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# Behavioral Disorders in Unilateral and Bilateral Cerebral Palsy: A Comparative Study

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### ABSTRACT

This study sought to compare behavioral patterns between clinical groups of children who had cerebral palsy and a control group with typically developing. 262 children (age range 6 and 10 years, M = 5.74 years; SD = 1.82) participated in this study (61 clinical; 201 control). The Child Behavior Checklist, a widely used tool for assessing behavioral and emotional problems in children, and the Raven's Colored Progressive Matrices Test, a non-verbal intelligence test, were used to assess the children. Data analysis was done with descriptive and inferential statistic techniques. Student t-tests have shown significant differences between groups. The primary behavioral disorders found in the clinical groups were Social Problems and Aggressive Behaviour.

#### **Keywords**

Cerebral Palsy, Behavioral Disorders, CBCL, Social regulation.

#### Introduction

Cerebral palsy (CP) is a non-progressive neurological syndrome characterized by variable motor impairments resulting from brain alterations during critical developmental stages [1]. The clinical diagnosis of CP is primarily based on its motor manifestations, which are classified through comprehensive physical and neurological assessments [2].

Research on CP underscores the necessity for a multidisciplinary approach in clinical practice involving experts from pediatrics, neurology, and rehabilitation. This collaboration is essential to avoid fragmented assessment and intervention strategies. Consequently, further investigation is warranted to understand the impact of CP on cognitive and behavioral development, which is crucial for enhancing rehabilitation outcomes [3,4].

Motor disorders such as CP can significantly hinder children's social and emotional development [5], potentially leading to a higher prevalence of behavioral problems among affected children. Mobility delays restrict the ability of these children to explore

their environments actively, hindering their spatial awareness and independence critical components of social learning [6,7]. Baker et al. [8] found that children with developmental delays exhibit higher rates of comorbidities, including behavioral disorders, compared to their typically developing peers.

Several studies have highlighted the association between CP and behavioral issues [9,10]. Findings converge on a notably higher prevalence of behavioral changes in children with CP relative to their typically developing counterparts. Developmental disorders may elevate the risk of behavioral problems emerging during childhood and adolescence [11,12]. The prevalence of behavioral and emotional disorders among children with CP varies widely, estimated to range from 30% to 80% [16]. Other studies have reported a similar prevalence of behavioral problems, around 40-50% [5,14]. Parkers et al. [15] utilized the Strengths and Difficulties Questionnaire (SDQ) to assess the prevalence and types of psychological disorders in children with CP, revealing that peer interaction difficulties (32%), hyperactivity (31%), emotional disorders (29%), and behavioral problems (17%) were the most commonly reported issues. Furthermore, evidence indicates that children with CP are at an elevated risk for behavioral problems, particularly externalizing behaviors [15]. A study by BrossardRacine et al. [5] found that socioeconomic factors do not significantly influence behavioral problems; parental stress is a significant variable. Typical behavioral profiles include ADHD, with children with CP facing heightened risks for conduct issues, peer difficulties, and hyperactivity [16,17].

Comparative studies examining children with CP alongside typically developing peers are instrumental in elucidating behavioral and cognitive changes. However, the heterogeneous nature of CP resulting from brain lesions in various regions necessitates research focused on the specificities of the condition. Evidence suggests that alterations in frontal brain areas may lead to cognitive and behavioral deficits. Executive function impairments can directly affect children's self-regulation and social behavior. Whittingham et al. [18] found that children with CP exhibit deficits in social skills and emotional regulation compared to their typically developing peers. Neuroimaging studies, such as those by Rogers and De Brito [19], identified structural differences between youths with typical behaviors and those with disruptive behavior problems, revealing deactivations in frontal and limbic regions [20]. Although neuroimaging results provide valuable insights, they are not widely accessible for diagnostic assessments in clinical practice.

Cognitive deficits significantly impact executive functions, which in turn affect social skills. Impairments in executive functions among children with unilateral and bilateral CP have been associated with behavioral problems [21-23]. These findings align with executive functioning theory, highlighting the role of these functions in self-regulating behavior and enhancing social skills.

This study aims to investigate specific behavioral profiles of different types of CP. This research aims to demonstrate that behavioral changes may be linked to clinical conditions varying according to CP classification and the specific brain areas affected. We hypothesize that children with behavioral problems will be more prevalent in the bilateral CP group compared to typically developing children and those with hemiplegic CP. This hypothesis is grounded in the relationship between bilateral CP and anterior subcortical frontal lesions, which may contribute to more significant deficits in social behavior. Assessing behavioral features can empower parents and healthcare practitioners including nurses, physiotherapists, physicians, and psychologists to devise new strategies for addressing children with CP's most common behavioral challenges.

