped diets, which may result in an adequate intake of fibre, which in turn can lead to constipation (Ibrahim et al., 2009). Use of psychotropic medication may also lead to feeding issues, as side-effects of medications may include appetite suppression or increased appetite (Ibrahim et al., 2009).

Black et al. (2002) found that only 9% of children with autism had gastrointestinal symptoms prior to diagnosis, similar to controls. Wang et al. (2011) compared gastrointestinal symptoms in children with autism to their typically developing siblings. It was found that there were significantly more gastrointestinal symptoms in children with ASD (42%) compared to their typically developing siblings (12%). The two most common gastrointestinal problems in children with ASD were constipation and chronic diarrhea. The researchers divided autism severity into three groups; Full Autism, Almost Autism and Spectrum. Increased autism symptom severity was associated with higher odds of gastrointestinal problems (Wang et al., 2011). In contrast, Molloy & Manning-Courtney (2003) found that frequency of gastrointestinal symptoms did not vary by age, gender, race or severity of autism. In support of this, Nikolov et al. (2009) also found that those with gastrointestinal problems were no different from those without gastrointestinal problems in autism symptom severity, demographic characteristics or measures of adaptive functioning. 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. With regards to irritability, those with current gastrointestinal symptoms had lower irritability scores than those with a history of gastrointestinal symptoms.

Similar to the lack of instruments available for measuring comorbid psychopathology in individuals with ASD, there is an absence of instruments to measure gastrointestinal symptoms in those with ASD. Molloy and Manning-Courtney (2003) used medical record reviews to determine if participants in their study had gastrointestinal symptoms. Nikolov et al. (2009) similarly reviewed medical records, as well as using a Side Effects Review Form (Research Units of Pediatric Psychopharmacology, RUPP). Valicenti-McDermott et al. (2008) derived The Gastrointestinal Questionnaire from an existing questionnaire, designed for typically developing children. The Autism Treatment Network developed the the Gastrointestinal Symptom Inventory (Autism Treatment Network, 2005), which is a parental-report questionnaire.

Mazurek, Vasa, Kalb, Kanne, Rosenberg, Keefer et al. (2013) used the Gastrointestinal Symptom Inventory (Autism Treatment Network, 2005) to study the relationships between chronic GI symptoms, anxiety and sensory over-responsivity. There was a strong association between anxiety and sensory over-responsivity, with higher levels of anxiety among children who have greater levels of reactivity to various sensory stimuli. Children with chronic GI symptoms evidenced higher levels of both anxiety and sensory over-responsivity. Increasing numbers of chronic GI symptoms were associated with higher levels of anxiety and sensory over-responsivity.

Mannion et al. (2013) also used the Gastrointestinal Symptom Inventory (Autism Treatment Network, 2005) to determine the frequency of GI symptoms in children and adolescents with ASD. The authors found that 79.3% of individuals had at least one gastrointestinal symptom within the last 3 months. The most common gastrointestinal symptom was abdominal pain, where 51.7% of individuals presented with it, followed by constipation where 49.4% presented with the symptom. Total number of GI symptoms was found to be a significant predictor of sleep problems. Specifically, abdominal pain predicted sleep anxiety.

The Questionnaire on Pediatric Gastrointestinal Symptoms-Rome III Version (QPGS-RIII) is an adaptation and abbreviation of the Questionnaire on Pediatric Gastrointestinal Symptoms (QPGS) (Walker, Caplan-Dover & Rasquin-Weber, 2000). The 71 item parentalreport questionnaire assesses symptom criteria for pediatric functional gastrointestinal disorders and additional gastrointestinal symptoms. Gorrindo, Williams, Lee, Walker, McGrew and Levitt (2012) used the QPGS-RIII as well as clinical evaluations by pediatric gastroenterologists. Agreement between parental-report gastrointestinal symptoms and physician diagnosis was high (92.1%). The study divided participants into three groups; those with ASD and gastrointestinal symptoms, those with ASD and no gastrointestinal symptoms and those with gastrointestinal symptoms only. Gastrointestinal symptoms in ASD were not associated with diet or medication usage. Constipation was the most common gastrointestinal symptom, with 85% of those with ASD and gastrointestinal symptoms presenting with it. Odds of constipation were associated with younger age, increased social impairment and lack of expressive language.

Valicenti-McDermott et al. (2008) investigated the relationship between gastrointestinal symptoms and language regression. It was found that 68% of children with ASD were reported to have one or more lifetime gastrointestinal symptoms. Children with language regression had more gastrointestinal problems (84%) than those without language regression (61%). An association was observed between children with language regression, a family history of autoimmune disease and gastrointestinal symptoms. Molloy & Manning-Courtney (2003) found that a history of regression was present in 23.4% of children with ASD. In contrast to Valicenti-McDermott et al. (2008), Molloy & Manning-Courtney (2003) found that regression was not significantly associated with gastrointestinal symptoms. Hansen, Ozonoff, Krakowiak, Angkustsiri, Jones, Deprey et al. (2008) used two definitions of regression: 1) loss of both language and social skills, and 2) loss of either language or social skills. No significant differences were found between the children with or without regression in terms of gastrointestinal symptoms, history of seizures or sleep problems.

Buie, Fuchs III, Furuta, Kooros, Levy, Lewis, Wershil and Winter (2010b) published an article which provides guidelines for evaluation and treatment of common gastrointestinal problems for health care practitioners. As many practitioners may not be aware of the high co-occurrence of GI symptoms in those with ASD, this is an extremely important article for health care practitioners. Buie, Campbell, Fuchs III, Furuta, Levy, VandeWater et al, (2010a) conducted a literature review of gastrointestinal symptoms in ASD, and provided a list of consensus statements, including a key statement: 'Individuals with ASDs who present with gastrointestinal symptoms warrant a thorough evaluation, as would be undertaken for individuals without ASDs who have the same symptoms and signs'. The authors also included a table of vocal and motor behaviors and changes in overall state. Vocal and motor behaviors that may be markers of abdominal pain or discomfort in individuals with ASD include behaviors like frequent clearing of throat and facial grimacing. Changes in overall state may include sleep disturbances, increased irritability and non-compliance with demands. The authors recommend that a functional behavior assessment would be useful in interpreting these behaviors. The article also includes a concise table of key take-away messages. One of the messages is that the communication impairments characteristic of ASD may lead to unusual presentations of gastrointestinal disorders including sleep disturbances and problem behaviors.

