

“Fine Manual Control, Coordination and Function of Children with Cerebral Palsy - A Cross Sectional Psychology Based Study”

¹Dr. Vinuta Deshpande MPT,(Ph.D), ²Dr. Riya Shejale MPT

¹Assistant Professor

Kaher Institute of Physiotherapy, Belagavi-590010

Contact number: +918754466612

Email id: vinuta.gangvatikar@gmail.com

²kaher Institute of Physiotherapy, Belagavi-590010

Contact number: 8830697144

Email ID: riyashejale616@gmail.com

Received: 13-March-2023

Revised: 21-April-2023

Accepted:10-May-2023

Abstract

A significant factor to childhood persistent impairment is cerebral palsy (CP). The developing of skills in them depends with development of motor performance. Impairments in fine motor skills may hamper daily activities of living. Since there is limited literature on fine motor control, coordination and functional levels this present study will determine level of fine manual control, coordination and function in cerebral palsy children and will aid and promote optimal evaluation of interventions, treatment planning, and patient progress of fine motor development.

To determine level of fine manual control, coordination and function in children diagnosed with cerebral palsy and to determine co-relation between each of the variables.

45 children were included in an observational study. visiting Pediatric Department Physiotherapy, Tertiary care hospital, Belagavi. Fine manual control, coordination and function were evaluated by Bimanual Fine Motor Function, Manual Ability Classification System, and Bruininks-Oseretsky Test of Motor Proficiency-2.

Study establishes the ranges of fine manual control, coordination and function in children diagnosed with cerebral palsy. The research concludes that there is moderate correlation between Fine manual control and Manual coordination. Also, MACS, Manual coordination and BFMF depends on type of cerebral palsy and tone of muscle.

Keywords – Cerebral palsy, fine manual control, coordination, function, motor skills

Introduction

Fine motor development in cerebral palsy children is crucial for participation in school and other activities as well as for lifelong physical activity patterns that will support growth into adulthood. Daily tasks like dressing, fastening shoes, eating, and writing can be made more difficult by fine motor skill deficiencies.⁸ Limited ability to grasp objects with the hands has been found to be one of the strongest indicators of limitations in everyday activities and participation restrictions in children with CP. In order to evaluate interventions and progress and to optimise treatment planning, it is crucial to monitor effectiveness, physical appearance, level of activity, and involvement results in CP children. There has been little research on fine motor control, coordination, and functional levels in previous studies on children with CP in the area where our study is being conducted. Therefore, the focus will now move from gross to fine motor development, manual dexterity, and dexterity of children with CP, which will increase knowledge of the condition.¹² Additionally, it will support and encourage the best possible treatment planning, evaluate interventions, and track the improvement of fine motor skills. Determining the degree of fine hand control, coordination, and function in kids with cerebral palsy is the aim of the current study.

Data Collection Method And Analytical Approaches

A hospital based cross-sectional observational study primary data was collected from 45 children diagnosed with cerebral palsy. Before conducting the study, ethical approval was taken from ethical institutional committee of KLE Institute of Physiotherapy (KIPTCOPT/IEC/2021/676). It was a non-probability convenient sampling. The data was collected from Department of Paediatric Physiotherapy, Tertiary care hospital, Belagavi, Karnataka, India from 10/12/2021– 10/05/2022. Those with cerebral palsy in children visiting Department of Paediatric Physiotherapy OPD of age 4-15 year of both genders and parents allowing to participate in study were included. Children with diagnosis other than cerebral palsy, children with upper limb surgeries, with insufficient cooperation of botulinum toxin within the previous six months were excluded from the investigation. Parents were given a written explanation of the study's purpose and procedures, and their

informed consent was obtained. Outcome measures for Fine manual control and coordination was assessed using BOT2 scale, while functional levels were assessed using MACS and BFMF. In individuals between the ages of 4 and 21, the Bruininks-Oseretsky Test of Motor Proficiency (BOT-2) ($r=0.80$) measures a wide range of motor skills, including fine motor integration, fine motor precision, manual dexterity, and upper limb coordination. The MACS($r=0.97$) explains how cerebral palsy patients use their hands to grip objects during daily activities. Five levels are detailed by MACS. The levels are determined by how independently the children can handle items and whether they require support or adaption to carry out manual tasks in daily life. They are classified using the Bimanual Fine Motor Function (BFMF) ($r=0.89$), according to their fine motor function. It covers the whole spectrum of fine motor function impairments that may be present in children with different cerebral palsy sub-types, discusses the five levels of fine motor function, and describes the five forms of cerebral palsy and is appropriate for use with children aged 4 to 18. Children with minimal impairments are included in level I, whereas children with significant functional limitations are described in levels IV–V.

Findings

The present study included 45 participants and Bruininks Oseretsky Test for Motor Proficiency (BOT-2 scale) was used to assess performance. The current study's statistical analysis was carried out using SPSS software, version 26.0 (SPSS Inc., Chicago, IL). Descriptive The data was compiled using statistics, frequency, percentage, mean, and standard deviation. The Pearson correlation coefficient was utilised to determine the relationship between fine manual control and manual coordination. To ascertain how the variables related to one another, the likelihood ratio test was used. (qualitative). Significant data was defined as a p value of 0.05 or less.

