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Efficacy of Brain Gym Exercises for Improving Academic Performance in Mentally Retarded Children - An Experimental Study

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ABSTRACT

- ***Introduction*:**
The purpose of this study is to determine if brain gym exercises may improve academic achievement in kids with mild to severe intellectual disabilities (ID). In order to evaluate its effect on cognitive processes including memory, attention, and processing speed, a structured intervention was used. Evidence-based support for integrating brain gym activities into educational and therapeutic programs is the goal of the studies.

- ***Methods:***
At EKTA VOCATTIONAL TRAINING CENTER, an experimental investigation was carried out on a sample of 30 children with mild to moderate ID, ages [6-16]. Brain gym activities were administered to participants three times a week for 20-30 minutes each throughout a 12-week intervention. Academic performance was assessed using the Academic Performance Scale both before and after the intervention. Descriptive and inferential statistics, such as paired t-tests, were used for statistical analysis

- ***Results:***
Academic performance was significantly improved by the intervention group, as evidenced by mean post-intervention scores and qualitative advancements in the processing speed, memory, and attention domains. Advances in standardized evaluation metrics were linked to the use of brain gym activities, indicating a noteworthy improvement in participants targeted cognitive and academic abilities. The analysis shows a statistically significant improvement in ASP scores after the intervention, with the mean ASP-POST score (32.1) much higher than the mean ASP-PRE score (17.07). A paired t-test confirms this difference is highly significant ($p<0.01$$p<0.01$), with a t-value of 25.15 and a mean difference of 15.03 between scores. The average age of participants was 9.5 years, with a standard deviation of 2.35. Gender distribution was 56.7% females and 43.3% males. The results indicate the intervention was effective in increasing ASP values among the study group. This substantial improvement provides strong evidence that the implemented intervention caused a meaningful positive change in ASP outcomes.

- ***Conclusion:***
In children with mild to moderate ID, brain gym activities can greatly improve academic performance. They provide a straightforward, affordable, and adaptable intervention that can be used in school and community settings with limited resources. It is advised that more controlled research be done to confirm these results and encourage wider use in educational and therapeutic plans.

Keywords: *Brain Gym Exercises, Intellectual Disability (ID), Academic Performance (AP), Cognitive Development (CD), Memory (M), Attention (A), Processing Speed (PS).*

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I. INTRODUCTION

Educating children with developmental disabilities requires targeted methods that address motor, sensory, behavioural, and cognitive challenges.[1] W.M. Cruickshank (1974) described special children as those whose development differs so much from the norm that traditional schooling is of limited benefit, making focused educational and therapeutic interventions essential. Among these conditions, intellectual developmental disorder (IDD), formerly termed mental retardation, is one of the most common.[2] The WHO defines it as incomplete or halted mental development affecting adaptive skills like academics, communication, and self-care, while the DSM-5 classifies it into mild to profound levels based on IQ, adaptive behaviour, and support needs. In India, ID is a significant public health and educational concern, with prevalence estimates of about 2% but likely underreported due to stigma, particularly among girls. National data show that around 5.6% of people with disabilities have a mental disability, with neurodevelopmental disorders affecting nearly 10–14% of young children. These figures underscore gaps in recognition and service delivery. Effective, affordable, and culturally sensitive school- and community-based interventions are needed. Children with ID often require individualized education plans and support from multidisciplinary teams including educators, therapists, and psychologists, highlighting that the burden extends beyond medical care to the education system itself.[3]

