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Comorbid Psychopathology, Challenging Behavior, Sensory Issues, Adaptive Behavior and Quality of Life in Children and Adolescents with Autism Spectrum Disorder

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ABSTRACT

Aim: Comorbid psychopathology refers to having a diagnosis of two or more co-occurring psychological disorders. The current study investigated the differences between children and adolescents with no-mild, moderate and severe comorbid psychopathology in children and adolescents with ASD.

Method: Parents of 133 children completed the Autism Spectrum Disorder-Comorbid for Children, Behavior Problems Inventory-Short Form, Pediatric Quality of Life Inventory, Vineland Adaptive Behavior Scales, Social Communication Questionnaire, Short Sensory Profile, and Behavioral/Educational Interventions and Complementary/Alternative Medicine (CAM) Interventions of the Autism Treatment Network Registry Parent Baseline Assessment.

Results: A significant difference was found between severity of comorbid psychopathology and all types of challenging behavior and all sensory issues except movement. A small effect size was also found between comorbid psychopathology and quality of life.

Conclusion: The findings from this study show significant difficulties associated with those with comorbid psychopathology in ASD in challenging behavior, sensory issues and quality of life.

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Introduction

Comorbid Psychopathology in Autism Spectrum Disorder (ASD)

Comorbid psychopathology is defined as the occurrence of two or more forms of psychopathology in the same person.[1] Since autism spectrum disorder (ASD) may present with other conditions occurring simultaneously, therein lies a challenge in separating a condition that can be due to ASD or a comorbid psychopathological condition. Comorbid physical conditions can include gastrointestinal symptoms, epilepsy, feeding problems and toileting issues.[2–5] Comorbid psychopathology in ASD includes mood disorders, anxiety disorders, conduct and oppositional defiant disorders, attention-deficit/hyperactivity disorder (AD/HD), and other psychological disorders, such as schizophrenia.[6,7]

Individuals with ASD often develop and engage in comorbid psychiatric symptoms including obsessions and/or compulsions, anxieties, phobias, depression, hyperactivity, attention problems, and mood lability.[8–10] Research has found comorbid psychopathology and high degree of maladaptive behavior which were not directly attributable to ASD symptom severity or intellectual disability in minimally verbal children and adolescents with ASD.[11] Correctly identifying comorbid diagnoses in children and adolescents with ASD is important in guiding clinicians toward more appropriate and targeted treatment or better informing mistreatment for these symptoms.[12]

Comorbid Psychopathology and Challenging Behavior

Challenging behaviors are associated conditions noted that interfere with everyday activities and overall quality of life of individuals with ASD.[13] Challenging behaviors are more frequent among children with ASD than among children with intellectual disability,'[14,15] with a varying prevalence rate estimated from 56% to 94%.[16–22] There has been debate about whether challenging behavior and psychopathology should be viewed upon as separate entities, however, evidence has shown that there can be an overlap. Previous studies have found that symptoms of comorbid psychopathology are present at a very early age for children with ASD and elevated levels of these symptoms may exacerbate challenging behaviors, with evidence suggesting that the level of psychopathology may affect the presentation of challenging behaviors.[23]

Comorbid Psychopathology and Sensory Issues

Sensory processing is a condition where there is a deficit in processing which affects creating self-prompted appropriate responses to environmental stimuli.[24] Previous research assessed sensory abnormalities in children aged between 20 and 54 months with a diagnosis of ASD, and found that across the sample, pain and hearing were the most commonly affected modalities, providing support for the assertion that sensory abnormalities are common in young children with ASD.[25] Children with sensory processing deficits often have difficulty

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identifying and regulating responses to sensations and specific stimuli, and may use self-stimulation to compensate for limited sensory input or to avoid overstimulation.[26] Sensory processing differences have been suggested to contribute to many of the higher-order cognitive and social deficits associated with ASD.[27]

The importance of studying sensory regulation is highlighted by the increased evidence regarding the impairing effects of poor sensory regulation on everyday functioning.[28] One study found that 33–63% of children meeting criteria for sensory dysregulation also met criteria for a psychiatric disorder of early childhood at any level of impairment.[29] Research has reported that sensory processing differences in children with ASD and/or AD/HD in home and classroom contexts, were only found in the ASD group, which could be related to contextual hyper selectivity.[30]

Comorbid Psychopathology and ASD Severity

Deficits in social communication along with social interaction are core diagnostic criteria in the DSM-5 for ASD. Severity of these symptoms can vary substantially from mild difficulties in interpreting social situations to being completely non-verbal. Previous literature highlighted that children and adolescents with ASD and disruptive behavior disorder often demonstrate limited insight into their anxiety symptoms and motivation to change.[31] Accurately assessing and diagnosing comorbid psychopathology in individuals with ASD is difficult for these reasons and has a direct impact on symptom severity and quality of life. One study showed that more severe symptoms of ASD resulted in more symptoms on multiple comorbidities.[32] Similar research also focused on ASD severity, co-occurring psychopathology, and intellectual functioning predicting supportive school services for youth with ASD.[33] This research discussed how greater ASD symptom severity necessitates more intensive and frequent school supports, in addition to ASD severity, co-occurring psychiatric symptoms and low intellectual functioning may also interfere with a student's academic progress.[33]

Comorbid Psychopathology and Quality of Life

The World Health Organization operationally defines quality of life as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns".[34 (p.558)] One study presented a long-term prospective follow-up study of a population-based cohort of 120 individuals diagnosed with ASD in childhood.[35] Results showed that a majority remained very dependent on parents or other caregivers for support in education, residential and occupational situations in late adolescence.

