"EFFECT OF BRAIN GYM EXERCISE ON COGNITION AND GROSS MOTOR PERFORMANCE IN CHILDREN WITH CEREBRAL PALSY-

A QUASI-EXPERIMENTAL DESIGN"

By

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In Partial fulfilment of the requirements for the degree of

MASTER OF PHYSIOTHERAPY (M.P.T)

in

NEUROLOGY

Under the guidance of

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Bhubaneswar, Odisha

2023-2025

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled "**EFFECT OF BRAIN GYM EXERCISE ON COGNITION AND GROSS MOTOR PERFORMANCE IN CHILDREN WITH CEREBRAL PALSY- A QUASI-EXPERIMENTAL DESIGN"** is a bonafide and a genuine research work carried out by me under the guidance of DR. DEEPAK KUMAR PRADHAN (PT), ASSOCIATE PROFESSOR of Abhinav Bindra Sports Medicine & Research Institute, Bhubaneswar, Odisha and there are no conflict of interest associated with this dissertation work.

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CERTIFICATE OF ACCEPTANCE

This is to certify that the dissertation entitled entitled "**EFFECT OF BRAIN GYM EXERCISE ON COGNITION AND GROSS MOTOR PERFORMANCE IN CHILDREN WITH CEREBRAL PALSY- A QUASI-EXPERIMENTAL DESIGN**" carried out by **Ms. SHRABASTI MANNA**, bearing University Registration Number **23MP435017**, has been evaluated and accepted by me as an **Examiner/ Evaluator**, appointed by the **Odisha University of Health Sciences, Bhubaneswar**, in partial fulfilment of the requirements for the award of the degree of **Master of Physiotherapy (MPT)** in **Abhinav Bindra Sports Medicine and Research Institute, Odisha.**

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LIST OF ABBREVIATIONS USED

ABSMARI- Abhinav Bindra Sports Medicine and Research Institute

BG- Brain Gym Exercise

CBFAE- Community- Based Functional Aerobic Exercise

CP- Cerebral Palsy

GMFM- Gross Motor Functional Measure

MMC- Mini- Mental State Examination for Children

EFORTS- Executive Function & Occupational Routines Scale

SPSS- Statistical Package for Social Science

SD- Standard Deviation

ABSTRACT

Background- Cerebral palsy is one of the most common cause of disability in children, characterized by motor dysfunction, spasticity, sensory and perceptual disfunction, difficulties in cognition and communication, behavioral challenges and reduce independence in daily activities. This study aimed to measure the effect of brain gym exercise on cognition and gross motor performance in children with cerebral palsy. Brain gym is an educational kinesiology theory-based movement of body, which include cross-lateral, balance-demanding movements that stimulate both hemispheres of brain through the motor and sensory cortices.

Method- The research was a single group intervention study involving 22 children with cerebral palsy aged between 5-10 years. Participants received brain gym exercise with 8 super space movement (Brain Button, Lazy Eight, Earth Button, Thinking Cap, Cross Crawl, Hooks Ups, Arm Activation, Calf Pump) for 5 min each, 5 times a week for 4 weeks. Pre- and post-intervention data were collected from Mini-mental State exam for children (MMC), GMFM-88 and Executive Function & Occupational Routines Scale (EFORTS).

Result- Data analysis was performed with SPSS 27. The Shapiro- Wilk test assessed normality and paired sample t- tests compare pre- and post- intervention outcome and the result shows a significance difference in p-value i.e. GMFM($p=0.003$), MMC($p<0.01$), and EFFORTS($p<0.01$), indicating enhanced of motor function and cognitive function.

Conclusion- The findings suggest that brain gym exercises is an effective approach to improving memory, attention, listening comprehension, balance and coordination in children with cerebral palsy.

Keywords: Brain Gym Exercise, Cerebral Palsy, Cognition, Executive Function, Memory, Attention, Gross motor function, Balance, Coordination, Children.

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INTRODUCTION

INTRODUCTION

Cerebral Palsy (CP) is a group of permanent disorders affecting movement and posture, results activity limitation. It caused by a non-progressive disturbance in the brain during fetal or early infant stage.[1] The brain lesion remains unchanged over time, but the symptoms may change as the child grow. CP is commonly associated with sensory and perceptual disturbances, cognitive and communitive deficits, behavioural challenges, as well as musculoskeletal abnormalities and an increased prevalence of epilepsy along with motor impairments. [1][32]

The most common of clinical types is spastic cerebral palsy, characterized by increased muscle tone and stiffness. The severity and body parts involved depend on the location and extent of the brain damage, which may present as hemiplegia, diplegia, or quadriplegia. [1][2][32]

Epidemiologically, the occurrence of CP varies worldwide. In low- and middle-income countries (LMICs), the prevalence is around 3.4 per 1,000 live births, much higher than in high-income countries (HICs). In the HICs, pre- or perinatal acquired CP occurs around 1.5 per 1,000 live births, with postnatal-acquired CP has a prevalence around 1.6 per 1,000 live births. The higher prevalence in the LMICs due mainly to inadequate prenatal and perinatal care, birth complications, and infections. [3]

In India, the estimated birth prevalence for CP is 2.95 per1000 live births, with reported prevalence ranges between 2.08-3.88 per 1000 live birth. It ranks the leading causes of disability in the India. [4]

According to data from Odisha (2019-21), about 0.8% of the individuals aged 0-24 years with disabilities were reported to have locomotor impairments in both rural and urban areas.[5]

CP results from permanent, non-progressive damage to the motor cortex, typically occurring within the first two years of life. This damage reduces the excitatory and regulatory inputs from the cortex through the corticospinal and reticulospinal tracts to the brain stem and the spinal cord motoneuron. [9] As a result, fewer motor unites are activated, leading to weakness and poor muscle control. Furthermore, the loss of the descending inhibitory signals, mediated by the reticulospinal pathways, from other systems increases gamma and alpha-motoneurons excitability, causing spasticity-defined as involuntary muscle activity or resistance to stretching. Spasticity may present secondary complication such as contracture, pain, and joint subluxation, which impact functionality. The spastic component exacerbates also by primary or secondary complications of the spinal cord, such as alterations of nociceptive inputs. The reduction of spasticity facilitates more efficient and functional utilization of residual selective motor control in individuals with cerebral palsy. [9][13]

Due to damage to the extrapyramidal system can cause involuntary movement disorders like athetosis, chorea, dystonia, or rigidity. Specific types of CP are connected to brain lesions, like diplegia is a result from periventricular leukomalacia, hemiplegia and quadriplegia from multiple lesions. The type and extent of damage in the CNS, the

nature of the injury (which is permanent), as well as the brain's ability to adapt and compensate over time are present as clinical presentation of CP [9][10][14]

The severity of clinical presentations in CP is influenced by factors such as gestational age and causal factors, chronological age, size of the lesion, and pre-, peri-, and post-natal etiological factors.[10]

Spastic cerebral palsy is the common subtype, accounting for about 80% of all cases. Spasticity affects daily activities such as dressing, feeding, writing, walking, and bathing. [15] Gross motor function in children with CP is commonly assessed using the Gross Motor Function Classification System (GMFCS) which categorizes children into five levels of functional activity: levels I and II represent independent walking, walking with aid in level III, and the level IV and V children who are non-ambulatory. Gross motor development presents the level of physical activity and involves the use of large muscle groups in tasks such as rolling, sitting, crawling, walking, jumping, running, hopping, leaping, and skipping—skills that require controlled motor coordination. [15][18][14][20]

Spastic diplegia is the most common form of cerebral palsy, characterized by pyramidal motor dysfunction commonly affects the lower limbs. It is commonly associated with perinatal hypoxic-ischemic injury due to lesions in the periventricular white matter, known as periventricular leukomalacia. These areas contain the projection corticospinal tracts to the lower limbs, and the damage in the area results motor impairments. Besides motor deficulties, focal or diffuse white matter injuries may disrupt commissural and association fibers of brain, leading to impairments in perception, cognition, attention, memory, and other higher brain functions. [14]

Cognition involves multiple psychological domains, such as perception, language, intelligence, learning, memory, attention and processes related to decision-making. [17] Executive function, a subset of cognitive control processes involves skills such as inhibition control, task initiation, planning, problem-solving, cognitive flexibility, judgment, and feedback regulation. The functional neuroimaging studies emphasize the prefrontal cortex and its white matter connections with posterior brain regions as essential for developing executive functions. [17] [18]

The research also shows a strong link between motor and cognitive abilities, with the prefrontal cortex, basal ganglia, and cerebellum involved in both domains. Motor and cognitive development are often considered interrelated, with some researchers proposing that motor skill acquisition influences cognitive changes, while others consider motor ability as a foundation for higher-level cognitive processes. [19]

