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RESEARCH ARTICLE

Prevalence Of Developmental Coordination Disorder And Its Association With Cardiorespiratory Fitness In School Children Aged 6–12 Years In Bangalore, India

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Abstract: ***Background***: Developmental Coordination Disorder (DCD) is a neurodevelopmental condition that impairs motor coordination and affects daily life and physical health posing considerable health risks to children. While studies globally have linked DCD with poorer cardiorespiratory fitness (CRF), data from urban Indian populations are limited. Objective: This study aimed to assess the prevalence of DCD in school children aged 6–12 years in Bangalore, India, and examine its association with CRF. ***Methods:*** A total of 800 children were screened for DCD using the Developmental Coordination Disorder Questionnaire (DCDQ'07). Children who screened positive underwent further evaluation with the Movement Assessment Battery for Children (MABC-2) and DSM-5 criteria for diagnosis. CRF was assessed via the 20-meter shuttle run test, with resting heart rate and recovery heart rate measured. Demographic data were collected to match the control group of typically developing children. ***Results:*** The prevalence of DSM-5 confirmed DCD was 4.3% (34/800 children). Children with DCD had significantly poorer CRF, including higher resting heart rates (84.21 bpm vs. 80.32 bpm, $p = 0.012$), slower recovery at 1 minute (110.76 bpm vs. 100.79 bpm, $p = 0.001$), and lower predicted VO_2 max (25.97 ml/kg/min vs. 35.58 ml/kg/min, $p = 0.001$). These differences were statistically significant, indicating a clear association between DCD and reduced cardiovascular fitness. ***Conclusion:*** DCD is prevalent in urban Indian children, with significant deficits in cardiorespiratory fitness. Early diagnosis and intervention targeting both motor skills and fitness are essential.

Keywords: Developmental Coordination Disorder, Prevalence, Cardiorespiratory Fitness, DCDQ'07, MABC-2, Urban Indian Children

INTRODUCTION

Developmental Coordination Disorder (DCD) is a neurodevelopmental condition characterized by marked difficulties in acquiring and executing coordinated motor skills, which significantly interferes with daily activities and academic achievement (Harris et al., 2015 and Indra Adi Budiman et al., 2025) Globally, the prevalence of DCD in children is estimated at around 5% (95% CI: 4%–7%) with variation by region, sex, and birth circumstances. (Blank et al., 2019) Compared with the global average (5%) and North America (6%), the estimate for Asia is somewhat lower (4%), but the confidence interval is wide (2–8%), reflecting substantial uncertainty. (Li et al., 2024) This pattern likely reflects the limited number of Asian epidemiological studies, heterogeneity in sampling and measurement (including the use of different cut-offs and tools not always culturally normed), and probable under-recognition of DCD in clinical and educational settings, rather than a clearly lower underlying incidence. In India, Girish et al. (2016) found a prevalence of 0.8% among 6–15-year-old children in southern India using a two-stage procedure in which children were first screened with the Kannada version of the DCDQ'07 and then underwent standardized motor assessment, with DCD diagnosed only when all DSM-5 criteria were met. (Girish et al., 2016) In contrast, Deshmukh et al. (2024) used the parent-administered DCDQ'07 as a stand-alone screening tool and classified children scoring below the age-specific cut-offs as having suspected DCD, reporting a prevalence of 23.9% in 5–10-year-olds and particularly high rates among preterm and low birth weight children. (Deshmukh et al., 2024) Similar questionnaire-based studies that rely solely on DCDQ'07 and apply inclusive cut-offs have yielded suspected DCD rates of around 10–15% in Indian school samples (Attarde et al., 2022). Together, these findings suggest that strict DSM-5 diagnostic confirmation produces conservative prevalence estimates, whereas parent questionnaire screening with less stringent criteria identifies a much larger group of children with motor difficulties, which contributes to the wide range of prevalence figures reported from Asian settings. Equally important is the association between DCD and health outcomes beyond motor coordination. One such outcome is cardiorespiratory fitness (CRF), which reflects the ability of the cardiovascular and respiratory systems to supply oxygen during sustained physical activityStudies of children with probable DCD (pDCD) indicate that they have significantly lower CRF compared to typically developing peers. Lower predicted peak VO_2 using the 20-m shuttle run test among 9–14-year-olds with pDCD than those without are already documented (Cairney et al., 2007) . Low CRF in childhood is linked to adverse health trajectories, including obesity, metabolic syndrome, and poorer quality of life (Rivilis et al., 2011). Further studies found that children with pDCD had poorer VO_2 max (estimated via both shuttle run and cycle ergometer) than controls (Cairney et al., 2010). Despite these findings internationally, there is a paucity of data from Indian urban population. Two Indian studies examined cardiorespiratory fitness (CRF) in children with Developmental Coordination Disorder (DCD). One study found lower CRF in children with DCD in Tamil Nadu, using the 20-meter shuttle run test, suggesting increased cardiovascular risk. The second study showed higher BMI and poorer performance on the 5-sit-to-stand and 6-minute walk/run tests, indicating reduced physical capacity. Limitations of both studies include small sample sizes (n=24 and n=20), reliance on indirect fitness measures, which limit generalizability to larger populations. (Sankar & Monisha, 2018; Sujatha et al., 2021) As both previous studies were done in Tamil Nadu, which is the southernmost part of India, other areas are still unexplored. With so much of diversity in health status, culture, socio socioeconomic status in India, we felt there is a clear need to assess other parts of India for the association of DCD with cardio-respiratory parameters. Bangalore, with its diverse socioeconomic strata and increasing awareness of neurodevelopmental disorders, provides a relevant context for examining both prevalence of DCD and the potential cardiopulmonary fitness deficits in affected children. Hence, the current study aimed to assess, among 6-12-year-old school children in Bangalore, (1) the prevalence of DCD using a combination of screening (questionnaire) and diagnostic assessment tools, and (2) to compare cardiorespiratory fitness parameters (resting heart rate, recovery rate, predicted VO_2 max from 20-m shuttle run) between children with DCD and typically developing peers.