Other research found a correlation between comorbid psychopathology and quality of life in adults with ASD and found that being female, having a current mental health diagnosis and higher severity of ASD symptoms were predictive of lower QoL.[36] Another study found significant associations between ASD and QoL and the variable of psychiatric comorbidity in a nationwide Danish survey in adults and adolescents with ASD.[37] Research is needed to investigate this relationship in children with ASD and how comorbid psychopathology may affect QoL.

Comorbid Psychopathology and Adaptive Behavior

Adaptive functioning refers to a set of behaviors related to success in one's own environment, in areas such as independence, home living skills, community navigation, self-care and social communication.[38] One study examined predictors of daily living skills attainment and trajectories of daily living skills in a longitudinal sample referred for possible ASD and followed them from 2 to 21 years of age, and found that early childhood nonverbal mental age was the strongest predictor of daily living skills attainment for both ASD and non ASD groups.[39] There is a lack of research on comorbid psychopathology and adaptive behavior in children, which may be due to such areas in adaptive functioning like independence and community navigation being more related to adults than children.

Comorbid Psychopathology and Behavioral/Educational and Complementary/Alternative Medicine (CAM) Interventions

Behavioral and educational interventions have the most validity through their evidence base and are also widely used. A meta-analysis of early intensive behavioral intervention concluded that early intensive behavioral intervention (EIBI) was an effective intervention strategy for many children with ASD.[40] The unknown etiology and high prevalence rates of ASD have led to many biological or non-biological complementary and alternative medicine (CAM) interventions, such as gluten-free or casein-free diets, spiritual healing, dolphin therapy, secretin, withholding immunizations, or craniosacral manipulation.[41] It has been documented that CAM do not have sufficient empirical evidence from the literature to support the efficacy of their use; specific reference is made in the literature to music therapy, dance therapy and Omega 3 supplementation.[42,43] CAM has high acceptance rates with parents with some studies detailing that 74% of families were using CAM for their child with ASD, with other reports entailing upwards of 50% in using CAM.[44,45]

Current Study

The aim of the current study was to investigate the differences between children and adolescents with ASD with no-mild, moderate and severe comorbid psychopathology. Differences were examined in severity of comorbid psychopathology in relation to challenging behavior, sensory issues, ASD symptoms, quality of life, adaptive behavior, and behavioral/educational and CAM interventions.

Method

Participants

The study sample comprised 133 children and adolescents with a diagnosis of ASD. A licensed psychologist or pediatrician

independent of the study provided diagnoses. The mean age of the sample was 9 years old (*SD* = 4.02), between the ages of 2 and 18 years. It was found that 75.2% (*n* = 100) were males and 24.8% (*n* = 33) were female. It was found that 33.1% (*n* = 44) of participants had an intellectual disability and 66.9% (*n* = 89) did not have an intellectual disability. The analyses revealed that a mild intellectual disability was reported for 13.5% (*n* = 18) of males and for 3% (*n* = 4) of females. A moderate intellectual disability was reported for 9.8% (*n* = 13) of males and 3% (*n* = 4) for females. A severe intellectual disability was reported for 5.3% (*n* = 7) of males and for 0.8% (*n* = 1) of females.

Procedure and Informants

Parents were recruited through schools, ASD service providers and parent support groups. If parents wished to participate in the study, they were provided with a participant information form and a consent form to complete. Once consent was obtained, the informants were provided with the questionnaires to complete in their own time. Informants were parents of children and adolescents with a diagnosis of ASD. Rating scales were completed by parents remotely and independently according to the instructions which were at the top of each questionnaire.

Measures

Demographic Information

A self-constructed demographic questionnaire provided information on age, gender, whether they have been diagnosed with a co-occurring disorder (e.g. AD/HD, anxiety disorder or any other co-occurring disorder), whether they take any medication at present and whether they had an intellectual disability, and what level of intellectual disability they were diagnosed with, if any.

Autism Spectrum Disorder-Comorbid for Children (ASD-CC)

The ASD-CC[46] is a 39-item informant-based rating scale designed to assess symptoms of psychopathology and emotional difficulties which are common in individuals with ASD. Items encompass comorbid conditions such as depression, conduct disorder, AD/HD, tic disorder, OCD, specific phobia, and eating difficulties. Caregivers rate each item to the extent that 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." Previous studies determined the measure as having good internal consistency (α = .91).[47] The ASD-CC has been used in a number of published studies with children and adolescents with autism and other developmental disabilities.[48–51] A comparison of the ASD-CC to the Child Behavior Checklist (CBCL)[52] found that both scales displayed convergence.[53] The scale also demonstrated construct validity[54] and convergent and discriminant validity[55] when compared with the Behavioral Assessment System for Children, Version 2 (BASC-2).[56] These findings demonstrate that the ASD-CC is comparable to well-known measures of psychopathology and emotional difficulties among children.

