



PREVALENCE OF DEVELOPMENTAL COORDINATION DISORDER IN 6-12 YEARS OF SCHOOL GOING CHILDRENS IN JALGAON CITY

¹Jidnyasa Attarde, ²Dr.Shruti Chaudhari, ³Dr.Kalyani Nagulkar, ⁴Dr.Jaywant Nagulkar, ⁵Dr.Nikhil Patil

¹Intern, ²Assistant Professor, ³Associate Professor, ⁴ Principal/Professor, ⁵Assistant Professor

¹⁻⁴Dr.Ulhas Patil College Of Physiotherapy, Jalgaon, India.

Abstract:

Background: Developmental coordination disorder (DCD) is the most common disorder in the school-aged children. This study had been done to know the prevalence of DCD in 6-12 years of school going children in Jalgaon by using DCDQ'07- English and Marathi Version.

Aim: Aim is to find the prevalence of developmental co-ordination disorder in school going children of age group between 6 to 12 years in Jalgaon City.

Methodology: A survey based cross sectional study was conducted among five hundred school going in Jalgaon. The DCCQ'07 were distributed among children in school and inform them to fill it by the parents. The filled questionnaires were scored according to the summary score sheets, which interpret indication of DCD or suspect DCD, probably no DCD. The data was evaluated statistically and results were obtained.

Result: Totally 500 children (Boys 46.40% and Girls 53.60%) were evaluated. The total prevalence of DCD is 14.18%. The overall prevalence in the boys was 0.13% and the girls 0.16%, as it was seen that girls are more affected than boys.

Conclusion: The study concluded the prevalence of DCD by using DCDQ'07- Marathi Version and English Version was found to be 14.80% in School going children of age 6 to 12 years in Jalgaon City.

Keywords: Developmental Coordination Disorder, DCDQ'07, Prevalence.

INTRODUCTION

Development refers to qualitative and quantitative changes. It may be defined as a progressive series of orderly, coherent changes. "Progressive" signifies that the changes are directional, that they lead forward rather than backward. "Orderly" and "coherent" suggest that there is a definite relationship between the changes taking place and those that preceded or will follow them.¹

Coordination is the temporal-spatial quality of task execution. Being "well-coordinated" means having movements that are accurate, reliable, effective, quick, and adaptable. Coordination also requires an efficient musculoskeletal system, including the properties of muscles and tendons. Impaired coordination refers to movement that appear awkward, uneven, clumsy, or inaccurate and results from the disruption of the activation, sequencing, timing, and scaling of muscle activity.⁴

Motor development comes from the development of reflexes and mass activity present at birth. Mass activity present at birth, gradually develops into simple patterns of voluntary activity. The cerebellum which controls balance develops rapidly during the early years of life and reaches its mature size by 5 years old. The cerebrum, which control skilled movements, develop in the early years. Skilled movements cannot be mastered until the muscular mechanism of the child matures. The striated muscles, which control voluntary movements, develop at a slow rate throughout the childhood years.¹

Development of hand to mouth coordination (feeding)-By the age of 1 year the baby tries to feed himself with a spoon but in the process he often rotates the spoon and spills the contents. By 15 months he learns to feed himself with spoon without spilling its contents. By 18 months he can feed himself from a cup with only slight spilling.⁶

Development of hand skills, for example, ball throwing and catching. Some babies roll and even attempt to throw balls before they are 2 years old. Even at 4, however, few can throw well. By 6 years, most children are proficient though there are marked variation at every age. At first, children use the whole body to grasp the ball when it is thrown to them. Then they use the arms, with less random movements. After 6 years old, they begin to perfect a coordinated movement of the hands to catch the ball between the palms.¹

During the first 4 or 5 years of postnatal life, the child gains control over gross movements. These movements involve the large areas of the body used in walking, running and so on. After 5 years of age, major development takes place in the control of finer coordination's, which involves smaller muscle groups used in grasping, throwing, and writing. After 6 years old will be ready to adjust to the demands of school and to participate in the play activities of peers.¹

There are various coordination disorders which are: Assessed syndromes; Autism/Autism spectrum disorders (ASD); Dyspraxia [sub grouped as i) Developmental coordination disorder and ii) Developmental verbal disorder; Emotional disturbance and/or Behavioral problems; exceptionally able; General learning disabilities; Specific speech and language disorders; Physical disabilities; Sensory impairments and Specific learning disabilities.⁵

Developmental coordination disorder (DCD) is defined, using the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV), as a condition marked by a significant impairment in the development of motor coordination, which interferes with academic achievement and/or activities of daily living (ADL). These difficulties are not due to a general medical condition (e.g. cerebral palsy) and are in excess of any learning difficulties is present.⁷

Before the DSM era, children with DCD were described as 'motor impairment', 'motor delayed', 'physically awkward', 'perceptual motor dysfunction'/ 'motor perceptual dysfunction (MPD)', 'developmentally agnostic/apractic', or as 'clumsy child syndrome'.

