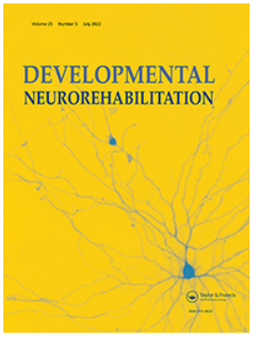
The co-occurrence of autism spectrum disorder and cerebral palsy and associated comorbid conditions in children and adolescents



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The Co-Occurrence of Autism Spectrum Disorder and Cerebral Palsy and Associated Comorbid Conditions in Children and Adolescents

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ABSTRACT

Background: Comorbidity is the co-occurrence of two or more disorders in the same person.
Aim: This study investigated the frequency of comorbid conditions, in children and adolescents, with autism spectrum disorder (ASD), cerebral palsy (CP), and a comorbid diagnosis of ASD and CP.
Method: Ninety-six children and adolescents with ASD, CP, and both ASD and CP aged between 4 and 18 years participated in this study. Parents completed the Gastrointestinal Symptom Inventory, Children's Sleep Habits Questionnaire, Child Behavior Checklist, Social Communication Questionnaire, and the Vineland Adaptive Behavior Scales.
Results: Results of ANOVA analyses revealed significant group differences in sleep problems, social communication difficulties, and adaptive behavior. Regression analysis found that the presence of an intellectual disability significantly predicted levels of adaptive behavior.
Conclusion: This research demonstrated the importance of studying comorbidities in children and adolescents with CP alone, ASD alone, and combined ASD and CP.

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Autism spectrum disorder; cerebral palsy; comorbidity; gastrointestinalsymptoms; sleep problems; challenging behavior

Introduction

Autism Spectrum Disorder

A diagnosis of autism spectrum disorder (ASD) is made based on individuals meeting three social criteria: nonverbal communicative behavior; difficulties developing, understanding, or maintaining relationships; and social-emotional reciprocity.[1]Individuals must also meet two out of four behavioral criteria: restricted interests; responding to sensory input atypically; repetitive motor movements or speech; or an insistence on sameness.[1] ASD can occur with or without intellectual disability (ID)[2] and ID is reported to be present for between 40% and 55% of individuals with ASD.[3,4]

ASD affects approximately 1 in 54 children,[5] with a male-to-female ratio of 3:1.[6] Comorbidity, the co-occurrence of two or more conditions in the same person with ASD, has been noted in the literature.[7–9] Comorbidities found in individuals with ASD may overlap with those of other conditions such as Fragile X Syndrome and 22q11.2 Deletion Syndrome,[10,11] and a diagnosis of ASD can co-occur with cerebral palsy (CP).[12]

Cerebral Palsy

CP is an umbrella term that describes a group of neurodevelopmental disorders[13] that are caused by a non-progressive or abnormal development of the brain.[14] CP is characterized by a reduced ability to exhibit voluntary muscle movement and posture problems.[15] The physical symptoms of CP vary for every person but they can include ataxia, dystonia, spasticity, or choreoathetosis.[16–19] People with CP may also experience disturbances in sensation, communication, behavior, perception, epilepsy, and they or may not have an ID.[20] ID was found in 45% of the cohort in one population-based study.[21] Approximately 2–3.5 per 1000 babies born have CP,[22] with a male to female prevalence ratio of approximately 1.4:1.[23]

ASD and CP and Comorbidity

Between 6% and 30% of children and adolescents with CP also have an ASD diagnosis.[22,24,25] Individuals with a dual diagnosis often present with other comorbid conditions and they are more at risk of comorbid disorders, such as ID and asthma than those with CP alone.[24,26–28] Approximately, 70–80% of individuals with ASD present with one or more comorbid conditions.[28,29] However, 95% of individuals with CP have one or more comorbidity.[30]