Pediatric Quality of Life Inventory – Version 4.0

The Pediatric Quality of Life Inventory (PedsQL) version 4.0 Generic Core Scales is a 23-item questionnaire which measures health-related quality of life (HRQoL) in individuals aged between 2 and 18 years.[57] The questionnaire has four main areas which encompass: physical functioning, emotional functioning, social functioning and school functioning. The parent report version of the PedsQL was used due to potential communication deficits of the participants. Respondents complete the questionnaire based on how much of a problem each item has been during the past month. Respondents answer on a five-point scale where 0 is never a problem, 1 is almost never a problem, 2 is sometimes a problem, 3 is often a problem and 4 is almost always a problem. Previous studies established good internal consistency for the total parent-report health-related quality of life scores; this has also been found through other studies.[58,59]

Behavior Problems Inventory-Short Form (BPI-S)

The Behavior Problems Inventory-Short Form is a 30-item informant-based behavior rating tool that was designed to assess maladaptive behaviors in individuals with intellectual disabilities.[60] The items fall into three subscales: Self-injurious Behavior (8 items), Stereotyped Behavior (12 items), and Aggressive/Destructive Behavior (10 items). Each item is rated on a frequency scale (0 = never to 4 = hourly), and a severity scale (0 = no problem to 3 = severe problem). Internal consistency, construct validity and confirmatory and discriminant validity were established for the BPI-S through retrospective data analysis.[60]

Behavioral/Educational Interventions and Complementary and Alternative Interventions

The Behavioral/Educational Interventions (Section E) of the Autism Treatment Network Registry Parent Baseline Assessment was used to assess type of behavioral or educational interventions that the child was receiving.[61] A question asked if the child is receiving any behavioral or educational services. Parents were then asked what interventions their child received within the last month. Options included speech therapy, behavioral therapy, occupational therapy, developmental individual differences relationship-based approach (DIR)/floor-time, physical therapy, verbal behavior therapy, learning center/resource room, family therapy, academic tutoring, social skills training, and other interventions. The number of hours of intervention per week was also queried about.

The Complementary/Alternative Medicine (CAM) Interventions (Section F) of the Autism Treatment Network Registry Parent Baseline Assessment was used to assess complementary or alternative medicines (CAM) interventions.[61] A question asked if the child is receiving any complementary or alternative treatments. Parents were then asked whether their child received any of the following: (1) Chiropractics, (2) High Dosing Vitamin B6 and Magnesium, (3) Other Vitamin Supplements, (4) Probiotics, (5) Digestive Enzymes, (6) Glutathione, (7) Amino Acids, (8) Essential Fatty Acids, (9) Gluten-Free Diets, (10) Casein-Free Diets, (11) No Processed Sugars, or (12) Other. This questionnaire has been employed in

published research and other research has also highlighted findings and potential further uses.[62,63]

Short Sensory Profile (SSP)

The Short Sensory Profile helps determine how well children process sensory information in everyday situations and to profile the sensory system's effect on functional performance. The Short Sensory Profile is a 38-item caregiver questionnaire designed for use in screening and research protocols. The items on the Sensory Profile are grouped into three major sections: sensory processing, modulation and behavioral and emotional responses. The SSP has been shown to have acceptable test–retest reliability and internal consistency to analyze children's sensory processing patterns.[64]

Vineland Adaptive Behavior Scales – 2nd Edition

The Vineland Adaptive Behavior Scales-2nd edition (VABS-II) is an informant-based measure designed to evaluate adaptive functioning from birth through to adulthood.[65] The measure consists of four sub groups including communication (receptive, expressive, written), daily living skills (personal, domestic, community), socialization (interpersonal relationships, play and leisure time, coping skills), and motor skills (gross, fine). The fine motor and gross motor subdomains do not have to be completed for children ages 7 years and older. Respondents answer on a Likert-type 3-point scale (0 = never, 1 = sometimes/partially and 2 = usually). Each group yields a total raw score which is converted into a standard score. Standard scores are then summed and converted into an overall adaptive behavior composite score. The Vineland was found to have good internal consistency (α = .77 or higher for the four developmental domains), and a good test–retest reliability (r > .76).[66]

Social Communication Questionnaire-Second Edition (SCQ)

The Social Communication Questionnaire is a 40-item principal caregiver respondent autism screening tool, information must be given about current behavior and historical development.[67] The SCQ items assess autism symptoms, verbal communication, and restricted repetitive stereotyped behaviors, and are based on DSM-IV PDD criteria.[68] Caregivers can rate the individual's "lifetime" characteristics (which would be used to support a diagnosis) or "current" characteristics (which would be used to support an evaluation of current difficulties). Questions assess the domain of communication by creating scenarios that a "yes" or "no" answer must be given. The SCQ has been shown to have good psychometric properties, cross-cultural validity, and diagnostic validity.[69]

Results

Analyses

A chi-square test was used for the demographic information: gender, age, AD/HD diagnosis, medication at present, intellectual disability at present and level of intellectual disability. This was completed to determine what associations the variables had with levels of severity in comorbid psychopathology groups: no/mild, moderate and severe. A chi-square test for independence was also used to explore the associations between behavioral/educational and CAM interventions and impact of level of severity differences in comorbid psychopathology groups. An analysis of variance (ANOVA) was run to investigate if there were significant differences between levels of severity in comorbid psychopathology groups and quality of life using the Pediatric Quality of Life Inventory. Since the PedsQL groups were split by age, there was missing data in each total column, to combat this "exclude cases analysis by analysis" was selected. A one way between groups multivariate analysis of variance (MANOVA) was performed four times, firstly, to investigate impact of level of severity differences in comorbid psychopathology groups on challenging behavior using the BPI-S. A MANOVA was performed to investigate impact of level of severity differences in comorbid psychopathology groups on sensory issues using the SSP. A MANOVA was performed to investigate the impact of level of differences in comorbid psychopathology severity groups on adaptive behavior using the VABS-II. A final MANOVA was conducted to investigate the impact of level of differences in comorbid psychopathology severity groups on ASD symptoms using the SCQ.