Developmental Coordination Disorder (DCD) is one of the most common disorders amongst school-aged children.

The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) provides four criteria to classify a child as having DCD:

A. Performance in daily activities that require motor coordination is substantially below given the person's chronologic age and measured intelligence. This may be manifested by marked delays in achieving motor milestones (e.g., walking, crawling, sitting) dropping things, "clumsiness," poor performance in sports, or poor handwriting.

B. The disturbance in criterion A significantly interferes with academic achievement or activities of daily living.

C. The disturbance is not due to a general medical condition (e.g., cerebral palsy, hemiplegia or muscular dystrophy) and does not meet criteria for a Pervasive Developmental Disorder.

D. If mental retardation is present, the motor difficulties are in excess of those usually associated with it.⁹

Motor impairment compromises success in everyday activities and school progress. The condition is idiopathic and the child has no identifiable medical, cognitive, psychological, social, or other obvious condition or reason for the movement difficulty. Some studies have demonstrated that the children with DCD do not simply 'grow out of' their difficulties.¹⁰

Macnab identified 5 different subtype profiles of DCD.

The first subtype included children with better gross motor than fine motor skills, although both were still below normal while standing balance and visual-perceptual skills were both within normal ranges, Compared with children of the same age with DCD.

Children in the second subtype scored high on measures of upper-limb speed and dexterity, visuomotor integration, and visual-perception skills, but they demonstrated poor performance on measures of kinesthetic ability (accuracy in discriminating movement and position of the upper limbs) and balance.

Children in subtype 3 demonstrated the greatest overall motor involvement and were the only subtype to have difficulty with both kinesthetic and visual skills, Compared with their peers with DCD.

Children in subtype 4 performed well on kinesthetic tasks but demonstrated poor performance on task requiring visual and dexterity skills.

Children in subtype 5 demonstrated poor performance on measurements of running speed and agility compared with their peers with DCD; however, they performed well relative to their peers with DCD in the tasks involving visual-perception skills.¹¹

Children with DCD may have a wide range of dysfunctions. These dysfunctions can be grouped into 3 areas: gross motor, fine motor, and psychosocial.

Gross Motor

Hypotonia, persistence of primitive reflexes, immature balance reactions, awkward running pattern, fall frequently, drop items, and have difficulty imitating body positions and following 2 to 3 step motor commands.

Fine Motor

Difficulty with handwriting or drawing, difficulty in planning and executing fine motor skills such as gripping and dressing.

Psychosocial

Learning disabilities or reading problems and may be at increased risk for lower intelligence. Exhibit less socially desirable means of gaining recognition and friends.¹¹

Developmental coordination disorder appears to be a fairly common disorder of childhood and is usually identified in children between 6 and 12 years of age. Ten years ago, researchers estimated that DCD occurred in 10% to 19% of school-aged children. With a more precise definition of DCD, the current prevalence is estimated to be between 5% and 8% of all school-aged children, with more boys than girls (2:1) being diagnosed with DCD. This difference may reflect higher referral rates for boys, because the behavior of boys with motor incoordination may be more difficult to manage at home and in the classroom. In addition, a higher incidence of DCD may be found among children with a history of prenatal or perinatal difficulties.¹¹

A number of tools have been developed which focus on identifying the presence, and extent, of a movement skill deficit tested under clinical and standardized conditions, in order to meet requirements for a motor impairment as stipulated under Criterion A of the DSM-IV:

“Performance in daily activities that require motor coordination is substantially below given the person's chronologic age and measured intelligence. This may be manifested by marked delays in achieving motor milestones (e.g., walking, crawling, sitting) dropping things, “clumsiness,” poor performance in sports, or poor handwriting.”¹¹

Tests commonly used in North America include the Movement Assessment Battery for Children (MABC); the Bruininks-Oseretsky Test of Motor Proficiency (BOT); the Beery-Buktenica Developmental Test for Visual Motor Integration (VMI).¹¹

In contrast, fewer standardized measures are available to ascertain the impact of these movement problems on functional everyday home and school tasks, to determine whether Criterion B has also been met. Criterion B requires evidence of poor performance of daily living and academic skills, which must be measured within the context of the situation. Interviews and information from qualitative studies are available, and several instruments have been developed for the identification of DCD by teachers. Parent report has been found to be useful in the process of identification of developmental and movement difficulties.¹¹

