TPM Vol. 32, No. S7, 2025
ISSN: 1972-6325
https://www.tpmap.org/

PREVALENCE AND PREDICTORS OF PHYSICAL DISABILITY IN CHILDREN WITH AUTISM SPECTRUM DISORDER: A CROSS-SECTIONAL STUDY

MUHAMMAD HARIS[1*], FAIKA ABDUL RAZZAQ[2], WAJIHA ABRAR[3], DR. MARIA ANWAR KHAN[4], DR. URFA SHAHID[5], IQRA SAEED[6], IRAM SOHAIL QURAISHI[7], HUMA BATOOL[8]

[1.] DEPARTMENT OF REHABILITATION & HEALTH SCIENCES, ABASYN UNIVERSITY, ISLAMABAD CAMPUS, PAKISTAN. HTTPS://ORCID.ORG/0009-0002-8781-0139.
[2.] ASSISTANT PHYSIOTHERAPIST AT BUCH INTERNATIONAL HOSPITAL, MULTAN, PAKISTAN.
[3.] STUDENT COUNSELLOR AND LECTURER, RASHID LATIF MEDICAL COLLEGE, LAHORE PAKISTAN.
[4.] ASSISTANT PROFESSOR, APPLIED PSYCHOLOGY DEPARTMENT, NATIONAL UNIVERSITY OF MODERN LANGUAGES, MULTAN, PAKISTAN.
[5.] RESEARCH STUDENT IN MEDICAL SCIENCES IN UNIVERSITY OF LANCASHIRE, PRESTON, UNITED KINGDOM.
[6.] PSYCHOLOGY LECTURER, RIPHAH INTERNATIONAL UNIVERSITY, GULBERG 3, LAHORE, PAKISTAN.
[7.] PHD SCHOLAR, DEPARTMENT OF APPLIED PSYCHOLOGY, BAHAUDDIN ZAKARIYA UNIVERSITY, MULTAN. PAKISTAN
[8.] PHD SCHOLAR, DEPARTMENT OF APPLIED PSYCHOLOGY, BAHAUDDIN ZAKARIYA UNIVERSITY, MULTAN, PAKISTAN

Abstract

Background. Although motor impairments are also a widely acknowledged but underestimated characteristic of autism spectrum disorder (ASD), it is mainly defined by a lack of social communication and repetitive behaviors. This research paper investigated the occurrence of physical disabilities amongst ASD Pakistani children with ASD and found the major predictors of motor coordination challenges.

Methods. A cross-sectional study was performed on 323 children aged 5-15 years (73.4% male) who were diagnosed with ASD in special education schools and rehabilitation centers in Pakistan. The parent-reported Developmental Coordination Disorder Questionnaire (DCDQ-2007) was used to assess physical disability; it measures three motor domains, namely fine motor skills, control during movement, and overall coordination. The data were examined with the help of chi-square tests, independent samples t-tests, one-way ANOVA, correlation analysis, and CHAID decision tree modeling with SPSS version 27.0.

Findings. The vast majority of respondents were at risk of probable Developmental Coordination Disorder (DCD). Means scores showed impairments in all areas: control during movement, fine motor control, and general coordination. Age was the only other notable predictor of the general motor impairment, and it was found in all the children at the age of 8.0-9.11 years. There was a great age difference during control during movement, with older children performing better. There was no significant relationship between gender and DCD classification, with females having slightly higher fine motor skills.

Conclusion. This Pakistani sample of children with ASD nearly all experience physical disabilities, and patterns in age indicate developmental trends unlike those of typically developing children. Such results highlight the urgent importance of regular motor examinations as one of the components of the overall ASD diagnosis and early inclusion of physiotherapy and occupational therapy into the intervention strategies.

Keywords: autism spectrum disorder, developmental coordination disorder, motor impairment, physical disability, children, DCDQ, prevalence, Pakistan

INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that is mainly associated with ongoing social communication and social interaction problems, as well as limited and repetitive behavioral, interest, or activity patterns (American Psychiatric Association, 2013; Greaves-Lord et al., 2022). Estimates of the prevalence of ASD across the globe show that the condition affects about 1-2 percent of the population (Roman-Urrestarazu et al., 2021;

Zeidan et al., 2022), and recent surveillance data in the United States show the prevalence to be up to 1 in every 36 children (Maenner et al., 2023). In South Asia, there is scanty prevalence data, but some evidence is now emerging that indicates prevalence rates are similar to those of the world when adjusted by taking into consideration the resources and awareness to diagnose the disease (Arora et al., 2018; Chauhan et al., 2019). Although the diagnostic criteria of ASD focus on social-communicative and behavioral aspects (DSM-5, American Psychiatric Association, 2013; ICD-11, World Health Organization, 2022), there is growing evidence indicating that motor impairments are a commonly, but often unnoticed, aspect of the condition (Bhat, 2020, 2023; Green et al., 2009; Lloyd et al., 2013). Motor challenges in people with ASD appear early in life and can be continued in the teenage years and even adulthood (Licari et al., 2020; Moseley & Pulvermuller, 2018). These motor disabilities are distributed across several areas, such as fine motor (handwriting, working with small objects, and using tools) and gross motor (running, jumping, balance, and gait), and general coordination of complex actions (Fournier et al., 2010; Jasmin et al., 2009; Mohd Nordin et al., 2021).

Studies show that half to three-quarters of children with ASD have clinically significant motor coordination problems (Fournier et al., 2010; Green et al., 2009; Whyatt & Craig, 2012), and that many of them have met criteria of Developmental Coordination Disorder (DCD) - a syndrome of motor performance that is significantly lower than expected by age and intelligence and that results in a significant interference with normal everyday activities (American Psychiatric Association, 2013). A recent systematic review and meta-analysis by Kangarani-Farahani et al. (2024) of 27 studies concluded that 92.5% of children with ASD were reported to have significant motor difficulties, but only 15% of the studies had officially diagnosed co-occurring DCD. This diagnostic gap implies that there is a systematic under-awareness of motor impairments in clinical practice, even though they are very prevalent and functional (Ahmed et al., 2023).

The morphological effects of motor impairments in ASD have many implications beyond movement. Ineffective motor skills may slow down the academic involvement, especially in handwriting and physical education (Fuentes et al., 2009; Wiggins et al., 2009), restrain the involvement in recreational activities and sports (MacDonald et al., 2013; Obrusnikova & Miccinello, 2012), decrease chances of peer interaction and friendship formation (Bhat et al., 2011; Hilton et al., 2014), and deter autonomy in activities of daily living like dressing, eating Moreover, motor problems can contribute to core ASD symptoms due to the restrictions in social activity and heightened frustration, anxiety, and behavioral disturbances (Williams et al., 2020).

Recent longitudinal studies have shown that early motor delays can be used as a predictor of the ASD diagnosis and severity of the symptoms. In their analysis of data on 32,850 children with ASD in the Autism and Developmental Disabilities Monitoring (ADDM) Network, Pokoski et al. (2025) discovered that more than 71.5% had delays in the motor milestones of walking or movement coordination. Importantly, children with motor difficulties were diagnosed with autism around eight months earlier than their counterparts without motor delays, which indicates that a motor assessment may potentially lead to improved early identification endeavors and the ability to promptly gain access to intervention services (Landa et al., 2006; Lloyd et al., 2013).

