

Exploring Motor Coordination And Cognitive Performance In Children With Attention Deficit Hyperactivity Disorder: Insights From Assessment

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ABSTRACT

This study focuses on investigating the severity distributions, cognitive and motor coordination performance characteristics and examine the demographic groups among children with Attention-Deficit/Hyperactivity Disorder (ADHD).

This cross sectional observational study was conducted over six months at A.C.S Medical College and Hospital, Let's speak Multispecialty and Rehabilitation center, and My First Steps, Pediatric Physiotherapy clinic. The time frame for this study was between June 2025 and November 2025.

A total of 230 children with a diagnosis of ADHD between the ages of 7 and 12 years were included in this study. The cognitive-coordination abilities of each child were measured using the Developmental Coordination Disorder Questionnaire (DCDQ) and the Trail Making Test (TMT) - Child Modified Version. Each child was categorized according to age, gender, and subtype of ADHD (Inattentive, Hyperactive-Impulsive, Combined).

The statistical analysis of the data collected from these cognitive and coordination tests indicated that boys are more affected by coordinate deficits than girls. Children aged between 9 - 10 years are more likely to exhibit poor coordination scores than children of either younger or older ages. Children with Combined subtype of ADHD are more impaired in their cognitive and motor skills compared to those with other subtypes.

This study successfully highlighted the prevalence of and the distribution of cognitive-coordination difficulties among children with ADHD. Thus findings helped to contribute to the knowledge of the developmental skills of children with ADHD, and their potential need for intervention or rehabilitation.

Keywords: Attention Deficit Hyperactivity Disorder, Executive Function, Developmental Coordination Disorder, motor Skills, Neuropsychological Tests.

INTRODUCTION

Developmental Coordination Disorder (DCD) and Attention-Deficit/Hyperactivity Disorder (ADHD) are two of the most common diagnoses made of children with neurodevelopmental disorders. While the symptoms of ADHD typically include difficulties with attention, hyperactivity, and impulsivity, there are also symptoms associated with deficits in motor coordination. ¹

Often, the motor coordination deficiencies of ADHD are ignored during the diagnostic process of ADHD (due to their omission from diagnostic manuals like the DSM-5 or ICD-11).

² However, a growing body of literature indicates a substantial overlap between ADHD and DCD: several studies estimate that approximately 30–50% of children with ADHD meet criteria for comorbid DCD or display significant motor deficits. ³ Some clinical samples even suggest a co-occurrence rate of around 50%. ²

These coordination difficulties are not trivial: children with ADHD + DCD tend to perform worse not only in gross and fine motor tasks (e.g., balance, writing, sports) but also in daily activities that require motor coordination, such as self-care, play, and participation in school-related tasks. ¹ Moreover, such co-occurrence is associated with more pronounced functional impairment including poorer performance in activities of daily living (ADL), reduced participation in physical activities, and lower overall quality of life compared with children who have only ADHD or only DCD. ¹

Beyond purely motor difficulties, the overlap between ADHD and DCD may reflect shared or interacting neurodevelopmental mechanisms. The “shared etiology” hypothesis posits that ADHD and DCD may arise from common neurobiological substrates such as atypical brain development leading to deficits across attention, executive control, and motor coordination. ⁴ Neuroimaging and functional connectivity studies (though still limited) support the possibility that neural circuits underlying motor planning, execution, and coordination may also contribute to attentional and executive function deficits typical of ADHD. ⁴

Despite this growing understanding, several gaps remain. First, many studies rely on either parent-report

measures (e.g., questionnaires) or standard motor tests but few integrate both subjective (questionnaire-based) and objective (performance-based) assessments of cognitive-motor integration. Second, there is a lack of studies investigating the coordination deficits among subgroups of children with ADHD. Most of the research on the topic of coordination deficits in children with ADHD has been conducted on populations of Western nations. There is a dearth of literature on coordination among children with ADHD from low- and middle-income nations such as India.