Addition and revision of items was undertaken by a clinical advisory committee consisting of five occupational therapists with experience with DCD. A 24-item version was then completed by 287 parents, of which 283 were used for analysis. Cronbach's alpha coefficient for the 24-item version was 0.90. After examination, the questionnaire was revised to include only 15 items. Cronbach's alpha coefficient was 0.89. To determine predictive validity and cut-off scores, the sample was extended to include the original population based sample, a second sample in Calgary and a clinical sample from England. Cut-off scores were determined for “DCD or Suspect DCD” and “No DCD”. Overall sensitivity is 84.6% and specificity is 70.8% when using age related cut-off scores which are adjusted for the 3 age groups. Strong internal consistency, construct validity and concurrent validity were demonstrated, confirming that the revised DCDQ'07 is an appropriate clinical screening tool for DCD in children aged 6-12 years.¹¹

The prevalence of DCD in India is found to be 1.37% at kattankulathur. The prevalence of DCD in other countries is estimated to be (5-8%) USA, (1.8%) UK, (5.7%) Greek, (5-9%) Canada, (1.7%) Belgium and 6% worldwide. Previous research in Indian scenario was found with prevalence of 1.37% in Chennai, 22.33% in Karnataka and 30% in Loni, with more boys than girls (2:1) being diagnosed with DCD.

As per the literature there are few studies found on the prevalence of DCD using DCDQ'07 in 6-12 years of age group in Indian scenario. Hence, there is a need to conduct the study among children residing in Jalgaon, Maharashtra, India on prevalence of DCD in 6 to 12 years of children using DCDQ'07. As this part of Maharashtra studies are lacking.

As DCD is very difficult to diagnose among developing children because the symptoms of DCD may be confusing with other coordination disorder and delayed in diagnosis may lead to complications. If diagnosed early, it can be beneficial to enhance the mature development of child by giving age appropriate measures.

So the study have been conducted aiming to find out the prevalence of DCD in school going children in Jalgaon city

AIM OF THE STUDY

Aim is to find the prevalence of developmental co-ordination disorder in school going children of age group between 6 to 12 years in Jalgaon City.

OBJECTIVE OF THE STUDY

To find out the prevalence of developmental co-ordination disorder by using DCDQ-07- Marathi and English Version in normal school going children.

MATERIALS AND METHODS

- a) **Source of the Data Collection:** Parents of typically developing school children of age 6 to 12 years residing in Jalgaon.
- b) **Method of Collection of Data:** Ethical clearance has been obtained from Dr. Ulhas Patil College of Physiotherapy, Jalgaon. All the typically developing children between age group of 6 to 12 years has been included in the study. As per their inclusion criteria and exclusion criteria, subjects who are willing to participate in this study has included. The demographic data has collected from the parents. Each selected child has given a DCDQ'07 Marathi version and English version and a letter regarding what is the study about, and written informed consent in Marathi language. The researcher phone number has been provided to contact if in case parents have any query at any point during filling of the questionnaire. The parents has been assured that their participation and non-participation would not affect their child's education and that their responses will be anonymous. Parents has be instructed to return completed questionnaire by hand delivery to school.
- c) **Material:**
 - 1) Developmental Coordination Disorder Questionnaire 2007 (DCDQ'07)-Marathi and English Version.
 - 2) Patient Information Sheet.
 - 3) Consent Form.
- d) **Research Design:**
 1. Study Design: Cross-sectional Study.
 2. Study Duration: 6 Months.
 3. Study Setting: Jalgaon City.
 4. Target Population: Typically developing school going children age 6 to 12 years.
 5. Sampling Methods: Stratified Sampling
 6. Sample Size: 500
- e) **Inclusion Criteria:**
 1. Normal children between age group of 6 to 12 years.
 2. Both boys and girls.
- f) **Exclusion Criteria:**
 1. Any known psychological disorder.
 2. Any general medical condition (According to DSM-4th Edition) - CP, Muscular dystrophy, Muscular impairments, Mental retardation.
 3. Unwilling parents after inclusion.

METHODOLOGY

For this study children in the age group of 6 to 12 years has been selected. The children has been selected on the basis of multistage sampling method.