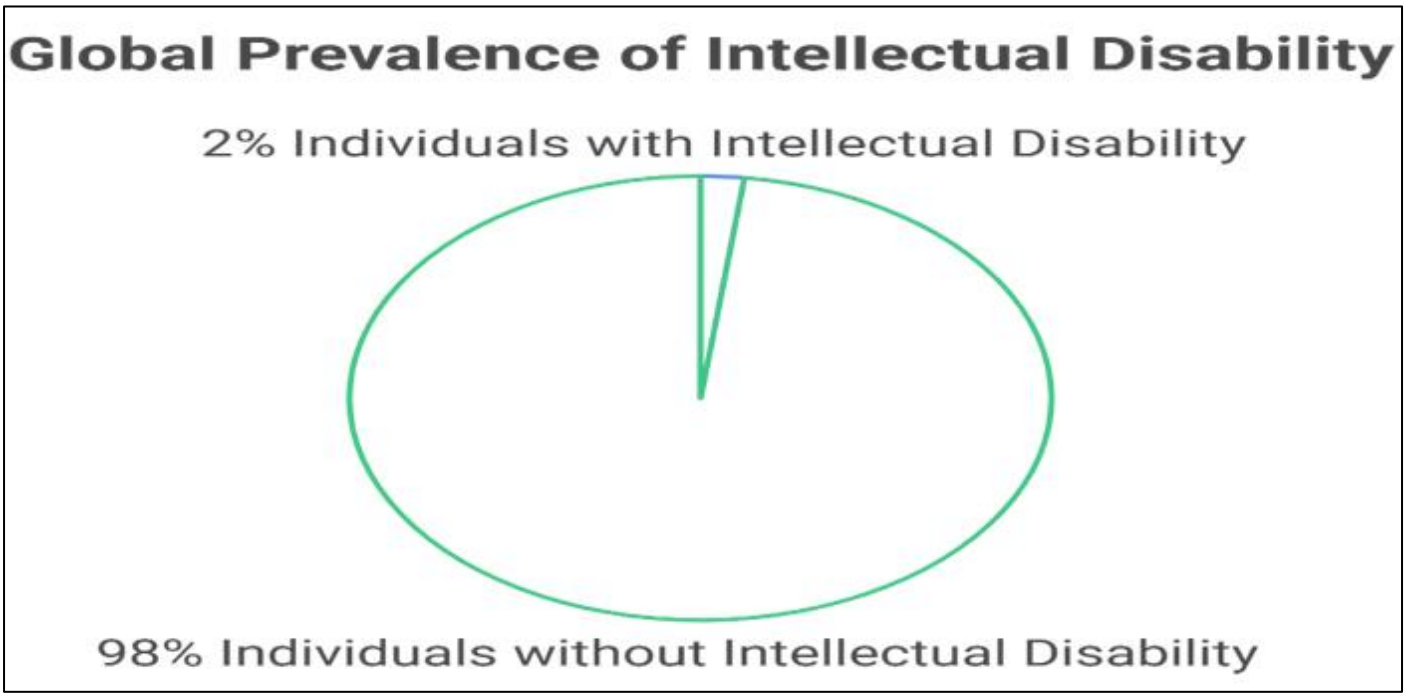

Fig 1 Global Prevalence of Intellectual Disability

Intellectual disability has a diverse aetiology that includes prenatal, perinatal, postnatal, and genetic causes. A sizable percentage of cases are caused by genetic abnormalities such Down syndrome, fragile X syndrome, and phenylketonuria. Maternal malnourishment, exposure to teratogens like alcohol and some medicines, infections (such CMV and rubella), and untreated maternal conditions like hypothyroidism are among the prenatal causes. Prematurity, low birth weight, and birth asphyxia are examples of perinatal factors; traumatic brain damage, meningitis, encephalitis, and environmental deprivation are examples of postnatal causes. However, in many instances, the ailment is classified as idiopathic because no apparent explanation can be found. [5][1]

Many interrelated factors influence how well children with intellectual disability succeed academically. The acquisition, retention, and application of new information are directly impacted by core neurocognitive deficiencies, including working memory, attention, processing speed, and executive function limits. From early childhood through adolescence, academic achievement is significantly predicted by memory, intelligence quotient (IQ), and executive functions (which include planning, cognitive flexibility, and inhibitory control), according to longitudinal research. The connection between IQ and reading ability is especially significant as advancements in one frequently support advancements in the other. In academic fields, children with IDD frequently perform inconsistently, exhibiting relative strengths in some areas and noticeable deficiencies in others. [3][5]

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Children with intellectual disabilities have a variety of unique difficulties in the classroom, many of which are connected. Inability to focus during class can be a sign of attention deficit disorder, which can result in a lack of comprehension of the material. Limitations in working memory make it more difficult to store and process information required for comprehension and problem-solving. While cognitive rigidity causes trouble adjusting to new instructions or shifting techniques, reduced processing speed can cause sluggish job completion. Asking the same question over and over again or going back to previously discussed information are examples of persistent behaviors. Participation in class discussions is restricted by language problems, which impact both expressive and receptive communication. Engagement can also be further limited by behavioral and emotional problems like anxiety, social disengagement, or low motivation. Learning is further hampered by physical comorbidities such as fatigue, problems with motor coordination, and issues with sensory integration. [1]