Gastrointestinal Symptoms in ASD and CP

Gastrointestinal (GI) symptoms, including abdominal pain, nausea, constipation, diarrhea, and bloating, are common for people with ASD.[31,32] Indeed, 79% of parents of children and adolescents with ASD reported that in the previous 3 months, their child experienced at least one type of GI symptom.[33] GI symptoms that are associated with CP include regurgitation, vomiting, abdominal pain, chronic constipation, swallowing.[30,34] Indeed, gastrointestinal symptoms are present in 92% of children with CP.[34] GI symptoms are linked to other

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comorbid conditions in ASD.[35–38] For example, GI Symptoms may present as sleep problems, or challenging behaviors, in children with ASD.[35]

Sleep Problems in ASD and CP

Difficulty initiating sleep, or its quality, timing, or duration are regarded as sleep problems if they result in impairment of daytime functioning and distress.[1] Sleep problems impact between 77% and 80% of children and adolescents with ASD.[33,39] They are associated with GI symptoms in 67% of these young people,[8] and GI symptoms are predictor variables for sleep problems in individuals with ASD.[33] Sleep problems are more common in children with CP than unaffected children occurring in between 23% and 46% of children[12,40,41] They may be caused by sensory processing difficulties, mobility impairment, and pain.[42] Indeed, pain may be caused by GI symptoms.[43]

Challenging Behavior in ASD and CP

Challenging behaviors are defined as socially unacceptable actions that jeopardize the safety of the individual, people around them, or they can interfere with education.[44–46] They include self-injurious, aggressive, destructive, or disruptive behavior.[44] Challenging behaviors are more common in children with ASD than in typically developing children.[47–49] and 358% of children with ASD present with them.[50] Untreated GI symptoms may trigger or increase challenging behavior in non-verbal children with ASD.[37] They are also common in CP, impacting up to 88.5% of children and adolescents.[5] Furthermore, strong relationships have been identified between challenging behavior, sleep problems, the presence of an ID, and ASD symptoms.[51]

Social Communication Problems in ASD and CP

Social communication problems involve the impairment of non-verbal communication, verbal expressive language, and difficulty processing language concerning metaphors, humor, aphorisms, taking turns in conversations and greeting people.[1] Children with ASD frequently have impaired language, communication, and socialization skills,[52] although the severity of problems varies widely between individuals.[53] Similar variation occurs in the social communication difficulties that are experienced by people with CP. Some people are unable to speak at all, but between 21% and 36% of individuals have difficulty speaking[54,55] and conversation is difficult for 55% of children with CP.[56]

Adaptive Behavior in ASD and CP

Adaptive behaviors are behaviors that allow a person to be self-reliant. They include daily living skills, and social, and communication skills.[57] Children with ASD typically exhibit lower levels of adaptive behavior, across all domains, compared to typically developing children and children with developmental disorders.[58,59]

The high prevalence in the co-occurrence of ASD and CP and other co-occurring conditions, including the presence of ID, makes comorbidity in ASD and CP an important topic of further research.[24,60] Increased understanding is needed to ensure that comorbid disorders are accurately assessed and diagnosed, and to enable the provision of optimal treatment for individuals with ASD and CP in clinical settings.[57] No research to date has compared the symptoms experienced by individuals with both CP and ASD with those who have a single ASD diagnosis and a single CP diagnosis. To our knowledge, only one unpublished study has investigated a sample of infants and toddlers in all these three groups.[61]

Current Study

This study investigated the frequency of comorbid conditions in children and adolescents with ASD alone, CP alone, and those with comorbid ASD and CP. It focused on GI symptoms, sleep problems, behavior problems, social communication difficulties, and levels of adaptive behavior. Age of ASD diagnosis and presence of ID were also examined as variables of interest, that may help in predicting the occurrence of comorbid disorders. ID was examined due to the high prevalence of ID in people with ASD and CP, as described above, and because if the presence of ID can predict comorbid disorders, this knowledge could potentially help clinicians to predict their occurrence.