In 1st stage - We have randomly approach to 5 schools in Jalgaon. In 2nd stage - Only 2 schools has given the positive approach to conduct the study at their school. In 3rd stage - Total 500 children were selected to participate. From each standard, any one division was selected randomly and from every division boys and girls of same age were selected by random sampling method. In the final stage- After collection of all data from children, data was categorized into 7 groups on the basis of chronological age which will be 6-6.11 years, 7-7.11 years, 8- 8.11 years, 9-9.11 years, 10-10.11 years, 11-11.11 years, and 12-12.11 years.

The procedure to follow for completing questionnaire has been explain to the children in short.

As each children were given the Information sheet in Marathi which briefly explain the study to parents or guardian and also the written consent in Marathi has been taken. A valid and reliable DCDQ'07 – Marathi Version and English Version was given to the parents or the caregivers.

This questionnaire consists of 15 items which includes control during movement, fine motor/handwriting and general coordination. The subject's parents responded to each behavioural statement, using a 5-point Likert scale in which 1=not at all like your child; 2= bit like your child; 3=moderately like your child; 4=quite like your child; 5=extremely like your child.

Also contact number has been provided to parents as if any parents have any query during completing the questionnaire and children were inform to submit their questionnaire to their class teacher after completing it by the parents.

The duly filled questionnaire have been returned to the therapist.

The therapist has score it according to summary score sheets and which has been interpret whether the child has DCD or not.

OUTCOME MEASURES

Developmental Coordination Disorder Questionnaire 2007 (DCDQ'07):

Developmental Coordination Disorder Questionnaire (DCDQ) is a parent report measure developed to assist in the identification of Developmental Coordination Disorder in children.

Parents are asked to compare their child's motor performance to that of his/her peers using a 5 point Likert scale in which 1=not at all like your child; 2= bit like your child; 3=moderately like your child; 4=quite like your child; 5=extremely like your child.

It provides a standard method to measure a child's coordination in everyday, functional activities.

The DCDQ'07 consists of 15 items, which group into three distinct factors. The first factor contains a number of items related to motor control while the child was moving, or while an object was in motion, and is labelled "Control during Movement". The second factor contains "Fine Motor and Handwriting" items and the third factor relates to "General Coordination". These factor scores alone do not provide an indication of whether the child may have DCD.

The DCDQ usually takes parents about 10-15 minutes to complete. The overall sensitivity is 84.6% and the specificity is 70.8%.²⁶

In present study DCQ'07- English Version has been converted into DCDQ'07- Marathi Version by using Test-retest reliability method and reliability was found to be 0.98%, as parents of children in this City were not well acquainted to English language, so for easy convenience this questionnaire was converted into Marathi.

DATA ANALYSIS

A total 500 participants were screened in the study. The obtained data from participants of the study was entered in MS Excel before it was statistically analysed.

Descriptive statistical was used to analysed age and gender.

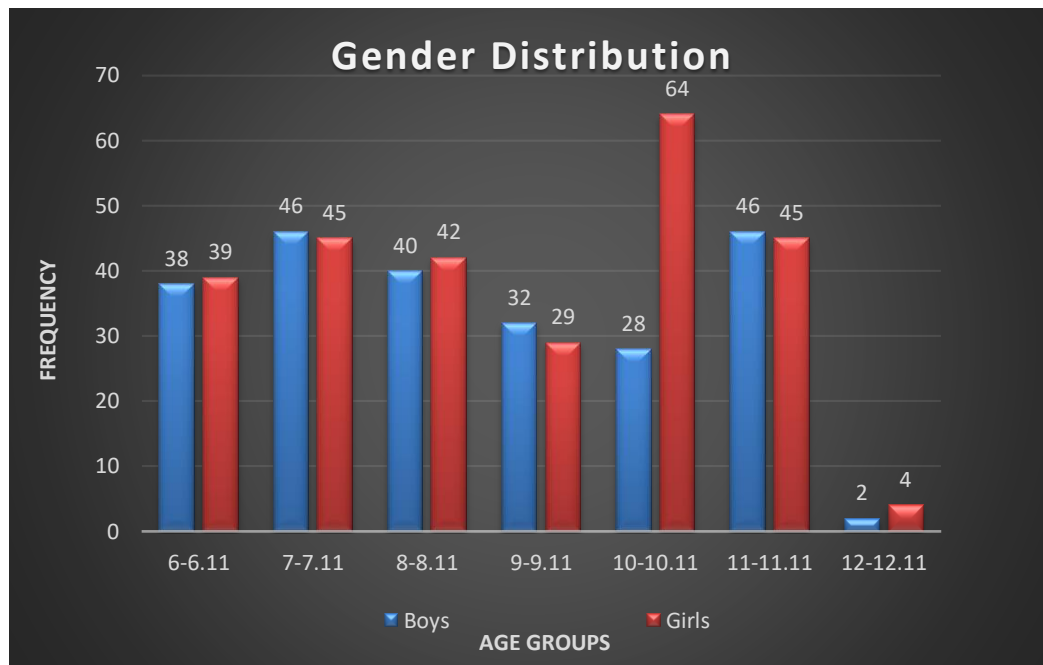
The chi square test was done for finding the prevalence of Developmental Coordination Disorder in School going children of age 6 to 12 years.

