Development of diagnostic assessment tool for developmental coordination disorder

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Abstract---Objectives: The purpose of the study was to develop diagnostic assessment tool for Developmental Coordination Disorder (DCD). Method: Methodological research, quantitative research design. Diagnostic assessment tool for Developmental coordination disorder was developed based on literature review and expert opinion. Content reliability was established through item-item analysis with 50 samples. Test-retest reliability of DCD diagnostic tool was examined in 3 week interval with 30 samples. Interrater reliability of DCD diagnostic assessment tool was examined with 30 samples. Results: DCD diagnostic assessment tool has 5 subtest with 25 items. There was positive correlation between each items and subtest of DCD diagnostic assessment tool. Test-retest reliability and interrater reliability of DCD diagnostic assessment tool was adequate. Conclusion: Diagnostic assessment tool for Developmental coordination assessment tool has good content reliability, interrater and test-retest reliability. Further study can be conducted with large sample size to strength psychomotor abilities of DCD diagnostic assessment tool.

Keywords---DCD diagnostic Assessment tool, Subtests, Interrater reliability, test-retest reliability, content validity.

Introduction

Developmental Coordination Disorder (DCD) is characterized by inability to perform fine and gross motor skill to match the age appropriate level. It is fairly a common disorder affecting 6% of school children[1]. Children with DCD experience movement coordination difficulties and they needs special attention at home, school and community as they experience activity limitation, these children

isolate themselves from everyone and from everything that demands motor coordination skill. If left without early attention and identification, these children will mug amplified motor difficulties and that extends to have an impact over the child's emotional and social development and this continues through adulthood [2].

Developmental Coordination Disorder is the common threat for children and it is considered as the most common developmental dysfunctions and majority of children were diagnosed with DCD. There is huge debate on establishing the prevalence estimate of children with DCD [3]. There is a huge variation on the prevalence data and it varies in relation to the diagnostic criteria and the assessment tool. Green et al, documented that 15% of children from Australian schools was found to have clumsiness and diagnosed as DCD suspects [4].

In addition researchers around 2007 documented that 10% of primary school children's from various country is diagnosed to have DCD, which estimates that one child per class was diagnosed to have DCD. Lingam et al, in 2009 documents that in England, 18 out of 1000 children were diagnosed to have DCD and 49 out of 1000 were suspects of DCD and documented that the prevalence estimate for DCD can vary if assessed with different motor coordination assessment tools [5].

However, many countries exhibit the different percentages and also demonstrate different prevalence of DCD. In 2010 estimated 3.5%-17.9% at Taiwan. However in 2013 at America reported that 6% of prevalence exists among primary school children. Comparatively it was proposed by Zwicker et al that, there exist a high prevalence of 19% in Greece [6]. Sweden is with prevalence of 13.5% and at the same time in United Kingdom, there is a low occurrence of DCD as documented by Lingam in 2009. Add on to all these documented evidences, a research study published from South Africa, reported that there is a high prevalence of 52% in the year 2004 and 61.2% in the year 2008. Using DSM-5 criteria, estimated the prevalence of 1.16% in west India.

In Tamilnadu, Ganapathy Sankar documented that there is a prevalence of 1.37% at Kattankulathur in the year 2011.Ganapathy Sankar in his another study on advocating the prevalence of Developmental Coordination Disorder at Kattupakkam, Tamilnadu in 2018 estimated that the prevalence rate is 3.22%. A gender difference is also documented to play a huge role in establishing prevalence estimate of DCD. In 2004, boys and girls ratio for DCD is documented as 4:1 and 7:1 and the authors identified teachers rated samples of children with DCD and established that high number of boys was diagnosed as DCD with the ratio from 3:1 to 5:1 [7].

Majority of the parents and teachers fails to identify the children with developmental coordination disorder at the early stage; the reason is that they fail to identify the background reasons for their clumsiness [8]. They fail to motivate the child identified as clumsy at school and at home, there is a need to relate the factor of motivation and teaching to analyze and reason out the causes of clumsiness. Since 1990 majority of the parents of children with DCD believes that children with motor coordination difficulties "grew out" of their difficulties on their own with no rehabilitation attempts and intervention.