---Insert Table 6 about here---

Sleep problems

Johnson (1996) reported that 34% to 80% of children with an intellectual disability (ID) have a sleep problem (Richdale, Francis, Gavidia-Payne & Cotton, 2000). Rzepecka, McKenzie, McClure and Murphy (2011) found that 77.2% of children with ASD had sleep problems. They investigated the relationship between sleep problems, anxiety and challenging behavior. Medication usage, sleep problems and anxiety accounted for 42% of the variance in challenging behavior, with sleep problems being the strongest predictor. It can also be noted that children on medication scored higher on sleep problems, anxiety and challenging behavior.

Mannion et al. (2013) found that 80.9% of children and adolescents with ASD presented with sleep problems. The study also investigated predictors of sleep problems. Total number of gastrointestinal symptoms predicted sleep, as did the ASD-CC subscales of under-eating and avoidant behavior. The types of sleep problems predicted by these variables were sleep anxiety, parasomnias and daytime sleepiness. Specifically, abdominal pain predicted sleep anxiety.

Many studies have investigated the relationship between sleep and problem behavior. Goldman, McGrew, Johnson, Richdale, Clemons and Malow (2011) compared children with ASD who were good sleepers to poor sleepers. It was found that poor sleepers had a higher percentage of behavioral problems than good sleepers. Over 75% of poor sleepers had problems with attention span and social interactions. Poor sleepers displayed more stereotypy, hyperactivity and anxiety, as well as having more sensory and eating issues. A poor sleeper had a high risk of exhibiting self-injurious behavior, even when age was adjusted for. A poor sleeper had a 20.4% higher likelihood of self-injurious behavior than a good sleeper. Younger children who were poor sleepers were more likely to have language problems, aggression, hyperactivity and poor eating habits than older poor sleepers.

Mayes and Calhoun (2009) found that sleep problems were not related to age, IQ, gender, race, parent occupation, neuropsychological functioning and learning ability. Sleep problems increased with severity of autistic symptoms and with severity of parent reported symptoms, such as oppositional behavior, aggression, explosiveness, attention deficit, impulsivity, hyperactivity, anxiety, depression and mood variability. Autism severity was the single most powerful predictor of sleep problems and explained 20% of the variance. The

most powerful combined predictors of sleep disturbances were autism severity, hyperactivity, mood variability and aggression, explaining 31% of the variance.

Children in the pervasive developmental disorders (PDDs) group are more likely to fall asleep later at night, have longer sleep latencies, sleep less at night, and spend a significant period of time awake during the night, when compared to controls (Patzold, Richdale & Tonge, 1998). Children in the PDD group displayed significantly more energetic and more difficult daytime behavior, compared to a control group (Patzold et al., 1998). Richdale et al. (2000) used a control group in their study of children with intellectual disability (ID), where 13% of those with an ID had a diagnosis of autism also. Sleep problems were associated with both the intensity and frequency of family stress, and the presence of problem behavior (Richdale et al., 2000). Children with intellectual disability and severe sleep problems showed more severe levels of daytime problem behavior, such as aggression, non-compliance and hyperactivity (Didden, Korzilius, van Aperlo, van Overloop, & de Vries, 2002). In a single-subject study, sleep deprivation was found to increase escapemaintained self-injurious behavior in a child with intellectual disability (O' Reilly & Lancioni, 2000).

Research has compared sleep problems in children with ASD, attention deficit/hyperactivity disorder (AD/HD), epilepsy and typically developing children (Tsai, Chiang, Lee, Gau, Lee, Fan, et al., 2012). While children with ASD and AD/HD exhibited more sleep problems than children with epilepsy, current or lifetime sleep problems did not differ between children with ASD and children with AD/HD, or between children with epilepsy and typically developing children (Tsai et al., 2012). Schreck, Mulick and Smith (2004) conducted a study where information was retrieved from a database of parent reported sleep problems; therefore all participants had sleep problems. Fewer hours of sleep per night predicted overall autism severity scores and social skills deficits, while stereotypic behavior was predicted by fewer hours of sleep per night and screaming during the night. Increased sensitivity to environmental stimuli in the bedroom and screaming at night predicted communication problems. Therefore, it if of extreme importance to identify and treat sleep problems, as they may influence the effectiveness of daily interventions (Schreck et al., 2004).

---Insert Table 7 about here---

Feeding problems

Children with autism were found to have significantly more feeding problems and eat a significantly narrower range of foods than children without autism (Schreck, Williams & Smith, 2004). Matson and Kuhn (2001) developed the Screening Tool of fEeding Problems (STEP) to identify feeding problems in adults with an intellectual disability. Fodstad and Matson (2008) compared feeding problems in those with intellectual disabilities with and without autism. Individuals with ASD and intellectual disability displayed more behaviorally-based feeding issues like food selectivity and refusal related behaviors than those with intellectual disability alone. The ASD and intellectual disability group had more severe feeding and mealtime problems than the intellectual disability alone group (Fodstad & Matson, 2008).

Seiverling, Hendy and Williams (2011) modified the STEP for use with children, calling it the STEP-CHILD. The authors then compared children with autism to children with special needs and to children with no special needs. Stealing food was more common in children with autism than those with and without special needs. Emond, Emmett, Steer and Golding (2010) conducted a longitudinal study on feeding symptoms in children with ASD. Children with ASD demonstrated feeding difficulties from infancy and had a less varied diet at 15 months of age than controls. However, energy intake or growth was not impaired. The infants with ASD were described as 'slow feeders' at 6 months old. The authors suggested

that effective behavioral strategies need to address the neophobia and sensory sensitivities e.g. colour, taste, texture, for children with ASD.