MATERIALS AND METHODS

Study Design and Setting

This investigation was designed as an analytical cross-sectional study and was carried out between January and June 2025 in Bangalore, Karnataka, India. Bangalore was selected as the study site because of its heterogeneous urban population, representing children from diverse socioeconomic backgrounds and educational settings. Schools were chosen as the primary recruitment sites since they provide access to a large number of typically developing children as well as those with suspected developmental disorders. The study adhered to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for reporting cross-sectional studies. Ethical clearance was obtained from the Institutional Ethics Committee of Madhav University, Sirohi, India, and permission was secured from the school management boards before data collection. Informed consent was obtained from every class teacher, who, in turn, had already informed the parents well in advance, seeking permission for the same.

Participants

Eligibility criteria.

Children were eligible for inclusion if they were between 6 and 12 years of age (as per the school records, which were based on AADHAR information), enrolled in the selected schools, and had no known neurological, orthopaedic, or sensory impairments that could independently affect motor performance. Children were excluded if they had a diagnosis of cerebral palsy, muscular dystrophy, autism spectrum disorder, intellectual disability, or congenital heart disease, or if they were unable to participate in moderate-intensity physical activity due to medical contraindications.

Sampling technique

Using stratified random sampling, 10 schools were selected from different zones of Bangalore (North, South, East, West, and Central), followed by simple random sampling to select classes within each school, and systematic random sampling to invite all children within the eligible age group from each selected class.

Sample size estimation.

Sample size was calculated using the single population proportion formula. (Egbuchulem, 2023) Based on a global prevalence estimate of 5% for DCD (Li et al., 2024), with a 95% confidence level and ±2% precision, the minimum required sample size was ~760 children. Accounting for a 5% non-response or attrition rate, the final target was set at 800 participants. The 5% global prevalence estimate falls within a confidence interval of 4%–7%, which ensures adequate sample size for accurate inference.

Outcome Measures

Along with the DCDQ'07 for screening and MABC-2 for confirmatory assessment, the DSM-5 criteria for Developmental Coordination Disorder were applied to ensure a comprehensive diagnosis. Children who screened positive on the DCDQ'07 and demonstrated a total MABC-2 score ≤ 5th percentile, or were classified as 'at-risk' (6th–15th percentile), were further evaluated against the DSM-5 criteria, which include significant motor coordination difficulties that impact daily functioning and are not better explained by other conditions. 20-Meter Shuttle Run Test (20mSRT): Conducted according to the Léger protocol (Leger & Lambert, 1982) Children ran back and forth on a 20-meter course at a pace dictated by an audio beep. The speed increased by 0.5 km/h each minute, starting at 8.5 km/h. The test ended when the child failed to reach the line on two consecutive beeps. VO_2 max estimation: The final running speed was entered into Léger's regression equation to estimate maximal oxygen uptake (VO_2 max, in ml/kg/min). Heart rate measurement: Resting heart rate (after 5 minutes seated rest) was recorded using a validated wrist-worn monitor. Recovery heart rate was measured at 1 minute and 3 minutes post-test to assess cardiovascular recovery.