#### Materials and Methods Design

This study utilized a cross-sectional design to compare cognitive and behavioral profiles between a clinical group of children with cerebral palsy (CP) and a control group of typically developing children (TD).

## Participants

Two children participated in the study: a clinical group of children with CP and a comparison group of typically developing children (see Table 1). The CP group was recruited from a significant rehabilitation facility in a large state capital in Southeast Brazil, which serves approximately 400 children. A total of 35 children with CP were included, of which 21 (60%) were male. The participants' ages ranged from 6 to 10 years (mean age = 7.49, SD = 1.29). Children in this group had diagnoses of spastic unilateral (hemiplegia) or bilateral (diplegia) CP, as confirmed by an assistant neurologist. A total of 27 children with CP were excluded due to diagnoses of spastic quadriplegia, intellectual disabilities, uncorrectable visual or auditory impairments, or difficult-to-control epilepsy.

The TD group consisted of 65 children (33 male) aged 6 to 10 years (mean age = 6.94, SD = 0.80), all enrolled in regular schools. All TD participants demonstrated average intelligence and had no history of significant neuropsychiatric or neurosensory impairments.

 Table 1: Descriptive data of the control and clinical groups.

Group	Sex		Age (years)			
	Female	Male	Mean	SD	Range	
Bilateral	15(55.6%)	12(44.4%)	7.41	2.43	4 to 12	
LH	09(47.4%)	10(52.6%)	7.74	3.76	4 to 18	
RH	07(46.7%)	08(53.3%)	6.40	1.40	5 to 9	
Control	89(44.3%)	112(55.7%)	5.28	1.07	4 to 9	
Total	120(45.8%)	142(54.2 %)	5.74	1.82	4 to 18	
Legend: Bilateral (Diplegic); LH = Left Hemiplegia/Unilateral;						

RH = Right Hemiplegia/Unilateral

## Instruments

- 1. Intelligence: The Brazilian-validated version of Raven's Coloured Progressive Matrices [24] was used to estimate general fluid intelligence. For analysis, individual age-normed z-scores were calculated.
- 2. Child Behavior Checklist (CBCL): Behavioral problems were assessed using the Brazilian-validated version of the CBCL [25]. Mothers of the children responded to the scale. The CBCL is a widely used instrument for evaluating social competence and behavioral problems in children aged 6 to 18. Scores for internalizing and externalizing disorders are generated, with corresponding DSM diagnoses [26]. This study employed 113 items assessing behavioral issues and generating scores across eight subscales: Withdrawal, Somatic Complaints, Anxiety/Depression, Social Problems, Thought Problems, Attention Problems, Delinquent Behavior, and Aggressive Behavior. The CBCL has been effectively used to assess behavior and social functioning in children with CP [13,27].

## Procedures

Informed consent was obtained from the mothers, and oral assent was secured from the children. The research project received prior approval from the local research ethics board and adhered to the Helsinki Declaration regarding research ethics with human participants. Mothers of children in the CP group completed the CBCL during an interview conducted at the rehabilitation center, while mothers of TD children filled out the CBCL in written form. The primary researcher and a trained research assistant with a background in psychology collected all the data.

#### **Data Analyses**

Data analysis was conducted using SPSS 25.0. Initial analyses assessed potential age differences between groups using oneway ANOVA, while gender frequency differences were evaluated with chi-square tests. Comparisons of intelligence z-scores from the Raven's Coloured Progressive Matrices were also conducted using ANOVA. The chi-square test was used to identify behavioral problems above the cutoff point on each CBCL scale. As outlined in the instrument's handbook, descriptive statistical techniques were employed to determine the percentage of children exceeding the cutoff point for each subscale. Additionally, independent samples t-tests were performed to identify significant differences between groups. Pearson's correlation analysis assessed the correlation between intelligence and behavioral problems. The reliability of the Brazilian version of the CBCL was evaluated using Cronbach's alpha and the Spearman-Brown split-half coefficient.

#### Results

Before group comparisons, we rigorously assessed the psychometric properties of the Child Behavior Checklist (CBCL) within our sample. Reliability analyses yielded a Cronbach's alpha of 0.91 and a Spearman-Brown coefficient of 0.86, confirming the high reliability of the instrument for our study participants. Further analysis was conducted to examine the correlation between behavioral and intelligence assessments. Pearson's correlation coefficients revealed weak and non-significant correlations between intelligence scores and key CBCL metrics: Total Score (r = -0.09; p = 0.45), Externalizing Scale (r = -0.07; p = 0.53), and Internalizing Scale (r = -0.08; p = 0.49). Consequently, there was no need for additional statistical techniques to control for intelligence's effect on behavioral outcomes. Comparative analysis between the clinical subgroups and the control group demonstrated significant differences in intelligence, particularly between children with bilateral CP and the control group (t = -6.20; p < 0.001) and between children with right unilateral CP and the control group (t = -4.03; p = 0.001).