Method

Participants

Study participants were children and adolescents (n = 96) with a diagnosis of either CP, ASD, or comorbid CP and ASD who originated from UK, Ireland, and the US. The participants ranged in age from 4 to 18 years, with a mean age of 9.67 years (*SD* = 3.64). Sixty percent (*n* = 58) of the sample were male and 40% (*n* = 38) were female. Sixty-three participants (66%) had a diagnosis of ASD, while 58 (60%) had a diagnosis of cerebral palsy. Twenty-six percent (*n* = 25) of the sample were diagnosed with comorbid ASD and CP. Caregiver information on the professional diagnosis, diagnostic setting/organization, and professional(s) who made the diagnosis was obtained. This data confirmed that diagnoses had been made independent of the study, according to DSM-5[1] criteria and formal diagnostic protocols, by licensed psychologists or pediatricians. For the purposes of analysis, the participants were categorized as belonging to the following groups: 'ASD alone' 40% (*n* = 38); 'CP alone' 34% (*n* = 33); and 'ASD & CP' 26% (*n* = 25).

Procedure and Informants

Informants were parents and guardians of the children and adolescent participants. Informants were recruited through social media, online forums, and parenting support groups. During the recruitment process, a flyer was used which stated that the study was looking for parents of children and adolescents with AS, children and adolescents with CP, and children and adolescents with both ASD and CP to participate. If

parents wished to participate in the study, they were provided with a participant information sheet and a consent form to complete. Once consent was obtained, the informants were provided with the battery of the questionnaires that are described below. These they completed in their own time, independently, according to the instructions that were printed on the top of each questionnaire.

Measures

Demographic Information

A bespoke demographic information questionnaire was used to obtain information on the age of participants, their gender, diagnosis (ASD, CP, or comorbid ASD and CP), age at diagnosis, presence of ID, and the level of ID.

Gastrointestinal Symptom Inventory

The GI Symptom Inventory[62] is a 35-item questionnaire that assesses GI symptoms that have occurred in the previous 3 months. There are additional items to complete for individuals who exhibit symptomology, and the total scale includes 77 items. This scale was developed by the Autism Treatment Network[62] from previous questionnaires, and the clinical symptom assessment of children and adolescents with ASD. This scale has been utilized in published research studies,[63,64] but it has not to date been psychometrically validated.

Children's Sleep Habits Questionnaire (CSHQ)

The CSHQ[65] is a 52-item parental-report instrument designed to assess sleep and sleep disturbance in typically developing 4 to 10-year olds. It has been used previously with younger and older children with ASD.[66,67] Informants answer questions with reference to the previous week. Forty-two items are rated on a 3-point Likert scale, with responses: 'rarely' (never to once a week), 'sometimes' (2 to 4 times a week), and 'usually' (5 or more times a week). The CSHQ comprises eight subscales that address: bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night awakenings, parasomnias, daytime sleepiness, and sleep-disordered breathing. A total CSHQ score of 41 is a sensitive clinical cutoff for the identification of probable sleep problems.[65] Therefore, a score of 41 or above was used as the operational definition for sleep problems. The CSHQ has demonstrated good internal consistency, ranging from .68 to .78, and good test–retest reliability between .62 and .79.[68]

Child Behavior Checklist

The Child Behavior Checklist (CBCL)[69] is a parent-report questionnaire containing 118 items, used to screen for emotional, behavioral, and social problems. The CBCL has separate subscales for children 1½ to 5 years and those aged 6 to 18 years. These have seven and eight behavior subscales respectively. The subscales are grouped into internalizing, externalizing, and other problems based on: anxiety and depression, social withdrawn, somatic complaints, social problems, thought and attention problems, rule-breaking, and aggressive behavior. Informants answer on a 3-point scale; 'not true,' 'sometimes true,' and 'very true.' Responses are then coded. The CBCL has been used in a wide variety of research. For example, to examine parenting,[70] and to determine the diagnoses of children and adolescents with generalized anxiety disorder.[71] The CBCL has shown strong test–retest reliability, inter-rater agreement, and internal consistency.[72] It has also illustrated reliability and convergent and discriminative validity in large clinical samples.[73,74]