In rehabilitation, children with CP receive more focus on motor skills (gross, fine and oral-motor therapy) compared to cognitive aspect. On the contrary, the cognitive impairment domain, which has an equally vital role to play to ensure the overall development of a CP child, becomes neglected. Previous studies indicate that physical exercise can improve motor function and cognitive ability. [19] [20]

Brain gym, created in the 1970s by Paul and Gail Dennison, is one intervention to enhance attention, memory, and academic performance. It consists of 26 simple movements used to stimulate both hemispheres of the brain through neurological repatterning to enable whole brain-learning.[1][27]

Brain Gym is a curriculum predominantly concerned with neuroscience and educational kinesiology theories. The brain gym intervention is composed of coordinated, cross-

lateral, balance-demanding movements that mechanically engage both brain hemispheres via the moto and sensory cortexes.[1][27]

These are simple body exercises and they also trigger profound changes in the areas of: Concentration and focus, Memory, Physical coordination, Gross and Fine motor development, Self-responsibility, Organizational skills, Attitude, and Academic performance in areas such as reading, writing, math, and taking exams. [28][27]

The Brain Gym 26 is designed to facilitate learner utilization of their intrinsic orientation capacities when encountering limitation in the expansion of their motor skill repertoire. The efficacy of the activity does not require knowledge about infant development. Using movements, babies construct an inner map through which they orient their bodies, connect to the world, and teach themselves.[1][28]

Perceptual-motor and child-development specialists recognize discrete reflexes and sequences of movements through which infants pass before they begin to incorporate more complex learned movements.[1]

Right from the infant's first play, a child is acquiring the coordination between their sensory input and three basic movement skills: equilibrium, locomotion, and sensory coordination. They then bring all these together as they increase in order to contribute to her physical skills for acquiring academics, their perceptual, behavioural, and postural counterparts.[1] [25][28]

The Brain Gym exercises can assist children in refining and differentiating their

movement through a process of learning to use their body to achieve large-motor control and ultimately fine-motor dexterity and it is not children alone but individuals of any age who can through the 26 achieve their movement map for stability, locomotion, hand-eye manipulation and numerous other such life skills. [1]

The exercises in the Brain Gym are divided into four categories - the energy exercises, Deepening Attitudes, the Lengthening activities, and the Midline movements - that are consistent with the three main categories of movements: stabilization, locomotion, and manipulation. These three categories of movements, contributors to physical skills for learning, co-function to establish the spatial orientation, which makes flexibility in directions up and down, forward and backward, left-right feasible. They sustain the physical machinery in the three principal domains of function

Organization/up-down: Energy exercise to centre and align; for planning, creating order, and lining things up. Deepening attitudes to relax, calm, and physically or emotionally stabilize, for sharing and play, cooperating, and sensory memory.

Focus/forward-backward: The activities to extend and release tension stored and initiate action involving focusing, comprehending, expressing yourself, and taking the initiative.

Left-right communication: The midline movements to foster sensorimotor coordination, the processing of information required to read, write, hear, and speak. [1]

The Brain Gym 26 simple movements that activate both hemispheres of the brain through neurological repatterning to promote whole-brain learning. [24][28]

Brain gym exercise will improve blood and oxygen flow to the brain and optimize brain function. According to brain gym exercise, engaging in the movement of the brain causes new neural pathways to grow. Daily practice of brain gym exercise leads to

activation and development of various sections of the brain, which allows more organized communication between the two hemispheres of the brain for high-level thinking. [28][23]

BGI Educational Kinesthetic provides body movements to enhance brain function. It is a drug-free and non-invasive method to convert blocks to learning bridges. BGI states that exercise in the movement of brain gym stimulates the development of new pathways of the brain. [28]

Brain Gym intervention technique engaged the patient in activity to impact the neuroplasticity process and brain executive function, mainly working memory and productivity of life. [28]

Brain Gym exercise is primarily based on various physical activities and movement skills that are closely linked to cognitive development, as both are supported by similar brain structures, such as the cerebellum and premotor cortex. Brain Gym exercises can engage these areas through easy, fun movements that stimulate motor and sensory pathways. Stimulation of these areas by these exercises improves the motor skills of balance, coordination, and strength, which provide the basis for the development of higher functions.[27]

Brain Gym exercises can increase sensory integration and motor planning, resulting in improved motor task execution. Improved motor function through the practice of the simple, specific movements of Brain Gym can improve the neural pathways involved in motor control. This, in turn, corresponds to improved balance, coordination, and strength, all of which are vital to overall motor development, particularly in children with developmental delay or mental disability. [1][27]

Need of the study

Children with cerebral palsy experience limitation in both cognitive and motor domains, which affect their independence and participation in daily life. There are various therapeutic intervention, but some method target both cognitive enhancement and motor skill development. Brain Gym exercise may serve as a cost-effective, non-invasive intervention to address these challenges. This study aims to improve cognitive function and overall quality of life, promote greater functional independence and support their education.

AIM OF THE STUDY

The primary aims of this study was to investigate the effect of brain gym exercises on cognitive functioning and gross motor performance (balance and postural control) in children with cerebral palsy.

Objective of the study

To evaluate the impact of brain gym exercise on cognitive functioning and gross motor performance (balance and postural control) in children with cerebral palsy.

Hypotheses

- NULL HYPOTHESIS (H0)**:** Brain gym exercises will have no significant effect on cognitive function and gross motor performance in cerebral palsy.
- ALTERNATIVE HYPOTHESIS(H1)**:** Brain gym exercises will produce a significant effect in both cognition and gross motor performance in children with cerebral palsy.

REVIEW OF LITERATURE

Review of literature

1. **WHITE DA, CHRIST SE. 2005** studied on Executive control of learning and memory in children with bilateral spastic cerebral palsy**.** In the study a total 16 children with bilateral spastic cp child, age ranged from 6-18yrs and 19 children in controlled group age ramged7-18yrs assessed by CVLT-C. In this study, the inhibitory deficit was more pronounced in younger children with spastic cp and suggesting a developmental delay in controlling for general verbal ability.
2. **Fatma Mohamed El swerky et al.2021** studied on Effect of Brain Gym Training on Intelligence, Knowledge and Information Retention among Children with Developmental Disabilities. This study conducted on 100student with developmental disorder as autism and ADHD. The study was randomly assigned and divided into two groups of 50 student in each group. Brain gym exercise had a higher intelligence, knowledge and information retention score in the study than control group.
3. **Bungawali Abduh et al. 2018** studied on The Effectiveness of Brain Gym and Brain Training Intervention on Working Memory Performance of Student with Learning Disability**.** 15 students with learning disability participated in the study. The study involved three groups of students, each group has 5 members in number, a Brain Gym intervention group, a Brain Training intervention group, and a control group. In the study, Brain gym & Brain training intervention used in learning disability student to showed outcomes in enhancing working memory performance, specially in tasks related to recalling number in correct order and visual-spatial skill. It is enhancing sensorial integration and brain executive function

4. **Osei Evans Owusu Ansa et al.2021** studied on Effect of Community-Based Functional Aerobic Training on Motor Performance and Quality of Life of Children with Spastic Cerebral Palsy. The study utilized a quasi-experimental design involving children with spastic cerebral palsy, specifically those classified at GMFCS level I and II. Participants engaged in an 8week community based functional aerobic exercise program for 4 session per week, each lasting 50 min. and intensity of exercise40-80% of their max. hear rate; The study concluded that community-based functional aerobic exercise significantly improves gross motor function, walking distance and quality of life in children with spastic cerebral palsy. The program led to a notable enhancement in standing, walking, running and jumping abilities as well as improvement in overall quality of life.
5. **Dr. Rajesh Pandani et al. March 2023** studied on Advancement in gross motor and fine motor functions with quality of daily activities through brain gym exercise in down syndrome children: an interventional study. The study was an intervention study involving 60 down-syndrome with age 5 to 12 years were randomly divided into 2 groups. Pre and post assessment done by Test of gross motor development second edition and functional dexterity test for gross and fine motor respectively. Quality of life measure by functional independent measure scale. The study concluded that there was a significant effect of brain gym exercise on gross motor and fine motor function with improvement in the quality of daily activities.
6. **Larissa de Souza Salvador et al.2019** studied on The Mini-Mental Examination for Children (MMC) Evidence of validity for children with learning difficulties**.** The study was conducted on 168 children aged 7-12 years

and group A control group and group B learning difficulties group include math difficulties, spelling difficulties; The findings indicate MMC is accurate (0.80) and useful for screening children with LD.