 Table 2: Descriptive analysis of the Raven's percentile results for each study group.

	n	Minimum	Maximum	Mean	SD
Bilateral	27	1	60	23.20	18.76
RH	19	5	95	32.00	25.27
LH	15	5	80	25.67	24.54
Control	201	10	99	53.35	33.98
Total	262	1	90	47.82	33.71

**Legend:** Bilateral (Diplegic) LH = Left Hemiplegia/Unilateral; RH = Right Hemiplegia/Unilateral.

Behavioral assessments indicated that children with CP exhibited the highest prevalence of behavioral problems, as summarized in Table 3. Descriptive analyses highlighted that behavioral disorders were most frequently reported in the following subscales: Social Problems, Delinquent Behavior, and Aggressive Behavior. Notably, all three types of CP showed elevated rates of Social Problems. Hemiplegic children displayed a greater frequency of behavioral issues compared to those with other forms of CP, with only children with bilateral CP scoring above the cut-off on the Anxious/Depressive scale. Furthermore, children with left unilateral CP uniquely scored above the cut-off for Attention Problems, indicating specific behavioral deficiencies within that subgroup. Given that bilateral CP is associated with more severe motor impairments, this may account for the higher prevalence of behavioral challenges observed.

**Table 3:** Percentages of children with cerebral palsy with behaviour problems above the cut-off points on the CBCL scales.

	Bilateral (%)	LH (%)	RH (%)
Anxious/Depressive	11.8	-	-
Withdrawn	23.5	9.1	-
Somatic Complaints	17.6	18.2	20.0
Social Problems	41.2	36.4	40.0
Thought Problems	5.9	18.2	20
Attention Problems	-	9.1	-
Delinquent Behaviour	17.6	18.2	20
Aggressive Behaviour	17.6	27.3	40

**Legend:** Bilateral (Diplegic); LH = Left Hemiplegia/Unilateral; RH = Right Hemiplegia/Unilateral.

Statistically significant differences were found when comparing means between the CP and control groups for Social Problems (t = -3.481; p = 0.001), Delinquent Behavior (t = -2.293; p = 0.024), and Aggressive Behavior (t = -2.44; p = 0.01), as detailed in Table 4. Additionally, significant differences were observed in the Externalizing Scale (t = -3.22; p = 0.002) and the Total CBCL Score (t = -3.07; p = 0.003).

**Table 4:** Comparison of the CBCL Total score between children in the control and clinical groups using Student's t-tests.

	Control (n=201)		CP (n=61)			
	Mean	SD	Mean	SD	t	Р
Anxious/Depressive	5.9	4.0	6.1	3.0	-0.269	0.789
Withdrawn	3.0	2.5	3.0	2.3	0.000	1.000
Somatic Complaints	3.2	2.8	3.4	2.4	-0.338	0.736
Social Problems	5.6	3.6	8.2	3.1	-3.481	0.001*
Thought Problems	3.3	2.3	3.8	3.1	-0.897	0.373
Attention Problems	5.1	3.2	5.1	2.9	-0.650	0.949
Delinquent Behaviour	3.0	2.7	4.3	2.4	-2.293	0.024*
Aggressive Behaviour	8.3	5.3	11.2	7.5	-2.059	0.043*
<b>Legend:</b> CP= Cerebral Palsy; * $p \le 0.05$						

Within subgroup analyses, children with unilateral CP showed significant differences in Social Problems (p = 0.002), Aggressive Behavior (p = 0.01), and Attention Problems (p = 0.008) compared to controls. Left Hemiplegia CP children also exhibited significant differences in Social Problems (t = -3.09; p = 0.007), Attention Problems (t = -2.34; p = 0.03), Externalizing Scale Score (t = -2.34;

p = 0.03), and Total Score (t = -2.45; p = 0.03). In contrast, only the Social Problems subscale (t = -2.64; p = 0.01) showed significant differences when comparing Diplegic CP children to controls.

## Discussion

Behavioral disorders significantly impact the psychosocial development of children and can adversely affect family quality of life and psychosocial adjustment [28]. Such challenges can hinder educational experiences and social interactions, often correlating with increased family stress [29,30]. Understanding the behavioral profiles of children with cerebral palsy (CP) is critical for developing effective interventions that promote their well-being and development. This study examined the primary behavioral issues faced by children with unilateral and bilateral CP, comparing them with typically developing peers. Our findings reveal significant differences in behavioral disorders, particularly in Social Problems, Delinquent Behavior, and Aggressive Behavior subscales. This aligns with previous research indicating heightened behavioral issues among children with developmental disorders [31].