Comorbid Psychopathology

Table 1 presents the calculations for the means and standard deviations of each seven subscales of the ASD-CC. The mean score for the ASD-CC was 34.40 (*SD* = 12.38). All the mean scores in the study were determined to have no/mild, moderate, and severe impairment, when means were compared to established cutoffs.[70] Participants were compared between three groups: no/minimal impairment, moderate impairment, and severe impairment of comorbid psychopathology. Participants were determined as having no/minimal impairment if they indicated having no/minimal impairment in at least six out of the seven ASD-CC subscale cutoff scores. Participants were determined as having a moderate impairment if they indicated scoring moderate impairments in at least two of the ASD-CC subscale cutoff scores. Participants were determined as having a severe impairment if they indicted having severe impairment in any of the ASD-CC subscale cutoff scores. Cutoff scores for the ASD-CC were derived from Thorson and Matson's (2012) study.[70] The classification of impairment was based on this study which meant "No/minimal impairment" was used when scores fell within one standard deviation of the mean.[70] Scores between one and two standard deviations of the mean were classified under "Moderate impairment", and scores of two or more standard deviations from the mean were classified as "Severe impairment". Two decimal places were utilized in the calculation of

Table 1. Autism spectrum comorbid for children (ASD-CC) subscale mean scores, and standard deviation.

ASD-CC subscale	*M*	*SD*
Repetitive Behaviors	6.96	3.65
Worry/Depressed	4.77	2.59
Avoidant Behaviors	6.91	3.14
Undereating	1.21	1.77
Conduct Behaviors	2.56	2.22
Overeating	1.59	1.81

cutoff scores while whole numbers were utilized in the determination of final cutoff scores given the scoring system of the ASD-CC, which are illustrated in Table 1.

Demographic Information

Table 2 presents the descriptive demographic participant information in the form of frequencies and percentages. The presentation of this information was split into three groups: (1) no-mild, (2) moderate and (3) severe comorbid psychopathology using the ASD-CC with regards to gender and age. Similarly, Table 3 conveys this information with regards to AD/HD diagnosis, medication taken at present, presence and the level of intellectual disability. A chi-square test for independence was run on level of comorbid psychopathology and all demographic information, which resulted in one significant association (Table 2), while all other associations reported no significant results at the $p < .05$ level. There was a significant association between AD/HD diagnosis and level of comorbid psychopathology $\chi 2$ (2, $n = 133$) = .26, $p = .01$, $phi = .26$.

Comorbid Psychopathology and Challenging Behavior

A one way between groups MANOVA was performed to investigate impact of level of severity differences in comorbid psychopathology groups on challenging behavior. Five dependent variables were used: SIB frequency, SIB severity, aggressive/destructive behavior frequency, aggressive/destructive behavior severity and stereotypy frequency. The independent variable was comorbid psychopathology severity with three levels: no/mild, moderate and severe. There was a statistically significant difference between no/mild, moderate and severe comorbid psychopathology level and all subscales of challenging behavior $F = 3.98$, $p = <.001$; Wilks' Lambda = .74; partial eta squared = .13. As displayed in Table 4, an inspection of mean scores indicated that the severe comorbid psychopathology group reported the higher levels of stereotyped behavior frequency ($M = 20.96$, $SD = 12.41$) in comparison to mild ($M = 10.16$, $SD = 6.37$) and moderate comorbid psychopathology ($M = 14.12$, $SD = 7.97$). To compare ASD-CC domains/factors to the domains/factors of the outcome measures of challenging behavior and quality of life, Table 5 presents

Table 2. Demographic information, frequencies and percentages.

		No/mild comorbid psychopathology (12.8%; $n = 17$)		Moderate comorbid psychopathology (30.8%; $n = 41$)		Severe comorbid psychopathology (56.4%; $n = 75$)		Total sample ($N = 133$)		χ^2	p
Demographic		n	Percent	n	Percent	n	Percent	n	Percent		
Gender	Male	11	64.7%	30	73.2%	59	78.7%	100	75.2%	1.34	.511
Age	Female	6	35.3%	11	26.8%	16	21.3%	33	24.8%		
	2–4 years	3	17.6%	3	7.3%	3	4%	12	9%	39.82	.227
	5–7 years	7	41.2%	12	29.3%	20	26.7%	38	28.6%		
	8–12 years	5	29.4%	18	43.9%	34	45.3%	55	41.4%		
	13–18 years	2	11.8%	8	19.5%	18	24%	28	21%		

Table 3. Current comorbid diagnoses and medication usage including frequencies and percentages in no/mild, moderate and severe comorbid psychopathology.

		No/mild comorbid psychopathology (12.8%; $n = 17$)		Moderate comorbid psychopathology (30.8%; $n = 41$)		Severe comorbid psychopathology (56.4%; $n = 75$)		Total sample ($N = 133$)		χ^2	p
		n	Percent	n	Percent	n	Percent	n	Percent		
ADHD diagnosis	ADHD diagnosis	3	17.6%	8	19.52%	33	44%	44	33.1	.26**	.01
	No ADHD diagnosis	14	82.4%	33	80.5%	42	56%	89	66.9		
Medication at present	Yes	3	17.6%	19	46.3%	40	55.3%	62	46.6%	5.71	.058
	No	14	82.4%	22	53.7%	35	46.7%	71	53.4%		
Presence of intellectual disability	Intellectual Disability	8	47.1%	10	24.4%	27	36%	44	33.1%	3.36	.186
	No Intellectual Disability	9	52.9%	31	75.6%	48	64%	89	66.9%		
Level of intellectual disability	Mild Intellectual Disability	3	17.6%	6	14.6%	13	17.3%	22	16.5%	10.97	.089
	Moderate Intellectual Disability	5	29.4%	4	9.8%	8	10.7%	18	12.8%		
	Severe Intellectual Disability	0	0.0%	0	0.0%	8	10.7%	8	6.1%		

Table 4. Behavior problems inventory-short form (BPI-S) subscale mean scores, standard deviations, Partial Eta Squared results, and mean scores between no-mild, moderate and severe comorbid psychopathology groups.