Although there has been increased awareness regarding motor problems in ASD, much is still unknown about how prevalent, patterned, and predictable they are, especially in non-Western individuals (Bremer et al., 2016; Srinivasan et al., 2014). Most of the current studies have been undertaken in advanced and well-developed societies with established autism care, and there are still many unanswered questions regarding the presentation of motor impairments in different cultural, linguistic, and socioeconomic backgrounds (De Luca et al., 2020; Memari et al., 2013). In addition, although a number of studies have studied motor skills in preschool-aged children (Ketcheson et al., 2017; Liu and Breslin, 2013) or adolescents (Pan et al., 2009; Staples and Reid, 2010), not many studies have explored motor coordination over the entire school-age sample (5-15 years), when demands on motor skills rise so dramatically in both school and social environments.

There is also unequal access to proper motor-oriented interventions. Although studies have shown that physical activity interventions, such as swimming, yoga, horseback riding, aquatic therapy and structured movement training, can benefit motor development, behavior, and executive functioning of children with ASD (Bremer et al., 2016; Healy et al., 2018; Louie et al., 2021; Srinivasan et al., 2014), it has been revealed that physical therapy is received by only 37-55% of children with ASD and only 15-19% attend recreational Such a gap occurs despite an estimated 88.3% of ASD children having a risk of DCD (Bhat, 2024) and indicating a high level of unmet clinical need and potential systemic obstacles to receiving motor-oriented interventions.

In Pakistan, where the development of autism services is still at an early stage, and rehabilitation resources are still not sufficient (Mahmood, 2023; Minhas et al., 2015), the nature and scope of motor limitations among children with ASD have not been sufficiently defined. The frequent occurrence of physical disability and predictors in this population is necessary to inform service development, clinical practice, and policy changes that guarantee the holistic and multidisciplinary care of children with ASD.

The purpose of the proposed study was to: (1) assess the prevalence of physical disability (operationalized as probable DCD) among Pakistani children aged 5-15 years with clinically diagnosed ASD; (2) evaluate which motor domains (fine motor skills, control during movement or general coordination) are the most affected ones; and (3) see whether

age or gender predicts the occurrence or the level of motor impairments in this group. We wrote the hypothesis that physical disabilities were going to be very common among children with ASD and that the patterns of motor development would be systematically different in terms of age and gender, in line with developmental motor theories.

METHODS

Study Design and Setting

This cross-sectional observational research was undertaken in several special schools and rehabilitation centers in Pakistan, and has several special centers dealing with children with developmental disabilities. The Research Ethics Committee of the Department of Rehabilitation and Health Sciences, Abasyn University, Islamabad Campus, approved the study protocol.

Participants

Children whose clinical diagnosis of ASD met DSM-5 criteria of 5-15 years of age were the target population (APA, 2013). This age sample was chosen to meet the established validated age caution of the main outcome measure (DCDQ-2007; Wilson et al., 2009) and also to mirror the school-age range when motor requirements grow significantly. The minimum required sample of 323 participants was determined by the application of Epitool epidemiological calculators in the assumption of a 50 percent prevalence estimate (because of the lack of previous data on the same topic in Pakistan), the confidence level of 95 percent, and a margin of error of 5 percent.

Study criteria were: (1) clinical diagnosis of ASD by a qualified medical practitioner or mental psychologist based on the DSM-5 criteria; (2) age 5.0 to 15.0 years of age; (3) was enrolled in a special education school or receiving services in a rehabilitation center; and (4) willing and able to complete study questionnaires using Urdu or English. The exclusion criteria were the following: (1) uncorrected visual or audible impairments that could be a confounding factor to evaluate motor coordination; (2) having diagnosed neurological conditions that would confound motor performance evaluation (e.g., cerebral palsy, muscular dystrophy, epilepsy); (3) a history of serious trauma, burns, or fractures that would affect mobility; and (4) other severe medical conditions that necessitate hospitalization in the last six months.

Sampling Strategy

The sampling method used was convenience sampling of the available institutions of special education and rehabilitation centers. The parents of eligible children were contacted during school or therapy time following institutional permission. The research objective was discussed both orally and using written information sheets, and informed consent was signed by all of the parents or legal guardians who participated. Young children gave verbal consent when age-appropriate.

Measurement Instrument

Motor coordination was evaluated with the help of the Developmental Coordination Disorder Questionnaire (DCDQ-2007), which is a parent-report screening measure that is used to diagnose children with DCD at risk (Wilson et al., 2007, 2009). The DCDQ has 15 questions that are to be answered in a 5-point Likert scale (1 = Not at all like your child to 5 = Extremely like your child) where the higher the score the higher the motor competence. Items also test functional motor skills in real-life situations, but not isolated motor skills, which increases ecological validity (Schoemaker et al., 2012).

The questionnaire provides the total score and three subscales, namely, 1) Control During Movement (6 items): Measures ball skills (throwing, catching, hitting), jumping over obstacles, speed and quality of running, motor planning in complex activities, 2) Fine Motor/Handwriting (4 items): Measures printing/writing speed, legibility, pencil pressure and grasp, cutting, and 3) General Coordination (5 items): Measures interest in sports, learning new motor activities, speed in self-care activities (dressing, tying shoes), clumsiness when performing everyday tasks.

Age-specific cutoff scores classify children as: *Probable DCD* (motor difficulties likely), *Suspect DCD* (at risk, monitoring recommended), or *Probably Not DCD* (motor coordination within typical range) (Wilson et al., 2009). For this study, children scoring in the "Probable DCD" or "Suspect DCD" ranges were grouped as "Suggestive of DCD" (indicating the presence of physical disability), while those in the "Probably Not DCD" range were classified as having no significant physical disability.

The DCDQ-2007 demonstrates strong psychometric properties, with internal consistency (Cronbach's $\alpha = 0.94$), test-retest reliability (ICC = 0.84), and sensitivity/specificity of 84.6%/70.8%, respectively, when compared against standardized motor assessments such as the Movement Assessment Battery for Children (MABC-2) (Wilson et al., 2009). The questionnaire has been validated internationally across diverse populations (Kennedy-Behr et al., 2011; Prado et al., 2009; Schoemaker et al., 2008) and shows cultural applicability.

Data Collection Procedure

After getting ethical approval and institutional permission, trained research assistants visited parents of qualified children at the participating sites. The DCDQ questionnaire and a demographic information sheet with information such as child age, gender, education level, ASD diagnosis details, and present therapies were provided to the parents after informed consent was obtained. Questionnaires were given to parents either at the place of the research with the help of research assistants (in case of difficulties) or sent home to be completed within a period of one week. Any

questionnaire that was returned was verified as being complete; any missing questions were resolved over the phone when feasible. The questionnaires that had greater than 20 percent of missing data were eliminated. The process of data collection took more than six months to reach the target sample size.

Statistical Analysis

Data were entered, cleaned, and analyzed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY). Descriptive statistics (frequencies, percentages, means, standard deviations, ranges) characterized the sample and motor coordination scores. Distribution normality was assessed through visual inspection (histograms, Q-Q plots) and statistical tests (Skewness, Kurtosis values between ±2).

For prevalence analysis, frequencies and percentages were calculated to determine the proportion of children meeting DCD criteria overall and stratified by age and gender. Chi-square tests of independence (χ^2) examined associations between DCD classification and categorical predictors (age group, gender), with Fisher's exact test used when expected cell counts were below 5.