Extrinsic factors that affect the child with DCD needs elaborate assessment at the early stage to redirect the clumsiness and motor coordination difficulties into successful activity of daily living [9]. The motor difficulties that resolved at the early years seems to resolve later, when the child is exposed to stress of learning a new task that demands motor skill. Children with DCD were having low self esteem as these children compare them with typically developing peer group children in several domains that includes physical activity, academics, appearance of self and also in social acceptance [10]. If children's were not identified at their early years, they experience social isolation, negativism and experiences other psychiatric illness like mood and anxiety disorders. The long term impact of DCD worsens the prognosis and children presented with mixed presentation were continuing to exhibit difficulties in adulthood.

Long term impact of DCD includes psychiatric morbidity and other disorders like Affective anxiety disorder, borderline personality disorder, Withdrawal, depression and suicidal risk[11].Children with motor coordination defect experiences poor perception of self and considers themselves as poor and physically unfit to execute the simple activities of daily living task that other typically developing peer group children perform with ease. As a result of frequent failure in academics and sports they isolate themselves from others. BOT-2 and M-ABC assessment tool commonly used to identify coordination problem in children with DCD [11]. Developmental Coordination Disorder Questionnaire (DCDQ) was used to screen the children with DCD. But there is no gold standard diagnostic or assessment tool for Developmental coordination disorder. Hence current study was intended to develop Developmental coordination disorder assessment tool and establish reliability of DCD assessment tool.

Methodology

This study was methodological research in quantitative research design. Ethical clearance was obtained from Institutional ethical committee of SRM Medical college Hospital and Research center to conduct this research work. Ethical clearance number was 1755/IEC/2019. This study has 2 phases. The first phase was development of DCD assessment and second phase was establishing reliability for DCD assessment.

Phase 1:

Literature review found that children with DCD have problem in muscle strength, balance, bilateral coordination, visual motor coordination, fine motor skills, Activities of daily living skills, play and handwriting skills. Primary investigator has developed 8 subtests for DCD assessment with 45 items based on literature review. Likert scale was used to score each items in subtest of DCD. This DCD assessment was sent to 10 experts in the field of Developmental coordination disorder to obtain expert opinion. Some of the Subtest and items of the DCD assessment was deleted based on expert analysis. Finally, DCD assessment has 5 subtests with 25 items.

Table 1
Developmental Coordination (DCD) assessment

Sl.No.	Subtest
1	Muscle power
2	Movement
3	Inhand manipulation
4	Gross motor skill
5	Eye hand coordination

Phase 2:

The Purpose of the study was explained to head of the institution and consent form obtained from parents of participants. Fifty samples were recruited through random sampling method for item-item analysis and internal consistency of DCD assessment. 30 samples were included to establish interater reliability. The principal investigator and co-investigator administer DCD assessment on 30 samples. DCD assessment tool was administered on 30 samples with typically developing within 3 weeks interval for test-retest reliability Sample were taken from mainstream school in Chennai,Tamilnadu from the age group of 5-10 years.

Results

Table 2
Item-Total Statistics of DCD assessment tool items of the subtest

S.NO	Items	Scale Mean	Scale Variance	Total Correlation	Cronbach's Alpha
1.	Standing on dominant leg	40.01	511.200	.822	.999
2.	Standing on non dominant leg	41.00	510.013	.823	.999
3.	Standing on dominant leg with closed eyes	40.12	518.111	.833	.999
4.	Standing on non dominant leg with open eyes	40.00	511.011	.845	.999
5.	Standing with wide stance eyes closed	41.23	512.140	.800	.999
6.	Walking on a static balancing beam	40.21	513.322	.821	.999
7.	Walking on a static balancing beam with limbs abducted	40.12	510.117	.845	.989
8.	Jumping on a stepper	40.15	514.118	.843	.988
9.	Hopping with dominant leg	41.00	510.124	.800	.972
10.	Hopping with non dominant leg	42.11	528.236	.812	.977
11.	Catching a ball	40.14	568.234	.834	.999

S.NO	Items	Scale Mean	Scale Variance	Total Correlation	Cronbach's Alpha
12.	Throwing a ball at the target with both hands	40.00	538.238	.889	.999
13.	Playing foot ball	41.12	550.526	.899	.999
14.	Running by crossing hurdles	41.11	528.223	.815	.912
15.	Long jump	40.11	510.482	.854	.900
16.	Drawing a circle	41.19	506.126	.821	.991
17.	Drawing a square	40.00	512.116	.883	.911
18.	Drawing a line	40.16	520.118	.881	.999
19.	Coloring a circle	40.00	511.100	.882	.999
20.	Coloring a cube	41.08	525.802	.885	.999
21.	Puzzling match	41.00	530.318	.852	.991
22.	Building blocks	40.05	522.218	.878	.991
23.	Matching cards	41.08	511.424	.846	.992
24.	Arranging cubes	41.00	512.404	.896	.991
25.	Assembling beads	42.91	521.111	.875	.991

The cronbach's alpha was used to analyze the item –items analysis of DCD subtest. The results showed that item-total correlation statistics was positive.