RESULT**TABLE 1: Distribution of children according to age group and gender.**

Variable	Groups	Frequency	Percentage
Age	6-6.11	77	15.40
	7-7.11	91	18.20
	8-8.11	82	16.40
	9-9.11	61	12.20
	10-10.11	92	18.40
	11-11.11	91	18.20
	12-12.11	6	1.20
Gender	Boys	232	46.40
	Girls	268	53.60
DCD	Probably Not	426	85.20
	Indication or suspect	74	14.80

TABLE 2: Distribution of children according to gender in age groups.

Age Groups	Boys		Girls	
	Frequency	Percentage	Frequency	Percentage
6-6.11	38	16.38	39	14.55
7-7.11	46	19.83	45	16.79
8-8.11	40	17.24	42	15.67
9-9.11	32	13.79	29	10.82
10-10.11	28	12.07	64	23.88
11-11.11	46	19.83	45	16.79
12-12.11	2	0.86	4	1.49
Total	232	100.00	268	100.00

GRAPH 1: Distribution of gender according to age groups.

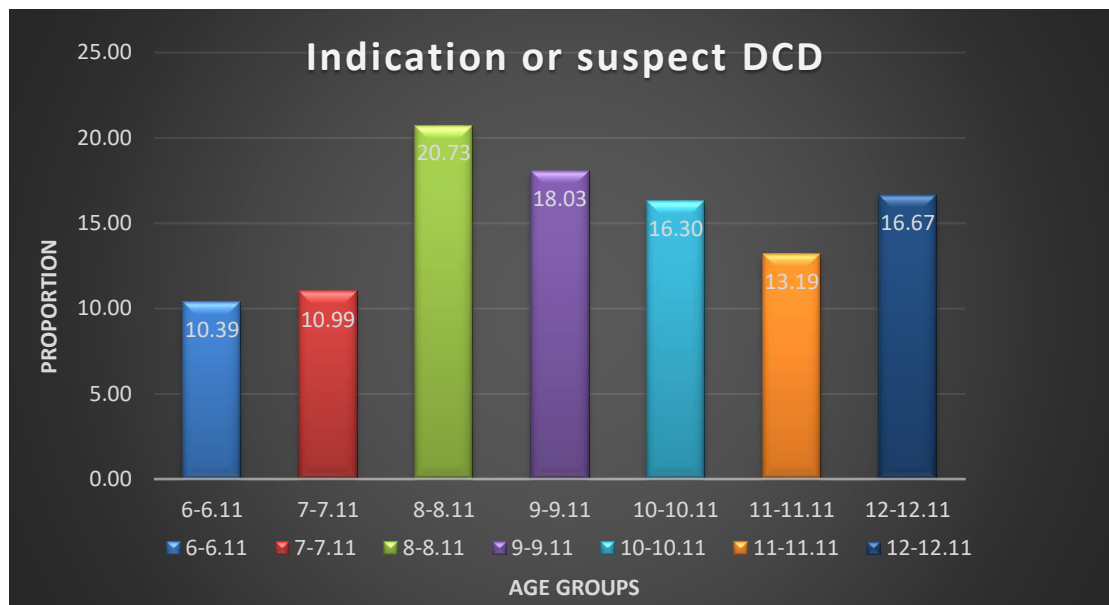
This study investigated the prevalence of DCD at Jalgaon. **Table 1 and 2 and Graph 1** revealed that Five hundred (n=500) were participated, 232 were Boys and 268 were Girls. The age range was 6 to 12 years with mean age of 9 years. Descriptive statistics was used to analyse the data.

TABLE 3: Prevalence of DCD (indication of DCD or suspect DCD) according to age group.