For predictor analysis, independent samples *t*-tests compared DCDQ scores between genders, with Levene's test assessing homogeneity of variance. When variances were unequal, Welch's correction was applied. Cohen's *d* quantified effect sizes. One-way ANOVA assessed differences across age groups, with eta-squared (η^2) quantifying effect sizes and Tukey's HSD post-hoc tests identifying specific group differences when omnibus F-tests were significant. Pearson correlation coefficients (*r*) examined relationships among DCDQ subscales. A Chi-squared Automatic Interaction Detection (CHAID) decision tree analysis identified the most important predictors of DCD classification through recursive partitioning, using Bonferroni adjustment for multiple comparisons ($\alpha = .05$ for splitting, $\alpha = .05$ for merging). Statistical significance was set at $\alpha = .05$ (two-tailed). Effect sizes were interpreted using Cohen's conventions: small ($d = 0.20$, $\eta^2 = 0.01$, $r = 0.10$), medium ($d = 0.50$, $\eta^2 = 0.06$, $r = 0.30$), large ($d = 0.80$, $\eta^2 = 0.14$, $r = 0.50$) (Cohen, 1988).

RESULTS

Participant Characteristics

The final sample comprised 323 children with ASD aged 5.0 to 15.0 years. Demographic characteristics are presented in Table 1. The sample was predominantly male (73.4%, $n = 237$), consistent with the known 3:1 to 4:1 male predominance in ASD (Loomes et al., 2017; Maenner et al., 2023). Age distribution was relatively balanced: 37.5% ($n = 121$) in the youngest group (5.0-7.11 years), 25.7% ($n = 83$) in the middle group (8.0-9.11 years), and 36.8% ($n = 119$) in the oldest group (10.0-15.0 years). Nearly all participants (99.7%) were enrolled at the primary education level, with only one child (0.3%) in secondary education.

Table 1 *Demographic Characteristics of Participants (N = 323)*

Characteristic	*n*	%
Gender		
Male	237	73.4
Female	86	26.6
Age Group		
5.0–7.11 years	121	37.5
8.0–9.11 years	83	25.7
10.0–15.0 years	119	36.8
Education Level		
Primary	322	99.7
Secondary	1	0.3
DCD Classification		
Probably not DCD	9	2.8
Suggestive of DCD	314	97.2

Note. DCD = Developmental Coordination Disorder.

Prevalence of Physical Disability

An overwhelming majority of participants (97.2%, $n = 314$) scored in the range suggestive of DCD, indicating clinically significant motor coordination difficulties (Table 1). Only 2.8% ($n = 9$) scored above the cutoff, suggesting motor skills within the typical range for age. Table 2 presents descriptive statistics for DCDQ total and subscale scores. Mean total DCDQ score was 0.97 ($SD = 0.16$), reflecting near-ceiling prevalence of motor difficulties. Subscale means indicated impairments across all motor domains: control during movement ($M = 12.70$, $SD = 3.52$, range = 5.00-22.00), fine motor coordination ($M = 11.59$, $SD = 3.43$, range = 5.00-22.00), and general coordination ($M = 11.81$, $SD = 2.70$, range = 5.00-20.00).

Relationships Among Motor Domains

Correlation analysis (Table 2) revealed significant negative correlations between total DCDQ score (where higher scores reflect fewer difficulties due to scoring direction) and all three subscales, as expected. More importantly, the three motor domains demonstrated strong positive intercorrelations: control during movement and fine motor coordination ($r = .70$, $p < .001$), control during movement and general coordination ($r = .65$, $p < .001$), and fine motor coordination and general coordination ($r = .64$, $p < .001$). These robust correlations, all in the large effect size range (Cohen, 1988), suggest that motor difficulties in ASD tend to be pervasive across domains rather than domain-specific, consistent with previous research (Faber et al., 2022; Green et al., 2009).

Table 2 *Correlations Among DCDQ Subscales*

Variable	*M*	*SD*	1	2	3	4
1. Total DCDQ Score	0.97	0.16	—			
2. Control During Movement	12.70	3.52	−.22**	—		
3. Fine Motor Coordination	11.59	3.43	−.20**	.70**	—	
4. General Coordination	11.81	2.70	−.23**	.65**	.64**	—

Note. DCDQ = Developmental Coordination Disorder Questionnaire.
*$p < .01$ (two-tailed).

Age as a Predictor of Physical Disability

Chi-square analysis revealed a statistically significant association between age group and DCD classification ($\chi^2 = 10.58$, $df = 2$, $p = .005$; Table 3). Remarkably, 100% of children in the middle age group (8.0-9.11 years, $n = 83$) met criteria for DCD, while the youngest group showed the lowest prevalence (93.4%, $n = 113/121$), with 6.6% ($n = 8$) scoring above the DCD threshold. Among the oldest children (10.0-15.0 years), 99.2% ($n = 118/119$) met DCD criteria, with only one child (0.8%) classified as probably not having DCD.

Table 3 *Prevalence of DCD by Age Group*

Age Group	Probably Not DCD	Suggestive of DCD	Total
	n (%)	*n* (%)	*N*
5.0–7.11 years	8 (6.6)	113 (93.4)	121
8.0–9.11 years	0 (0.0)	83 (100.0)	83
10.0–15.0 years	1 (0.8)	118 (99.2)	119
Total	9 (2.8)	314 (97.2)	323

Note. DCD = Developmental Coordination Disorder; $\chi^2 = 10.58$, $p = .005$.

One-way ANOVA (Table 4) demonstrated significant age group differences for total DCDQ score ($F = 5.42$, $p = .005$, $\eta^2 = .033$) and control during movement ($F = 8.29$, $p < .001$, $\eta^2 = .049$). The effect size for control during movement approached medium magnitude ($\eta^2 = .049$), indicating that approximately 5% of variance in this domain was attributable to age group differences. Post-hoc examination of means indicated that older children (10.0-15.0 years) demonstrated better control during movement ($M = 13.71$, $SD = 3.31$) compared to both younger groups (5.0-7.11 years: $M = 12.25$, $SD = 3.73$; 8.0-9.11 years: $M = 11.92$, $SD = 3.16$). However, fine motor coordination ($F = 0.49$, $p = .616$, $\eta^2 = .003$) and general coordination ($F = 1.80$, $p = .167$, $\eta^2 = .011$) did not differ significantly across age groups, suggesting these domains may be more resistant to developmental improvements or reflect persistent deficits.

Table 4 *DCDQ Subscale Means by Age Group*

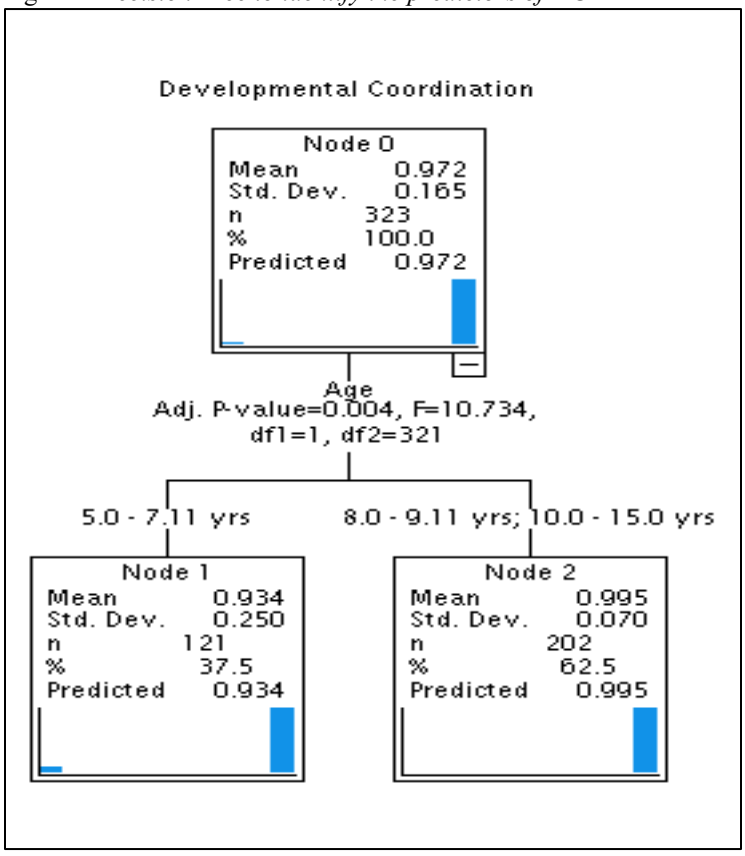
Subscale	5.0–7.11 yrs	8.0–9.11 yrs	10.0–15.0 yrs	*F*	*p*	η^2
	M (*SD*)	*M* (*SD*)	*M* (*SD*)			
Total DCDQ Score	0.93 (0.25)	1.00 (0.00)	0.99 (0.09)	5.42	.005	.033
Control During Movement	12.25 (3.73)	11.92 (3.16)	13.71 (3.31)	8.29	< .001	.049
Fine Motor Coordination	11.77 (3.49)	11.29 (3.87)	11.62 (3.05)	0.49	.616	.003
General Coordination	11.65 (2.91)	11.52 (2.34)	12.18 (2.68)	1.80	.167	.011