Interventions that focus on both the cognitive and physical domains have the potential to improve academic achievements in light of these complex issues. It is becoming more well acknowledged that physical activity is a controllable factor that promotes cognitive function. Improvements in attention, memory, mood, and executive function have been associated with aerobic exercise, resistance training, and coordinated movement activities. These mechanisms include increased cerebral blood flow, hippocampal neurogenesis, and the release of neurotrophic factors like brain-derived neurotrophic factor (BDNF). Physiotherapy has evolved to include techniques that engage the cognitive and sensory systems in addition to its conventional goal of regaining physical function. For the purpose of promoting neuroplasticity and integrating brain-body functions, movement-based programs that incorporate various senses— kinaesthetic, tactile, visual, and auditory— are particularly successful. Neuroplasticity underpins recovery and adaptation through rehabilitative therapies in addition to supporting cognitive processes. Brain Gym exercises can help mentally challenged individuals connect sensory-motor pathways, maximize brain function, and enhance general academic achievement by utilizing these mechanisms. [1]

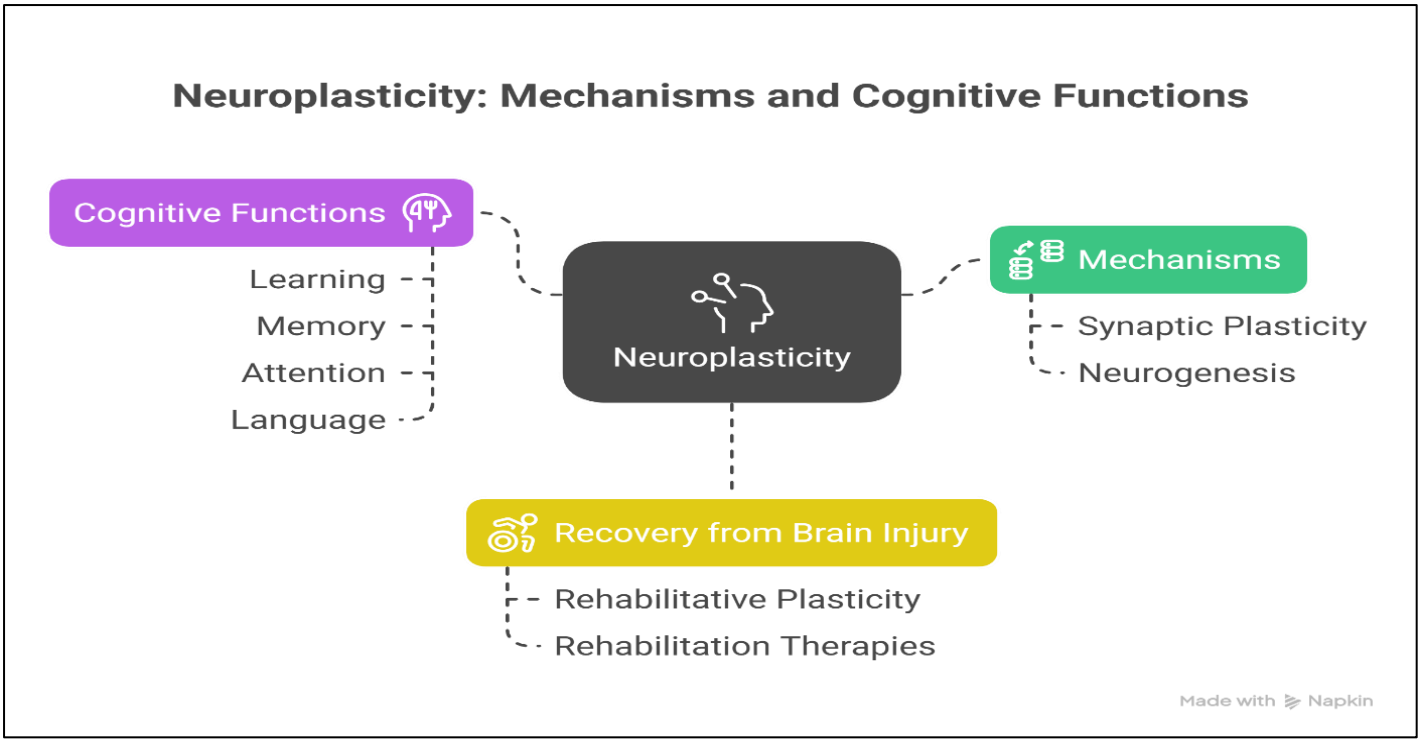

Fig 2 Neuroplasticity [Mechanism and Cognitive Function]