Subscale	M	SD	F	p	Partial eta squared	M no-mild	M moderate	M severe
BPI-S SIB Frequency	4.46	4.26	10.63	.000*	.14	2.67	2.65	5.87
BPI-S SIB Severity	3.24	3.41	12.49	.000*	.16	1.61	1.73	4.44
BPI-S Aggressive/ Destructive Behavior Frequency	7.98	7.06	7.00	.001**	.09	4.44	6.05	9.87
BPI-S Aggressive/ Destructive Behavior Severity	6.30	6.072	8.75	.000*	.11	3.39	4.20	8.12
BPI-S Stereotyped Behavior Frequency	17.44	11.32	10.32	.000*	.13	10.17	14.13	20.96

** $p < .001$, * $p < .005$

Table 5. Pearson correlations between ADS-CC subscales and subscales of the BPI-S and PedsQL.

	ASD-CC subscale						
	Tantrum behaviors	Repetitive behaviors	Worry	Avoidant behaviors	Undereating	Conduct behaviors	Overeating
PedsQL Subscale							
2–4 yrs							
Psychosocial Health	−.87**	−.41	−.59	−.52	−.39	−.59	−.41
Physical Health	−.63	−.34	−.27	−.70	−.71*	−.02	−.47
5–7 yrs							
Psychosocial Health	−.74**	−.54**	−.58**	−.70**	−.19	−.52**	−.39*
Physical Health	−.37*	−.44**	−.38*	−.57**	−.04	−.28	−.37*
8–12 yrs							
Psychosocial Health	−.46**	−.36**	−.44**	−.65**	−.04	−.34*	−.24
Physical Health	−.43**	−.23	−.55**	−.47**	−.05	−.15	−.08
13–18 yrs							
Psychosocial Health	−.67**	−.51**	−.65**	−.55**	−.48**	−.02	−.19
Physical Health	−.55**	−.44*	−.53**	−.43*	−.47*	.13	−.23
BPI-S Subscale							
SIB Frequency	.37**	.60**	.12	.27**	.23**	.05	.20*
SIB Severity	.41**	.62**	.18*	.32**	.22*	.07	.25**
Aggressive/ destructive behavior Frequency	.68**	.31**	.15	.18*	−.05	.53**	.09
Aggressive/ destructive behavior Severity	.67**	.31**	.19*	.15	−.04	.55**	.10
Stereotyped Behavior Frequency	.36**	.76**	.19*	.37**	.15	.12	.28**

*$p < .05$
**$p < .01$

Table 6. Short Sensory Profile (SSP) subscale mean scores, standard deviation, Partial Eta Squared results, and mean scores between no-mild, moderate and severe comorbid psychopathology groups.

Subscale	*M*	*SD*	*F*	*p*	Partial eta squared	*M* no-mild	*M* moderate	*M* severe
Tactile sensitivity	21.92	6.74	11.56	.000**	.15	28.00	22.48	20.17
Taste/Smell sensitivity	9.25	5.54	14.52	.000**	.18	14.78	9.70	7.70
Movement sensitivity	11.27	3.50	2.19	.116	.03	12.83	10.85	11.12
Under responive/Seeks sensation	19.24	7.33	12.30	.000**	.15	24.22	21.63	16.77
Auditory Filtering	14.03	5.04	13.17	.000**	.16	17.28	15.90	12.25
Low energy/Weak	19.96	7.41	6.09	.003*	.08	23.28	21.98	18.09
Visual/Auditory sensitivity	14.42	5.14	8.06	.001*	.11	18.33	14.85	13.25

** $p < .001$, * $p < .005$

Pearson Correlations between ASD-CC subscales and subscales of the BPI-S and the PedsQL. The ASD-CC subscale of tantrum behavior was negatively associated with psychosocial and physical health across all age ranges. Moderate to strong positive correlations were observed between another ASD-CC subscale, tantrum behavior, and the subscales of the BPI-S.

Comorbid Psychopathology and Sensory Issues

A one way between groups MANOVA was performed to investigate the impact of level of severity differences in comorbid psychopathology groups on sensory issues. Seven dependent sensory subscale variables were used, as displayed in Table 6. The independent variable was comorbid psychopathology severity with three levels: no/mild, moderate and severe. There was a statistically significant difference between levels of comorbid psychopathology and sensory issues (except movement) $F = 4.58$, $p = <.001$; Wilks' Lambda = .63; partial eta squared = .20. When the results for the dependent variables were considered separately, the only difference to reach statistical significance in all subscales (except movement), using a Bonferroni adjusted alpha level of .017, was the severe comorbid psychopathology condition, in comparison to the no/mild comorbid psychopathology condition.

Comorbid Psychopathology and Quality of Life

The mean total score on the PedsQL was 18.79 ($SD = 5.8$). A one way between groups ANOVA was conducted to explore the impact of level of differences in comorbid psychopathology severity groups on quality of life. There was a statistically significant difference at the $p < .05$ level in PedsQL scores between groups for age group 5–7 years: $F = 9.1$, $p = <.001$, age group: 8–12 years: $F = 3.5$, $p = .03$, age group: 13–18 years: $F = 6.0$, $p = <.001$. Despite reaching statistical significance, the actual difference in mean scores between groups was quite small. As summarized in Table 7, the effect size calculated using eta squared, for the specific age groups, was age group 5–7 years: 0.33, age group 8–12 years: 0.11, age group 13–18 years: 0.32.