7. **Ricardo Moura et al.2017** studied on Mini-mental state exam for children (MMC) in children with hemiplegic cerebral palsy. Cognitive Impairment is common in cerebral palsy and there are very few multiprofessional screening instruments available. The study aimed at investigating the utility of the Mini-Mental Examination for Children (MMC), an adopted version of Mini Mental state Examination, screening for cognitive impairments in children with CP. A total of Brazilian children was assessed, including 310 with typical development and 87 with CP (hemiplegic and quadriplegic subtypes), between 5 and 16 years of age. The relation between MMC performance and general intelligence was examined using the colored progressive Matrices test. The MMC showed acceptable psychometric properties and strong discriminatory validity across ages, with defined cut-off values. Children with CP, particularly with quadriplegia, displayed greater difficulties. The MMC moderately correlated with intelligence scores and reliable identified children with proper cognitive functioning.
8. **Carmit Frisch et al,2014** studied on Reliability and Validity of the Executive Function and Occupational Routines Scale (EFORTS); The study was conducted on 261 children with ADHD between 3 to 10year of age; The findings indicate EFFORTS is a highly reliable (range 0.83 to 0.92) and internal reliability α=0.947 and valid tool to assess children with EF deficit.
9. **Gokcen Akyurek et al,2022** studied on Turkish Adaptation of the Executive Functions and Occupational Routine Scales: Validity and Reliability Among

Children with Dyslexia; The study aimed to adapt the Executive Functions and Occupational Routines Scale (EFFORTS) into Turkish (EFFORTS-T) and evaluate its psychometric properties in children with dyslexia. The study sample consisted of mothers of children with dyslexia (study group, n = 158) and mothers of typically developing children matched for age and sex (control group, n = 167). Participants completed a demographic questionnaire, the EFFORTS-T, and the behaviour Rating Inventory of Executive Function Parent Form (BRIEF-P). The EFFORTS-T demonstrated excellent internal consistency (α = .93) and high test-retest reliability across a 14-day interval (r = .91) and criterion related validity with BRIEF-P was found moderate (r = .73). These findings provide evidence for the validity and reliability of the Turkish version of EFFORTS in assessing executive function and their role in daily occupational routines among children with dyslexia.

10. **Osei Evans Owusu Ansa et al, 2020**, studied to show the Effect of Community-Based Functional Aerobic Training on Motor Performance and Quality of Life of Children with Spastic Cerebral Palsy. In this study CP children with GMFCS levels I - II participated in 8 weeks CBFAE training four times/ week, 50 min./ day at 40-80% maximum heart rate. Gross motor function (GMF), walking distance and quality of life were assessed pre and post CBFAE training. A significant improvement was observed in GMF, walking distance and in social wellbeing, acceptance, participation and physical health. CBFAE training helps to improved standing, walking, jumping and running, self-esteem, quality of life of children with spastic cerebral palsy.

Sl. No.	Authors (Year)	Aim	Method	Findings	Insights
1.	WHITE DA, CHRIST SE. 2005	To determine the executive control of learning and memory in children with bilateral spastic cerebral palsy.	In the study a total 16 children with bilateral spastic cp child, age ranged from 6-18yrs and 19 children in controlled group age ramged7-18yrs assessed by CVLT-C.	The inhibitory deficit was more pronounced in younger children with spastic CP.	The findings suggest a developmental delay in controlling for general verbal ability in younger children with spastic CP.
2.	Fatma Mohamed El, swerky, et al.2021	To determine the effect of Brain Gym Training on Intelligence, Knowledge and Information Retention among Children with Developmental Disabilities.	This study conducted on 100 students with developmental disorder as autism and ADHD. The study was randomly assigned and divided into two groups of 50 student in each group.	The Brain Gym exercise group had higher intelligence level, knowledge, and information retention scores compared to the control group.	Brain Gym exercise present a positive impact on cognitive function like intelligence, knowledge and information retention in children with developmental disabilities.

3.	Bungawali Abduh et al. 2018	The investigate effectiveness of Brain Gym and Brain Training Intervention on Working Memory Performance of Student with Learning Disability.	15 students with learning disability participated in the study. The study involved three groups of students, each group has 5 members in number, a Brain Gym intervention group, a Brain Training intervention group, and a control group.	Both Brain Gym (p=0.41) and Brain training (0.43) interventions showed positive result in enhancing working memory performance in students with learning disabilities, especially in specific tasks.	The study suggested both the intervention improved the working memory specially the digit span and spatial memory.
4.	Osei Evans Owusu Ansa et al 2021	To determine effect of Community-Based Functional Aerobic Training on Motor Performance and Quality of Life of Children with Spastic Cerebral Palsy.	The study utilized a quasi-experimental design involving children with spastic cerebral palsy, specifically those classified at GMFCS level I and II. Participants engaged in an 8week community based functional aerobic exercise program for 4 session per week, each lasting 50 min. and intensity of	Community-based functional aerobic exercise significantly improved gross motor function, walking distance and quality of life in children with spastic cerebral palsy.	The intervention showed a notable enhancement in standing, walking, running, and jumping abilities as well as an improvement in overall the quality of life.

			exercise40-80% of their max. hear rate		
5.	Dr. Rajesh Pandani et al. March 2023	To determine advancement in gross motor and fine motor functions with quality of daily activities through brain gym exercise in down syndrome children	The study was an intervention study involving 60 down-syndrome with age 5 to 12 years were randomly divided into 2 groups. Pre and post assessment done by Test of gross motor development second edition and functional dexterity test for gross and fine motor respectively. Quality of life measure by functional independent measure scale.	significant effect of brain gym exercise on gross motor and fine motor function with improvement in the quality of daily activities.	In this study the intervention lead to an improvement in quality of daily activities which result greater independence and participation in everyday tasks.

6.	Larissa de Souza Salvador et al.2019	To find the validity of the mini-mental examination of children with learning disability	The study was conducted on 168 children aged 7-12 years and group A control group and group B learning difficulties group include math difficulties, spelling difficulties	The findings indicate MMC is accurate (0.80) and useful for screening children with LD.	To demonstrate the validity of the MMC in assessing children with learning difficulties.
7.	Ricardo Moura et al.2017	To dertermined the utility of the Mini-Mental Examination for Children (MMC), an adopted version of Mini Mental state Examination, screening for cognitive impairments in children with CP.	A total of Brazilian children was assessed, including 310 with typical development and 87 with CP (hemiplegic and quadriplegic subtypes), between 5 and 16 years of age.	The MMC moderately correlated with intelligence scores and reliable identified children with proper cognitive functioning.	The MMC is a useful screening tool for cognitive impairments in children with CP, providing a reliable measure.

8	Carmit Frisch et al,2014	To determined Reliability and Validity of the Executive Function and Occupational Routines Scale (EFORTS)	The study was conducted on 261 children with ADHD between 3 to 10year of age	The findings indicate EFFORTS is a highly reliable (range 0.83 to 0.92) and internal reliability α=0.947 and valid tool to assess children with EF deficit.	The study found that the EFORTS is a highly reliable and valid tool for assessing children's executive function control in three occupational daily routines: morning and evening routines, leisure and social interaction.
9.	Gokcen Akyurek et al,2022	to adapt the Executive Functions and Occupational Routines Scale (EFFORTS) into Turkish (EFFORTS-T) and evaluate its psychometric properties in children with dyslexia.	The study sample consisted of mothers of children with dyslexia (study group, n = 158) and mothers of typically developing children matched for age and sex (control group, n = 167). Participants completed a demographic questionnaire, the EFFORTS-T, and	The EFFORTS-T demonstrated excellent internal consistency (α = .93) and high test-retest reliability across a 14-day interval (r = .91) and criterion related validity with BRIEF-P was	The study focuses on a reliability and validity of a assessment tool for enabling accurate assessment of executive function in children with dyslexia.

			the behaviour Rating Inventory of Executive Function Parent Form (BRIEF-P).	found moderate (r = .73).	
10	Osei Evans Owusu Ansa et al, 2020	to show the Effect of Community-Based Functional Aerobic Training on Motor Performance and Quality of Life of Children with Spastic Cerebral Palsy.	In this study CP children with GMFCS levels I - II participated in 8 weeks CBFAE training four times/ week, 50 min./ day at 40-80% maximum heart rate. Gross motor function (GMF), walking distance and quality of life were assessed pre and post CBFAE training.	A significant improvement was observed in GMF, walking distance and in social wellbeing, acceptance, participation and physical health.	CBFAE is an effective intervention for improving mobility, functional performance and quality of life. This suggests that community-based rehabilitation programs are crucial in limited settings.