Paul and Gail Dennison created Brain Gym, a movement-based learning program based on educational kinesiology, in the early 1980s. It includes 26 planned tasks that are easy to do, need little equipment, and may be readily integrated into therapy or school settings. The purpose of these activities is to improve neuronal integration, activate both cerebral hemispheres, and prime the brain for learning. The program is structured around three fundamental aspects: centring (emotional stability and physical balance that enable optimal learning readiness), focusing (the ability to process and priorities pertinent information efficiently), and laterality (the ability to coordinate left and right hemispheres for language and motor skills). These simple exercises—including cross-lateral movements, eye and ear massages, breathing routines, and two-handed drawing—help improve coordination, focus, motor skills, sensory integration, and overall readiness for learning.[1]

Its capacity to enhance interhemispheric communication, sensory integration, executive function activation, neurochemical modulation, stress regulation, and cerebellar engagement provides the neurophysiological

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foundation for Brain Gym's effects. By stimulating the corpus callosum, cross-lateral activities enhance hemisphere-to-hemisphere communication. The exercises' multisensory design improves motor planning, spatial awareness, and attention by fortifying pathways in the parietal and cerebellar cortices. Working memory, cognitive flexibility, and goal-directed behaviour all depend on the prefrontal cortex and supplementary motor regions, which are activated by bilateral coordination and sequencing activities. The neurochemicals BDNF, dopamine, and serotonin—which promote neuroplasticity, attention control, and motivation—are released more readily when one is physically active. By decreasing the activation of the amygdala and the hypothalamic-pituitary-adrenal axis, relaxation techniques lower cortisol levels and enhance emotional preparedness for learning. Traditional motor coordination is linked to the cerebellum, which also plays a role in timing, prediction, and cognitive fluency. Rhythmic Brain Gym exercises probably enhance these abilities, assisting with tasks like handwriting, reading fluency, and problem-solving.[1]