Comorbid Psychopathology and Adaptive Behavior

All participants in the sample scored in the low range of adaptive behavior (a score between 21 and 70) in every subscale. The means and standard deviations for total adaptive behavior and the domains are illustrated in Table 8. A one way between groups MANOVA was performed to investigate the impact of level of differences in comorbid psychopathology severity groups on adaptive behavior. Five dependent sensory

Table 7. Pediatric Quality of Life Inventory (PedsQL) total mean scores, standard deviations, Partial Eta Squared results, and mean scores between no-mild, moderate and severe comorbid psychopathology groups.

Subscale	*M*	*SD*	*F*	*p*	Partial eta squared	*M* no-mild	*M* moderate	*M* severe
PedsQL 2–4 years	6.18	1.37	3.29	.207	0.05	7.19	6.22	5.16
PedsQL 5–7 years	4.45	1.49	9.10	.001*	0.33	6.10	4.69	3.74
PedsQL 8–12 years	4.01	1.42	3.50	.036*	0.11	4.91	4.45	3.63
PedsQL 13–18 years	4.56	1.41	6.00	.007*	0.32	7.08	4.90	4.09

* $p < .005$

Table 8. Vineland II Adaptive Behavior scales (VABS) total mean score, subscale mean scores, standard deviation, Partial Eta Squared results, and mean scores between no-mild, moderate and severe comorbid psychopathology groups.

Subscale	*M*	*SD*	*F*	*p*	Partial eta squared	*M* no-mild	*M* moderate	*M* severe
Adaptive behavior composite	37.05	11.66	.09	.917	.00	32.43	30.65	31.31
Communication	42.97	12.78	.28	.760	.01	38.26	35.67	38.96
Daily living skills	36.23	13.87	.01	.989	.00	27.37	27.00	26.78
Socialization	31.94	11.24	.38	.689	.02	31.67	29.27	28.19
Motor skills	23.75	6.48	.08	.926	.00	23.39	23.31	24.19

subscale variables were used, as displayed in Table 6. The independent variable was comorbid psychopathology severity with three levels: no/mild, moderate and severe. There were no statistically significant differences in adaptive behavior between no/mild, moderate and severe comorbid psychopathology.

Comorbid Psychopathology and Behavioral/educational Interventions and Complementary/alternative Medicine (CAM) Interventions

A chi-square test for independence was used to explore the association between behavioral/educational, CAM interventions and impact of level of severity differences in comorbid psychopathology groups. Table 9 summarizes the reported frequencies of the various interventions. The percentage of the sample receiving behavioral or educational interventions was 59.4% ($n = 79$). However, the chi-square test for independence indicated no significant associations between behavioral/educational services and severity level of comorbid psychopathology condition groups χ^2 (2, $n = 133$) = .13, $p = .28$, *phi* = .13. A chi–square test for independence also indicated no significant association between CAM interventions and severity level of comorbid psychopathology condition groups χ2 (2, $n = 133$) = .06, $p = .78$, *phi* = .06.

Comorbid Psychopathology and ASD Symptoms

A one way between groups multivariate analysis of variance (MANOVA) was performed to investigate severity level of comorbid psychopathology condition groups' differences in ASD symptoms, as measured by the SCQ. There was a statistically significant difference between no/mild, moderate and severe comorbid psychopathology groups on the combined dependent variables (SCQ), $F = 4.1$, $p = <.001$; Wilks' Lambda = .83; partial eta squared = .08. An inspection of mean scores, displayed in Table 10, indicated that the severe comorbid psychopathology group reported slightly lower SCQ than no/mild and moderate comorbid psychopathology groups (See Figure 1).

Table 9. Behavioral/Educational and Complementary/Alternative Medicine (CAM) Interventions, total frequency and percentages in no/mild, moderate and severe comorbid psychopathology groups.

Behavioral/educational and CAM interventions	No/mild comorbid psychopathology (12.8%; $n = 17$)		Moderate comorbid psychopathology (30.8%; $n = 41$)		Severe comorbid psychopathology (56.4%; $n = 75$)	
	n	Percent	*n*	Percent	*n*	Percent
Speech therapy	8	47.1%	11	26.8%	26	34.7%
Behavioral therapy	2	11.8%	2	4.9%	13	17.3%
DIR floor time	1	5.9%	1	2.4%	6	8%
Physical therapy	3	17.6%	4	9.8%	11	14.7%
Verbal behavior training	0	0%	3	7.3%	7	9.3%
Family therapy	1	5.9%	6	14.6%	4	5.3%
Academic tutoring	1	5.9%	6	14.6%	18	24%
Social skills training	1	5.9%	11	26.8%	25	33.3%
Chiropractics	1	5.9%	3	7.3%	2	2.7%
Amino acids	0	0%	0	0%	1	1.3%
High dosing Vitamin B6 and Magnesium	1	5.9%	3	7.3%	4	5.3%
Essential fatty acids	1	5.9%	3	7.3%	4	5.3%
Other vitamin supplements	2	11.8%	13	31.7%	15	20%
Gluten free diet	1	5.9%	4	9.8%	1	1.3%
Probiotics	3	17.6%	8	19.5%	10	13.3%
Casein free diet	0	0%	1	2.4%	3	4%
No processed sugars	0	0%	1	2.4%	2	2.7%
Glutathione	0	0%	1	2.4%	0	0%
Other CAM	1	5.9%	7	17.1%	5	6.7%

Discussion

This study's central aim was to investigate the differences between children and adolescents with no/mild, moderate and severe comorbid psychopathology in relation to challenging behavior, sensory issues, social responsiveness, quality of life, adaptive behavior, behavioral/educational interventions and complimentary/alternative medicine interventions in children and adolescents with ASD. This study found that a frequent issue was that participants with severe comorbid psychopathology frequently scored poorer in challenging behavior, quality of life, adaptive behavior, social communication, sensory processing and engaged more in behavioral/educational interventions than the other groups (no/mild and moderate).