Bandini, Anderson, Curtin, Cermak, Evans, Scampini et al. (2010) compared food selectivity between children with ASD and typically developing children. Children with ASD exhibited more food refusal and had a more limited food repertoire than typically developing children. Sharp, Jaquess and Lukens (2013) completed a multi-method assessment battery involving standardized mealtime observation, a food preference inventory and the Brief Autism Mealtime Behavior Inventory (BAMBI) (Lukens & Linscheid, 2008). Food selectivity on the BAMBI were negatively associated with a child's acceptance of bites and positively associated with disruptions during the presentation of foods during a structured mealtime observation. There was no relationship between ASD symptom severity and feeding problems. Neither was there a relationship between growth parameters and feeding problems.

Nadon, Feldman, Dunn and Gisel (2011) examined the relationship between sensory processing problems and the number of eating problems in children with ASD, and found there was an association between both. A significant association was found between visual and auditory sensitivity and the number of eating problems in children with ASD. The relationship between sensory processing and feeding problems needs to be further examined in the future. For practitioners interested in the treatment of feeding disorders, Matson and Fodstad (2009) conducted an excellent review of the treatment of food selectivity and other feeding problems in children with ASD.

---Insert Table 8 about here---

Toileting problems

Toileting is a critical skill necessary for independent living, and incontinence is a significant quality of life barrier for individuals with autism (Kroeger & Sorensen-Burnworth, 2009). Kroeger and Sorensen-Burnworth (2009) conducted a very thorough literature review about toilet training individuals with autism and other developmental disabilities. They examined teaching strategies such as graduated guidance, reinforcement-based training, scheduled sittings, elimination schedules, punishment procedures, hydration, manipulation of stimulus control, night time training for diurnal continence and priming and video modelling.

Dalrymple and Ruble (1992) found that lower cognition and lower verbal levels were significantly correlated with age of accomplishment of bowel and urine training in individuals with autism. In their survey of toileting issues, the authors found that twenty-two percent of individuals still wet at night time, with their ages ranging from nine to 32 years. Five percent of the sample with a mean age of 23.8 years were not trained for urine, bowel or during the night. About 30% of the individuals with autism had fears associated with toileting, whereby verbal individuals had the most. The most common toileting problems were urinating in places other than the toilet, constipation, stuffing up toilets, continually flushing and smearing feces.

Matson, Dempsey and Fodstad (2010) developed the Profile of Toileting Issues (POTI) questionnaire for individuals with an intellectual disability between the ages of 4 through adulthood. Matson, Neal, Hess and Kozlowski (2011) examined the reliability of the POTI and found it have good internal consistency (α =.83). Belva, Matson, Barker, Shoemaker and Mahan (2011) used the POTI questionnaire to investigate toileting issues in individuals with intellectual disability, ranging from 23 to 72 years. They found that lower adaptive functioning was associated with greater toileting problems. Matson, Horovitz and Sipes (2011) used the POTI questionnaire in 153 adults with intellectual disability, and found that the most frequently endorsed problems were toileting accidents during the day and night. Significant differences on total POTI score were found based on verbal ability, ambulatory ability, fiber or laxative use and level of intellectual disability. Therefore, those who were non-verbal, non-ambulatory, using fiber or laxatives and with a profound intellectual disability had higher total scores on the POTI.

Matson and LoVullo (2009) conducted a literature review on encopresis, soiling and constipation in children and adults with developmental disabilities. The authors note that etiology, prevalence, assessment and treatment of encopresis, soiling and constipation have received very little attention, and suggest that future attention and efforts by researchers are warranted. There is a lack of research on toileting problems in developmental disabilities, and this is especially true in the case of autism spectrum disorders. Much more research is needed to examine the prevalence of toileting problems in individuals with ASD, and to investigate other variables that may be associated with toileting problems, such as communication and challenging behavior.

---Insert Table 9 about here---

Conclusion

It is important that there is an understanding of the types of comorbid disorders that affect those with ASD among both practitioners and researchers. In order to implement the most effective intervention plans for those with ASD, comorbid conditions should be considered. Comorbidity in ASD is an area where much more research is required.

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Table 1.

Summary of comorbid psychopathology in babies/infants with ASD articles.

Study	Research Question	Age of participants	Number of participants	Measures used	Outcome
Davis, Fodstad,	To compare anxiety and	17-37 months	513	Baby and Infant Scale	Infants with Autistic
Jenkins, Hess,	avoidant behavior			for Children with	Disorder had
Moree, Dempsey	between infants/			aUtIsm Traits (BISCUIT)	higher anxiety and
et al., (2010).	toddlers with autistic			(Part II) (Matson, Boisjoli,	avoidant behavior
	disorder, PDD-NOS			& Wilkins, 2007).	scores than those
	and atypically				with PDD-NOS and
	developing children.				atypically
					developing
					children.
Davis, Moree,	To determine whether	15-36 months.	735	BISCUIT (Part II).	As communication
Dempsey, Hess,	deficits in communication	L			increased, so did
Jenkins, Fodstad	skills have an effect on th	e			anxiety in children
& Matson (2011).	expression of anxiety in				with ASD compared

infants and toddlers.

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to typically

developing children.

Fodstad, Rojahn &	To compare comorbid	12-39 months.	ASD: 109	BISCUIT (Part II)	Those with ASD
Matson (2010).	psychopathology in		Atypical		had more severe
	toddlers with ASD and		controls:		comorbid
	atypically developing		160		symptoms than
	children, and across				atypical controls,
	age ranges.				with there being
					an increasing trend
					of comorbid
					symptoms as age
					increased.
Kozlowski, Matson,	To compare feeding and	17-37 months.	1747	BISCUIT (Part II)	Children with
Belva & Rieske	sleeping difficulties				Autistic disorder
(2012).	between infants/toddlers				had more feeding
	with autistic disorder,				and sleeping
	PDD-NOS and atypically				difficulties than

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children with PDD-

NOS or atypically

developing

children.

developing children.