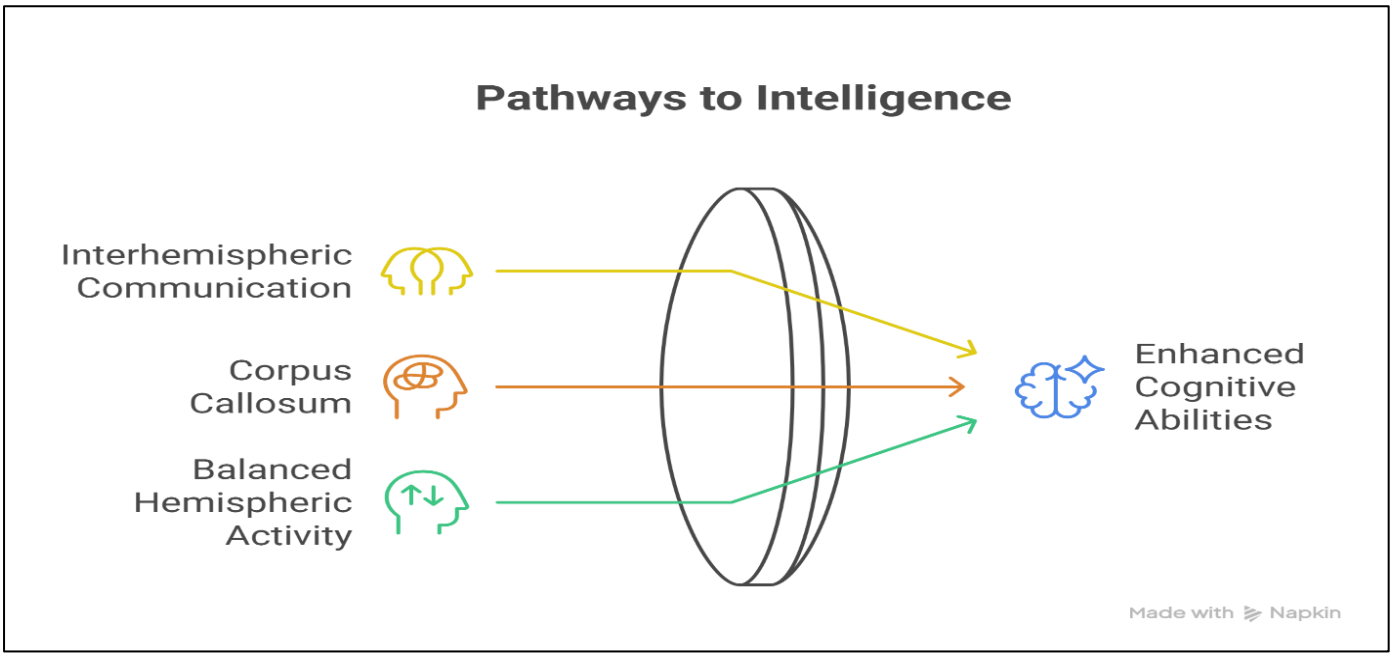

Fig 3 Pathway of Intelligence

The use of Brain Gym is supported by empirical data in a number of populations. Brain Gym has been demonstrated to enhance social interaction, memory retention, and attention span in kids with autism spectrum condition. Reading fluency, penmanship, and task completion have all improved in students with dyslexia and attention deficit hyperactivity disorder (ADHD). According to research by Andrea Watson and Ginger L. Kelso (2014), Brain Gym improved children with developmental disabilities' academic engagement and resulted in improvements in their focus, math, writing, and study habits. Brain Gym's relevance across the lifespan has been demonstrated by its correlation with gains in mood, cognitive flexibility, and mental attentiveness in older persons. [1][8][9]

Notwithstanding these positive results, research on children with intellectual disabilities in low-resource educational environments is conspicuously lacking, especially in India. Brain Gym is a potentially useful tool because of the high prevalence of IDD, the concomitant scholastic difficulties, and the scarcity of specialized solutions. It is affordable, doesn't require any special equipment, is simple for educators and carers to learn, and can be modified to accommodate varying skill levels. [5][6][9]

In order to close this gap, the current study assesses how well Brain Gym exercises can help Mentally Challenged Children succeed academically. To measure academic performance, the Academic Performance Scale will be utilized. A valid and organized instrument for evaluating students' development and competency in a range of academic areas is the Academic Performance Scale. It provides a thorough picture of a learner's educational status by assessing important areas like reading, writing, math proficiency, comprehension, classroom engagement, and the capacity to apply concepts learnt. In research, the ASP is useful for monitoring academic progress over time, especially in kids with intellectual disabilities, where focused interventions may affect not just academic performance in a given subject but also more general cognitive skills like memory, attention, and problem-solving. Direct monitoring of performance metrics, such as accuracy, task completion, output quality, and degree of independence, forms the basis of the scoring system. An intraclass correlation coefficient (ICC) of 0.8, which indicates its shown dependability, guarantees consistent measurement throughout multiple assessments. The ASP provides both sensitivities to change and relevance to the educational demands of mentally retarded children, making it a suitable outcome measure for the current study to assess how well Brain Gym exercises improve academic achievement. The study intends to contribute to a more integrated, holistic approach to learning that addresses both cognitive and physical elements of

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development by offering concrete data on the efficacy of Brain Gym in this demographic.[1]

II. METHOD

This research adopted an experimental study design to evaluate the effectiveness of targeted interventions within a specialized educational setting. Conducted at the Ekta Vocational Education/Training Centre for Divyan Children in Rahata, the study focused on mentally challenged children, specifically those falling within the 6 to 16 years age group. The selection of participants followed a convenience sampling approach, resulting in a sample size of 30 children who were actively engaged in the centre's programs. By utilizing this method, the study aimed to efficiently gather data from readily available subjects in a real-world educational environment, thereby ensuring the findings would reflect practical outcomes and inform future strategies for supporting children with intellectual developmental disabilities. This setting also provided access to multidisciplinary resources and tailored educational activities, further enhancing the relevance and applicability of the interventions tested for this population.