Thus, there is an evident need for studies investigating the prevalence and severity of coordination deficits among children with ADHD from diverse demographic subgroups. The aim of the present study is to investigate the cognitive-coordination abilities of children with ADHD from India using standardized questionnaires and tests. Furthermore, the study intends to investigate whether any differences exist in relation to age, gender, and subtype of ADHD among the children with ADHD included in the study. The identification of coordination deficits among children with ADHD can aid in the development of rehabilitation strategies to address such deficits, management of ADHD, and improving the lives of those with ADHD.

METHODS

The present study is a cross-sectional observational study that was conducted over a period of six months from June 2025 to November 2025 at A.C.S Medical College and Hospital, Let's Speak Multispecialty and Rehabilitation Centre, and My First Steps Pediatric Physiotherapy Clinic.

The study was performed in accordance to the ethical principles which are applicable to the research involving the human participation and was conducted according to the STROBE recommendations.

A total of 230 children with a diagnosed case of ADHD between the ages of 7 and 12 years were included in the study through purposive sampling techniques. Inclusion criteria for the study included meeting DSM-5 criteria for ADHD and being able to understand and follow instructions given to the children. Children with any form of neurological, musculoskeletal, intellectual, or neurodevelopmental disorders (such as autism) or those with a history of brain injury were excluded from the study.

The cognitive-coordination abilities of the children were measured using the Developmental Coordination Disorder Questionnaire (DCDQ) and the Trail Making Test (TMT) - Child Modified Version (TMT-C). Information regarding the demographics of the children was also recorded and used to classify the children according to age groups (7-8, 9-10, and 11-12 years), gender, and subtype of ADHD. The DCDQ questionnaires were completed by the parents of the children with ADHD, while the children with ADHD were individually assessed using the TMT-C. Each assessment took approximately 25-35 minutes to complete.

Ethical approval was obtained from the Institutional Ethics Committee of A.C.S Medical College and Hospital. Informed consent was obtained from the parents/guardians of the children in the study. Written informed consent was also obtained from the parents or legal guardians of the participating children and assent was obtained from the children to participate in the study. The data was handled in a way that ensured the privacy of the children, and the assessments were performed in a non-invasive manner.

STATISTICAL ANALYSIS

All data were scored according to standardized guidelines and verified by two independent examiners. Statistical analysis was performed using SPSS, employing descriptive statistics, chi-square tests for associations between coordination impairments and demographic variables, and ANOVA for comparing ADHD subtype differences, with significance set at $p < 0.05$.

Table 1: Descriptive statistics showing gender distribution of total study population.

Gender	N	Minimum	Maximum	Mean (DCDQ)	SD	Skewness
Boys	151	28	64	44.35	8.12	+0.40
Girls	79	31	63	46.70	7.85	+0.37
Total	230	28	64	45.16	8.03	+0.39

The above table indicates that Boys formed the higher proportion of the population, with slightly lower mean DCDQ scores compared to Girls, indicating greater coordination difficulties.

Figure 1: Gender Distribution of Study Population

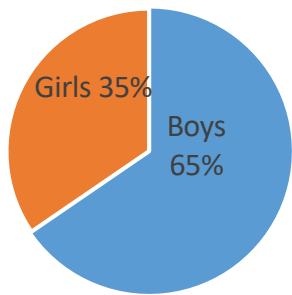


Table 2: Descriptive statistics showing age-wise distribution

Age Group (Years)	N	Percentage (%)
7–8 years	63	27.4%
9–10 years	113	49.1%
11–12 years	54	23.5%
Total	230	100%

The above table indicates that the largest representation was the 9–10 age group.