Table 2.

Summary of comorbid psychopathology in children with ASD articles.

Study	Research Question	Age of participants	Number of participants	s Measures used	Outcome
Amr, Raddad,	To estimate the	6-11 years.	60	Semi-structured clinical	Children with ASD
El-Mehesh, Bakr,	prevalence of			interview for children	and comorbid
Sallam & Amin	comorbid psychiatric			and adolescents (SCICA)	psychiatric disorders
(2012).	disorders in children			(McConaughy & Achenbach,	were found to have
	with ASD in 3 Arab			1994).	significantly lower IQ
	countries.				than those with ASD
					but without comorbid
					psychiatric disorders.
Davis, Moree,	Compared anxiety scores	s 2-14 years.	99	Autism Spectrum Disorders-	Anxiety decreased as
Dempsey, Reuther,	and communication defi	cits		Comorbidity for Children	communication
Fodstad, Hess et al.	in children with Pervasiv	ve		(ASD-CC) (Matson &	deficits increased for
(2011).	Developmental Disorder	r-		González, 2007).	those with Autistic
	Not Otherwise Specified	d		Diagnostic checklist	Disorder (AD),

				Comorbidity in a	autism spectrum disorder
	(PDD-NOS), children wi	th		from the Diagnostic	compared to those
	Autistic Disorder (AD) a	Autistic Disorder (AD) and			with Pervasive
	those with no diagnosis.			Fourth Edition-Text	Developmental
				Revision (DSM-IV-	Disorder-Not
				TR) (APA, 2000), and	Otherwise Specified
				the International	(PDD-NOS), or those
				Classification of Diseases,	with no diagnosis.
				Tenth Edition (ICD-10)	
				(World Health	
				Organization, 1992).	
Hess, Matson &	Examining symptom	ASD group: 14-16	65	Autism Spectrum Disorder	Differences between
Dixon (2010).	endorsements in	years.		Comorbidity-Child Version	worry/depressed
	children and adolescents	Control group:	72	(ASD-CC) (Matson &	behavior, under-eating,
	with ASD compared to	4-14 years.		González, 2007).	over-eating, avoidant
	typically developing				behavior and repetitive
	children and adolescents.				behavior.
Joshi, Petty,	Compared a	3-17 years.	ASD group: 217	Schedule for Affective	Youth with ASD have

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Wozniak, Henin,	psychiatrically referred		Control group: 217	Disorders and	high levels of
Fried, Galdo et al.,	population with ASD			Schizophrenia for	psychiatric
(2010).	to controls.			School-Age Children	comorbidity than
				(K-SADS-E)	those without ASD.
				(Orvaschel and Puig-Antch,	
				1987).	
Leyfer, Folstein,	Piloted modified	5-17 years.	109	Autism Comorbidity	Specific phobia was
Bacalman, Davis,	instrument, the Autism			Interview-Present and	the most common
Dinh, Morgan	Comorbidity Interview-			Lifetime Version (ACI-PL)	. comorbid disorder.
et al., (2006).	Present and Lifetime				
	Version (ACI-PL)				
Mannion, Leader	Investigated frequency	3-16 years.	89	ASD-CC	It was found that
& Healy (2013)	of comorbid				46.1% of individuals
	psychopathology, sleep				had a comorbid
	problems, gastrointestinal				disorder, with this
	symptoms and epilepsy.				number rising to
	Also investigated				78.7% if intellectual

				Comorbidity i	n autism spectrum disorder
	predictors of sleep				disability is included.
	problems.				
Matson, Fodstad	Comparing feeding	3-16 years.	279	ASD-CC	Those with autism and
& Dempsey (2009).	problems among				PDD-NOS had more
	with autism, PDD-NOS,				issues than atypically
	atypically developing				developing and
	children and typically				typically developing
	developing children.				children.
Ming, Brimacombe,	Investigating	2-18 years.	160	Retrospective analysis	Individuals with
Chaaban,	concurrent clinical			of a clinical practice	Asperger's syndrome
Zimmerman-Bier &	disorders in ASD.			database.	are more likely to have
Wagner (2008).					a psychiatric condition,
					while those with PDD
					are more likely to have
					a medical condition.
Simonoff, Pickles,	Analysed risk factors	10-14 years.	112	Child and Adolescent	Seventy percent of
Charman, Chandler,	of psychiatric disorders			Psychiatric Assessment.	children with ASD

				Comorbidity in a	56 utism spectrum disorder
Loucas & Baird	in children with ASD.				had at least one
(2008).					comorbid disorder.
Strang, Kenworthy,	Investigating	6-18 years.	95	Child Behavior	IQ and autism severity
Daniolos, Case,	depression and			Checklist (CBCL).	is not associated with
Wills, Martin et	anxiety symptoms				depression/anxiety
al. (2012).	in children with				symptoms.
	ASD.				

Table 3.

Summary of comorbid psychopathology in adults with ASD and throughout the lifespan articles.

Study	Research Question	Age of participants	Number of participants	Measures used	Outcome
Bakken,	Compared psychopathology	14-72 years.	194	Psychopathology	53.2% of those
Helverschou,	in those with ASD, and		(62 in autism	in Autism	with ASD+ID
Eilertsen,	those with ASD and		group and 132	Checklist (PAC)	had high
Heggelund,	intellectual disability (ID).		in ID group).	(Helverschou,	psychiatric
Myrbakk &				Bakken &	disorder scores,
Martinsen (2010).				Martinsen, 2008).	and severe
					general
					adjustment
					scores, while
					17.4% of the ID
					only group had
					high scores.
Bradley,	Comparing psychiatric	14-20 years.	12	Diagnostic	Individuals with

Summers,	and behavior disorders
Wood &	in individuals with
Bryson	severe ID with and
(2004).	without autism.