Data Collection Procedure

The data collection procedure for this study involved a systematic sequence of assessments to evaluate DCD and cardiorespiratory fitness (CRF). Demographic data was collected initially, which comprised age, gender, BMI, and academic performance (as a percentage of total marks secured in the last three examinations based on school records). The DCDQ'07 was administered as a screening tool to identify children at risk for DCD. Children who scored below the age-specific cut-off on the DCDQ'07 were referred for further assessment, with the following cut-offs: 5–6 years: score < 46, 7–8 years: score < 45, 9–10 years: score < 44, and 11–14 years: score < 42. Children screening positive on the DCDQ'07 underwent the MABC-2 (Movement Assessment Battery for Children - Second Edition) to assess motor coordination through a series of standardized tasks. A total score ≤ 5th percentile confirmed a diagnosis of DCD, while scores between the 6th and 15th percentile were classified as "at-risk." The DSM-5 criteria were applied to ensure a comprehensive diagnosis of DCD, confirming that motor coordination difficulties significantly impacted daily functioning and were not better explained by other conditions. To select age-matched normal children for comparison, simple random sampling using the lottery method was employed. Children who did not screen positive for DCD and had no known neurological, orthopaedic, or sensory impairments were randomly selected from the same schools, ensuring they were within the same age range (6–12 years) and from similar socioeconomic backgrounds. The ARNC (age related normal children) group was matched for age, gender distribution, and school environment to minimize confounding factors. After confirming the diagnosis of DCD, cardiorespiratory fitness (CRF) was assessed using the 20-Meter Shuttle Run Test (20mSRT), following the Léger protocol to estimate VO_2 max and assess cardiovascular fitness. Resting heart rate and recovery heart rate were recorded to evaluate cardiovascular health and recovery. This stepwise procedure ensured that motor coordination and CRF assessments were conducted independently, maintaining the integrity and ecological validity of the data.

Statistical Analysis

Descriptive statistics were computed for all variables, including demographic characteristics (age, gender, BMI, and academic performance), as well as the primary outcome measures (DCD status and cardiorespiratory fitness parameters). Continuous variables were summarized using means and standard deviations, while categorical variables were expressed as frequencies and percentages.

To assess the prevalence of Developmental Coordination Disorder (DCD), the proportion of children who screened positive on the DCDQ'07 and were confirmed with the MABC-2 assessment was calculated. The diagnosis was further validated using the DSM-5 criteria for DCD, and a comparison of the prevalence rates was made between the study population and previously reported figures in other regions.

The comparison of cardiorespiratory fitness (CRF) parameters between children with DCD and typically developing children was performed using independent t-tests for continuous variables (resting heart rate, recovery heart rate, and predicted VO_2 max from the 20-meter shuttle run test). Assumptions of normality were checked for continuous variables using the Shapiro-Wilk test.
For the analysis of the relationship between DCD and CRF parameters, Pearson's correlation coefficients were calculated to examine the strength and direction of the association between motor coordination difficulties (as determined by the MABC-2) and CRF measures (resting heart rate, recovery heart rate, and VO_2 max).

A p-value of <0.05 was considered statistically significant for all tests. Data were analyzed using SPSS version 26.0 (IBM Corp, Armonk, NY, USA). The sample size was determined to provide sufficient power to detect meaningful differences, and power analysis indicated that the study had adequate statistical power (greater than 80%) to detect differences in cardiorespiratory fitness measures between groups.

Figure 1: Flow Diagram of Screening, Diagnostic Confirmation, and Final Classification of DCD

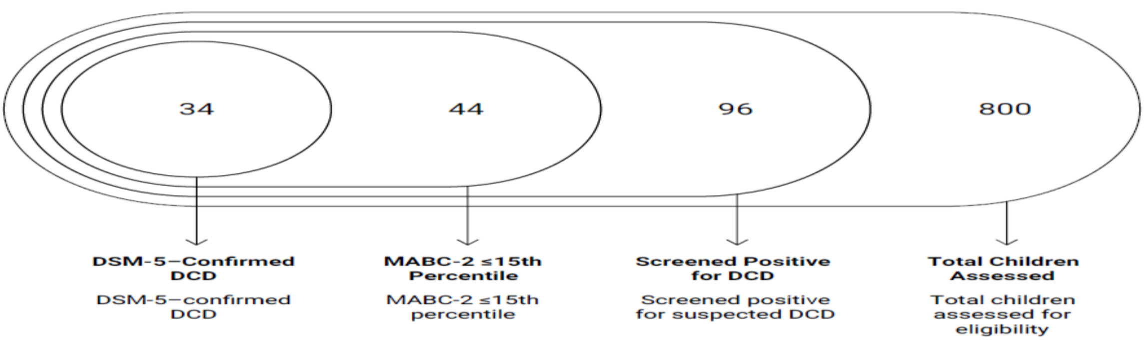


Table 1: Prevalence of DCD Based on Screening, Confirmatory Assessment, and DSM-5 Diagnosis