METHODOLOGY

METHODOLOGY

The methodology of the study is as follows-

- STUDY DESIGN –Quasi-Experimental Design
- SAMPLING TECHNIQUE – Purposive Sampling.
- STUDY SETTING – Healing Touch Therapy Centre, BBSR

The study was a one group quasi-experimental design, and the sample was 22, calculated by G*Power. The study was conducted on cerebral palsy children and the sample collected, those who met the specific criteria relevant to the research question. The sample was collected from Healing Touch Therapy Centre in Bhubaneswar. Before collection of data, parents of each subject were explained about the purpose of the study.

Selection Criteria

Inclusion Criteria:

- Age group- 5-10 yrs.
- Spasticity-1+ to 2
- Able follow verbal commands.
- GMFCS (level 1 & level 2)

Exclusion Criteria:

- With aids like cane, wheelchair.
- Any medical and neurological condition(seizure)
- Undergone any casting of lower limb in past 3 months
- Injection with Botulinum Toxin in past 3 months.

Variables

- **Independent variable-**

  - Age

  - Gender

  - Brain Gym exercise on cognition and motor performance

- **Dependent variable-**

  - GMFM-88

  - Mini-mental status examination- children version

  - Executive Function and Occupational Routines Scale (EFORTS)

Sample Size: Sample size was calculated in G-Power software using mean (33.15, 24.75) and standard deviation (3.63, 7.12), effect size (1.48), alpha (0.05), power (0.95).

Material to be used: - Pen, paper, objects like ball, toy.

Outcome Measure:

PRIMARY OUTCOME MEASURE

- Mini-Mental Status Examination- Children's Version.
- GMFM 88 and GMFM 66

SECONDARY OUTCOME MEASURE

- Executive Function & Occupational Routines Scale

MINI- MENTAL STATUS EXAMINATION CHILDREN'S VERSION

A children's version of the Mini-Mental State Examination was adopted from the original Mini-Mental State Examination, developed by Jain and Passi in collaboration with two of the authors (PMOA and VGH), who constructed initial version of the MMC. Age-appropriate geometric shapes were selected from the Brazilian developmental neurological examination. The final version consists of 13 items across five cognitive domains- orientation, attention and working memory, episodic memory, language and constructional praxis. The maximum attainable score is 37. This tool has been validated as appropriate for assessing cognitive function in children with cerebral palsy. [29]

GMFM- 88

The GMFM-88 is a standardized tool used to assess motor abilities in children with motor impairments. It evaluates five dimensions of motor function: lying and rolling, sitting, crawling and kneeling, standing, and walking, running, and jumping. For each category, both raw scores and percentage scores are recorded, along with an overall total score. Although the ordinal scale is ordinal scale may not capture subtle changes at the extremes, the GMFM-88 has demonstrated excellent inter-rater and intra-rater reliability (ICC=0.99) and strong validity, with a reported correlation coefficient of 0.82. [32]

Executive Function and Occupational Routine Scale (EFFORTS)

The Executive Functions and Occupational Routines Scale (EFFORTS) is a parents reported questionnaire developed to evaluate a child's executive functioning skills in everyday activities.

Originally developed in Hebrew, it comprises 30 items that measure how consistently a children express executive functioning skills during daily routines, such as initiating a morning-routines or problem-solving during play. Each is rated on a five-point scale ranging from “never” to always”, with higher scores presents stronger executive functioning. This tool is used both practical and effective in identifying strengths and challenges which guiding intervention strategies. [30]

Procedure

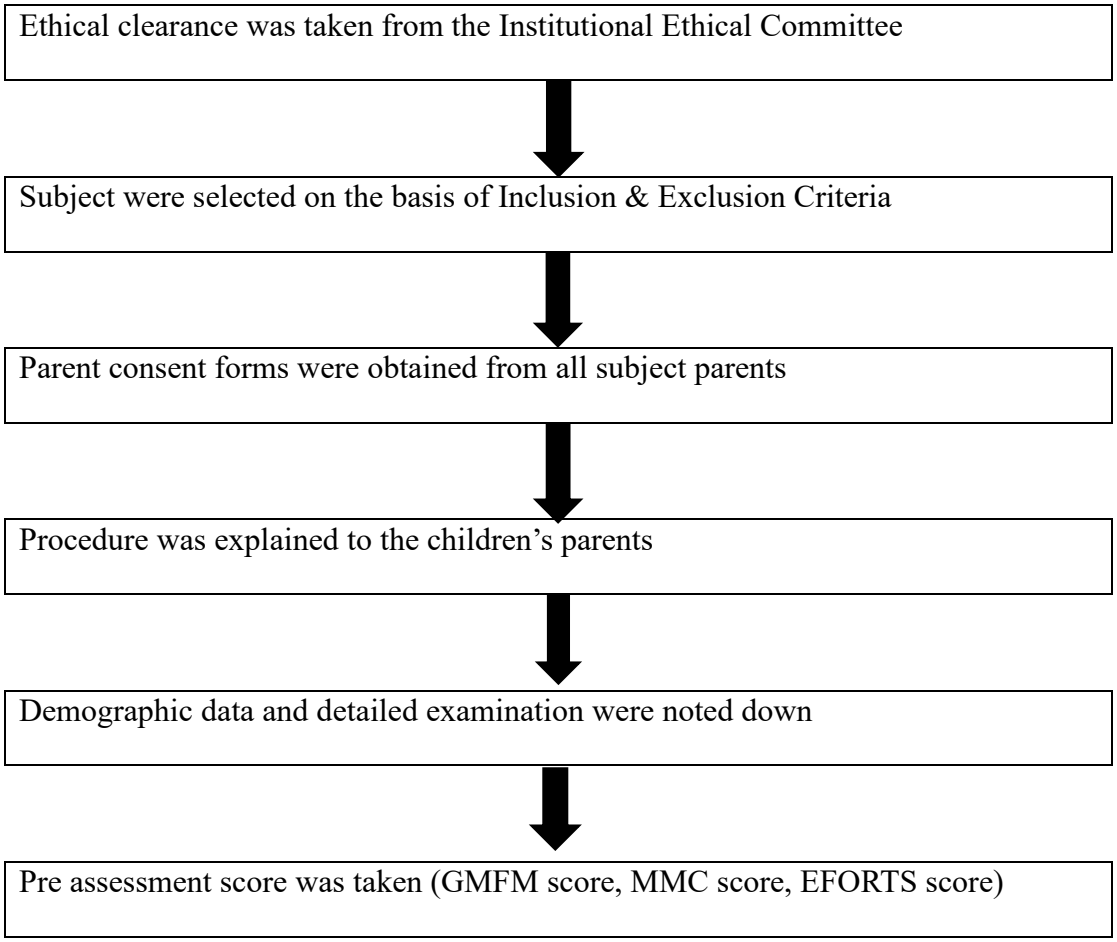
The study was carried over a period of 4 weeks at Healing Touch Therapy Centre, BBSR. A total of 22 children with cerebral palsy, aged between 5 to 10 years, were recruited for this interventional study through purposive sampling. The sample was recruited based on selection criteria, and informed consent was obtained from parents prior to participants. Ethical clearance for the study was granted by Institutional Ethics Committee (ABSMARI/IEC/2025/177).

Baseline assessment- Before beginning the intervention a baseline assessment performed. The Pre-test was conducted by using GMFM, MMC and EFORTS outcome measures to measure gross motor function, quality of life, cognitive, and executive function.

Intervention protocol- The subject prepared for intervention by drinking water before conducted any physical movement, and each pattern did for 5 min for 45 min per week for 4 weeks.

- BRAIN BUTTON – The child placed one hand on the chest and the other hand on the abdomen and then did breathe in and out slowly.
- LAZY EIGHT- The child drew an “eight” in the air with a marker and traced it in a diagonal motion up and to the left.
- EARTH BUTTONS – The child hand or fingertips placed on the upper lip and the other’s hand placed about six inches below the belly button. The position was hold for 4-6 breaths.