Davis, Hess,	Investigating anxiety	18-36 months.
Moree,	symptoms across the	3-16 years.
Fodstad,	lifespan in ASD.	20-48 years.
Dempsey,		49-65 years.
Jenkins &		

Matson (2011).

Comorbidity in autism spectrum disorder Assessment for ASD showed 4 the Severely times as much

(Matson, 1995a). Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT)

40

34

30

27

Handicapped-II

(DASH-II)

comorbidity as those without ASD. Anxiety rose from toddler-

psychiatric

hood, peaked in

childhood,

decreased

through young

adulthood and

rose again in

older adulthood.

Disorders-

Boisjoli &

Comorbidity-

(Part II) (Matson,

Wilkins, 2007).

Autism Spectrum

				Comorbidity in autism spectrum di	
				Child Version	peer unit disorder
				(ASD-CC)	
				Matson &	
				González, 2007).	
				Autism Spectrum	
				Disorders-	
				Comorbidity for	
				Adults (ASD-CA).	
				Matson, Terlonge	
				& González, 2006).	
Helverschou,	Pilot study using	17-56 years.	35	Psychopathology in	The scale has
Bakken &	the Psychopathology			Autism Checklist	acceptable
Martinsen	in Autism Checklist			(PAC) (Helverschou,	psychometric
(2009).	(PAC).			Bakken & Martinsen,	properties,
				2008).	and
					discriminates

between

				Comorbidity in autism	60 spectrum disorder
					adults with ASD and ID
					with and
					without
					psychiatric
					disorders.
Hofvander,	Investigated psychiatric	16-60 years.	122	Structured Clinical	Lifetime
Delorme,	problems in individuals			Interview for	psychiatric
Chaste, Nydén,	with ASD and normal			DSM-IV-Axis I	axis I
Wentz, Ståhlberg	intelligence.			Disorders (SCID-I)	comorbidity
et al. (2009).				(First, 1997).	was very
					common,
					especially
					mood and
					anxiety
					disorders, as
					well as

attention

Comorbidity in autism spectrum disorder

deficit/

hyperactivity

61

disorder (AD/

HD).

La Malfa, Lassi,	Compared those with	No age range given.	90	DASH-II	Pervasive
Salvini, Giganti,	pervasive developmental	Mean age: 38.4 years.			developmental
Bertelli & Albertini	disorders (PDDs) to those				disorders were
(2007).	without.				clearly
					correlated with
					increased
					presence of
					psychiatric
					disorders.
LoVullo & Matson	1) To calculate cut-off	No age range given.	313	ASD-CA	ID+ASD group
(2009).	scores for subscales	Mean ID group: 55			scored higher
	of the ASD-CA.	years.			than the ID
	2) To compare the	Mean ID+ASD group:			group on most

				Comorbidity in autism s	62 pectrum disorder
	Frequency of symptoms	49 years.			subscales,
	among 3 groups:	Mean ID+ASD+			except for
	individuals with ID;	psychopathology			conduct
	individuals with ID+ASD	group: 48 years.			problems.
	and individuals with ID,				
	ASD and additional				
	psychopathology.				
Lugnegard, Unenge	Investigated psychiatric	No age range given.	54	Structured Clinical	Mood
Hallerback &	comorbidity in young	Mean age: 27 years.		Interview for DSM-IV	disorders and
Gillberg (2011).	adults with Asperger			Axis I Disorders	anxiety
	Syndrome.			(SCID-I) (First &	disorders are
				Gibbon, 2004).	common in
					Asperger
					Syndrome.
Matson & Boisjoli	Developed ASD-CA	16-78 years.	169	ASD-CA.	The internal
	and tested its reliability.				consistency of
					the scale was

63 Comorbidity in autism spectrum disorder

good, and well

above the

acceptable cut-

off.

McCarthy, Hemmings,	Investigated the	18-65 years.	686 (125	International	There was
Kravariti, Dworzynski,	relationship		with ASD+ID;	Classification of	no association
Holt, Bouras et al.	between challenging		562 with ID	Diseases-10 (ICD-10)	between
(2010).	behavior and		alone).	clinical criteria using	comorbid
	comorbid			information gathered	psycho-
	psychopathology			from interviews with	pathology
	in adults with ASD			key informants and	and
	and ID, compared			the patients.	challenging
	to adults with ID				behavior,
	alone.				when level of
					ID, gender and
					age were
					controlled for.

			Comorbidity in autism sp	bectrum disorder
Examined the prevalence	No age range	164	Medical records and	Thirty-five
rates of major psychiatric	given.		psychiatric case notes.	percent of
disorders in learning				those with
disabled adults with autism				ASD had a
and analysed the use of				comorbid
medication.				psychiatric

					disorder.
Munesue, Ono,	Investigated the frequency	12+ years	44	Interviewing based on	Thirty-six
Mutoh, Shimoda,	of mood disorders in			Diagnostic and	percent of
Nakatani &	individuals with ASD.			Statistical Manual of	those with
Kikuchi (2008).				Mental Disorders IV	ASD had a
				(DSM-IV) criteria	mood
				of mood disorder.	disorder.

Morgan, Roy &

Chance (2003).

Table 4.

Summary of Attention deficit/hyperactivity (AD/HD) articles.