Age Groups	Probably not DCD		Indication or suspect DCD		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
6-6.11	69	89.61	8	10.39	77	15.40
7-7.11	81	89.01	10	10.99	91	18.20
8-8.11	65	79.27	17	20.73	82	16.40
9-9.11	50	81.97	11	18.03	61	12.20
10-10.11	77	83.70	15	16.30	92	18.40
11-11.11	79	86.81	12	13.19	91	18.20
12-12.11	5	83.33	1	16.67	6	1.20
Total	426	85.20	74	14.80	500	100.00

Chi-square = 5.39, d.f.=6, p value= 0.49

GRAPH 2: Prevalence of DCD according to age groups



The **Table 3 and Graph 2** showed that 74 out of 500 had scores that met the criteria for a diagnosis of DCD, giving a prevalence rate of 14.80%. Further analysis revealed that prevalence rate is high (20.73%) in age group 8-8.11 year and low (10.39%) in age group 6-6.11 year at Jalgaon. This confirms the existence of DCD among 6 to 12 year at Jalgaon.

TABLE 4: Gender wise Distribution and Prevalence of DCD.

Variable	Groups	N	DCD	Proportion	Z value	p value
Gender	Male	232	30	0.13	1.10	0.27
	Female	268	44	0.16		

GRAPH 3: Gender wise Proportion of DCD

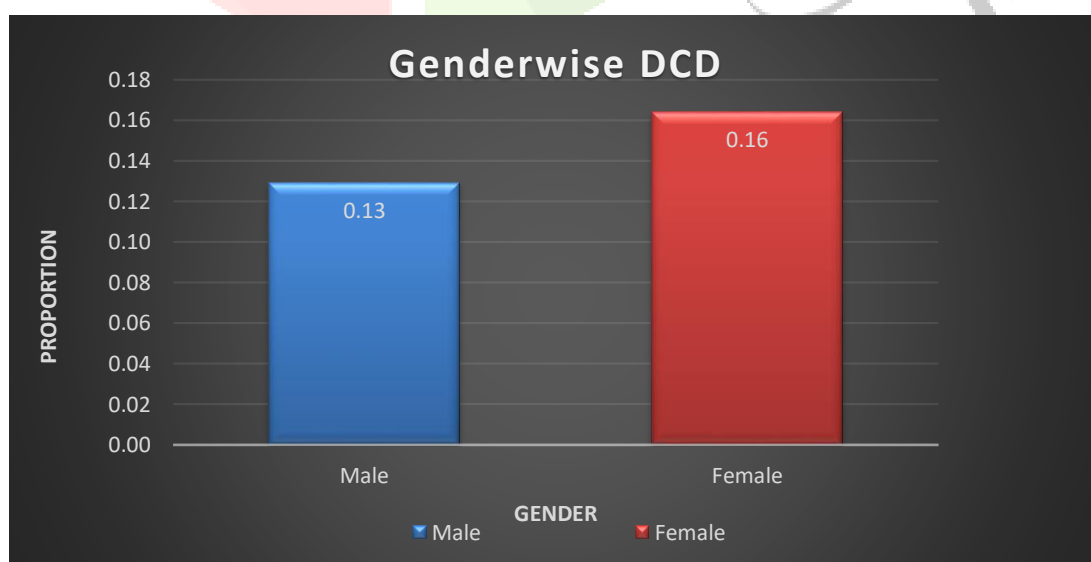


Table 4 and graph 3 revealed that Female has high (0.16%) rate than Boys (0.13%) at Jalgaon and p value is 0.27. According to P value statistically there is no significant difference between both groups.

DISCUSSION

Developmental Coordination Disorder is a chronic condition involving impairment in gross motor, postural, and/or fine motor performance that affects a child's ability to perform the skilled movements necessary for daily living, including the performance of academic and self-care tasks.²⁵ It also is defined, using the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV), as a condition marked by a significant impairment in the development of motor coordination, which interferes with academic achievement and/or activities of daily living (ADL). These difficulties are not due to a general medical condition (e.g. cerebral palsy) and are in excess of any learning difficulties that are present. Developmental coordination disorder appears to be a fairly common disorder of childhood and is usually identified in children between 6 and 12 years of age.⁷

The present study was conducted to identify the prevalence of DCD in children, aged 6-12 years, using DCDQ'07- Marathi Version and English Version, considering the chronological age and gender. As there are no studies on prevalence of DCD using DCDQ'07 (Marathi Version and English Version) in 6-12 years of age groups in Indian scenario. Hence there is a need to conduct the study among normal school going children residing in Jalgaon because early diagnosis of DCD can be helpful to prevent the future secondary complications.

The study was conducted on 500 participants. In the distribution of children according to age group and gender shows the distribution of children according to their age group and gender, It shows the distribution of age in 7 groups i.e 6-6.11 (15.40%), 7-7.11 (18.20%), 8-8.11 (16.40%), 9-9.11(12.20%), 10-10.11(18.40%), 11-11.11(18.20%), 12-12.11(1.20%).