The severe comorbid psychopathology group scored high in the challenging behavior subscales of self-injurious behavior

Table 10. Social communication questionnaire-second edition (SCQ) subscales, total mean scores, standard deviations, partial Eta Squared results, and mean scores between no-mild, moderate and severe comorbid psychopathology groups.

Subscale	*M*	*SD*	*F*	*p*	Partial eta squared	*M* no-mild	*M* moderate	*M* severe
Reciprocal social interaction	8.25	3.86	8.85	.001*	.10	12.00	8.88	7.72
Communication	7.82	3.09	1.66	.158	.02	9.33	9.33	8.29
Stereotypy	5.63	2.13	7.23	.004*	.08	5.00	6.40	7.28
SCQ total	24.09	6.61	1.72	.184	.02	26.33	24.60	23.29

* $p < .005$

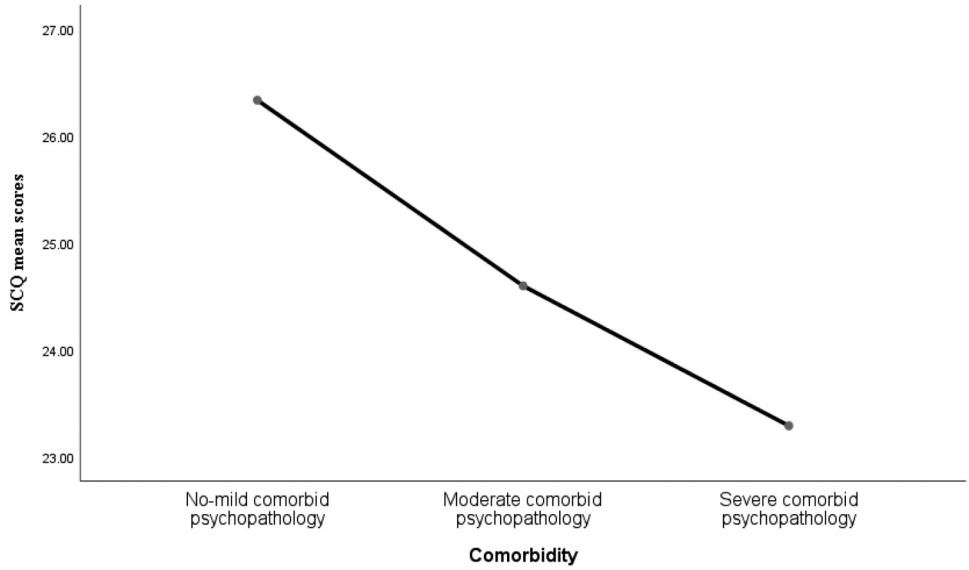

Figure 1. Scores on the SCQ for participants with no/mild, moderate and severe comorbid psychopathology.

frequency, self-injurious behavior severity, aggressive/destructive behavior frequency, and aggressive/destructive behavior severity. Stereotyped behavior frequency was markedly higher than the other subscales in the severe comorbid psychopathology group. One study found that challenging behavior and comorbid psychopathology were positively correlated in children and adolescents with Fragile X Syndrome.[51] This finding was replicated in the current study with an ASD population with stereotyped behavior being more frequent in children and adolescents with severe comorbid psychopathology.

The severe comorbid psychopathology group reported receiving more behavioral/educational services (65.3%) and engaged in the most CAM interventions (22.7%). In behavior/educational interventions, speech therapy was also highest in the severe comorbid psychopathology group (34.7%). This may suggest that the severe group may have higher needs than the no/mild and moderate comorbid psychopathology groups. This finding is important as it may inform future clinical implications and access to services. If a person was assessed and received a result of being placed in the severe comorbid psychopathology group, this may predict an additional need for behavioral/educational interventions which is important information for a parent/caregiver in seeking help and accessing services.

In sensory processing, it is interesting to note that the only subscale that did not provide significant results for any comorbid psychopathology severity level was movement. The group: severe comorbid psychopathology had significant results in the subscales: tactile sensitivity, taste/smell sensitivity, under responsive/seeks sensation, auditory filtering low energy/weak and visual/auditory sensitivity. An explanation for the finding of no significant results in the movement subscale may be due to the age of the sample, as all participants were within the age range of two to eighteen. Previous research concluded from their study that sensory abnormality is very common in young children with ASD and from the results in this study it seems these sensory issues can be exacerbated with higher levels of comorbid psychopathological conditions.[25] It was also previously discussed that children and adolescents who have a diagnosis of AD/HD have lower scores on the Sensory Profile than children without AD/HD.[71] The current study coincides with that finding and results also may suggest that having a more severe level of comorbid psychopathology may reliably predict or increase the likelihood of an AD/HD diagnosis as 44% of the severe group had this diagnosis in comparison to no/mild (19.5%) and moderate (17.6%).