Figure 2: Age-wise Distribution

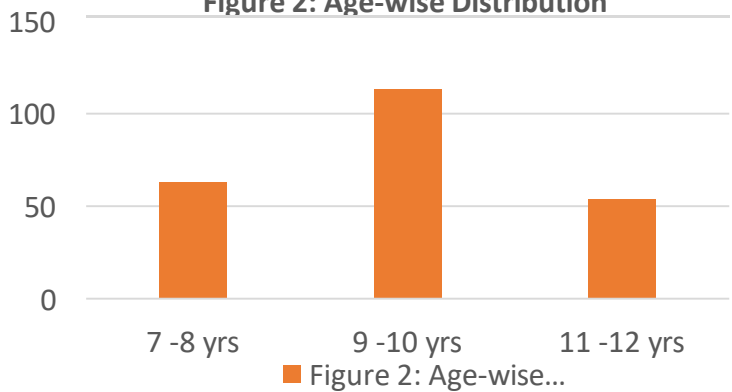


Table 3: Distribution of ADHD subtypes

ADHD Subtype	N	Percentage (%)
Inattentive Type	69	30%
Hyperactive–Impulsive Type	50	21.7%
Combined Type	111	48.3%
Total	230	100%

The above table indicates that the Combined Type was the most common subtype among participants.

Figure 3: Distribution Of ADHD Subtypes

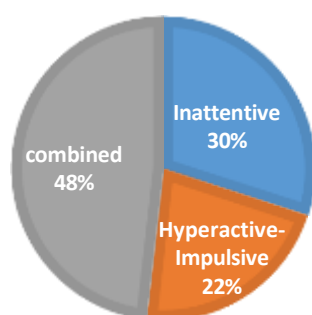


Table 4: Statistics of mild coordination impairment (DCDQ)

Group	N	Min	Max	Mean	SD	Skewness
Boys	53	42	64	54.35	6.40	–0.10
Girls	31	43	63	55.25	6.12	–0.14
Overall	84	42	64	54.70	6.29	–0.12

The above table indicates a considerable proportion of participants fell under mild impairment.

Table 5: Statistics of moderate coordination impairment (DCDQ)

Group	N	Min	Max	Mean	SD	Skewness
Boys	61	34	48	41.10	4.25	+0.22

Girls	31	36	49	42.05	4.18	+0.20
Overall	92	34	49	41.45	4.23	+0.21

The above table indicates moderate impairment remained the most common deficit category.

Table 6: Statistics of severe coordination impairment (DCDQ)

Group	N	Min	Max	Mean	SD	Skewness
Boys	37	28	33	30.35	1.58	+0.18
Girls	17	29	33	30.85	1.50	+0.16
Overall	54	28	33	30.56	1.54	+0.17

The above table indicates severe deficits were present among the smaller proportion sample.

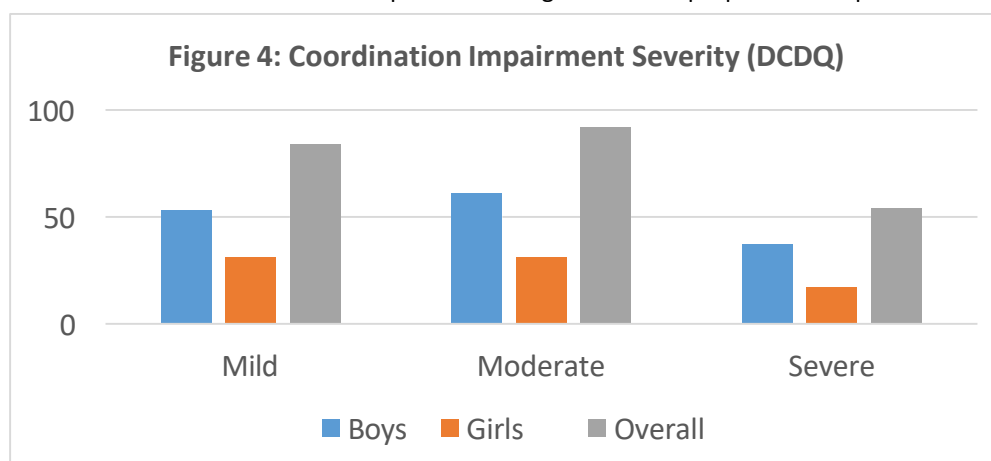
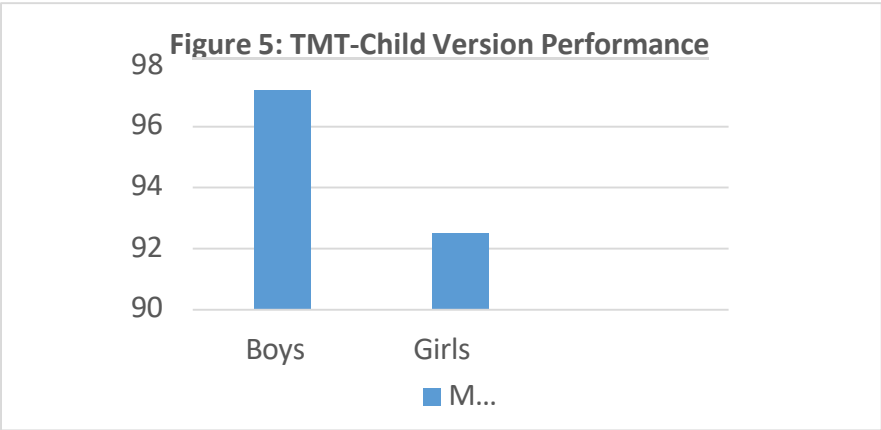