Study	Research Question	Age of participants	Number of participants	Measures used	Outcome
Goldstein &	To determine if a sample	Mean age=8.5 years.	57	Retrospective chart	26% of those
Schwebach (2004). of children with PDDs			review.	with PDDs
	display symptoms			Conners Parent and	met criteria for
	sufficiently related to			Teacher Rating	the combined
	AD/HD to warrant			Scales-Revised,	type of AD/HD,
	a comorbid diagnosis			Long Version	while 33% met
	of AD/HD.			(CPRS-R:L &	criteria for the
	Furthermore, do children			CTRS-R:L;	Inattentive type
	with PDDs and AD/HD			Conners, 1997).	of AD/HD.
	symptoms demonstrate				
	more impairment in daily				
	living activities than				
	those children with a				

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Mayes, Calhoun,	To determine the	2-16 years.	847 with autism	Based on DSM-IV	AD/HD
Mayes &	degree to which		158 with AD/HD	criteria, licenced	symptoms were
Molitoris (2012).	core ADHD and			PhD psychologists	common in
	autistic symptoms			made the diagnosis.	autism.
	overlap and are				
	distinct.				
Nydén, Niklasson,	To assess which	18+ years.	161	DSM-IV criteria	The dysfunctions
Stahlberg,	types of neuro-			checklist.	of the the ASD
Anckarsater,	psychological				and comorbid
Wentz, Rastam	deficits appear to				AD/HD group
& Gillberg	be most commonly				cannot be seen as
(2010).	associated with				a summary of the
	ASD and AD/HD				dysfunction
	in adults. The				found in the
	effect of the				ASD and
	combination of				ADHD groups.

PDD only.

ASD with AD/HD

was also studied.

Sinzig, Morsch,	To evaluate and	6-18 years.	80	Examination by	Those with
Bruning, Schmidt	compare executive			an experienced	ASD and
& Lehmkuhl	functioning (EF)			child and adolescent	comorbid
(2008).	profiles in children			psychiatrist according	g AD/HD
	with AD/HD and			to DSM-IV-TR	symptoms
	in children with			criteria.	showed more
	ASD with and				problems in
	without comorbid				inhibitory
	ADHD.				performance
					than those
					with ASD
					alone.
Skokauskas &	To examine patterns	ASD group: Mean=	134 (67 in	Child Behavior	Almost half
Gallagher (2012).	of comorbid psychiatric	12.73 years.	each group).	Checklist 6-18	(44.78%) of the
	problems in children with	Control group: Mean=		(CBCL/6-18)	ASD group met

Сс	omorbidity in autism s	68 spectrum disorder
ASD and their parents 11.85 years.	(Achenbach &	CBCL criteria
compared to age-matched	Rescorla, 2001).	for clinically
controls and their parents.		significant
		hyperactivity
		disorder.

Table 5.

Summary of epilepsy articles.

Study	Research Question	Age of participants	Number of participants	Measures used	Outcome
Amiet,	To compare the prevalence	1-28 years.	2112	Meta-analysis study	Epilepsy in autism
Gourfinkel-An,	of epilepsy in 1) those with			so variety of measures	is associated with
Bouzamondo,	and without intellectual			used in individual	intellectual
Tordjman,	disability, and 2) males and			studies.	disability and
Baulac, Lechat	females with autism.				gender.
et al. (2008).					
Bolton, Carcani-	To under-take a long-term	26-56 years.	150	Clinical records.	Epilepsy was
Rathwell,	follow-up study of			Semi-structured	associated with
Hutton, Goode,	individuals with autism in			interview.	gender (female),
Howlin &	order to better characterise			Where possible, the	intellectual
Rutter (2011).	the features and correlates			authors sought	disability and
	of epilepsy in individuals			reports of electro-	poorer verbal
	with autism.			cephalogram (EEG)	abilities.

				investigations that	
				had taken place.	
Gabis, Pomeroy	To address the incidence and	1-14 years.	56	Retrospective	Forty percent
& Andriola (2005).	electroencephalographic			review of EEG	of children with
	abnormalities in children			data and	autism were
	with pervasive			independent	diagnosed with
	developmental disorders			review of medical	epilepsy.
	(PDDs).			record charts.	
Matson, Neal,	To examine the effect that	18-24 months.	36(9 in each	Diagnoses of	Those with
Hess, Mahan	seizure disorder has on		group).	seizure disorders	seizures tended
& Fodstad (2010).	symptom presentation in			were previously	to be more
	toddlers with ASD compared			determined by the	impaired than
	to atypically developing			children's primary	those without.
	children.			care physican.	
Turk, Bax,	To compare developmental	7-17 years.	120 (60 in	Epilepsy was	Those with ASD
Williams,	and psychological		each group).	previously	and epilepsy
Amin, Eriksson	functioning in two groups			diagnosed by a	showed more

Comorbidity in autism spectrum disorder

				Comorbidity in autism	n spectrum disorder
& Gillberg	of children with ASD, one			medical professional.	motor
(2009).	with epilepsy and one without.				difficulties,
					developmental
					delays and
					challenging
					behaviors than
					those with ASD
					alone.
Smith & Matson	Compared behavior problems	29-72 years.	100 (25 in	International	Those with ASD
(2010a).	among 4 groups:		each group).	League Against	and a comorbid
	Group 1) ID			Epilepsy (ILAE).	condition (e.g.
	Group 2) Epilepsy			Clinical description	epilepsy) were
	Group 3) ASD			of seizure activity.	more impaired
	Group 4) ASD+epilepsy			Available medical	than those with
				information (e.g.	ID, ASD or
				family history, age	epilepsy.

of onset, prior
Comorbidity in autism spectrum disorder neurological trauma).

Smith & Matson	Compared psychopathology	29-72 years.	100 (25 in	International	Those with ASD
(2010b).	scores among 4 groups:		each group).	League Against	and a comorbid
	Group 1) ID			Epilepsy (ILAE).	condition (e.g.
	Group 2) Epilepsy			Clinical description	epilepsy) were
	Group 3) ASD			of seizure activity.	more impaired
	Group 4) ASD+ epilepsy			Available medical	than those with
				information (e.g.	ID, ASD or
				family history, age	epilepsy.
				of onset, prior	
				neurological trauma).	
Smith & Matson	Compared social skills	29-72 years.	100 (25 in	International	Those with ASD
(2010c).	scores among 4 groups:		each group).	League Against	and a comorbid
	Group 1) ID			Epilepsy (ILAE).	condition (e.g.
	Group 2) Epilepsy			Clinical description	epilepsy) were
	Group 3) ASD			of seizure activity.	more impaired

Comorbidity in autism	n spectrum disorder
Available medical	in social skills
information (e.g.	than those with
family history, age	ID, ASD or
of onset, prior	epilepsy.
neurological trauma).	