Social Communication Questionnaire (SCQ)

The SCQ[75] is a 40-item, parent-report screening measure for ASD, that is based on the Autism Diagnostic Interview-Revised (ADI-R). Each item in the SCQ requires a 'yes' or 'no' response, and each scored item receives one point for abnormal behavior and zero points for the absence of abnormal behavior. A score of 15 or higher, indicates a probable ASD diagnosis, and this marker was used as the operational definition of social communication problems in the current study. The SCQ has been widely used in both research and clinical contexts.[76] It has good psychometric properties, cross-cultural validity, and diagnostic validity.[77]

Vineland Adaptive Behavior Scale, Second Edition (Vineland-II)

The Vineland-II[78] is a 297-item scale used to assess an individual's adaptive behaviors, based on parent-report. The Vineland-II comprises four domains: communication, daily living skills, socialization, and motor skills. Only the daily living skills domain was used in the current study. This domain measures personal behavior as well as domestic and community interaction skills. The Vineland-II has a high degree of test–retest reliability and the four subdomains have demonstrated acceptable levels of internal consistency.[78] Norm-referenced scores for the daily living skills domain have a mean of 15 and a standard deviation of 3 (possible range = 1–24).[79]

Analyses

A one-way between-subjects ANOVA was conducted to evaluate the effect of the diagnostic groups (ASD, CP, or comorbid ASD and CP) on GI symptoms, sleep problems, challenging behavior, social communication difficulties, adaptive behavior, and age of diagnosis. Hierarchical multiple regression was used to test if diagnosis of ASD, age of ASD diagnosis, and presence or absence of ID, predicted sleep problems while controlling for age. In addition, a linear regression was deployed to test how well the presence of ID predicted adaptive behavior levels within the sample.

Results

Fifty-four percent (n = 52) of the total sample reported at least one GI symptom, while 71% (n = 68) experienced sleep problems. Twenty-nine percent (n = 28) of participants exhibited borderline or clinical levels of behavior problems. Sixty-five percent (n = 62) of participants experienced social or communication difficulties. Levels of adaptive behavior are presented in Table 1. The means and standard deviations across all comorbidities can be seen in Table 2.

Table 1. Frequency of Adaptive Behavior Levels.

Level of Adaptive Behavior	*n*	%
High	4	4.2
Moderately high	11	11.5
Adequate	38	39.6
Moderately low	8	8.3
Low	35	36.5

Table 2. Means and Standard Deviations of conditions across all three groups.

GI Symptoms	*M*	*SD*	*Levene's Statistic*
ASD	1.29	1.22	
CP	0.97	1.4	
ASD & CP	0.72	1.17	
			.03
CSHQ			
ASD	49.81	7.85	
CP	43.88	7.1	
ASD & CP	46.82	6.91	
			.33
Challenging Behavior			
ASD	46.92	17.92	
CP	50.09	15.97	
ASD & CP	57.48	16.98	
			.61
Social Communication Difficulties			
ASD	22.6	5.2	
CP	5.21	3.4	
ASD & CP	22.12	4.92	
			7.80**
Adaptive Behaviors			
ASD	67.86	34.4	
CP	91.38	22.16	
ASD & CP	83.72	34.35	
			7.96**

** $p < .001$

Gastrointestinal Symptoms

The one-way between-subjects ANOVA was conducted with the independent variable (IV) as the diagnostic group with three levels: a diagnosis of ASD alone, CP alone, or both ASD and CP. The dependent variable (DV) was GI symptoms measured on a scale of 0–5 symptoms (abdominal pain, bloating, nausea, diarrhea, and constipation). This ANOVA found no significant difference was found between groups regarding the total number of GI symptoms experienced ($F_{(2,93)} = 1.58$, $p = .21$).