Note. DCDQ = Developmental Coordination Disorder Questionnaire.

The CHAID decision tree analysis (Figure 1) confirmed age as the only significant predictor included in the final model. The algorithm identified age group as the primary splitting variable, classifying 62.5% ($n = 202$) of children aged 8.0-15.0 years in one terminal node with a mean DCD score of 0.995, and 37.5% ($n = 121$) of children aged 5.0-

7.11 years in another terminal node with a mean of 0.934. Gender was not selected as a significant splitting variable. The model achieved a relatively low risk estimate (0.026, *SE* = 0.008), indicating strong classification accuracy with minimal misclassification error.

Figure 1 *Decision Tree to identify the predictors of DCD*



Gender Differences in Motor Coordination

To the contrary, the chi-square test demonstrated that there was no significant relationship between gender and DCD classification ($\chi^2 = 1.51$, $df = 1$, $p = .220$; Table 5). The prevalence of DCD was almost the same in males and females: 97.9% (n = 232/237) of males and 95.3% (n = 82/86) of females were in the DCD criteria. This non-significant relationship was confirmed by Fisher's exact test ($p = .254$).

Table 5 *Prevalence of DCD by Gender*

Gender	Probably Not DCD	Suggestive of DCD	Total
	n (%)	*n* (%)	*N*
Male	5 (2.1)	232 (97.9)	237
Female	4 (4.7)	82 (95.3)	86
Total	9 (2.8)	314 (97.2)	323

Note. DCD = Developmental Coordination Disorder; $\chi^2 = 1.51$, $p = .220$.

Independent samples *t*-tests (Table 6) comparing males and females across DCDQ domains revealed no significant differences for total DCDQ score ($t = 1.23$, $p = .221$, $d = 0.15$), control during movement ($t = 0.72$, $p = .471$, $d = 0.09$), or general coordination ($t = 0.97$, $p = .333$, $d = 0.12$). All effect sizes were negligible ($d < 0.20$). However, females demonstrated significantly better fine motor coordination ($M = 12.31$, $SD = 3.98$) compared to males ($M = 11.33$, $SD = 3.18$), $t(321) = -2.29$, $p = .022$, $d = -0.29$, representing a small-to-medium effect size. This finding suggests that while overall motor impairment prevalence is comparable across genders, subtle domain-specific differences may exist, consistent with broader developmental literature showing female advantages in fine motor tasks (Junaid & Fellowes, 2006; Kokštejn et al., 2017).

Table 6 *DCDQ Subscale Means by Gender*

Subscale	Male	Female	*t*	*df*	*p*	Cohen's *d*

	M (*SD*)	*M* (*SD*)				
Total DCDQ Score	0.98 (0.14)	0.95 (0.21)	1.23	321	.221	0.15
Control During Movement	12.78 (3.31)	12.47 (4.05)	0.72	321	.471	0.09
Fine Motor Coordination	11.33 (3.18)	12.31 (3.98)	−2.29	321	.022	−0.29
General Coordination	11.90 (2.55)	11.57 (3.07)	0.97	321	.333	0.12

Note. DCDQ = Developmental Coordination Disorder Questionnaire; Male $n = 237$, Female $n = 86$.

DISCUSSION

This research suggests a strong demonstration that the physical disabilities, as reflected in motor coordination problems that are congruent with DCD, are predominantly widespread among Pakistani children with ASD who are being provided with specialized education. This high prevalence is of importance because 97.2% of what is likely to be considered as probable DCD, meaning that motor impairments are possibly pervasive in this clinical group which is considerably higher than the 50-80% prevalence rates typically observed in Western samples (Fournier et al., 2010; Green et al., 2009; Whyatt and Craig, 2012), and even higher than the 87% prevalence rate recently reported in a large US cohort of children with ASD (Bhat, 2023).

The existence of the remarkably high prevalence rates of developmental coordination disorder (DCD) in the discussion can be interpreted by a mixture of methodological, contextual, and developmental considerations (Sawangchai et al., 2022). First of all, sampling features must have been one of the significant factors. Only the special education schools and rehabilitation centres were used in recruiting the participants; this normally serves children with more severe functional impairment. Children with less severe cases of autism spectrum disorder (ASD) that are usually included in general schooling and show a tendency to be relatively more competent in motor skills (Srinivasan et al., 2014) were not represented. This sampling bias brings in referral bias (Berkson, 1946) and nearly guarantees the prevalence estimates exceed those of population-based or community samples, hence constrained extrapolation of the results (Fang & Mushtaque, 2024).

Second, motor troubles may be significantly worsened by cultural and environmental factors in the Pakistani environment. The availability of early intervention, formal physical activity initiatives, and play environments that are developmentally supportive is also still limited in most low and middle-income contexts. In high-resource nations, these resources have been demonstrated to affect motor development in children with ASD positively (Bremer et al., 2016; Healy et al., 2018; Louie et al., 2021; Srinivasan et al., 2014). Motor impairments may also be increased by socioeconomic disadvantage that is widespread in the area (World Bank, 2023), limited access to stimulating play materials, practice opportunities, late diagnosis, and nutritional deficiencies that negatively impact neurodevelopmental trajectories (Black et al., 2017; Minhas et al., 2015).

In a similar vein, the under-investment in early childhood and rehabilitation services in Pakistan is associated with the fact that a significant proportion of children fail to obtain timely motor-centered interventions, including occupational or physical therapy, at the time of increased neuroplasticity (Mahmood, 2023; Hadders-Algra, 2018). Conversely, high-income countries often have structured early intervention programmes accessed by children as young as two or three years old, and this could help avoid motor impairments before they get embedded (Zwaigenbaum et al., 2015). Lack of these services may also make the motor difficulties experienced by the current sample persistent and more severe.

The factor of measurement should also be taken into consideration. Even though the Developmental Coordination Disorder Questionnaire (DCDQ) has proved to have strong psychometric measures in different countries (Kennedy-Behr et al., 2011; Prado et al., 2009; Schoemaker et al., 2008), some of the items mention activities, potentially less cultural or less available in the South Asian contexts, like organised sports or certain recreational equipment. Such contextual misfits can result in reduced parental ratings, which overvalue impairment. Furthermore, the culture of gender and engagement in physical activities might impact the perceptions of the caregivers, especially to girls (Jago et al., 2011). These results demonstrate the necessity of culturally adapting and validating motor assessment instruments for local contexts (Sansakorn et al., 2024).