- THINKING CAP – The child gently massaged and rolled the outer fold of the ears from top to bottom to support listening and attention.
- CROSS CRAWL – The child touched the right elbow to the left knee alternatively and vice versa in sitting or standing position.
- HOOK UPS – The child crossed one ankle over another leg and put both arms in front of the body and crossed left wrist over the right. The hand placed towards the chest and breathed deeply.
- ARM ACTIVATION: The child lifted one arm overhead and the other hand resisted the movement.
- CALF PUMP: The child pressed down the heel in a stretching and lengthening the calf muscle like runner's stretch. (Paul and Gail Dennison) [1]



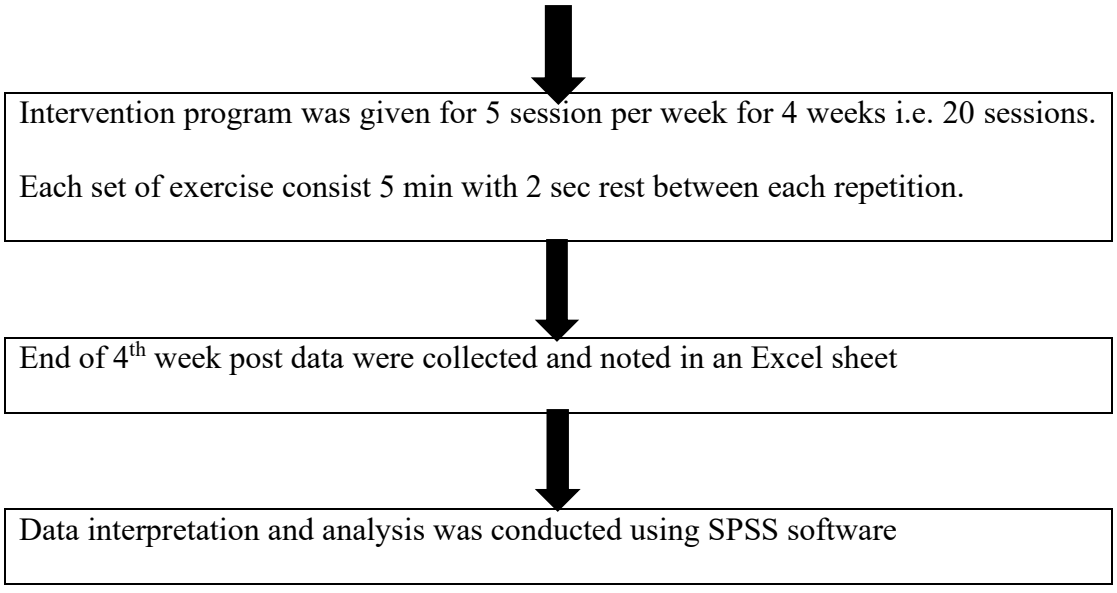


Figure No.1 - Flow chart of study procedure

Figure No.: 2.1 Hook Ups

Figure No.: 2.2 Cross Crawl

Figure No.: 2.3 Thinking Cap

Figure No.: 2.4 Brain Button

Figure No.: 2.5 Earth Button

STATISTICAL ANALYSIS

DATA COLLECTION

The demographic details and comprehensive clinical assessments were recorded before the intervention. Baseline data were collected using the Gross Motor Function Measure (GMFM scale), cognitive function measured by MMC and as secondary scale used EFORTS scale and noted in Ms-excel.

STATISTICAL ANALYSIS

Data was analysed by using the statistical package for social sciences (SPSS) software version 27. The categorical variables were presented in the form of numbers and percentage (%). On the other hand, the continuous variables presentation was done as mean, ± SD values. The normality of the data was assessed using the Shapiro- Wilk Test. Interferential statistics to find out within-group difference was done by using paired t-test.

RESULTS

RESULT

In the present study out of the 22 children 15 participants completed the study and were included in the final analysis.

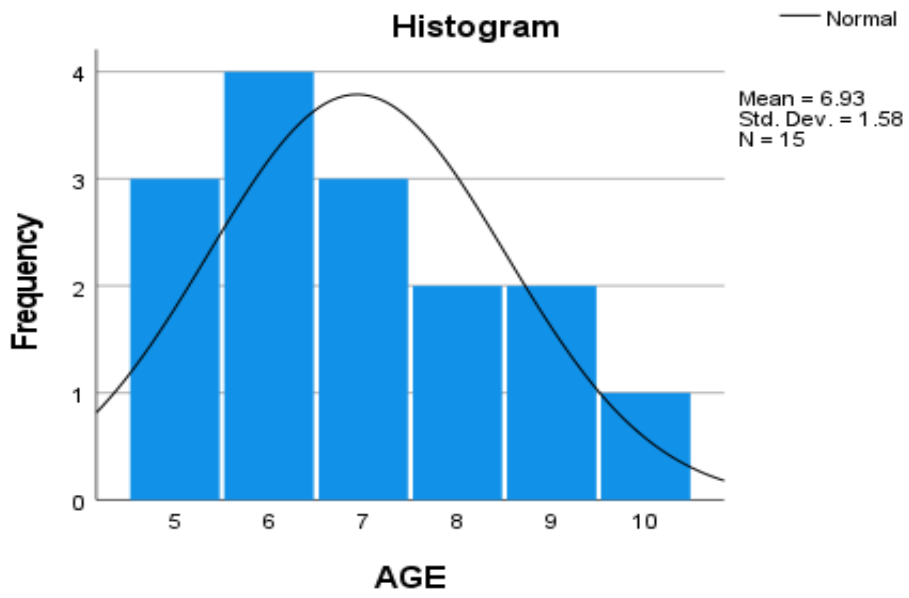
Demographic Details

The intervention group consisted of 15 CP children with mean age (6.93±1.58) ranging from 5 to 10 and MMC (18.20±7.12) ranged from 11 to 34.

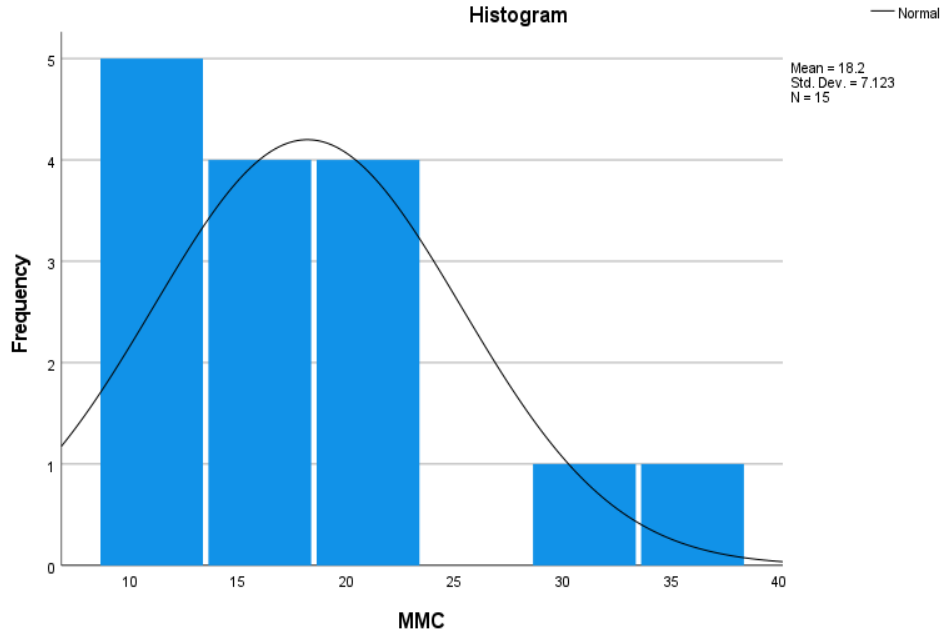
The baseline value of demographic data and screening outcomes were Age (p=0.201) and MMC (p= 0.026).

Variables	Mean (SD)	p-value
Age (in years)	6.93±1.58	0.201
MMC	18.20±7.12	0.026

Table 1: Descriptive and Normality value of demographic details



Graph No.: 1.1



Graph No.: 1.2

Comparison of Pre- and Post intervention score

Paired t-test was conducted to compare between pre and post intervention outcomes. The results demonstrated statistically significant improvements across all measure:

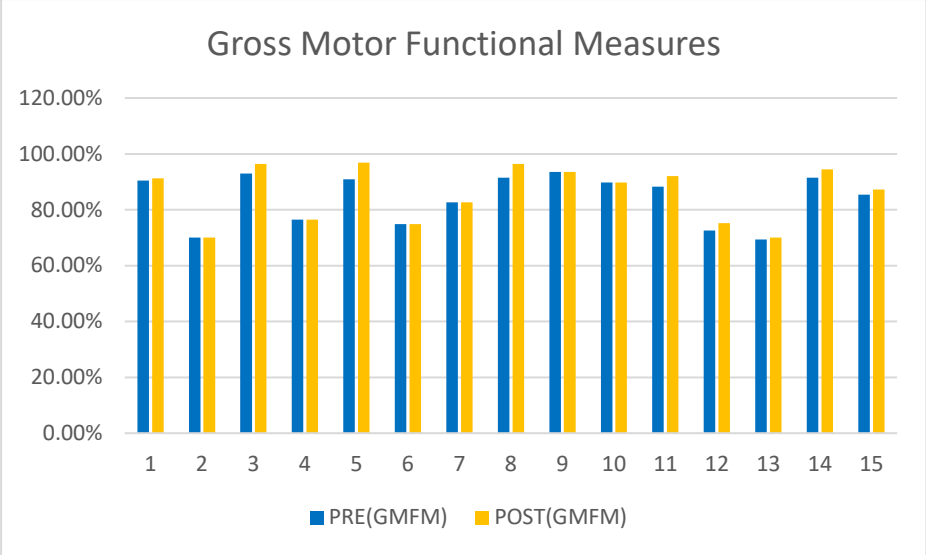
The comparison of pre-test (Mean = 84.00, SD = 8.91) to post test (Mean = 85.87, SD = 10.04) of Gross motor functional measure (GMFM) showed significant difference (t= -3.643, P= .003).