Sleep Problems

The one-way between-subjects ANOVA evaluating the effect of the diagnostic group on the frequency of sleep problems was conducted with the IV as the diagnostic group with three levels: a diagnosis of ASD alone, CP alone, or both ASD and CP. The DV was sleep problems measured using the CSHQ total score. A significant difference was found between groups and frequency of sleep problems ($F_{(2,93)} = 5.81$, $p = .004$). A Tukey HSD post hoc test was conducted to establish where the significant differences were. This revealed a significant difference between the ASD alone group and the CP alone group ($p = .003$). No significant differences were between the ASD and CP group and the ASD alone group ($p = .18$), or the CP alone group ($p = .40$). Eleven percent of the variability in sleep problems can be attributed to the interaction effect ($\eta^2 = .11$). The power of the interaction effect is .86, indicating reasonable interaction.

Table 3. Table of Bivariate Intercorrelations of the Variables.

	Variables	1	2	3	4	5
1	Sleep problems					
2	Age	.15				
3	ASD Diagnosis	.06	−.00**			
4	Intellectual disability	−.08	−.12	.02*		
5	Age of ASD diagnosis	−.23	.35	−.45	−.06	

Significance level: *$p < .05$, **$p < .01$

Table 4. Hierarchical Multiple Regression Analysis for Predictors of Sleep Problems.

	Variable	β	R^2	*Adj.* R^2	*F* change
1	Age	.34	.02	.00	1.03
2	ASD Diagnosis	.94	.03	−.02	.19
3	Intellectual disability	−.85	.03	−.04	.16
4	Age of ASD diagnosis	−2.41*	.12	.04	4.57*

Total $R^2 = .12$, Total *Adj.* $R^2 = .04$. Significance level: *$p < .05$

A hierarchical multiple regression was conducted to investigate the contribution of ASD, age of ASD diagnosis, and presence or absence of ID in predicting sleep problems. Age of participants was entered in the first step of the model. Diagnosis of ASD was entered in Step 2, presence of ID was entered in Step 3, and age of ASD diagnosis was entered in Step 4. Tests to determine whether the data met the assumption of collinearity indicated that multicollinearity was not a concern.

The results of the multiple regression analysis show that the overall model was significant ($F_{(4,\ 4)} = 1.51$, $p = .22$, $R^2 = .12$, *Adj.* $R^2 = .04$). In Step 1, the variable of age failed to account for any of the variance in sleep problems ($\beta = .15$, $p = .32$). The Step 2 variable was also insignificant ($\beta = .06$, $p = .67$). The presence of ID, as entered in Step 3, failed to account for any of the variance in this model ($\beta = -.06$, $p = .69$). The final step of the model, age of ASD diagnosis, was a significant predictor of sleep problems ($\beta = -.37$, $p = .04$). Table 3 displays the bivariate intercorrelations of the variables. Table 4 displays the significance of individual steps within the model.

Behavior Problems

The one-way between-subjects ANOVA to evaluate the effect of the diagnostic group on behavior problems had the IV as the diagnostic group with three levels: ASD alone, CP alone, or both ASD and CP. The DV was behavior problems measured using the CBCL. No significant difference was found between groups regarding behavior problems ($F_{(2,93)} = 2.92$, $p = .06$).

Social Communication Difficulties

The one-way between-subjects ANOVA to evaluate the effect of the diagnostic group on the frequency of social communication difficulties had the IV as the diagnostic group with three levels: ASD alone, CP alone, or both ASD and CP. The DV was social communication difficulties measured using the SCQ.

Table 5. Means and Standard Deviations of Age of ASD diagnosis across two groups.

Diagnostic group	*M*	*SD*
ASD alone	4.92 years (59 months)	.74 years
ASD & CP	5.95 years (71 months)	1.34 years

Welch's robust test of equality of means was subsequently conducted and was significant (F = 192.82, p < .01). A significant difference was found between groups in relation to social communication difficulties ($F_{(2,54)}$ = 155.97, p < .01). A Game-Howell post hoc test was conducted to establish where the significant differences were. This test revealed a significant difference between the CP alone group and the ASD alone group (p < .01). A significant difference was also found between CP alone group and the ASD & CP group (p < .01). There were no significant differences between the ASD & CP group and the ASD alone group (p = .93).