The only predictor that was found to be of significance was age, and in this case, older children were found to have greater control during movement. It is possible to indicate that, indeed, certain gross motor skills might be enhanced by maturity and experience even in ASD (Berkeley et al., 2001; Licari et al., 2020; Pan, 2014). Nevertheless, the lack of children with the age category of 8.09.11-year-old falling under the category of probably not DCD is also interesting and might indicate that growing academic and social motor requirements like handwriting fluency, physical education, and organised group play are surpassing the development of the compensatory measures (Blank et al., 2019; Missiuna et al., 2007). Notably, there was no age-related improvement in fine motor skills and general coordination, which suggests that these areas are possibly more enduring impairments that need to be addressed during a prolonged period of time (Fuentes et al., 2009; Paquet et al., 2016).

However, contrary to expectation, gender did not indicate general DCD classification, as both men and women had equal prevalence rates of the same. This is unlike the normal growth patterns, in which the female child tends to have a better motor performance (Junaid and Fellowes, 2006; Thomas & French, 1985). Nevertheless, they did demonstrate a slight superiority of females in fine motor skills, which is in line with the previous data (Kokštejn et al., 2017; Morley et al., 2015). The absence of gender disparities can be explained by the selection bias in clinical samples where females with ASD are rarely diagnosed unless the symptoms are severe (Loomes et al., 2017; Mandy et al., 2012).

Lastly, high correlation levels of all four DCDQ subscales show that motor impairment in ASD is not domain-specific. This justifies hypotheses that maintain that core impairments are in the higher-order motor processes, such as motor planning, motor learning, predictive control, and sensorimotor integration (Adams et al., 2014; Gowen and Hamilton, 2013; Mostofsky et al., 2006; Whyatt and Craig, 2013). Intervention perspectives that focus on transferable motor control skills of CO-OP, Neuromotor Task Training, and task-based therapies might be especially useful (Blank et al., 2019; Polatajko and Mandich, 2004; Schoemaker et al., 2003; Smits-Engelsman et al., 2013). Taken together, these results highlight the necessity of early, extended, and culturally sensitive motor treatments of children with ASD (Sarfraz et al., 2022).

Clinical and Service Delivery Implications

The motor challenges common in children with autism (97.2%) are almost universal, which requires fundamental modifications in the way assessment and intervention are conducted. Motor screening with standardized instruments such as the DCDQ should be the routine in initial ASD diagnostic assessments and at frequent intervals, as parents or teachers will not alert to the issue of ASD, and when they do, there will be systematic under-identification.

Existing service delivery models do not address motor needs. Although 88.3% of children with ASD are exposed to developmental coordination disorder, only 37-55% of them are provided with physical therapy. This policy gap in critical service provision is an area that needs policy reforms in terms of increased insurance cover and updated clinical guidelines. Physical and occupational therapists are not peripheral staff members of the interdisciplinary team: they are fundamental.

Early intervention should be done in the early stages of the motor system, when neuroplasticity is at its peak, and the intervention should include evidence-based practice, including structured physical activities, adaptive sports, and training of motor skills. Accommodations of education are also important, such as extended time in written work, assistive technology, modified physical education, and movement breaks that are systemically discussed in the individualized Education program.

At the policy level, these results demonstrate the need to increase the requirements towards categorizing the motor-oriented therapies as a necessity instead of a complementary service. Professional bodies need to change the clinical practice guidelines to clearly suggest that all children with ASD should undergo regular motor screening and intervention.

Limitations

These findings are limited in a number of ways, which should be taken into account. The cross-sectional design does not allow drawing causal inferences and studying developmental patterns in individuals. The longitudinal study monitoring the motor development during the early childhood and adolescence would be more conclusive about the changes as they occur with age, and about the sensitive stages during which the intervention would be most important. The selection of specialized education settings needs convenience sampling which restricts the generalizability of the sample to children with milder ASD in general schools, undiagnosed children (especially girls), and underserved groups in rural or low-income settings. The results probably over-represent the prevalence of motor impairment in the wider ASD population but accurately report children with a need to receive special services.

Possible biases due to reliance on parent-report assessment as compared to performance-based assessment are reference group effects, cultural expectations, typical development awareness, and parental mood or stress levels. Future studies need to include objective motor tests as well as parent report so that triangulation can be done and more precise skills profiles can be obtained. The research failed to measure various factors that can affect the motor performance: the severity of ASD symptoms, intellectual functioning, language skills, medication status, comorbid, and the history of interventions. These interactions would be better understood to facilitate less biased clinical decision-making. Moreover, validity of the DCDQ in Pakistani settings has not been formally proven and the research did not investigate the relationship between motor impairments and academic performance, behavioral functioning, social functioning, and quality of life.

Future Research Directions

There are a few questions that should be explored. Longitudinal cohort studies that would follow motor progression since early diagnosis, during adolescence, would help to understand developmental patterns, pinpoint the most important intervention stages, and also study the correlation between developmental motor problems and subsequent functional performance. Randomized controlled trials that are well designed are required immediately to compare methods of intervention, determine the most effective dosage and intensity, and find out the children who respond best to the interventions.

Studies of neurobiological processes connecting ASD symptoms with motor abnormalities would enhance the theoretical background by employing neuroimaging research of motor systems, exploring motor learning mechanisms, and studying sensorimotor integration. Comparative cross-cultural studies would help illuminate the effect of environmental influences on the development of motor skills, and research on long-term functional outcomes would demonstrate the influence of childhood motor impairment on the employment rate, independent living, relationships, and the quality of life.

CONCLUSION

This research offers solid proof that motor coordination problems that align with DCD are very common in Pakistani children with ASD, with 97.2% of them fulfilling DCD requirements. Such findings refute the historical perception of motor impairments as secondary characteristics and place them as the main characters to be carefully evaluated and acted on at all levels of care. Age was determined a significant predictor and several motor domains slightly increase with maturation whereas others are not vulnerable to spontaneous gains and they require the assistance of specific therapeutic aids. No gender prediction of general motor difficulty was present, but there were certain fine domain-specific differences. There exist close interrelationships within motor domains, which point to the presence of widespread problems, implying ineffective motor planning and control, and manifest themselves in a broad range of cases. The outcomes of such results need rapid reaction. Screening of motor skills should be a regular practice, which includes validated tools. In the activities of multidisciplinary teams, occupational and physical therapists are obliged to take a part. Early intervention programs are supposed to be able to incorporate motor elements systematically and education systems to be able to rationally accommodate. There is a need to roll out policy reforms that define motor therapies as streams of holistic ASD treatment. The best chance to maximize the results of children with ASD is through combined methods of treatment of motor impairments in conjunction with social-communicative and behavioral characteristics.