MMC score in pre-test (M= 18.2, SD = 7.1) and post-test (M = 20.06, SD = 7.94) showed a significant value (t= -4.404, P= <0.01)

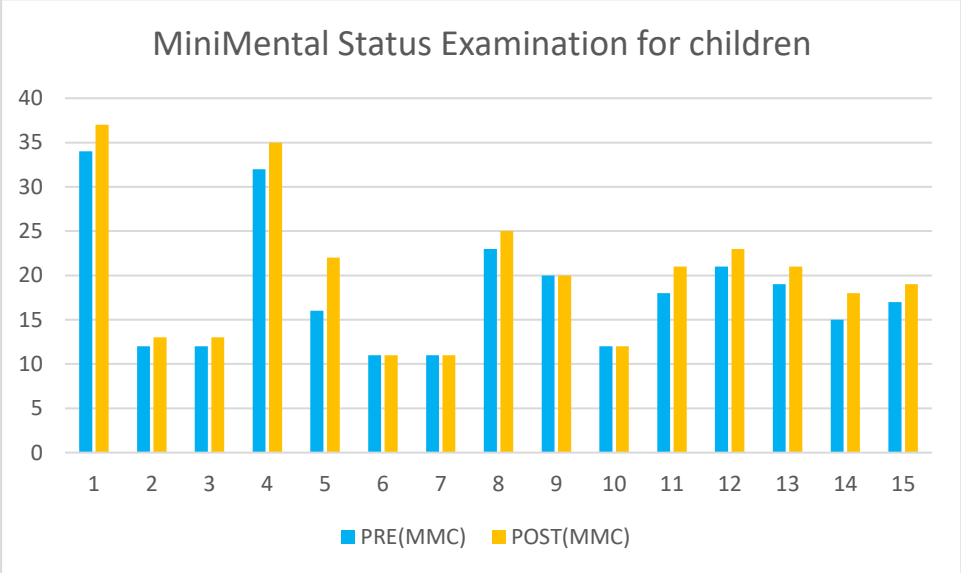
The comparison of pre-test (M= 111.93, SD=21.87) and post-test (M= 117, SD= 23.3) of Executive Function and Occupational routine Scale (EFORTS) showed a significant value (t= -6.466, P=<0.01).

Variables	Scores	Scores	t-value	p-value
	Pre Mean (SD)	Post Mean (SD)		
GMFM	84.007±8.91	85.87±10.04	-3.643	.003
MMC	18.2±7.12	20.06±7.94	-4.404	<.001
EFORTS	111.9±21.87	117±23.32	-6.466	<.001

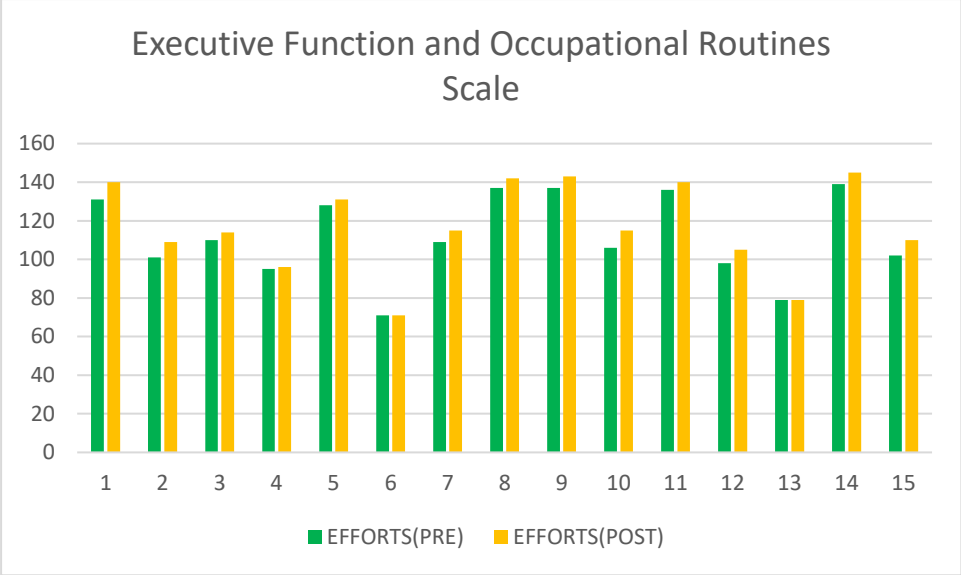
Table 2: Comparison of pre and post intervention scores



Graph No.2.1: Difference between pre- and post- intervention GMFM



Graph No.2.2: Difference between pre- and post- intervention MMC value



Graph No2.3.: Difference between the pre and post intervention EFORTS

Summary of findings: The intervention showed a significant post-intervention improvements in gross motor performance, cognitive function and executive functioning. These results confirm that BG exercises contributed positively to both motor and cognitive domains in children with cerebral palsy.

DISCUSSION

DISCUSSION

The present study evaluated the effect of brain gym exercise in improving both cognitive functioning and gross motor skills in children with cerebral palsy.

The novelty of this study is the intervention focus on both cognitive and motor domains. While previous studies predominantly evaluated that the physical exercise programs target only physical or mental skills but this study focus both the domains with this intervention.

The results of the present study showed that a significant improvement in cognitive function such as memory, attention-span, and listening and in motor abilities including balance and coordination

This intervention was based on three main domains of movement: stabilization, locomotion, and manipulation, fundamental to motor and cognitive development. Each activity consisted a specific series of activities- Cross crawl, supported reading, writing abilities, and comprehension skills; the Earth Button enhanced coordination; the Thinking Cap improved attention and listening comprehension; Brain Button facilitated energy flow. Hooks Up encouraged body balance and postural control, Arm activation strengthened the upper body and Calf Pump stretched the tendons of calf muscle. The Lazy Eight exercise boosted concentration. Overall, these activities stimulated neural pathways in a natural, movement-based manner, which helped in improvement in cognition and motor function. [1][28]

The findings of this study are consistent with previous research that highlights the positive influence of brain gym exercises on cognitive and motor development.

As per Renda Nataline Pratama et al. (2022) reported that brain gym intervention significantly improved cognitive outcomes in early childhood. Their statistical analysis demonstrated a significant result $p=0.018(p<0.05)$, supporting the hypothesis that brain gym enhanced cognitive performance. [8]

Similarly, Priya Kumari et al. (2024) found that brain gym was more effective to web-based cognitive training in enhancing working memory and attention. Their results showed that Group A, improved significantly in digit-span forward and backward test($p<0.05$), where Group B did not shoe similar result. In spatial memory and stroop test both groups showed a significant result which confirming the role of brain gym in enhancing higher- order cognitive abilities. [28] Similerly, Rajesh Pandnani et al. (2023) also observed that the brain gym exercises improved both gross and fine motor functions in children with Down syndrome, along with better performance in activities of daily living (ADLs). Their analysis revealed that group A had a significant difference between pre post data that is p value less than 0.005 while B group was not significant. The comparison between groups indicated that group A had significant improvements than group B. [6]

Also, studies by Galang Bagiwiyudin et al**.** demonstrated that rhythmic brain gym exercise among children with mental disabilities improved gross motor function. Their result showed an average improvement of 33.8% when comparing scores from the first five sessions with those of the last five sessions, demonstrating a clear effect on rhythmic movement-based intervention on gross motor development. [26] and Elvina Sari Sinaga et al, (2022) confirmed that brain gym could effectively promote both gross

and fine motor development in pre-school children. In their study, the intervention group showed highly significant results in both pre- and post-test comparisons $p = 0.000$ ($p<0.05$) after the similar intervention, while the control group showed $p = 0.012$ ($p>0.05$) meaning that there was no effect before and after intervention. [7]

All together, these studies providing strong evidence both cognitive and motor functions in different populations, including typically developing children and with developmental delays. The consistency of outcomes across multiple studies highlights the potential of brain gym exercise as a practical, low-cost, and non-invasive intervention that can be widely applied in rehabilitation programs.

CONCLUSION

The findings of this study indicate that brain gym exercise can significantly enhance both cognitive abilities and gross motor functions. Improvements were observed in such areas such as memory, attention span, listening comprehension, balance and postural control. The results of the exercises support the integration of brain gym into rehabilitation programs as an effective, non-invasive, and child friendly approach to improve functional independence and quality of life.