Table 7: Statistics of TMT-Child Version performance (Trail Completion Time in seconds)

Group	N	Min (sec)	Max (sec)	Mean (sec)	SD	Skewness
Boys	151	42	158	97.20	21.10	+0.54
Girls	79	40	150	92.50	20.00	+0.48
Overall	230	40	158	95.65	20.78	+0.51

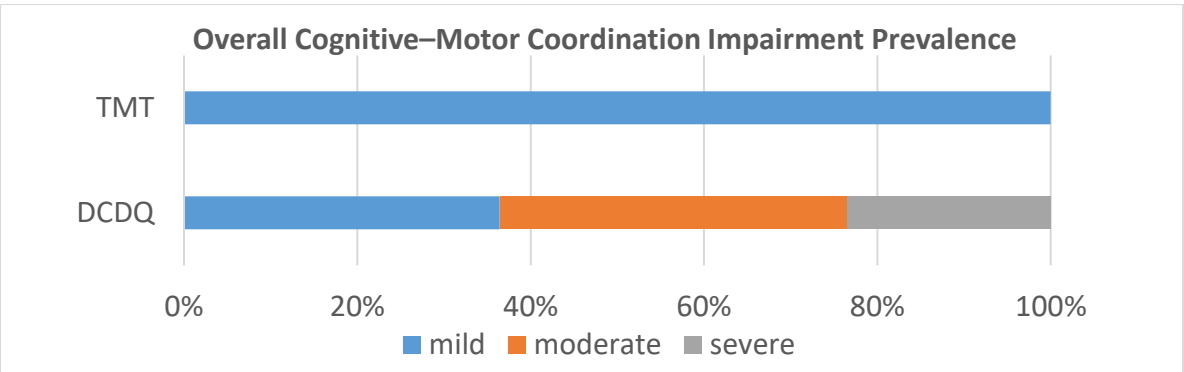
The above table indicates that the Boys showed weaker cognitive-motor integration, due to longer

completion times.



Overall Cognitive–Motor Coordination Impairment Prevalence

Assessment Tool	Impairment Category	N (out of 230)	Percentage (%)
DCDQ (Motor Coordination)	Mild	84	36.5%
	Moderate	92	40.0%
	Severe	54	23.5%
Total DCDQ Impairment	Overall Affected	230	100%
TMT–Child Version (Cognitive-Motor Speed)	Slower-than-age norms	230	100%
Combined Overall Impairment	(DCDQ + TMT)	230	100%



RESULT

The 230 respondents who participated in this study consisted of 151 boys (65.7%) and 79 girls (34.3%). Regarding the age distribution in the study, 63 (27.4%) were aged 7 to 8 years, 113 (49.1%) between 9 and 10 years and 54 (23.5%) between 11 and 12 years.