Step	Description	Actual Numbers
1. Screening for DCD	The proportion of children who screened positive for DCD using the **DCDQ'07** questionnaire.	Total screened - 800 children 96 screened positive for DCD (12%)
2. Confirmatory Assessment	Children who screened positive on the **DCDQ'07** were assessed using the **MABC-2** to confirm the diagnosis.	Out of 96 screened positive with DCDQ'07, 44 confirmed with **MABC-2** (45.8%)
3. Diagnosis Validation	The diagnosis of **DCD** was validated using the **DSM-5 criteria** to ensure comprehensive assessment.	Out of 44 confirmed with **MABC-2**, 34 confirmed with **DSM-5** (77.3%). 34 out of 800 were diagnosed with DCD which is 4.3%

Table 2: Demographic and Baseline Characteristics of Participants with DCD and ARNC group

Variable	DCD Positive Group (n = 400)	ARNC Group (n = 400)	Total (n = 800)	Test Statistic	p-value	95% Confidence Interval
Age (Chi-square)				**4.12**	**0.097**	**(0.001, 0.089)**
6-8 years (%)	40% (160)	30% (120)	35% (280)			
9-10 years (%)	35% (140)	40% (160)	37.5% (300)			
11-12 years (%)	25% (100)	30% (120)	27.5% (220)			
Gender (Chi-square)				**2.04**	**0.15**	**(-0.04, 0.12)**
Male (%)	60% (240)	55% (220)	57.5% (460)			
Female (%)	40% (160)	45% (180)	42.5% (340)			
BMI (mean ± SD) **Independent t-test**	18.5 ± 3.2	19.0 ± 3.5	18.8 ± 3.4	**-3.35**	**0.001**	**(-1.18, -0.37)**
Academic Performance (mean ± SD) **Independent t-test**	75.4 ± 8.1	80.1 ± 7.5	77.7 ± 7.8	**-5.23**	**< 0.001**	**(-6.21, -3.45)**

Table 3 Comparison of Cardiorespiratory Fitness Parameters Between Children with DCD and ARNC.

Variables		DCD group	ARNC group	t value	p value	CI
Resting heart rate (bpm)	Mean	84.21	80.32	3.17*	0.012	1.44-6.32
	SD	4.7	5.36			
	SEM	0.81	0.92			
	N	34	34			
Recovery HR 1min (bpm)	Mean (SD)	110.76	100.79	4.22*	0.001	5.26-14.68
	SD	9.37	10.07			
	SEM	1.61	1.73			
	N	34	34			
Recovery HR 3 min (bpm)	Mean	91.76	77.65	5.617*	0.001	9.10 -19.14
	SD	10.27	10.45			
	SEM	1.76	1.79			
	N	34	34			
Recovery HR 3 min (bpm)	Mean	35.585	45.5332	8.222*	0.001	-12.36 - -7.53
	SD	4.4568	5.4627			
	SEM	0.7643	0.9369			
	N	34	34			

Bpm – Beats per minute, *Statistically significant difference (level 0.05)

Table 4 - Correlation Between MABC-2 Scores and Cardiorespiratory Fitness Parameters in Children with Developmental Coordination Disorder

Parameter	Resting HR	Recovery HR (1min)	Recovery HR (3min)	VO_2 max
MABC-2 Score	r = -0.362	r = -0.462	r = -0.554	r = 0.834
p-value	p = 0.002	p = 0.001	p = 0.001	p = 0.001
Confidence Interval	(-0.553, -0.135)	(-0.631, -0.251)	(-0.700, -0.364)	(0.743, 0.895)

r-Pearson's r, HR-Heart rate

Table 5 - Regression Analysis of Cardiorespiratory Fitness Parameters in Children with Developmental Coordination Disorder

Parameter	Intercept (Constant)	Coefficient (Coef.)	Standard Error (Std. Err.)	t-statistic (t)	p-value	95% Confidence Interval
Resting Heart Rate (bpm)	86.059	-0.295	0.098	-1.724	0.089	(82.680, 89.439)
Recovery HR 1min (bpm)	114.323	-0.663	0.05	-1.941	0.057	(107.547, 121.099)
Recovery HR 3min (bpm)	98.26	-1.052	0.044	-3.65	0.001	(90.880, 105.640)
VO_2 max (ml/kg/min)	25.969	1.133	0.085	9.243	0.0	(23.431, 28.507)