Parkers et al. [15] similarly reported a higher prevalence of behavioral problems in children with CP compared to their typically developing counterparts, particularly concerning peer interaction (32%) and hyperactivity (31%). Our results corroborate these findings, with children with CP demonstrating elevated levels of Social Problems, Anxiety/Depression, Attention Problems, and Thought Problems. Furthermore, the increased risk of ADHD and other externalizing behavioral problems in children with CP is well-documented [32]. Cerebral palsy (CP) is a complex neurological condition resulting from early brain injuries, affecting not only mobility but also the cognitive and behavioral functions of children. Studies such as those by Gulati and Sondhi [33] emphasize the need for a deeper understanding of the specific cognitive and behavioral changes associated with CP. While the review presented is comprehensive, it overlooks the importance of understanding the emotional and behavioral difficulties often accompanying the condition. Recent research, such as that by Belmonte-Darraz et al., demonstrates that children with CP face significant challenges in emotional regulation, closely related to their ability to attribute thoughts and intentions to others, a concept known as "theory of mind." These difficulties can result in psychosocial adjustment problems, negatively impacting their social interactions and quality of life. The study by Adegboye et al. [34] confirms that the motor severity of CP may be associated with poorer social skills, highlighting the interrelationship between motor function and emotional and social competencies. Moreover, difficulties in forming friendships and experiences of bullying victimization have been identified as predictors of higher psychiatric conditions among children with CP. This suggests that social exclusion and negative interactions may exacerbate behavioral issues, underscoring the need for interventions that address not only physical limitations but also emotional and social support.

prevalence of mental disorders among children with CP, especially those living in non-traditional family settings or with cognitive disabilities. These findings emphasize the importance of considering the family and social context when addressing the needs of children with CP. Additionally, Levy-Zaks et al. found that children with CP experience more emotional and behavioral symptoms, such as depression and anxiety, compared to their siblings. This indicates that the implications of CP extend beyond physical difficulties, affecting psychological well-being and quality of life. Finally, research by Gosling [35] suggests that executive functions (EF) play a crucial role in the social interaction and behavioral development of children with CP. The interaction between deficits in EF and social problems can create a negative feedback loop, where difficulties in social skills limit participation in activities, consequently hindering the development of new skills. Therefore, clinical assessments must consider executive functions as a determining factor in the adaptation and behavior of children with cerebral palsy. In summary, the discussion surrounding cerebral palsy should extend beyond motor issues, encompassing the complexity of emotional and behavioral difficulties. Understanding the interactions between motor, cognitive, and social deficits is fundamental to developing effective interventions and promoting a better quality of life for these children.

The observed behavioral issues may be indicative of underlying executive function deficits. Previous studies suggest that children with early focal brain damage, such as that seen in CP, are at a heightened risk for developing social problems [36]. Our hypothesis posits that executive function impairments contribute to behavioral problems like delinquency and aggression. Externalizing behavior patterns are often associated with ADHD and similar disorders [37], and deficits in executive function may exacerbate these issues. While our findings highlight the behavioral challenges children with CP face, limitations exist. Notably, the reliance on caregiver reports for the CBCL may not fully capture the child's behavioral spectrum. Additionally, the absence of neuroimaging data restricts our ability to associate specific behavioral profiles with structural brain lesions.

The neurofunctional characteristics of CP arise from brain injury patterns, which differentiate various diagnostic classifications. For example, children with spastic diplegia have been found to exhibit more pronounced deficits in executive functions, which may explain their heightened levels of behavioral issues [38]. Our results demonstrate a higher prevalence of behavioral problems among children with bilateral CP, consistent with Beckung and Hagberg's [39] findings of behavioral disorders correlating with severe motor impairments. Behavioral problems in children with CP may influence their quality of life, particularly in physical and psychosocial domains [40]. The interplay between behavioral issues and emotional well-being underscores the need for targeted interventions that address both motor impairments and associated behavioral challenges [41].

The results from Rackauskaite et al. [9] revealed an alarming

Interestingly, children with CP who exhibit higher levels of

prosocial behavior report better quality of life across multiple domains [41]. This suggests that fostering prosocial skills may be vital for enhancing overall well-being in this population. Ultimately, while our findings identify behavioral limitations across all types of CP, further research into the determinants of these profiles could inform interventions. Identifying Social Problems as a common behavioral issue among the three investigated CP types highlights the importance of tailoring interventions to address specific behavioral challenges. Future studies should explore the relationship between clinical conditions, neurocognitive alterations, and environmental factors to develop comprehensive intervention strategies.

## Conclusion

In conclusion, our study emphasizes the need for a multidimensional approach to addressing the behavioral profiles of children with CP. By understanding the interplay of neurocognitive and psychosocial factors, healthcare professionals can better support children with CP and their families, ultimately enhancing their quality of life.

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