Limitations & Recommendations for Future Study

LIMITATION AND FUTURE STUDY SCOPE

The sample size was relatively small and several participants were excluded or dropouts, which may limit the generalizability of the result. Also, the absence of a control group makes it difficult to observed improvements to brain gym, as external factor such as maturation or environmental influences may also have contributed.

Future research should aim to include a larger population and longer intervention periods to strengthen the study.

Neurophysiological measure (e.g, EEG, MRI) could be included to know the neuroplasticity development by which brain gym influences cognitive and motor development.

SUMMARY

SUMMARY

Cerebral Palsy (CP) is a leading cause of children disability, presenting with motor impairment, spasticity, cognitive and communicative impairment, and reduced the functional ability. Spastic cerebral palsy, the most prevalent subtype, present impairment in mobility and functional skills.

The traditional therapeutic programs for children with CP primarily focus on improving motor skills through physiotherapy and occupational therapy. Beside motor function the cognitive function also equally important for learning and daily living. Brain gym exercises, consists cross-lateral and coordination-based movements which stimulate both hemispheres of the brain. These activities are improved sensory-motor integration and enhanced higher-order cognitive function. The study analysed the impact of brain gym exercise on children with CP improve not only the motor function but also the cognitive and academic performance.

The majority studies on brain gym exercise have been conducted in typically developing children or other developmental disorder condition like Down syndrome and learning difficulties. There is lack of studies of impact of brain gym exercise on both domains in children with CP. This study is taken to fill this gap by evaluating that brain gym exercise can enhance cognitive performance and gross motor function simultaneously in this population.

The study is a single-group intervention design with 22 children with cerebral palsy aged 5 to 10 years where 15 participants completed the intervention. The cognitive and

motor outcomes were measured by the pre- and post- intervention data using the MMC Scale, GMFM scale, and EFORTS. The data were analysed with SPSS using the Shapiro-Wilk test for normality value and paired t-test for interferential study. Post-intervention analysis showed significant improvements across all outcome measures. So, the study demonstrates that brain gym exercises enhanced memory, attention, and executive function along with balance, coordination and gross motor control. The result of brain gym exercise may support as a therapeutic tool in both clinical and educational settings and it is a non-invasive method.

STATEMENT OF FUNDING

Source of Funding: Not applicable

Nature of Funding: Not applicable

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ANNEXURES

ANNEXURES - 1

ABSMARI ETHICS COMMITTEE

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE,
BHUBANESWAR, ODISHA

CDSCO Reg. No.: ECR/1981/Inst/OD/24

Prof. (Dr.) E. Venkata Rao
Chairperson

Mr. Chinmaya Kumar Patra
Member Secretary

Ref. No. ABSMARI/IEC/2025/177

Date: 12/05/2025

APPROVAL LETTER
APPENDIX- VIII

To,

SHRABASTI MANNA
ABSMARI
273, PAHAL, BHUBANEWAR-752101

MEMBERS

Dr. Smaraki Mohanty
Clinician

Dr. Satyajit Mohanty
Scientific Member

Mr. Shib Shankar Mohanty
Legal Expert

Ms. Annie Hans
Social Scientist

Ms. Subhashree Samal
Lay Person

Mr. Deepak Ku. Pradhan
Scientific Member

IEC-SECRETARIAT

Mr. Gouranga Ku. Padhy
Mr. Susant Ku. Raychudamani

Protocol Title: Effect of Brain Gym Exercise on Cognition and Gross Motor Performance in Children with Cerebral Palsy-A Quasi Experimental Design.

Protocol ID.: ABS-IEC-2025-PHY-076

Subject: Approval for the conduct of the above referenced study

Dear Mr./**Ms.**/Dr **SHRABASTI MANNA**
With reference to your Submission letter dated 06/01/2025 the ABSMARI IEC has reviewed and discussed your application for conduct of the study on dated 25/04/2025.

The following documents were reviewed and discussed

S.N.	Documents	Document (Version/Date)
1	IEC Application Form	25/04/2025
2	Informed Consent Form	25/04/2025
3	Undertaking form PI	25/04/2025
4	CRF	25/04/2025
5	COI from the Investigators	25/04/2025

The following members were present at meeting held on 25-04-2025

ABSMARI ETHICS COMMITTEE
Dt. 12/05/25
BHUBANESWAR

ANNEXURES-2

PATIENTS ASSESSMENT FORM

Patient Information

- **Name:** _____
- **Age:** _____
- **Gender:** _____
- **Date of Assessment:** _____
- **Assessor/Clinician:** _____

Patient Report

- **Primary Concerns/Complaints:**

_____

Past History

Perinatal:

Natal:

Postnatal:

- **Mobility Concerns:**
  - ☐ Falls frequently
  - ☐ Needs mobility aid (walker/wheelchair)
  - ☐Canwalk independently
  - ☐ Other: _____
- **Communication Concerns:**
  - ☐ Limited speech
  - ☐ Uses gestures/visual cues
  - ☐ Understands instructions
  - ☐ Other: _____
- **Behavioral/Emotional Notes:**

_____

_____

Gross Motor Function

- **GMFCS Level:**☐ I ☐ II ☐ III ☐ IV ☐ V
- **Muscle Tone:**
  - ☐ Normal
  - ☐ Spastic
  - ☐Hypotonic
  - Areas affected: _____

ANNEXURES-3

PARENTAL CONSENT FORM

Title -EFFECT OF BRAIN GYM EXERCISE ON COGNITION AND GROSS MOTOR PERFORMANCE IN CHILDREN WITH CEREBRAL PALSY- QUASI EXPERIMENTAL

Name of the Principal investigator	Participants Details
Shrabasti Manna	Name
MPT (NEUROLOGY)	Age/Sex
ABSMARI	Name of Parent/guardian

Description of the study: Participants will be selected according to inclusion and exclusion criteria. Pre-test data will be taken. followed by a 4 weeks intervention program and post-test data will be collected.

Risks or discomforts: The risks in this study are no greater than those ordinarily encountered in daily life or the performance of routine physical or psychological examinations or tests. There are no foreseeable discomforts or dangers to your child in participating in this study.

Benefits: There may be improvement in cognitive function and gross motor performances to improve their quality of life.

Confidentiality of records: All records are kept confidential and will be available only to professional researchers and staff. If the results of this study are published, the data will be presented in group form and individual children will not be identified. Information collected as part of this research will not be used or distributed for future research studies.

Voluntary Participation: Your child's participation in this study is completely voluntary. We ask that you read this information to your child to ensure that he/she understands that participation is voluntary. He/she may stop or withdraw from the study at any time. If your child wishes to discontinue the research at any time; no information collected will be used.

CONSENT: **I, _____ willingly consent to my child's participation in above mentioned study. I have read this consent form (or it has been read to me) and I fully understand the contents of this document and voluntarily consent to participate in the study. All of my questions concerning this study have been answered. I understand that this consent ends at the conclusion of this study.**

Signature of the Investigator	Signature of the Participant's Parent/guardian

ANNEXURES-4

MASTER CHART

AGE	GENDER	TYPE OF CP	LEVEL OF SPASTICITY	GMFCS LEVEL	MMC	PRE(GMFM)	POST(GMFM)	PRE(MMC)	POST(MMC)	EFORTS(PRE)	EFORTS(POST)
9	M	Monoplegic	Grade-1	Level-1	34	90.39%	91.23%	34	37	131	140
6	F	Paraplegic	Grade-1+	Level-2	12	70.01%	70.01%	12	13	101	109
8	M	Monoplegic	Grade-1	Level-1	12	93.01%	96.44%	12	13	110	114
7	F	Tetraplegic	Grade-2	Level-2	32	76.40%	76.40%	32	35	95	96
6	F	Hemiplegic	Grade-1	Level-1	16	90.90%	96.84%	16	22	128	131
10	M	Paraplegic	Grade-2	Level-2	11	74.82%	74.82%	11	11	71	71
5	F	Hemiplegic	Grade-1+	Level-1	11	82.65%	82.65%	11	11	109	115
5	M	Monoplegic	Grade-1	Level-1	23	91.52%	96.44%	23	25	137	142
6	F	Paraplegic	Normal	Level-1	20	93.50%	93.50%	20	20	137	143
7	M	Monoplegic	Grade -1	Level-1	12	89.80%	89.80%	12	12	106	115
8	F	Hemiplegic	Grade-1	Level-1	18	88.25%	92.10%	18	21	136	140
9	M	Diplegic	Grade-2	Level-2	21	72.60%	75.20%	21	23	98	105
6	M	Tetraplegic	Grade-2	Level-2	19	69.30%	70.00%	19	21	79	79
7	F	Monoplegic	Grade-1	Level-1	15	91.52%	94.50%	15	18	139	145
5	M	Hemiplegic	Grade-1	Level-1	17	85.40%	87.20%	17	19	102	110