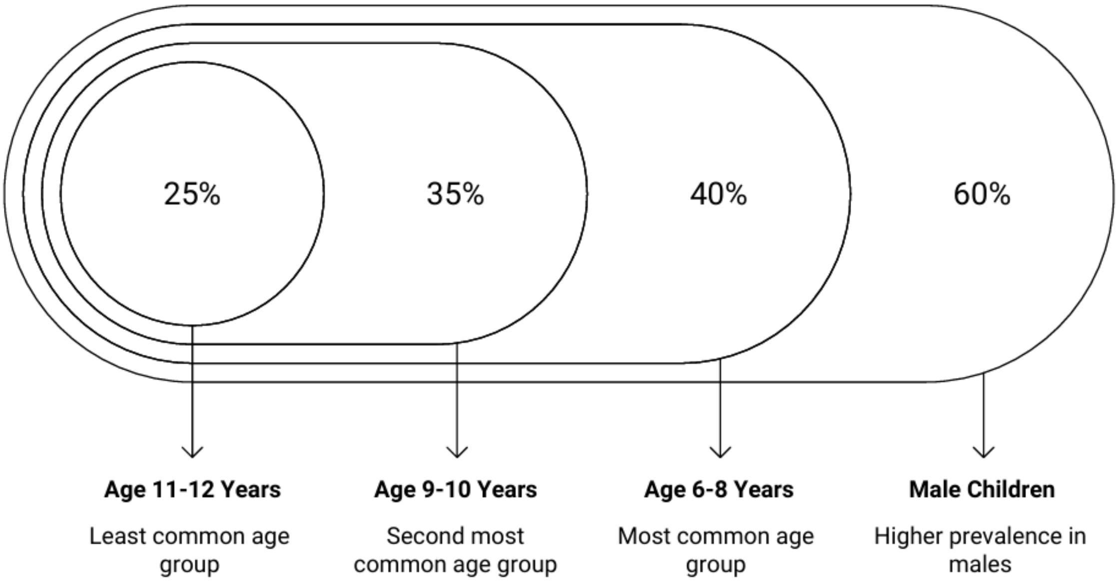
Table 6 Regression Analysis of Cardiorespiratory Fitness Parameters in Apparently Normal Children (ARNC)

Parameter	Intercept (Constant)	Coefficient	Standard Error	t-statistic	p-value	95% Confidence Interval
Resting Heart Rate (bpm)	19.526	-0.169	0.098	-1.724	0.089	(-0.364, 0.027)
Recovery HR 1min (bpm)	19.526	-0.098	0.05	-1.941	0.057	(-0.199, 0.003)
Recovery HR 3min (bpm)	19.526	-0.161	0.044	-3.65	0.0005	(-0.249, -0.073)
VO_2 max (ml/kg/min)	19.526	0.783	0.085	9.243	< 0.001	(0.614, 0.952)

Table 7 Effect Sizes (Cohen's d) for Differences in Cardiorespiratory Fitness Parameters Between Children with DCD and ARNC

Parameter	Cohen's d	95% CI for d	Direction (DCD vs ARNC)	Size (rule of thumb)
Resting HR (bpm)	**0.77**	0.28 to 1.26	DCD higher	Medium to large
Recovery HR 1 min (bpm)	**1.03**	0.52 to 1.53	DCD higher	Large
Recovery HR 3 min (bpm)	**1.36**	0.83 to 1.89	DCD higher	Very large
Predicted VO_2 max (ml/kg/min)	**-2**	-2.58 to -1.41	DCD lower	Extremely large

Fig 2 - Distribution of Developmental Coordination Disorder Prevalence by Age Group and Sex



RESULTS:

3.1 Participant Flow, Screening Yield, and Final Analytic Groups

A total of 800 school children (6–12 years) were screened using the DCDQ'07. Of these, 96 children (12.0%) initially screened positive for DCD and proceeded to confirmatory motor assessment using MABC-2. Forty-four of the 96 screened-positive children (45.8%) met MABC-2 criteria for motor impairment, and 34 of these 44 (77.3%) fulfilled DSM-5 criteria and were classified as DCD. Thus, 34 children constituted the final DSM-5–confirmed DCD group for subsequent analyses. The participant movement across screening, confirmation, and final classification is summarised in the study flow diagram [Figure 1]. The stepwise yield at each stage is presented in [Table 1].

3.2 Sample Characteristics (Overall) and Group Comparability

Baseline demographic and descriptive characteristics were examined across the study sample and between the DCD-positive and ARNC groups, as reported in [Table 2]. Age-group distribution did not differ significantly between groups (Chi-square p=0.097), and sex distribution was also comparable (Chi-square p=0.15), supporting successful matching on these two key variables [Table 2].

In contrast, BMI and academic performance differed significantly between groups. Mean BMI was lower in the DCD-positive group (18.5 ± 3.2) than the ARNC group (19.0 ± 3.5), and this difference was statistically significant (p=0.001) [Table 1]. Academic performance (percentage score) was also lower in the DCD-positive group (75.4 ± 8.1) compared with ARNC (80.1 ± 7.5) (p<0.001) [Table 2].