Adaptive Behavior

The one-way between-subjects ANOVA to evaluate the effect of the diagnostic group on adaptive behavior had the IV as the diagnostic group with three levels: a diagnosis of ASD alone, CP alone, or both ASD and CP. The DV was adaptive behavior measured using the daily living skills domain of the Vineland Adaptive Behavior Scale. Welch's robust test of equality of means was subsequently conducted, and was significant (F = 5.89, p = .005). A significant difference was found between groups regarding adaptive behavior ($F_{(2,54)}$ = 5.44, p = .006). A Game-Howell post hoc test was conducted to establish where the significant differences were. This test revealed a significant difference between the CP alone group and the ASD alone group (p = .003). There were no significant differences between the ASD & CP group and the ASD alone group (p = .93) or the CP alone group (p = .60).

The linear regression was conducted to evaluate how well the presence or absence of ID predicts adaptive behavior levels in the sample. Multicollinearity was tested, and the assumption was met, indicating that multicollinearity was not a concern, with a Tolerance of 1 and a VIF of 1. A significant regression equation was found ($F_{(1,94)}$ = 184.76, p < .01, R^2 = .66, *Adj.* R^2 = .66). These results suggest that the presence of an ID significantly predicted levels of adaptive behavior (β = −.81, p < .01).

Age of ASD Diagnosis

The one-way between-subjects ANOVA to evaluate the effect of the diagnostic group on the age of ASD diagnosis had the IV as the diagnostic group with two levels: a diagnosis of ASD alone or both ASD and CP. The DV was the age of ASD diagnosis. Levene's test for homogeneity of variance was not significant (F = 3.3, p = .07), ensuring homogeneity of variance. A significant difference was found between groups and age of ASD diagnosis ($F_{(1,47)}$ = 12.10, p = .001). Twenty-one percent of the variability in sleep problems can be attributed to the interaction effect (η^2 = .21). The power of the interaction effect is .93, indicating reasonable interaction. Table 5 presents the means and standard deviations for the age of ASD diagnosis across the two groups.

Discussion

This study has demonstrated several novel findings. Significant differences were found in sleep problems, social communication difficulties, and adaptive behavior levels, across the three groups. The presence of an ID was a significant predictor of adaptive behavior and the age of ASD diagnosis was a significant predictor of the differences between groups.

Children and adolescents across all three groups in this study scored above the mean CSHQ clinical cutoff point of 41 for sleep problems.[65] This suggests that sleep problems are prevalent across individuals with ASD, CP, and comorbid ASD and CP. Indeed, they are more prevalent in this sample than in neurotypical populations. A recent study that examined a large community population found that sleep problems occurred in 22% of children (n = 855) and 20% of adolescents (n = 1047).[80]

The current study also found that the number of sleep problems was significantly greater in the ASD and CP group and the ASD alone group than the CP alone group. These findings should be taken into consideration when diagnosing a child with CP because higher incidences of sleep problems may imply a comorbid diagnosis of ASD. It was also found that the age of ASD diagnosis was a predictor of sleep problems in the ASD alone group. This is an interesting finding that warrants further investigation to develop a more nuanced understanding as to how sleep problems relate to the age at which individuals are diagnosed, their individual characteristics, and ASD traits.