Descriptive and categorical demographical variables and levels of fine motor function in study participants (n=45)

The average age of the study participants was 9.8 years, with 73.3% of men and 26.7% of women. The hand dominance with which the task was performed were right-handed (n=35, 77.8%). The maximum number of children according to the type of cerebral palsy were spastic quadriplegia (n=16, 35.6%) and tone as assessed by Modified Modified Ashworth Scale was grade 2 (n=19, 42.2%). Analysis to determine level of fine manual control, coordination BOT 2 was used, and for function MACS and BFMF was used. Descriptive statistic was summarized using frequency, percentage, mean and standard deviation. As per MACS maximum participants were in level II (n=16, 35.6%) followed by III (n=12, 26.7%), IV (n=10,22.2%), V (n=6,13.3%) and level I (n=1,2.2%). The maximum number of children as per Bimanual Fine Manual Function were in level III (n=15, 33.3%) followed by level II (n=11,24.4%), level IV (n=10, 22.2%), level V (n=6, 13.3%) and level I (n=3, 6.7%). (Table 1).

Variables	Category	Mean	S. D
Age	-	9.80	3.07
Variables	Category	Frequency	%
Gender	Male	33	73.3
	Female	12	26.7
Hand Dominance	Left	10	22.2
	Right	35	77.8
Types of CP	Diplegic	14	31.1
	Hemiplegic	15	33.3
	Quadriplegic	16	35.6
Tone (MMAS)	Grade 1	4	8.9
	Grade 2	19	42.2
	Grade 3	8	17.8
	Grade 4	14	31.1
MACS	Level 1	1	2.2
	Level 2	16	35.6

	Level 3	12	26.7
	Level 4	10	22.2
	Level 5	6	13.3
BFMF	Level 1	3	6.7
	Level 2	11	24.4
	Level 3	15	33.3
	Level 4	10	22.2
	Level 5	6	13.3

Level of Fine manual control, and coordination in study participants

BOT2 was used to evaluate Hand dexterity and coordination of the upper body are two aspects of fine manual control (fine motor integration and precision). The scaled score range of FMP and the mean was (1-14, 2.51±2.87) whereas for Fine motor integration the range and mean was (1-17, 3.20±3.66). The standard score range and mean for Fine manual control was (20-50,23.69±6.70). The manual dexterity scaled score range and mean was (1-11, 3.07±2.97) whereas for upper limb coordination the range and mean was (1-14, 3.00±2.78). Manual coordination ranged between 20-36 and the total mean score was 23.93±5.64). (Table 2).

BOT2 subtest	Score	Minimum	Maximum	Mean ± SD
Fine motor precision	Point Score	0	32	8.44±10.11
	Scale Score	1	14	2.51±2.87
Fine motor integration	Point Score	0	38	9.38± 11.79
	Scale Score	1	17	3.20± 3.66
Fine manual Control	Standard Score	20	50	23.69±6.70
Manual Dexterity	Point Score	0	29	8.02±8.68
	Scale Score	1	11	3.07±2.97
Upper limb Coordination	Point Score	0	27	6.24±9.38
	Scale Score	1	14	3.00±2.78
Manual Coordination	Standard Score	20	36	23.93±5.64

Association between gender, hand dominance, types of CP, Tone with MACS, BFMF, Fine manual control (FMC) and Manual coordination (MC)

Correlation coefficient between FMC and MC was significant statistically (r=0.511, p= < 0.001). Likelihood ratio test applied to find association between dependent and independent variables like MACS and BFMF. Likelihood ratio were statistically significant for type of cerebral palsy and muscle tone. The level of MACS would depend 73.8 times on type of cerebral palsy whereas 57.5 times on tone of the muscle. The level of BFMF depends 84.6 times on type of cerebral palsy and 57.4 times on tone of the muscle. The Fischer exact test associated with fine manual control for type of cerebral palsy was (p=0.014) and for tone of the muscle was (p=0.015). The student t test for type of cerebral palsy (p=0.001) and tone of the muscle (p=<0.001) was statistically significant with manual coordination (Table 3).