3.3 Prevalence of DSM-5–Confirmed DCD and Distribution by Age and Sex

Based on DSM-5 confirmation, the prevalence of DCD in this school-based sample was 4.3% (34/800), with a reported 95% confidence interval of 2.9% to 5.7%. The age- and sex-wise distribution of DCD prevalence is depicted in [Figure 1].

3.4 Data Distribution and Justification for Parametric Testing

To assess the normality of the key physiological measurements—Resting Heart Rate, Recovery Heart Rate at 1 minute, Recovery Heart Rate at 3 minutes, and VO_2 max—the Shapiro-Wilk test was applied. Each test yielded a p-value greater than 0.05, indicating no significant deviation from normality. Specifically, the p-values were 0.623, 0.060, 0.853, and 0.652 for Resting Heart Rate, Recovery HR 1min, Recovery HR 3min, and VO_2 max, respectively. Based on these results, we concluded that the data for all variables were normally distributed, justifying the use of parametric statistical methods for subsequent analyses.

3.5 Cardiorespiratory Fitness (CRF) Comparison Between DCD and ARNC

Cardiorespiratory fitness (CRF) was compared between the DSM-5–confirmed DCD group (n=34) and the age- and sex-matched ARNC group (n=34) [Table 3]. Children with DCD showed significantly poorer CRF profiles across all measured indices:

- Resting Heart Rate was higher in the DCD group (84.21 bpm) than in ARNC (80.32 bpm), with a statistically significant difference (p=0.012) [Table 3].
- Recovery Heart Rate at 1 Minute was higher in the

DCD group (110.76 bpm) compared with ARNC (100.79 bpm) (p=0.001) [Table 3].

- Recovery Heart Rate at 3 Minutes remained higher in the DCD group (91.76 bpm) versus ARNC (77.65 bpm) (p=0.001) [Table 3].
- Predicted VO_2 max was substantially lower in the DCD group (≈25.97 ml/kg/min) than in ARNC (≈35.59 ml/kg/min), indicating reduced aerobic capacity (p=0.001) [Table 3].

3.6 Exclusion of "At-risk" Children from Final CRF Analysis

Children who scored between the 6th and 15th percentile on the MABC-2 were classified as "at-risk" for Developmental Coordination Disorder (DCD) in the Methods section. However, for the final analysis of cardiorespiratory fitness (CRF), only children with DSM-5–confirmed DCD were included. The "at-risk" children, who did not meet the full DSM-5 criteria for DCD, were excluded from the analysis. This decision ensured a consistent and stringent diagnosis of DCD in the final dataset used for CRF comparisons. Therefore, the "at-risk" children were neither combined with the DCD group nor analyzed separately.

3.7 Association Between Motor Coordination and Cardiorespiratory Fitness Within DCD

Within the DCD group, MABC-2 scores showed significant associations with CRF parameters [Table 4]. Higher (better) MABC-2 performance correlated with:

- lower resting heart rate ($r = -0.362$; p=0.002),
- lower recovery heart rate at 1 minute ($r = -0.462$; p=0.001),
- lower recovery heart rate at 3 minutes ($r = -0.554$; p=0.001), and
- higher predicted VO_2 max ($r = 0.834$; p=0.001) [Table 4].

3.8 Regression Models for CRF Outcomes

Regression analyses were conducted to quantify the relationship between motor coordination and CRF indices separately in children with DCD and in ARNC. In the DCD group, MABC-2 score significantly predicted recovery heart rate at 3 minutes (Coef = −1.052; p=0.001) and predicted VO_2 max (Coef = 1.133; $p<0.001$), while the associations with resting heart rate and recovery at 1 minute did not reach conventional statistical significance ($p>0.05$) [Table 5]. In the ARNC group, MABC-2 score similarly demonstrated significant associations with recovery heart rate at 3 minutes (p=0.005) and predicted VO_2 max ($p<0.001$) [Table 6].

3.9 Magnitude of Group Differences (Effect Sizes)

Effect sizes (Cohen's d) indicated that differences between DCD and ARNC were not only statistically significant but also practically meaningful across CRF variables [Table 7]. The direction of effects consistently suggested higher resting and recovery heart rates and lower predicted VO_2 max in children with DCD. The largest magnitude difference was observed for predicted VO_2 max ($d \approx -2.00$), while recovery heart rate differences ranged from large to very large [Table 7]

DISCUSSION

This study aimed to assess the prevalence of Developmental Coordination Disorder (DCD) in school children aged 6–12 years in Bangalore, India, and to examine its association with cardiorespiratory fitness (CRF). We used a combination of screening tools (DCDQ'07) and confirmatory assessment methods (MABC-2 and DSM-5 criteria) to provide a rigorous estimate of DCD prevalence. In addition, we compared CRF between children with DCD and their typically developing peers, focusing on key measures such as resting heart rate, recovery rate, and predicted VO_2 max. The study addresses a significant gap in the literature, as few studies have comprehensively assessed DCD and its impact on physical health in the Indian context (Girish et al., 2016; Deshmukh et al., 2024).