Group 4) ASD+ epilepsy

Table 6.

Summary of gastrointestinal symptom (GI) articles.

Study	Research Question	Age of participants	Number of participants	Measures used	Outcome
Gorrindo, Williams,	Compared 3 groups;	5-17 years.	121	Clinical evaluation	Constipation
Lee, Walker, McGrew	ASD+GI symptoms,			by pediatric	was the most
& Levitt (2012).	ASD+no GI symptoms			gastroenterologists.	common GI
	and GI symptoms only.			Questionnaire on	symptom in
				Pediatric	ASD. It was
				Gastrointestinal	associated
				Symptoms-Rome III	with younger
				Version (QPGS)	age, increased
				(Walker, Caplan-	social
				Dover & Rasquin-	impairment
				Weber, 2000).	and lack of
					expressive
					language.

					Comorbidity in autism	75 spectrum disorder
Hansen, Ozonoff,	Examined the prevalence	2 to 5 years	3. 3	333.	CHARGE	No statistically
Krakowiak,	of regressive autism and				Gastrointestinal	significant
Angkustsiri, Jones,	associated demographic,				history form.	differences
Deprey et al. (2008).	medical and developmental				CHARGE	were found
	factors.				Sleep history	between
					form.	children with/
						without
						regression in
						terms of
						gastrointestinal
						symptoms,
						history of
						seizures or
						sleep problems.
Ibrahim, Voigt,	Compared children with	Up to 18 years.	363 (121 ca	se	Medical records.	No significant
Katusic, Weaver	ASD and GI symptoms		participants			association
& Barbaresi (2009).	to matched control		and 2 control	ols per		found between

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	participants.		case participant).		ASD and GI
					symptoms,
					except more
					children with
					ASD had
					constipation
					and feeding
					issues.
Mazurek, Vasa,	Investigating the relationship	2-17 years.	2973	GI symptom	Children with
Kalb, Kanne,	between gastrointestinal			inventory	each type of GI
Rosenberg,	symptoms, anxiety and			questionnaire	symptom had
Keefer et al.	sensory over-responsivity.			(Autism Treatment	significantly
(2013).				Network, 2005).	higher rates of
					anxiety and
					sensory over-
					responsivity.
Molloy &	Investigated the prevalence	24-96 months.	137	Medical records.	Twenty-four

				Comorbidity in autism	77 spectrum disorder
Manning-	of GI symptoms in children				percent of
Courtney	with ASD.				children had a
(2003).					history of at
					least one GI
					symptom. No
					association
					was found
					between GI
					symptoms and
					developmental
					regression.
Nikolov,	Evaluated GI symptoms	5-17 years.	172.	Medical history.	Those with GI
Bearss,	in children with pervasive			Side Effects	symptoms
Lettinga,	developmental disorders			Review Form	were no
Erickson,	(PDDs).			(Research Units of	different from
Rodowski,				Pediatric	those without
Aman et al.				Psychopharmacology)	GI symptoms in

Comorbidity in autism s	78 spectrum disorder
	terms of
	adaptive
	functioning or
	autism
	symptom
	severity. Those
	with GI
	symptoms
	showed greater
	irritability,
	anxiety and
	social
	withdrawal,
	and were less
	likely to
	respond to
	treatment.

(2009).

				Comorbidity in autism s	79 spectrum disorder
Valicenti-	Investigated GI symptoms	1-18 years.	100	The Gastrointestinal	Children with
McDermott,	and language regression.			Interview.	language
McVicar,					regression had
Cohen,					more GI
Wershil &					problems than
Shinnar (2008).					those without
					language
					regression.
Wang, Tancredi	Compared children with	1-18 years.	752 (589 participants	Structured medical	More GI
& Thomas	ASD to their siblings in		with ASD and 163	history interview.	symptoms in
(2011).	relation to GI symptoms.		of their siblings in		children with
			control group).		ASD than
					their typically
					developing
					siblings.
					Increased

autism

Comorbidity in autism spectrum disorder symptom severity was associated with higher odds of GI

problems.

Table 7.

Summary of sleep problems articles.

Study	Research Question	Age of participants	Number of participants	Measures used	Outcome
Goldman,	Investigated the	2-18 years.	1784.	Children's Sleep	Poor sleepers had
McGrew,	relationship			Habits	a higher percentage
Johnson,	between sleep			Questionnaire	of behavioral
Richdale,	problems and			(CSHQ) (Owens,	problems than good
Clemons &	problem behavior			Nobile, McGuinn,	sleepers.
Malow (2011).	in children with			& Spirito, 2000).	
	ASD.			Parental Concerns	
				Questionnaire	
				(PCQ) (McGrew,	
				Malow, Henderson	1,
				Wang, Song &	
				Stone (2007).	
Mayes &	Investigated	1-15 years	477	Pediatric Behavior	• The strongest

				Comorbidity in auti	82 sm spectrum disorder
Calhoun	variables related			Scale (PBS)	predictors of sleep
(2009).	to sleep problems			(Chervin, Hedger,	disturbance were
	in children with			Dillon & Pituch,	autism severity,
	ASD.			2000).	hyperactivity,
					mood variability
					and aggression.
Patzold,	Explored the	3-14 years.	67 (31 children with	Sleep Diary.	Children with
Richdale &	relationship		ASD and 36		ASD are likely to
Tonge(1998).	between sleep		participants in control		to fall asleep later,
	problems and		group).		have longer sleep
	daytime behavior.				latencies, sleep
					less at night and
					spend a
					significant period
					of time awake
					during the night,
					when compared to

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controls. Those

with ASD

displayed

significantly more

difficult daytime

behaviort than

controls.