ANNEXURES- 5

APPENDIX 1

MMC (Mini-Mental State Examination for Children) - Adapted version of the MMSE (Mini-Mental State Examination)

Function	Tests	Score
Orientation	Name, surname, age, sex	0-1-2-3-4
	Name of parents, state, city, place	0-1-2-3-4
	Age, month, day of month, day of week	0-1-2-3-4
Object naming	Pen, watch, glasses	0-1-2-3
Digit span – forward	5 -3	0-1-2-3-4
	4-7-2	
	5-9-3-1	
	2-7-5-9-4	
Digit span – backward	3-6	0-1-2-3
	2-9-5	
	4-1-9-7	
Recall	Pen, watch, glasses	0-1-2-3
Naming body parts	Naming body part indicated by the examiner: hand, foot, knee, nose, ear	0-1-2-3-4-5
Command	"Take the paper in your right hand, fold it in half, and put it on the floor" ("Pegue o papel com a mão, dobre-o ao meio e coloque-o no chão")	0-1-2-3
Verbal string repetition	"No ifs, ands, or buts." ("Nem aqui, nem lá, nem acolá")	0-1
Reading	"Read this and do what it says" ("Close your eyes")	0-1
Writing	"Write your name"	0-1
Constructional praxis	"Copy the drawings. Do it as best you can" (Vertical line at age 3 years, cross at age 4 years, circle at age 5 years, square at age 6 years and diamond at age 7 years)	0-1
		Maximum total score 37

ANNEXURES-6

GROSS MOTOR FUNCTION MEASURE (GMFM)
SCORE SHEET (GMFM-88 and GMFM-66 scoring)

Child's Name: _____ ID#: _____

Assessment Date: _____ year / month / day

GMFCS Level[1]: ☐ I ☐ II ☐ III ☐ IV ☐ V

Date of Birth: _____ year / month / day

Chronological Age: _____ year / month / day

Evaluator's Name: _____

Testing Condition (e.g., room, clothing, time, others present):

_____

The GMFM is a standardized observational instrument designed and validated to measure change in gross motor function over time in children with cerebral palsy. The scoring key is meant to be a general guideline. However, most of the items have specific descriptors for each score. It is imperative that the guidelines contained in the manual be used for scoring each item.

SCORING KEY

0 = does not initiate
1 = initiates
2 = partially completes
3 = completes
9 (or leave blank) = not tested (NT) [used for the GMAE-2 scoring*]

It is important to differentiate a true score of "0" (child does not initiate) from an item which is Not Tested (NT) if you are interested in using the GMFM-66 Ability Estimator (GMAE) Software.

*The GMAE-2 software is available for downloading from www.canchild.ca for those who have purchased the GMFM manual. The GMFM-66 is only valid for use with children who have cerebral palsy.

ANNEXURES-7

Appendix A. Executive Function and Occupational Routines Scale (EFORTS)

Frisch & Rosenblum (2014)

English Version

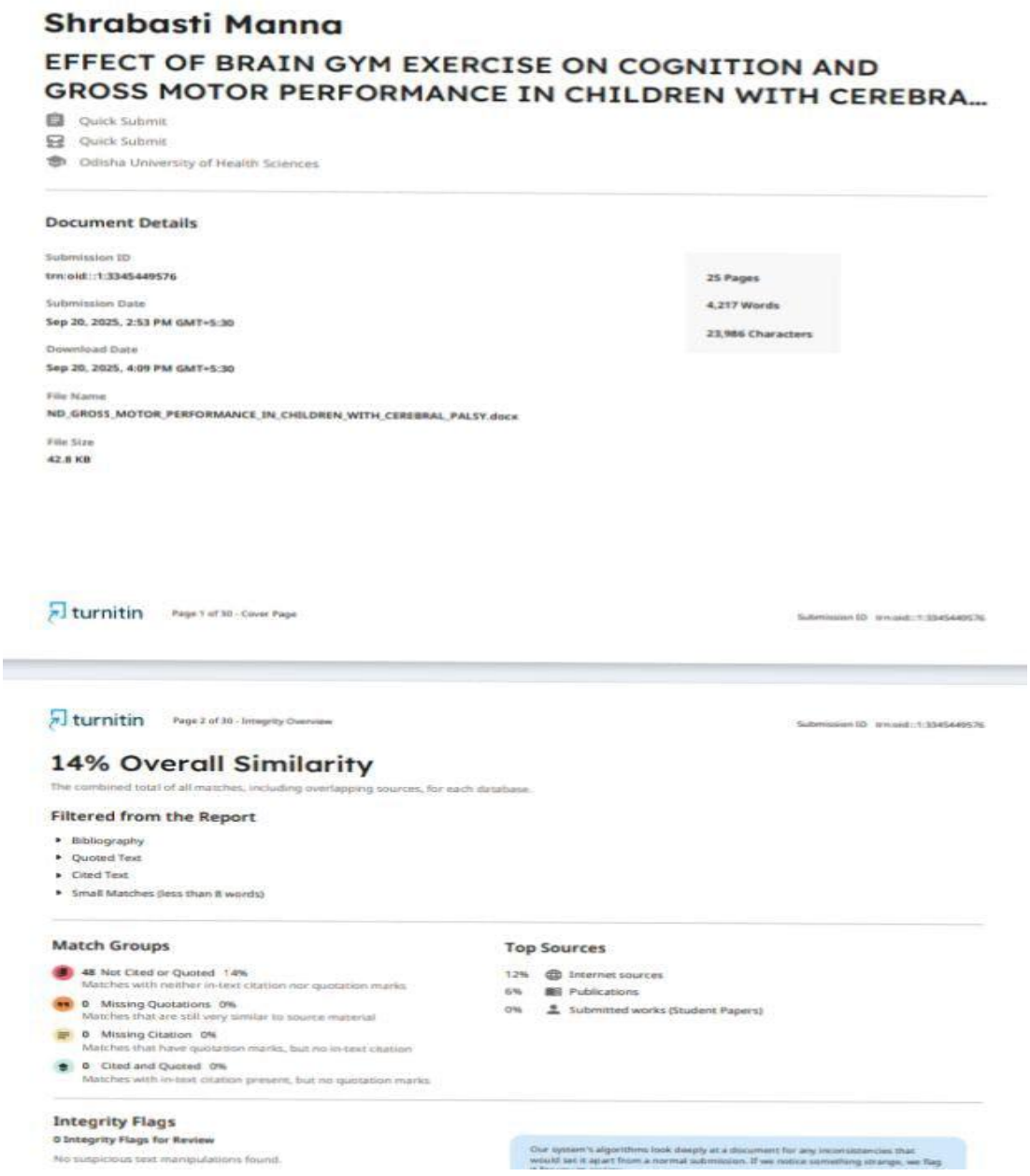
Name of child:_____ Date: _____ Birth date:_____ Age:_____

Throughout our lives, we and our children perform various daily activities. The purpose of this questionnaire is to evaluate your child's executive control during his daily routines. The following items ask how well he/she performs during frequent daily activities such as morning and evening routines, play and leisure, and social activities. Please read the following questions and mark √ below the most suitable answer in reference to your child's performance.

Morning and Evening Routines *Who is with your child during these routines? Mother/father/both parents/other*

In the morning routine context, please specify to what extent your child:	Never	Seldom	Some-times	Often	always
1. Initiates morning activities such as getting dressed, brushing teeth.					
2. Persists at an appropriate pace without needing a reminder from an adult.					
3. Remembers the sequence of activities to be done in the morning in the correct order.					
4. Gets organized according to the rules of the house, e.g. washes hands after using the toilet, puts pajamas on his/her bed, and removes plate from the table.					
5. Solves problems that arise during activity, e.g. searches independently when cannot find needed objects.					
6. Performs only activities that promote dressing and preparing to leave home, does not deal with other things that he/she sees or hears, e.g. ignores the television.					
7. Maintains the quality of execution, e.g. checks he/she took their sandwich (not other family member), checks clothes are worn the right way round.					
8. During morning activities, tends to complete actions without stopping in the middle and moving on to others.					
9. Initiates execution of activities, e.g. initiates putting on pajamas.					
10. Continues an activity at an appropriate pace, without being reminded by an adult.					
11. Remembers the sequence of evening activities in the correct order.					
12. Is organized in accordance with the house rules, e.g. helps clears up the table, puts dirty clothes in the correct place.					

ANNEXURES- 8



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ANNEXURES- 9

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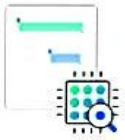

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