Prevalence of DSM-5 Confirmed DCD

The study found that 4.3% of children in Bangalore met the DSM-5 criteria for DCD. This is consistent with global prevalence rates that range from 4% to 7% (Li et al., 2024), and it is within the lower range compared to some other studies in India that reported higher rates (Deshmukh et al., 2024). The lower prevalence in our study may be due to the use of a stringent diagnostic process involving multiple assessment tools, which provides a more accurate diagnosis compared to studies that rely solely on parent report questionnaires (Girish et al., 2016).

Cardiorespiratory Fitness and DCD

Children with DCD exhibited poorer CRF compared to their age- and sex-matched peers. Specifically, those with DCD had higher resting heart rates, slower recovery rates post-exercise, and lower predicted VO_2 max, suggesting compromised cardiovascular function. These findings are consistent with earlier research showing that children with DCD typically demonstrate reduced physical fitness and increased cardiovascular risk (Cairney et al., 2007; Rivilis et al., 2011). Our results further corroborate studies that link DCD to lower VO_2 max, which is a key indicator of aerobic capacity and overall cardiovascular health (Cairney et al., 2010).

Demographic and Fitness Correlates

In addition to CRF, we observed that children with DCD had lower BMI and poorer academic performance compared to their typically developing peers. These findings are in line with previous research showing that children with motor coordination disorders often face broader developmental challenges, including academic difficulties and lower physical activity levels (Blank et al., 2019). The association between lower BMI and reduced physical activity in children with DCD highlights the importance of promoting physical activity not just for improving motor coordination, but also for overall health and development.

Prevalence of DCD

The 4.3% prevalence of DCD in our study is within the global range for DCD, and it is in alignment with similar studies that have examined the prevalence of DCD using comprehensive diagnostic criteria (Li et al., 2024). This figure highlights the widespread nature of the disorder, suggesting that DCD is a significant public health issue that may often go unrecognized. By using both a parent-report questionnaire and clinical diagnostic tools, we were able to more accurately estimate the prevalence of DCD compared to studies relying solely on questionnaire-based screening, which can lead to overdiagnosis (Girish et al., 2016). Further, our findings emphasize the need for more inclusive screening practices, particularly in urban settings where access to clinical assessments may be limited.

Cardiorespiratory Fitness in DCD

The observed differences in CRF between children with DCD and typically developing peers further support previous findings that motor coordination deficits are linked to lower physical fitness. Studies by Cairney et al. (2007) and Rivilis et al. (2011) similarly demonstrated that children with DCD have reduced aerobic capacity, which places them at higher risk for developing health problems such as obesity and metabolic syndrome later in life. Our study extends this understanding by providing evidence from an Indian context, where urban children may experience unique challenges related to socio-economic factors and access to physical activities.
Motor Coordination and Physical Health

Our study found significant correlations between MABC-2 scores and CRF parameters, indicating that children with better motor coordination also had better CRF. This supports the idea that improving motor skills through targeted interventions may not only enhance motor performance but also improve overall physical fitness, which could mitigate long-term health risks (Cairney et al., 2010). The finding is consistent with earlier research that suggests a link between motor coordination and physical activity levels, where children with DCD often have lower levels of physical engagement, leading to poorer fitness outcomes (Rivilis et al., 2011). This further underscores the importance of incorporating both motor skill development and fitness improvement strategies in interventions for children with DCD. The 4.3% prevalence of Developmental Coordination Disorder (DCD) found in our study is broadly consistent with global estimates reported in recent large scale research. A 2024 systematic review and meta analysis found that about 5% of children worldwide meet criteria for DCD, with regional variations but a consistent estimate around this range in Asia (Li et al., 2024). Within this pooled analysis, the prevalence in Asian samples was around 4%, which aligns closely with the prevalence observed in our sample of Indian school children. In contrast, data from southern India reported a much lower DCD prevalence of 0.8% when applying DSM 5 diagnostic criteria (Girish et al., 2016), which is substantially lower than our finding. However, the Girish et al. study screened over 2,200 children using a parent questionnaire (DCDQ'07) followed by clinical criteria, and the lower prevalence could reflect differences in screening tools, sample characteristics, or regional variations in motor development and recognition of DCD.

Other epidemiological evidence highlights that reported prevalence rates vary widely across studies, partly due to differences in assessment methods, sample age ranges, and cultural contexts. For example, some studies report prevalence figures spanning from 2% to over 20% depending on cut offs and diagnostic criteria used (Gao et al., 2024; Blank et al., 2019), demonstrating that methodological differences strongly influence prevalence estimates.