Richdale, Gavidia-	Examined stress,	2-19 years.	77(52 with ID,	Sleep Problems	Sleep problems
Payne & Cotton	challenging behavior		7 of which had	Questionnaire	were significantly
(2000).	and sleep problems		ASD and 25 in	(Richdale, Cotton	associated with
	in children with		control group).	& Habit, 1999).	intensity and
	intellectual disability			Epworth	frequency of
	(ID).			Sleepiness Scale	parental stress
				(ESS) (Johns,	and the presence
				1991).	of problem
				Apnoea and	behaviors.

narcolepsy scales

			C	comorbidity in autism s	84 pectrum disorder
				(Douglass,	L
				Bornstein,	
				Nino-Murcia,	
				Keenan, Miles,	
				Zarcone et al.,	
				1994).	
Rzepecka,	Investigated the	5-18 years.	187.	Children's Sleep	Medication,
McKenzie,	relationship between			Habits	sleep problems
McClure &	sleep, anxiety and			Questionnaire	and anxiety
Murphy (2011).	challenging behavior			(CSHQ).	accounted for
	in children with				42% of the
	intellectual disability				variance in
	and/or ASD.				challenging
					behavior.
Schreck, Mulick	Investigated the	5-12 years.	55.	Behavior	Fewer hours of
& Smith (2004).	relationship			Evaluation of	sleep per night
	between sleep problems			Disorders of	predicted

				Comorbidity in autism s	85 pectrum disorder
	and symptoms of			Sleep (BEDS)	overall autism
	autism.			(Schreck 1997/	severity scores
				1998; Schreck,	and social
				Mulick & Rojahn,	skills deficits.
				2003).	
Tsai, Chiang,	Compared sleep	6-17 years.	256.	Sleep Habits	There was an
Lee, Gau, Lee,	problems in those			Questionnaire	increased risk
Fan, Wu &	with ASD,			(SHQ) (Gau, 2006).	of sleep
Chiu (2012).	AD/HD and				problems in
	epilepsy.				children with
					ASD and
					AD/HD than
					typically
					developing
					children.

Table 8.

Summary of feeding problems articles.

Study	Research Question	Age of participants	Number of participants	Measures used	Outcome
Bandini,	To compare food	3-11 years.	111	Modified version of	Children with
Anderson, Curtin,	selectivity in children			Youth/Adolescent	ASD exhibited
Cermak, Evans,	with ASD and typically			Food Frequency	more food refusal
Scampini et al.	developing children.			Questionnaire	and had a more
(2010).				(YAQ) (Field,	limited food
				Camargo, Taylor,	repertoire than
				Berkey, Frazier,	typically
				Gillman et al. (1999).	developing
					children.
Emond, Emmett,	To investigate the	6-54 months.	86	Questionnaires	ASD children
Steer & Golding	feeding, diet and			designed by the	showed feeding
(2010).	growth of young			Avon Longitudinal	symptoms from
	children with ASD.			Study of Parents and	infancy and had a

					87
				Comorbidity in autis	m spectrum disorder
				Children (ALSPAC).	less varied at 15
				See	months, but
				http://www.bristol.	energy intake and
				ac.uk/alspac/	growth were not
					impaired.
Fodstad &	To compare feeding and	18-69 years.	60	Screening Tool of	Those with ASD+
Matson (2008).	mealtime problems in			fEeding Problems	ID displayed more
	adults with intellectual			(STEP) (Matson &	behaviorally-based
	disabilities with and			Kuhn, 2001).	feeding problems,
	without autism.				such as food
					selectivity and
					refusal related
					difficulties
					compared to those
					with ID alone.
Nadon, Ehrmann	To examine the relationship	3-10 years.	95	Eating Profiles	Sensory processing
Feldman, Dunn	between sensory processing			(Nadon, 2007).	problems were

				Comorbidity in auti	88 sm spectrum disorder
& Gisel (2011).	problems and the number				significantly
	of eating problems in children				related to an
	with ASD.				increase in the
					number of eating
					problems.
Schreck, Williams	To compare eating behaviors	7-9.5 years.	436	Children's Eating	Children with
& Smith (2004).	in children with and without			Behavior Inventory	autism have
	autism.			(CEBI) (Archer,	significantly more
				Rosenbaum &	feeding problems
				Streiner, 1991).	and eat a narrower
				Food Preference	range of foods than
				Inventory.	children without
					autism.
Seiverling, Hendy	To examine psychometric	2-18 years.	142	STEP-CHILD	Stealing food was
& Williams (2011).	qualities of the STEP			(Matson & Kuhn,	more common in
	-CHILD.			2001; Seiverling,	children with
				Hendy &	autism.

				Comorbidity in autism	n spectrum disorder
				Williams (2011).	
Sharp, Jaquess &	To assess feeding problems	3-8 years.	30	Food Preference	Increased food
Lukens (2013).	using multi-method			Inventory.	selectivity was
	assessment.			Brief Autism	positively
				Mealtime Behavior	correlated with
				Inventory (BAMBI)	problem
				(Lukens & Linscheid,	behaviors during
				2008).	the observation,
				Standardized	while ASD
				Mealtime	symptom
				Observation.	severity and
					growth
					parameters were
					unrelated to
					feeding data.

Table 9.

Summary of toileting problems articles.

Study	Research Question	Age of participants	Number of participants	Measures used	Outcome
Dalrymple &	To examine age of	9-38 years.	100	Survey of Toilet	Lower cognitive
Ruble (1992).	toilet training, toilet			Habits (STH)	level, being
	training methods,			(Dalrymple &	non-verbal and
	and toileting skills			Ruble, 1992).	needing
	and behaviors in				continued help
	individuals with				with toileting
	autism.				was associated
					with age of
					accomplishing
					toilet training.