Table 3
Correlation of DCD assessment tool subtest

Subtest	Static balance	Dynamic Balance	Gross motor skill	Fine motor skill	Visual perception
Muscle power	1	.900	.932**	.900**	.714*
Movement	.912**	1	.934*	.988	.688
Inhand manipulation	.921*	.978*	1	.956**	.653
Gross motor skill	.900*	.900	.912*	1	.638
Eye hand coordination	.712**	.713**	.732	.743**	1

** $p \leq 0.01$ level

Pearson correlation coefficient was used to identify relationship between subtests of DCD assessment. It showed that there was positive correlation between subtests of DCD assessment.

Table 4
Internal consistency and reliability of DCD assessment tool subtest

Sl.No	Subtest of DCD	Number of items	Cronbach alpha
1	Muscle power	5	0.911
2	Movement	5	0.900
3	Inhand manipulation	5	0.981
4	Gross motor skill	5	0.925
5	Eye hand coordination	5	0.915
6	Total	25	0.900

Cronbach alpha was used to identify internal consistency of subtest of DCD assessment. it showed that internal consistency between subtest of DCD was adequate.

Table 5
Interrater reliability of DCD assessment tool subtest

Sl.No	Subtest of DCD	Reliability coefficient
1	Muscle power	0.91
2	Movement	0.90
3	Inhand manipulation	0.80
4	Gross motor skill	0.81
5	Eye hand coordination	0.80
6	Total	0.90

ICC was used to identify interrater reliability. The results showed that agreement between 2 raters was good.

Table 6
Test-retest reliability of DCD assessment tool subtest

Sl.No	Subtest of DCD	Reliability coefficient
1	Muscle power	0.81
2	Movement	0.76
3	Inhand manipulation	0.90
4	Gross motor skill	0.911
5	Eye hand coordination	0.810

Reliability coefficient was used to identify test-retest reliability of DCD assessment. The results showed that test-retest reliability was adequeste.

Discussion

Developmental coordination disorder is marked by the impairment in the acquisition and execution of coordinated motor skills and the children have problem in muscle power, difficulty in execute movement and manipulate object within hand and perform gross motor activity and eye hand coordination activity. There are uncertainty existing in assessment tool and hence there is a need for assessment tool with good psychometric properties. The current study developed DCD assessment tool to diagnose or identify developmental coordination disorder based on literature and expert analysis in the field of developmental coordination disorder. Item total statistics analysis revealed that 25 items of DCD assessment tool was positively correlated with corrected items with total statistics. It shows that item-total correlation was adequate. Further, author found that there was positive correlation between subtests of developmental coordination disorder. The results indicated that sample performance in each items was dependent on other items and linear relationship between items. This result was consistent with study done by Brown, T.; Lalor [12] Bruininks, B.D [13]. Further, current study found that relationship between each subtest was correlated positive with other subtest. It depicts that all subtests was interrelated with each other and internal consistency between subtests was adequate. The agreement between 2 rater was

above 0.8 and it depicts that DCD assessment was not affected with different raters. Further administration of DCD assessment on samples in 3 weeks interval was analyzed by Pearson correlation co-efficient. Test-retest correlation within 3 weeks was above 0.8 and depicts that stability of DCD assessment was good.

Conclusion

DCD diagnostic assessment tool has 5 subtests with 25 items. It has good content reliability, test-retest and interrater reliability. This assessment tool can be used for diagnostic assessment as well as outcome measure to identify effectiveness of intervention for children with DCD. Further reliability studies can be conducted in large sample size to strengthen psychometric properties of DCD diagnostic assessment tool.

Ethical Clearance

Ethical clearance was obtained from Institutional ethical committee of SRM Medical college Hospital and Research center to conduct this research work. Ethical clearance number was 1755/IEC/2019

Acknowledgement

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