Regarding social communication difficulties, significant differences were found between the CP group and the ASD alone group, and the CP group and those with comorbid ASD and CP group. These results concur with previous research because social communication deficits were prevalent in the ASD population.[76] This finding supports the accuracy of the participants' ASD diagnosis. However, in the current study, a diagnosis of CP did not relate to the presence of social communication difficulties. This finding may be due to the characteristics of the participants with CP, as the frequency of communication limitation of children with CP relates to the clinical subtype of CP, the presence of ID, and poorer gross motor function.[55] However, the findings also suggest that clinicians should be alert to the possibility of a comorbid ASD in children with CP who do present with social communication difficulties. Particularly as co-occurring ASD and CP has been identified in up to 30% of children with CP.[25]

Concerning adaptive behavior, the significant difference between the CP alone group and the ASD alone group suggested that individuals with ASD had lower levels of adaptive behavior levels than those with CP alone. No significant difference was found between the comorbid ASD and CP group and the CP alone group. Further analysis found that ID was a significant predictor of adaptive behavior. This is expected because having a co-diagnosis of ID will increase the burden of impairment for a child. Further research is needed to corroborate this finding.

This study found a significant difference between the ASD alone group and those with comorbid ASD and CP in terms of age of ASD diagnosis. In children with ASD alone average age of diagnosis was 4.92 years, while this was 5.95 years for children with CP. These findings corroborate previous research that found the average age of ASD diagnosis is over 5 years,[81] whereas the mean age of ASD diagnosis for children with CP is 7 years.[26] The delayed age of ASD diagnosis in children with CP may occur through clinicians being misled by the overlapping presentation of symptoms in both conditions.[26] Delayed diagnosis is an important issue because early intervention is imperative for young children with ASD to ensure optimal outcomes.[26]

Fifty-four percent of the total sample in the current study experienced at least one GI symptom. Similar prevalence has been identified regarding feeding problems in 79% of people with ASD,[33] and 89% of individuals with CP populations.[82–84] As GI symptoms are commonly linked to other comorbid disorders, unexplained worsening of nonverbal behaviors in children with ASD and CP, such as sleep problems, self-injurious behavior, anxiety, or other challenging behavior, should encourage clinicians to investigate and treat these GI symptoms.

This study contributes to the literature by examining comparing the symptomatology and developmental functioning in children and adolescents of ASD alone, CP alone, and comorbid ASD and CP. It builds upon the insights of Jiang et al.[61] who examined the similarities and differences between these groups of infants and toddlers.

This study has several limitations. The cross-sectional research design allowed the researcher to compare all the variables at the same time; however, causal relationships between the variables could not be investigated. The interpretation of the study's findings and their generalizability were also limited by the sample size. Another limitation is that the study relied on parental reporting for all data, including the ASD and CP diagnoses. This may be problematic as ASD was not formally out-ruled from children in the CP-only group. However, it is noteworthy that that parental reporting has been found highly concordant with clinical diagnosis[85] and a score of above 15 on the SCQ would have alerted researchers to probable ASD symptoms in the CP-only children. Another limitation is that the degree of disability experienced by individuals in the sample was not ascertained. Not having done so makes the interpretation and generalization of the study findings difficult and this may create bias, if the parents of children with relatively more severe disability, and with the presence of comorbid conditions, were more likely to participate in the study than parents of children without these conditions.

Future research needs to replicate Jiang et al.,[61] and the current study, to corroborate these findings. This research should formally confirm the diagnoses of participants and ideally use larger samples to examine the sex and age of individuals sampled in the three groups, including the degree of physical and ID. Population-based studies in particular would also allow for the generalization of findings. Future knowledge could also be expanded using longitudinal research design to investigate the symptoms arising from comorbid conditions, to ascertain how they are experienced by individuals with ASD and CP, and how they impact the developmental functioning of young, middle-aged, and older adults, across their lifespan.

This study investigated the frequency of comorbid conditions including GI symptoms, sleep problems, challenging behavior, social communication difficulties, and adaptive behavior within a sample of children and adolescents with ASD, CP, and those with comorbid ASD and CP. The findings suggest there are significant differences between the groups regarding sleep problems, social communication difficulties, and that the presence of an ID significantly predicted levels of adaptive behavior. It also found that symptoms of these comorbid conditions in individuals may hinder the diagnostic process of ASD with co-occurring CP. These findings are important to inform clinicians, facilitate accurate and timely diagnosis, and provision of early intervention for individuals with ASD and CP.

Disclosure Statement

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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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