In relation to quality of life, there was a significant difference between severity levels of comorbid psychopathology groups in the age brackets 5–7 years, 8–12 years and 13–18 years. Using Cohen's (1988)[72] classification of effect size, all three of these groups are said to have a large effect size. This means that level of severity in comorbid psychopathology has a significant impact on quality of life, with a higher severity level having lower scores on quality of life measurements. These findings were replicated in similar research, where significant associations were found between ASD and quality of life and the

variable of psychiatric comorbidity in a nationwide Danish survey in adults and adolescents with ASD.[37] It is noteworthy that no significant difference was found for the age group 2–4 years, especially since the effect size was large in the three other age groups. A potential explanation for this is the difficulty of reliably measuring quality of life of someone so young; the potential occurrence of a floor effect may also provide an explanation.

In the analysis of comorbid psychopathology and ASD symptoms, a difference in mean scores indicated that the severe comorbid psychopathology group reported slightly lower levels of ASD symptoms than the no/mild and moderate comorbid psychopathology groups. This result appears counter-intuitive at first because it contradicts prior findings that more severe ASD symptoms are associated with more severe comorbid psychopathology.[73] It would therefore be expected that the severe comorbid psychopathology group would have the highest reported levels of ASD symptoms in this study. It is possible that in the context of the presence of severe comorbid psychopathology, parents of children in this group may have under-reported the social communication deficits experienced by their child. It has been documented that the symptoms of ASD overlap with many co-occurring disorders,[74] and parents of children in this group may have been more likely to (a) view their child's ASD symptoms as less pronounced, and (b) attribute presenting symptoms to their severe comorbid psychopathology. This alludes to the importance of assessing individuals with ASD for comorbid psychopathology, as once this assessment is made, it can inform many other assessments and predictions. This may increase the speed of diagnosis and intervention implementation.

In the severe comorbid psychopathology group, males were the main cohort of the study (78.7%) and the severe comorbid psychopathology group was overall the largest group when the sample was divided by severity level (56.4%). Highest level of reported intellectual disability was in severe comorbid psychopathology group. In addition, the only group that had a severe intellectual disability was the severe comorbid psychopathology group (10.7%), thus suggesting that a higher level of severity in comorbid psychopathology may predict a higher severity of intellectual disability diagnosis. This needs to be investigated in future studies.

All participants in the sample scored in the low range of adaptive behavior. Comorbid psychopathology severity levels did not reliably predict adaptive functioning. Since all participants fell in the low range of adaptive behavior, this may have created a floor effect, meaning that since all the scores were quite low, it is difficult to distinguish between them as there was little variance.

Future research should focus on longitudinal studies of quality of life with regard to children and adolescents who have a comorbid psychopathological condition to help better inform clinical implications on how to increase quality of life. As this study showed the majority of the sample was placed in the severe comorbid psychopathology group, a suggestion for future research would be to use the same comorbid psychopathology measure (ASD-CC) and investigate worldwide using country as a demographic variable to see if the main cohort of an ASD sample with a comorbid diagnosis also resides in the severe group.

The clinical implications from this current study are to test and treat for the appropriate diagnosis. The use of using an assessment tool like the ASD-CC may be justified, as once this assessment grouping is made, it can inform many other assessments and predictions. For example, after meeting the criteria for the severe comorbid psychopathology group, this may predict a potential further diagnosis of AD/HD. Another clinical implication from receiving this assessment grouping may be that it increases the speed of diagnosing other mental disorders, intervention implementation and access to services.

An important limitation in the current study is the use of parental report to obtain data. None of the participants of the current study were directly evaluated by the researchers as all data were obtained through questionnaires. This may be better evaluated by the researchers or a clinical practitioner, purely for the reason to obtain a more objective measure. A further limitation is the use of convenience sampling, and response bias may have also been a limitation. It is possible that more parents of children with a diagnosis of a comorbid psychopathology condition may have participated, as parents may have more interest in research that is a current concern for them and their families. This may explain the high number of participants who were in the severe comorbid psychopathology group, and the higher level of comorbid psychopathology severity scored on most assessments, as this may be an issue of concern for the families involved.

However, in a comparison study between parent report, self-report and real-life social behaviors (derived from observations), it was found that parental reports did not correspond to their child's self-report measures, but parents did more accurately predict their child's real-life social approach behaviors.[75] Other research also has indicated that there is a large percentage of agreement between parental report and clinical evaluation.[76] This research helps overcome the limitations given above. It is also important to note that parental questionnaires are less costly, time-consuming and may derive a wider sample not just restricted to the country in which the researchers reside.

In conclusion, this study is the first to investigate comorbid psychopathology and its relationship to challenging behavior, sensory issues, ASD symptoms, quality of life, adaptive behavior, behavioral/educational interventions, and complimentary/alternative interventions medicine in children and adolescents with ASD. Findings from this study indicated that participants in the severe comorbid psychopathology group engaged more in behavioral/educational interventions than the other groups (no/mild and moderate). Stereotyped behavior frequency was more common in children and adolescents with ASD and severe comorbid psychopathology than the other groups. The current study displays some important findings which are novel, such as the finding that being in the severe comorbid psychopathology group may predict a potential further diagnosis of AD/HD. This study showed a justification and importance for a diagnosis of severity level of comorbid psychopathology to enhance speed of diagnosis,

intervention implementation and access to services.

Disclosure statement

The authors declare that they have no conflict of interest.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of National University of Ireland Galway and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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