REFERENCES

1. Adams, I. L., Lust, J. M., Wilson, P. H., & Steenbergen, B. (2014). Compromised motor control in children with DCD: A deficit in the internal model?—A systematic review. *Neuroscience & Biobehavioral Reviews, 47*, 225-244. https://doi.org/10.1016/j.neubiorev.2014.08.011
2. Ahmed, S., Rosario Yslado Méndez, Naveed, S., Akhter, S., Iqra Mushtaque, Malik, M. A., Ahmad, W., Roger Norabuena Figueroa, & Younas, A. (2023). Assessment of hepatitis-related knowledge, attitudes, and practices on quality of life with the moderating role of internalized stigma among hepatitis B-positive patients in Pakistan. *Health Psychology and Behavioral Medicine*, *11*(1). https://doi.org/10.1080/21642850.2023.2192782
3. American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596
4. Arora, N. K., Nair, M. K. C., Gulati, S., Deshmukh, V., Mohapatra, A., Mishra, D., Patel, V., Pandey, R. M., Das, B. C., Divan, G., Murthy, G. V. S., Sharma, T. D., Sapra, S., Aneja, S., Juneja, M., Reddy, S. K., Suman, P., Mukherjee, S. B., Dasgupta, R., ... Bhutani, V. K. (2018). Neurodevelopmental disorders in children aged 2–9 years: Population-based burden estimates across five regions in India. *PLOS Medicine, 15*(7), e1002615. https://doi.org/10.1371/journal.pmed.1002615
5. Berkeley, S. L., Zittel, L. L., Pitney, L. V., & Nichols, S. E. (2001). Locomotor and object control skills of children diagnosed with autism. *Adapted Physical Activity Quarterly, 18*(4), 405-416. https://doi.org/10.1123/apaq.18.4.405
6. Berkson, J. (1946). Limitations of the application of fourfold table analysis to hospital data. *Biometrics Bulletin, 2*(3), 47-53. https://doi.org/10.2307/3002000
7. Bhat, A. N. (2020). Is motor impairment in autism spectrum disorder distinct from developmental coordination disorder? A report from the SPARK study. *Physical Therapy, 100*(4), 633-644. https://doi.org/10.1093/ptj/pzz190
8. Bhat, A. N. (2021). Motor impairment increases in children with autism spectrum disorder as a function of social communication, cognitive and functional impairment, repetitive behavior severity, and comorbid diagnoses: A SPARK study report. *Autism Research, 14*(1), 202-219. https://doi.org/10.1002/aur.2453
9. Bhat, A. N. (2024). Fewer children with autism spectrum disorder with motor challenges receive physical and recreational therapies compared to standard therapies: A SPARK data set analysis. *Autism, 28*(5), 1161-1174. https://doi.org/10.1177/136236132311931
10. Bhat, A. N., Landa, R. J., & Galloway, J. C. (2011). Current perspectives on motor functioning in infants, children, and adults with autism spectrum disorders. *Physical Therapy, 91*(7), 1116-1129. https://doi.org/10.2522/ptj.20100294
11. Black, M. M., Walker, S. P., Fernald, L. C. H., Andersen, C. T., DiGirolamo, A. M., Lu, C., McCoy, D. C., Fink, G., Shawar, Y. R., Shiffman, J., Devercelli, A. E., Wodon, Q. T., Vargas-Barón, E., & Grantham-McGregor, S. (2017). Early childhood development coming of age: Science through the life course. *The Lancet, 389*(10064), 77-90. https://doi.org/10.1016/S0140-6736(16)31389-7

12. Blank, R., Barnett, A. L., Cairney, J., Green, D., Kirby, A., Polatajko, H., Rosenblum, S., Smits-Engelsman, B., Sugden, D., Wilson, P., & Vinçon, S. (2019). International clinical practice recommendations on the definition, diagnosis, assessment, intervention, and psychosocial aspects of developmental coordination disorder. *Developmental Medicine & Child Neurology, 61*(3), 242-285. https://doi.org/10.1111/dmcn.14132
13. Bremer, E., Crozier, M., & Lloyd, M. (2016). A systematic review of the behavioural outcomes following exercise interventions for children and youth with autism spectrum disorder. *Autism, 20*(8), 899-915. https://doi.org/10.1177/1362361315616002
14. Chauhan, A., Sahu, J. K., Jaiswal, N., Kumar, K., Agarwal, A., Kaur, J., Singh, M., & Pandey, S. (2019). Prevalence of autism spectrum disorder in Indian children: A systematic review and meta-analysis. *Neurology India, 67*(1), 100-104. https://doi.org/10.4103/0028-3886.253970
15. Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.
16. De Luca, C. R., Wood, S. J., Anderson, V., Buchanan, J. A., Proffitt, T. M., Mahony, K., & Pantelis, C. (2020). Normative data from the CANTAB. I: Development of executive function over the lifespan. *Journal of Clinical and Experimental Neuropsychology, 25*(2), 242-254. https://doi.org/10.1076/jcen.25.2.242.13639
17. Faber, L., van den Bos, N., Houwen, S., Schoemaker, M. M., & Rosenblum, S. (2022). Motor skills, visual perception, and visual-motor integration in children and youth with autism spectrum disorder. *Research in Autism Spectrum Disorders, 96*, 101998. https://doi.org/10.1016/j.rasd.2022.101998
18. Fang, S., & Iqra Mushtaque. (2024). The Moderating Role of Health Literacy and Health Promoting Behavior in the Relationship Among Health Anxiety, Emotional Regulation, and Cyberchondria. *Psychology Research and Behavior Management*, *Volume 17*, 51–62. https://doi.org/10.2147/prbm.s446448
19. Fournier, K. A., Hass, C. J., Naik, S. K., Lodha, N., & Cauraugh, J. H. (2010). Motor coordination in autism spectrum disorders: A synthesis and meta-analysis. *Journal of Autism and Developmental Disorders, 40*(10), 1227-1240. https://doi.org/10.1007/s10803-010-0981-3
20. Fuentes, C. T., Mostofsky, S. H., & Bastian, A. J. (2009). Children with autism show specific handwriting impairments. *Neurology, 73*(19), 1532-1537. https://doi.org/10.1212/WNL.0b013e3181c0d48c
21. Gowen, E., & Hamilton, A. (2013). Motor abilities in autism: A review using a computational context. *Journal of Autism and Developmental Disorders, 43*(2), 323-344. https://doi.org/10.1007/s10803-012-1574-0
22. Greaves-Lord, K., Skuse, D., & Mandy, W. (2022). Innovations of the ICD-11 in the field of autism spectrum disorder: A psychological approach. *Clinical Psychology in Europe, 4*(Special Issue), e10005. https://doi.org/10.32872/cpe.10005
23. Green, D., Charman, T., Pickles, A., Chandler, S., Loucas, T., Simonoff, E., & Baird, G. (2009). Impairment in movement skills of children with autistic spectrum disorders. *Developmental Medicine & Child Neurology, 51*(4), 311-316. https://doi.org/10.1111/j.1469-8749.2008.03242.x
24. Hadders-Algra, M. (2018). Early human motor development: From variation to the ability to vary and adapt. *Neuroscience & Biobehavioral Reviews, 90*, 411-427. https://doi.org/10.1016/j.neubiorev.2018.05.009
25. Healy, S., Nacario, A., Braithwaite, R. E., & Hopper, C. (2018). The effect of physical activity interventions on youth with autism spectrum disorder: A meta-analysis. *Autism Research, 11*(6), 818-833. https://doi.org/10.1002/aur.1955
26. Hilton, C. L., Zhang, Y., Whilte, M. R., Klohr, C. L., & Constantino, J. (2014). Motor impairment in sibling pairs concordant and discordant for autism spectrum disorders. *Autism, 16*(4), 430-441. https://doi.org/10.1177/1362361311423018
27. Jago, R., Sebire, S. J., Edwards, M. J., & Thompson, J. L. (2011). Parental TV viewing, parental self-efficacy, media equipment and TV viewing among preschool children. *European Journal of Pediatrics, 172*(11), 1543-1545. https://doi.org/10.1007/s00431-013-2077-5
28. Jasmin, E., Couture, M., McKinley, P., Reid, G., Fombonne, E., & Gisel, E. (2009). Sensori-motor and daily living skills of preschool children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 39*(2), 231-241. https://doi.org/10.1007/s10803-008-0617-z
29. Junaid, K. A., & Fellowes, S. (2006). Gender differences in the attainment of motor skills on the Movement Assessment Battery for Children. *Physical & Occupational Therapy in Pediatrics, 26*(1-2), 5-11. https://doi.org/10.1080/J006v26n01_02
30. Kangarani-Farahani, M., Izadi-Najafabadi, S., Wishart, L. R., & Zwicker, J. G. (2024). How common is developmental coordination disorder in children with autism spectrum disorder? A systematic review and meta-analysis. *Developmental Medicine & Child Neurology, 54*(5), 1977-1997. https://doi.org/10.1007/s10803-023-05948-1
31. Kennedy-Behr, A., Wilson, B. N., Rodger, S., & Mickan, S. (2011). Cross-cultural adaptation of the Developmental Coordination Disorder Questionnaire 2007 for German-speaking countries: DCDQ-G. *Neuropediatrics, 44*(5), 245-251. https://doi.org/10.1055/s-0033-1347936