Concerning their ADHD symptoms, 69 (30.0%) of the participants had symptoms of the Inattentive Type of ADHD, 50 (21.7%) had symptoms of the Hyperactive-impulsive Type of ADHD and 111 (48.3%) had symptoms of the Combined Type of ADHD.

Of the participants, 84 (36.5%) had mild coordination impairment and 92 (40.0%) had moderate coordination impairment and 54 (23.5%) had severe coordination impairment according to the DCDQ classification system.

The average time (in seconds) that it took for participants to complete the TMT-Child test was 95.65 seconds. The boys on average required 97.20 seconds to complete the task, the girls on average required 92.50 seconds to complete the same task.

DISCUSSION

This cross-sectional study examined the motor coordination and cognitive performance among 230 children aged 7–12 years with ADHD. The principal findings found that coordination difficulties were common in the study population. Where moderate coordination impairment represented the largest DCDQ category, and boys had lower mean of DCDQ scores and longer mean TMT-C completion times than girls. The combined ADHD presentation was also the most frequently represented presentation in the sample.

The present study found that 36.5% of participants were classified as mild, 40.0% as having moderate, and 23.5% as having severe coordination impairment according to the study's DCDQ classification. Each of these percentages are in accordance with recent studies that show that between 50 and 60% of children with ADHD have coordination difficulties according to the DCD-Q questionnaire provided to their parents. The predominance of moderate impairment suggests that motor difficulties may not be limited to a small subgroup of children with ADHD.

A diagnosis of DCD requires consideration of developmental history, functional impact, standardized motor assessment, and exclusion of other explanations for motor difficulties. In addition to these results, it is generally well known within the scientific community that children with ADHD have poorer coordination abilities than typically developing children. 5

The relatively lower mean DCDQ score observed among boys compared with girls is also noteworthy. Boys constituted 65.7% of the sample, and their mean DCDQ score was approximately 2.35 points lower than that of girls. However, sex differences in ADHD populations can be influenced by referral patterns, symptom presentation, sampling characteristics, and differences in recognition of symptoms.

The combined ADHD presentation accounted for almost half of the sample (48.3%). The original study hypothesis proposed that children with the combined presentation would have greater cognitive and motor difficulties than children with other presentations.

The TMT-C findings provided that the overall mean completion time was 95.65 seconds, and boys required longer to complete the task than girls. Furthermore, that 96.48 seconds mean to complete the Trail Making Test indicates that children with ADHD have a compromised cognitive-motor skill performance, which is also correlated with ADHD itself. 6

An important strength of the present study is the use of both a parent-reported motor coordination measure and a direct performance-based cognitive task. The DCDQ provided information about motor performance as observed in an everyday context, whereas the TMT-C provided a standardized task-based measure of cognitive performance. Combining these perspectives the study provided a broader understanding of the difficulties experienced by children with ADHD. In spite of the limitations and recommendations, the study provided valuable input to the existing body of literature and provided a basis to future research that can help to optimize assessment and management strategies for children with ADHD.

CONCLUSION

Children with ADHD showed moderate motor coordination problems among DCDQ category. Boys scored lower on the DCDQ mean and longer on the TMT-C completion time mean than girls population.

The results underscored the possible merit of integrating the motor coordination and cognitive-performance screening into the multi-disciplinary evaluation of ADHD children. The early detection of motor and cognitive impairments of children with ADHD can help to implement individual rehabilitation, therapeutic approaches, educational support and other measures that will assist in enhancing their functional participation.

Although limited in scope, this research study adds to the existing literature on the topic, and creates the groundwork for future studies on the topic of ADHD and coordination difficulties.

CONFLICT OF INTEREST

Authors declared no conflicts of interest for this study.

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