Taken together, while our estimate is somewhat higher than some regional reports from India, it is well within the globally reported range and aligns especially with aggregated Asian data. This supports the generalizability of our findings while also underscoring that the use of uniform, stringent diagnostic criteria (DSM 5 plus standardized tests) may yield more stable prevalence estimates.

Our study found that children with DCD exhibited significantly poorer cardiorespiratory fitness (CRF) — indicated by elevated resting heart rates, slower post exercise recovery, and lower predicted VO_2 max — compared with age and sex matched typically developing peers. This pattern is consistent with earlier work by Cairney et al. (2007), who reported that children with DCD scored significantly lower on predicted peak aerobic power derived from the 20 meter shuttle run test and were much more likely to fall into a low fitness category (<20th percentile) than peers without DCD. A systematic review of fitness outcomes in children with poor motor proficiency also found that various aspects of physical fitness — including cardiorespiratory capacity — are negatively associated with reduced motor coordination, suggesting a broader profile of physical health challenges in this population. Regionally, Sujatha et al. (2020) also demonstrated lower cardiovascular fitness in DCD children compared with normally developing controls in an Indian cohort using the 20 meter shuttle run, reinforcing that CRF deficits in DCD are not geographically isolated phenomena but seem consistent across diverse populations. Other research has linked poorer CRF in DCD to reduced participation in physical activities and a tendency toward sedentary lifestyles, which further compounds fitness deficits (Silman et al., 2011; Cermak et al., 2015). These converging findings bolster the view that reduced CRF is a consistent and meaningful aspect of the DCD phenotype, highlighting that the impact of DCD extends beyond motor skills to affect broader aspects of physical health and aerobic capacity. Cultural practices, lifestyle patterns, and socioeconomic factors can shape both the expression of DCD symptoms and the likelihood of detection in different populations. Prevalence variability between regions — such as our finding of 4.3% versus 0.8% in southern India (Girish et al., 2016) — may partly reflect differences in physical activity environments, parental awareness, and opportunities for motor engagement. Additionally, broader international data indicate that prevalence can vary from 2% to over 20% in different settings (Gao et al., 2024), suggesting that external factors such as educational expectations, recreational opportunities, and cultural norms around play and exercise might influence both motor development and the manifestation of coordination difficulties. In urban Indian contexts, lifestyle factors — including high academic demands, limited recess or outdoor playtime, and increasing sedentary behaviors — may contribute to lower baseline physical activity levels across all children, possibly amplifying fitness disparities for those with DCD. Studies on motor development have suggested that children exposed to environments with richer physical play opportunities show better motor competence and fitness outcomes, underscoring the role that environment and routine physical culture play in shaping developmental trajectories. Socioeconomic differences also intersect with physical health outcomes, as lower income groups may have limited access to safe play spaces, organized sports, or opportunities for structured physical activity, which are all known correlates of cardiorespiratory fitness and motor skill development (Eguia et al., 2025; De Roubaix et al., 2025). In sum, while motor coordination difficulties are biologically grounded, regional cultural, lifestyle, and socioeconomic contexts shape both prevalence estimates and associated fitness outcomes. Our findings add to the understanding of DCD within an urban Indian setting by illustrating that children with DCD may experience compounded challenges due to these contextual factors, pointing to the importance of culturally sensitive screening, awareness, and intervention strategies. The findings of this study have several important implications. First, the high prevalence of DCD in urban Indian children underscores the need for routine screening and early intervention to address motor coordination difficulties. Second, the observed deficits in cardiorespiratory fitness highlight the importance of integrating physical fitness programs alongside motor skill development in school curriculums. Finally, the relationship between DCD and poorer physical health outcomes calls for targeted public health initiatives to improve the overall well-being of affected children through holistic approaches that include physical activity and healthcare support.

Limitations

This study's cross sectional design limits the ability to infer causal relationships between DCD and cardiorespiratory fitness. Additionally, the study was conducted in urban Bangalore, which may not represent rural populations or other regions with different socio cultural dynamics. Finally, the reliance on self reported academic performance and BMI could introduce bias, although these measures were cross checked with school records for accuracy.

CONCLUSION

This study highlights a 4.3% prevalence of Developmental Coordination Disorder (DCD) in urban Indian children, aligning with global estimates but showing regional variability. It also reveals that children with DCD have significantly lower cardiorespiratory fitness (CRF), marked by higher resting heart rates and lower VO_2 max. These findings stress the need for early diagnosis and interventions that address both motor coordination and cardiovascular health. Future research should focus on longitudinal studies to track long-term outcomes in children with DCD, particularly regarding cardiovascular health. Exploring effective interventions targeting both motor skills and CRF will be key. Additionally, studying the impact of regional and cultural factors on DCD prevalence and management in diverse populations across India is crucial for developing tailored healthcare strategies.

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