Distribution of children according to gender in age groups shows the distribution of gender in age groups. There were 232 Boys and 268 Girls included in the study from age groups of 6-12 years. As also shows the gender distribution in age groups and it was seen that Girls sample are more than Boys.

In present study the prevalence of DCD according to age groups of 6-12 Years using Chi- square test and it shows that indication of DCD or suspect DCD ranged from 10.39% to 20.73% in the age group of 6-12 years, it also shows that prevalence of indication of DCD or suspect DCD is higher at age group of 8-8.11 (20.73%) and lower at age group of 6-6.11 (10.39%). As older children showed a higher prevalence of suspected DCD but scored significantly higher in all motor coordination factors. As noted in previous research, children of age 8 and older are more likely to present DCD symptoms, while simultaneously scoring better on DCDQ'07 (Marathi Version). Same result was found in previous study done in Spanish in 2019 by Laura Delgado Lobete. This could be because motor skills improve with age and therefore the DCDQ'07 scores increase. However those children with poor motor skills are more likely to be identified by the DCDQ'07 as having suspected DCD. It has been also noted that DCD diagnosis at early ages lacks stability. Additionally, DCD is a chronic condition that affects everyday performance and academic achievement, even during adolescence and adulthood, Therefore it is possible that DCD become more evident and readily detected in older children because their motor coordination difficulties have a greater impact on their everyday activities.²²

As this the first study assess the prevalence of suspected DCD of normal school aged children in Jalgaon. In this study 14.80% of children were identified as having suspected DCD. These findings are in line with other studies that report a similar rate of DCD. The previous study in Spanish by Laura Delgado Lobete 2019 has found prevalence rate of 12.2%, In Sao Carlos (Brazil) by Patricia Carla de Souza 2017 has prevalence rate of 30%, and In Southern India by Srilatha Girish 2016 found prevalence rate of 18.9%.

Regarding the prevalence of DCD in relation to gender present study showed that there is no significant difference between the presence of signs in both boys and girls, the percentage found is very similar between gender (Boys 13% and Girls 16%). This same result was found in the study done by Srilatha Girish 2016 done in southern India by using Kannada version of DCDQ'07 and has found that Girls (1.1%) affected more than Boys (0.5%). The prevalence was found more in Girls than Boys because with respect to gender.²⁴ As according to previous study done by Rubén Navarro-Patón 2021 shows that Boys and Girls go through the same sequence of motor competence development. However girls tends to show lower levels of motor competence and object control and manipulation skills than boys, As Girls show a better performance in fine motor skills than Boys.²¹

But in present study, sample collection according to gender distribution was not equal. Total no of girls participation was more (268) than boys. So we can't firmly state that girls has more prevalence of DCD than boys.

CONCLUSION

The study concluded the prevalence of DCD by using DCDQ'07- Marathi Version and English Version was found to be 14.80% in School going children of age 6 to 12 years in Jalgaon City.

LIMITATIONS

1. Prenatal and Natal/Postnatal history has not been taken.
2. No past musculoskeletal trauma/injury which may create associated problems related to activities of daily living (ADL) were considered.

SUGGESTIONS

1. Further Study can be done on larger population.
2. Equal Sample distribution according to gender can be done to find out if girls has more prevalence of DCD than boys.
3. One to one interview with parents, including Prenatal, natal and postnatal history, gross examination of child related to development may give significant result to conclude the prevalence of DCD.