		MACS		BFMF		Fine manual Control (Standard Score)		Manual coordination (Standard score)	
		Likelihood Ratio	p value	Likelihood Ratio	p value	Fisher Test	p value	Student t Test	p value
Gender	Male	3.850	0.427	1.201	0.878	0.867	0.391	0.665	0.510

	Female								
Hand Dominance	Left	3.451	0.485	3.514	0.476	-0.259	0.797	0.802	0.427
	Right								
Types of CP	Diplegic	73.863	< 0.001*	84.692	< 0.001*	4.735	0.014*	7.973	0.001*
	Hemiplegic								
	Quadriplegic								
Tone (MMAS)	1	57.564	< 0.001*	57.443	< 0.001*	3.92	0.015*	7.948	<0.001*
	2								
	3								
	4								

Association between MACS, BFMF with Fine manual Control and Manual coordination

Likelihood ratio test was applied to find relation between MACS and BFMF. The likelihood ratio between MACS and BFMF was 86.1 times relational. The Fischer exact test was used to find relationship between MACS, BFMF with FMC and MC. The test was statistically significant for MACS (p=0.031) and BFMF (p=0.006) with manual coordination (Table 4)

	Fine manual control (Standard score)		Manual coordination (Standard score)	
	“F”	P value	“F”	P value
MACS	1.631	0.185	2.961	0.031*
BFMF	2.227	00.83	4.294	0.006*

Discussion

The present observational study determined the level of fine manual control, coordination and function in children diagnosed with cerebral palsy. 45 children recruited, the outcomes were evaluated by BOT2, MACS and BFMF. The findings demonstrated a correlation between each of the factors, indicating that children with cerebral palsy had lower levels of fine manual control, coordination, and function.

In this study, maximum were males compared to females. This is supported by the previous evidences present. A critical review studied on gender inequalities in individuals with cerebral palsy shows male participants are severely affected leading to increased biological vulnerability in considering cerebral development, hormone protecting part, and hereditary polymorphism.¹⁴

A review of the MACS's dimension concluded it is frequently utilised in literature as it possesses competent standards for classifying the hand functions in their daily events. The research also confounds the use of MACS the participants are characterised as an independent variable. In line with this study, the present study confounds its use as an independent variable. The MACS is not a specified assessment but is done by asking how the child typically prefer hand activities. In the present study parents provided an excellent description of the child's performance. The present findings support the study done to determine the parents and therapist perception of content of MACS. MACS was developed to categorise how During daily activities, individuals who suffer from cerebral palsy use their hands to manipulate objects. Research showed that there was significant differences in the degree of spasticity, muscular weakness, and sensory impairments depending on the manual dexterity.¹⁵

When the profile of children with cerebral palsy's motor skills was done, they found that increasing of gross motor limitation cause a decline in functional independence. The present study supports the finding as there were more of quadriplegic individuals and Bimanual fine motor functional level is based on the evaluation of level of impairment and capacity.¹⁶

The level of standard scores of present study for fine manual control ranges between 20-50 and manual coordination ranges between 20 to 36 whereas the level of function lied in level 3 for BFMF and level 2 for MACS. In this study MACS and BFMF are co-relating with manual coordination

A cross sectional study stated a strong positive significant association existed between dominant hand with great fine motor control and coordination which supports the finding of present study. As per the literature, individuals with CP with fine motor integration, and visual-perceptual impairment is more common as a result of periventricular leukomalacia, which may disrupt the Optic radiations are responsible for poor visual perception. This could explain why there is a decrease in cerebral palsy children's fine motor skills.

Previous studies done on hand functioning in cerebral palsy concluded that Manual dexterity varies significantly dependent on the level of manual dexterity, showing that activity measures are significantly influenced by manual dexterity.³ The level of deformity, deficits, and motor control had an impact on participants with CP's ability to use their hands and perform gross motor tasks. results in reduced performance and capacity in carrying out daily activities.⁷

in line with the reference study used to evaluate the validity and reliability of BOT2-UL and BOT2-SF in children with CP. The results used in this study are a reliable and valid tool to evaluate the gross motor function of cerebral palsy children. The current research supports the feasibility of BOT2 to assess motor proficiency in young cerebral palsy patients.¹⁷

As per the current study, MACS and BFMF are highly related to each other which is in line with the study to determine and classify motor skills. BFMF may therefore be able to distinguish between various levels of fine motor function in children with cerebral palsy.

Previous study found that both fine hand movements and coordination are necessary for manual dexterity and the performance of dexterity tasks. Their purpose were to evaluate degree of manual dexterity in children with cerebral palsy, gross manual dexterity is a reliable indication of manual ability according to research done on this subject.⁷ In line with this study, the present study states that accurate hand coordination and control are necessary for performance of fine motor tasks.

Multiple limitations must be considered. The major limitation is individuals visiting tertiary care hospital Belagavi city were taken in the study. The other major limitation of the study is that it used a convenient non probability sampling. The other major drawback was the study includes a limited number of children hence it is difficult to generalise findings.

Present study establishes the ranges of fine manual control, coordination and function in children diagnosed with cerebral palsy. The study concludes that there's moderate correlation between Fine manual control and Manual coordination. Also, MACS, Manual coordination, BFMF depends on type of cerebral palsy and tone of muscle.

Conclusion

The study establishes the ranges of fine manual control, coordination and function in children diagnosed with cerebral palsy. It concludes moderate correlation between FMC and MC. Also, MACS, Manual coordination, BFMF depends on type of cerebral palsy and tone of muscle.

Acknowledgment: To the children and their parents who took part in the study, the authors would like to express their gratitude.

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