32. Ketcheson, L., Hauck, J., & Ulrich, D. (2017). The effects of an early motor skill intervention on motor skills, levels of physical activity, and socialization in young children with autism spectrum disorder: A pilot study. *Autism, 21*(4), 481-492. https://doi.org/10.1177/1362361316650611
33. Kokštejn, J., Musálek, M., & Tufano, J. J. (2017). Are sex differences in fundamental motor skills uniform throughout the entire preschool period? *PLOS ONE, 12*(4), e0176556. https://doi.org/10.1371/journal.pone.0176556
34. Landa, R. J., & Garrett-Mayer, E. (2006). Development in infants with autism spectrum disorders: A prospective study. *Journal of Child Psychology and Psychiatry, 47*(6), 629-638. https://doi.org/10.1111/j.1469-7610.2006.01531.x
35. Licari, M. K., Alvares, G. A., Varcin, K., Evans, K. L., Cleary, D., Reid, S. L., Glasson, E. J., Bebbington, K., Reynolds, J. E., Wray, J., & Whitehouse, A. J. O. (2020). Prevalence of motor difficulties in autism spectrum disorder: Analysis of a population-based cohort. *Autism Research, 13*(2), 298-306. https://doi.org/10.1002/aur.2230
36. Liu, T., & Breslin, C. M. (2013). Fine and gross motor performance of the MABC-2 by children with autism spectrum disorder and typically developing children. *Research in Autism Spectrum Disorders, 7*(10), 1244-1249. https://doi.org/10.1016/j.rasd.2013.07.002
37. Lloyd, M., MacDonald, M., & Lord, C. (2013). Motor skills of toddlers with autism spectrum disorders. *Autism, 17*(2), 133-146. https://doi.org/10.1177/1362361311402230
38. Loomes, R., Hull, L., & Mandy, W. P. L. (2017). What is the male-to-female ratio in autism spectrum disorder? A systematic review and meta-analysis. *Journal of the American Academy of Child & Adolescent Psychiatry, 56*(6), 466-474. https://doi.org/10.1016/j.jaac.2017.03.013
39. Louie, D. L., Eng, J. J., & Lam, T. (2021). Gait speed using powered robotic exoskeletons after spinal cord injury: A systematic review and correlational study. *Journal of NeuroEngineering and Rehabilitation, 12*, 82. https://doi.org/10.1186/s12984-015-0074-9
40. MacDonald, M., Esposito, P., & Ulrich, D. (2013). The physical activity patterns of children with autism. *BMC Research Notes, 4*, 422. https://doi.org/10.1186/1756-0500-4-422
41. Maenner, M. J., Warren, Z., Williams, A. R., Amoakohene, E., Bakian, A. V., Bilder, D. A., Durkin, M. S., Fitzgerald, R. T., Furnier, S. M., Hughes, M. M., Ladd-Acosta, C. M., McArthur, D., Pas, E. T., Salinas, A., Vehorn, A., Williams, S., Esler, A., Grzybowski, A., Hall-Lande, J., ... Shaw, K. A. (2023). Prevalence and characteristics of autism spectrum disorder among children aged 8 years—Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2020. *MMWR Surveillance Summaries, 72*(2), 1-14. http://dx.doi.org/10.15585/mmwr.ss7202a1
42. Mahmood, Q. (2023). The challenges of providing rehabilitation services for children with cerebral palsy in Pakistan. *Journal Riphah College of Rehabilitation Sciences*, *11*(03), 139-140.
43. Mandy, W., Chilvers, R., Chowdhury, U., Salter, G., Seigal, A., & Skuse, D. (2012). Sex differences in autism spectrum disorder: Evidence from a large sample of children and adolescents. *Journal of Autism and Developmental Disorders, 42*(7), 1304-1313. https://doi.org/10.1007/s10803-011-1356-0
44. Memari, A. H., Ghaheri, B., Ziaee, V., Kordi, R., Hafizi, S., & Moshayedi, P. (2013). Physical activity in children and adolescents with autism assessed by triaxial accelerometry. *Pediatric Obesity, 8*(2), 150-158. https://doi.org/10.1111/j.2047-6310.2012.00101.x
45. Minhas, A., Vajaratkar, V., Divan, G., Hamdani, S. U., Leadbitter, K., Taylor, C., Aldred, C., Tariq, Q., Bristow, J., Mir, S., Le Couteur, A., & Rahman, A. (2015). Parents' perspectives on care of children with autistic spectrum disorder in South Asia—Views from Pakistan and India. *International Review of Psychiatry, 27*(3), 247-256. https://doi.org/10.3109/09540261.2015.1049128
46. Missiuna, C., Moll, S., King, G., Stewart, D., & Macdonald, K. (2007). Life experiences of young adults who have coordination difficulties. *Canadian Journal of Occupational Therapy, 75*(3), 157-166. https://doi.org/10.1177/000841740807500307
47. Mohd Nordin, A., Ismail, J., & Kamal Nor, N. (2021). Motor development in children with autism spectrum disorder. *Frontiers in Pediatrics, 9*, 598276. https://doi.org/10.3389/fped.2021.598276
48. Morley, D., Till, K., Ogilvie, P., & Turner, G. (2015). Influences of gender and socioeconomic status on the motor proficiency of children in the UK. *Human Movement Science, 44*, 150-156. https://doi.org/10.1016/j.humov.2015.08.022
49. Moseley, R. L., & Pulvermüller, F. (2018). What can autism teach us about the role of sensorimotor systems in higher cognition? New clues from studies on language, action semantics, and abstract emotional concept processing. *Cortex, 100*, 149-190. https://doi.org/10.1016/j.cortex.2017.11.019
50. Mostofsky, S. H., Burgess, M. P., & Gidley Larson, J. C. (2006). Increased motor cortex white matter volume predicts motor impairment in autism. *Brain, 130*(8), 2117-2122. https://doi.org/10.1093/brain/awm129
51. Obrusnikova, I., & Miccinello, D. L. (2012). Parent perceptions of factors influencing after-school physical activity of children with autism spectrum disorders. *Adapted Physical Activity Quarterly, 29*(1), 63-80. https://doi.org/10.1123/apaq.29.1.63