REFERENCES

- 1) Elizebeth B. Hurlock. Child Development. 6th Ed. New Delhi: Tata McGraw Hill; 1997. Chapter no 2. Pg. no.23.
- 2) Ronald S. Illingworth. The Normal Child. 10th Ed. New Delhi: Edinburgh, Churchill Livingstone; 2002. Chapter no 12. Pg. no.127-128.
- 3) Gupta Suraj. The Short Textbook of Pediatrics. 10th Ed. New Delhi: Jaypee; 2009. Chapter no 3. Pg. no.32.
- 4) Paula Kramer, Jim Hinojosa. Pediatric Occupational Therapy. 3rd ed. Philadelphia: Lippincott Williams and Wikins/Wolters Klower; 2010. Chapter no 7. Pg. no.209-210.
- 5) Dyspraxia. Available from URL: <http://www.sess.ie/categories/dyspraxia>.
- 6) O.P. Ghai, Piyush Gupta and U.k.Paul. GHAI Essential Pediatrics. 6th Ed. New O.P. Ghai; 2004. Chapter no 1. Pg. no.46.
- 7) Raghu Lingam, Linda Hunt, et.al. Prevalence of Developmental Coordination Disorder Using the DSM-IV at 7 years of Age: A UK Population-Based study. Pediatrics Volume-123, Number 4, April 2009.
- 8) Christopher Gillberg and Bjorn Kadesjo. Why Bother About Clumsiness? The Implication of Having Developmental Coordination Disorder (DCD). Neural Plasticity. Volume 10, NO.1-2, 2003.
- 9) Wilson B.N, Crawford S.G. et.al. Administration manual for the DCD'07 with psychometric properties. Physical and Occupational Therapy in Pediatrics, 29(2):182-202.
- 10) Judith M Peters and Ann Markee. Physiotherapy for Children. 1st Ed. New York Elsevier Health Sciences; 2007. Chapter no 9. Pg. no.123.
- 11) Robert C Barnhart, Mary Jo Devenport. Et.al. Developmental Coordination Disorder. Physical Ther. 2003; 83:722-731.
- 12) Georgia D. Tsiotra, Andreas D. Flouris et.al. A Comparison of Developmental Coordination Disorder Prevalence Rates in Canada and Greek Children. Journal of Adolescent Health 39 (2006) 125-127
- 13) Cheryl Missiuna, Robin Gaines et.al. Description of children identified by physician as having developmental coordination disorder. Developmental Medicine and Child Neurology 2008, 50:839-844.
- 14) Raghu Lingam, Marian J. Jongmans et.al. Mental Health Difficulties in Children with Developmental Coordination Disorder. Pediatrics volume 129, no 4, April 2012.
- 15) Ganapathy Sankar U, S. Saritha. Study of prevalence of Developmental Coordination Disorder at Kuttankulathur, Chennai. SRM college of Occupational Therapy, SRM University, Chennai. Indian Journal of Physiotherapy and Occupational Therapy. Jan.-March, 2011, Vol. 5, No. 1

- 16) Nadia Cristina Valentini, Monia Taina C et.al. Prevalence of motor deficits and developmental coordination disorder in children from South Brazil. *Rev Paul Pediatrics* 2012; 30(3):377-84.
- 17) J Cairney, JA Hay et.al. Developmental coordination disorder and overweight and obesity in children aged 9-14y. *International Journal of Obesity* (2005)29, 369-372.
- 18) Bulent Elbasan, Hlya Kayihan and Irem Duzgun. Sensory integration and activities of daily living in children with developmental coordination disorder. *Italian Journal of Pediatrics* 2012, 38:14.
- 19) Raghu Lingam, Jean Golding, Marian J. Jongmans et.al. The Association between Development Coordination Disorder and Other Developmental Traits. *Journal of the American Academy of Pediatrics*. *Pediatrics* 2010; 126; e1109; originally published online October 18, 2010; DOI:10.1542/peds.2009-2789.
- 20) David Sugden and Dr Carolyn Dunford. Recognizing Developmental Coordination Disorder. *Assessment and Development Matters*. Vol.1.No.2.Summer 2009.
- 21) Ruben Navarro Paton, Joaquin Lago Ballesteros, Victor Arufe Giraldez “Gender Differences on Motor Competence in 5-Year-Old Preschool Children Regarding Relative Age” *International Journal of Environmental Research & Public Health* 2021, 18, 3143. <https://doi.org/10.3390/ijerph18063143>.
- 22) Laura Delgado-Lobete, Sergio Santos-del-Riego, Sonia Pértega-Díaz, Rebeca Montes-Montes “Prevalence of suspected DCD and associated factors in Spanish Classrooms” *University of Coruna, Research in Developmental Disability* 86 (2019) 31-40.
- 23) Komal K B, Parmar Sanjay “Indication or Suspect of DCD in 5-15 years of school going children in Dharwad, Karnataka India”, *Internal Journal of Health Science & Research* Vol 4, Issue 6; June 2014.
- 24) Srilatha Girisha, Kavitha Rajab, Asha Kamath “Prevalence of developmental coordination disorder among mainstream school children in India” *Journal of Pediatric Rehabilitation Medicine: An Interdisciplinary Approach* 9 (2016) 107–116 107 DOI 10.3233/PRM-160371.
- 25) Robert J. Palisano, Margo N Orlin, Joseph Schreiber, *Campbell’s Physical Therapy for Children 5th Edition*, Elsevier 2017, Chap 17, Page-399.
- 26) B.N. Wilson, S.G. Crawford “The Developmental Coordination Disorder Questionnaire 2007 (DCDQ’07)”, *Physical & Occupational Therapy in Pediatrics*, 29(2):182-202.