52. Pan, C. Y. (2014). Motor proficiency and physical fitness in adolescent males with and without autism spectrum disorders. *Autism, 18*(2), 156-165. https://doi.org/10.1177/1362361312458597
53. Pan, C. Y., Tsai, C. L., & Chu, C. H. (2009). Fundamental movement skills in children diagnosed with autism spectrum disorders and attention deficit hyperactivity disorder. *Journal of Autism and Developmental Disorders, 39*(12), 1694-1705. https://doi.org/10.1007/s10803-009-0813-5
54. Paquet, A., Olliac, B., Golse, B., & Vaivre-Douret, L. (2016). Current knowledge on motor disorders in children with autism spectrum disorder (ASD). *Child Neuropsychology, 22*(7), 763-794. https://doi.org/10.1080/09297049.2015.1085501
55. Pokoski, O. M., Furnier, S. M., Gangnon, R. E., Howerton, E. M., Kirby, A. V., Protho, T., Fitzgerald, R. T., Shaw, K. A., Bakian, A. V., Bilder, D. A., Durkin, M. S., Shenouda, J., Esler, A., Salinas, A., Williams, S. W., Hughes, M. M., Patrick, M., & Maenner, M. J. (2025). Prevalence of motor milestone delays in autistic children. *JAMA Pediatrics*. Advance online publication.
56. Polatajko, H. J., & Mandich, A. (2004). *Enabling occupation in children: The Cognitive Orientation to daily Occupational Performance (CO-OP) approach*. CAOT Publications ACE.
57. Prado, M. S., Magalhães, L. C., & Wilson, B. N. (2009). Cross-cultural adaptation of the Developmental Coordination Disorder Questionnaire for brazilian children. *Brazilian Journal of Physical Therapy, 13*(3), 236-243. https://doi.org/10.1590/S1413-35552009005000024
58. Roman-Urrestarazu, A., van Kessel, R., Allison, C., Matthews, F. E., Brayne, C., & Baron-Cohen, S. (2021). Association of race/ethnicity and social disadvantage with autism prevalence in 7 million school children in England. *JAMA Pediatrics, 175*(6), e210054. https://doi.org/10.1001/jamapediatrics.2021.0054
59. Sansakorn, P., Mushtaque, I., Muhammad Awais-E-Yazdan, & Muhammad. (2024). The Relationship between Cyberchondria and Health Anxiety and the Moderating Role of Health Literacy among the Pakistani Public. *International Journal of Environmental Research and Public Health*, *21*(9), 1168–1168. https://doi.org/10.3390/ijerph21091168
60. Sarfraz, M., Waqas, H., Ahmed, S., Rurush-Asencio, R., & Mushtaque, I. (2022). Cancer-Related Stigmatization, Quality of Life, and Fear of Death Among Newly Diagnosed Cancer Patients. *OMEGA - Journal of Death and Dying*, 003022282211406. https://doi.org/10.1177/00302228221140650
61. Sawangchai, A., Raza, M., Khalid, R., Fatima, S. M., & Mushtaque, I. (2022). Depression and Suicidal ideation among Pakistani Rural Areas Women during Flood Disaster. *Asian Journal of Psychiatry*, 103347. https://doi.org/10.1016/j.ajp.2022.103347
62. Schoemaker, M. M., Flapper, B., Verheij, N. P., Wilson, B. N., Reinders-Messelink, H. A., & de Kloet, A. (2008). Evaluation of the Developmental Coordination Disorder Questionnaire as a screening instrument. *Developmental Medicine & Child Neurology, 48*(8), 668-673. https://doi.org/10.1017/S001216220600140X
63. Schoemaker, M. M., Flapper, B., Verheij, N. P., Wilson, B. N., Reinders-Messelink, H. A., & de Kloet, A. (2012). Evaluation of the Developmental Coordination Disorder Questionnaire as a screening instrument. *Developmental Medicine & Child Neurology, 48*(8), 668-673. https://doi.org/10.1017/S001216220600140X
64. Schoemaker, M. M., Niemeijer, A. S., Reynders, K., & Smits-Engelsman, B. C. M. (2003). Effectiveness of neuromotor task training for children with developmental coordination disorder: A pilot study. *Neural Plasticity, 10*(1-2), 155-163. https://doi.org/10.1155/NP.2003.155
65. Smits-Engelsman, B. C. M., Blank, R., van der Kaay, A. C., Mosterd-van der Meijs, R., Vlugt-van den Brand, E., Polatajko, H. J., & Wilson, P. H. (2013). Efficacy of interventions to improve motor performance in children with developmental coordination disorder: A combined systematic review and meta-analysis. *Developmental Medicine & Child Neurology, 55*(3), 229-237. https://doi.org/10.1111/dmcn.12008
66. Srinivasan, S. M., Pescatello, L. S., & Bhat, A. N. (2014). Current perspectives on physical activity and exercise recommendations for children and adolescents with autism spectrum disorders. *Physical Therapy, 94*(6), 875-889. https://doi.org/10.2522/ptj.20130157
67. Staples, K. L., & Reid, G. (2010). Fundamental movement skills and autism spectrum disorders. *Journal of Autism and Developmental Disorders, 40*(2), 209-217. https://doi.org/10.1007/s10803-009-0854-9
68. Thomas, J. R., & French, K. E. (1985). Gender differences across age in motor performance: A meta-analysis. *Psychological Bulletin, 98*(2), 260-282. https://doi.org/10.1037/0033-2909.98.2.260
69. Whyatt, C. P., & Craig, C. M. (2012). Motor skills in children aged 7–10 years, diagnosed with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 42*(9), 1799-1809. https://doi.org/10.1007/s10803-011-1421-8
70. Whyatt, C., & Craig, C. (2013). Sensory-motor problems in autism. *Frontiers in Integrative Neuroscience, 7*, 51. https://doi.org/10.3389/fnint.2013.00051
71. Wiggins, L. D., Robins, D. L., Bakeman, R., & Adamson, L. B. (2009). Brief report: Sensory abnormalities as distinguishing symptoms of autism spectrum disorders in young children. *Journal of Autism and Developmental Disorders, 39*(7), 1087-1091. https://doi.org/10.1007/s10803-009-0711-x

72. Williams, Z. J., He, J. L., Cascio, C. J., & Woynaroski, T. G. (2020). A review of decreased sound tolerance in autism: Definitions, phenomenology, and potential mechanisms. *Neuroscience & Biobehavioral Reviews, 121*, 1-17. https://doi.org/10.1016/j.neubiorev.2020.11.030
73. Wilson, B. N., Crawford, S. G., Green, D., Roberts, G., Aylott, A., & Kaplan, B. J. (2007). Psychometric properties of the revised Developmental Coordination Disorder Questionnaire. *Physical & Occupational Therapy in Pediatrics, 29*(2), 182-202. https://doi.org/10.1080/01942630902784761
74. Wilson, B. N., Crawford, S. G., Green, D., Roberts, G., Aylott, A., & Kaplan, B. J. (2009). Psychometric properties of the revised Developmental Coordination Disorder Questionnaire. *Physical & Occupational Therapy in Pediatrics, 29*(2), 182-202. https://doi.org/10.1080/01942630902784761
75. World Bank. (2023). *Pakistan poverty assessment: Toward ending poverty*. World Bank Group.
76. World Health Organization. (2022). *ICD-11: International classification of diseases* (11th rev.). https://icd.who.int/
77. Zeidan, J., Fombonne, E., Scorah, J., Ibrahim, A., Durkin, M. S., Saxena, S., Yusuf, A., Shih, A., & Elsabbagh, M. (2022). Global prevalence of autism: A systematic review update. *Autism Research, 15*(5), 778-790. https://doi.org/10.1002/aur.2696
78. Zwaigenbaum, L., Bauman, M. L., Choueiri, R., Kasari, C., Carter, A., Granpeesheh, D., Mailloux, Z., Smith Roley, S., Wagner, S., Fein, D., Pierce, K., Buie, T., Davis, P. A., Newschaffer, C., Robins, D., Wetherby, A., Stone, W. L., Yirmiya, N., Estes, A., ... Natowicz, M. R. (2015). Early identification and interventions for autism spectrum disorder: Executive summary. *Pediatrics, 136*(Supplement 1), S1-S9. https://doi.org/10.1542/peds.2014-3667C