➢ *Inclusion Criteria*

- Age: 6 – 16 years
- Both genders
- Assessed by psychologist and neurologist
- IQ level [mild, moderate]
- IV-Tr Classification
- No Orthopaedic Disability
- Special School Going Children

➢ *Exclusion Criteria*

- Children with Epilepsy and Seizures
- Any Orthopaedic Disability
- IQ Level Severe and Profound
- Unable to Understand the Scale

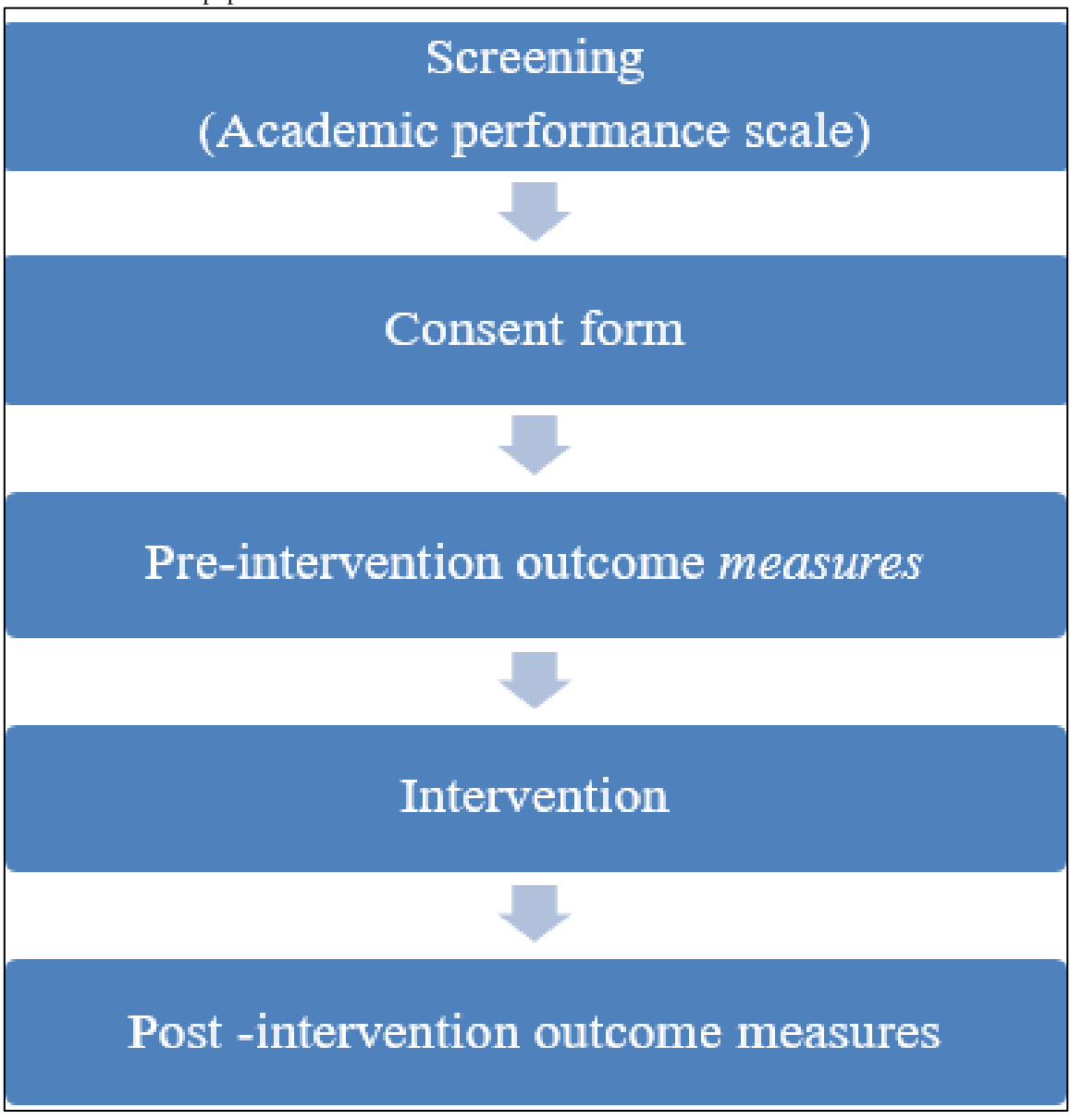

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Fig 4 Flow Chart

Ethical approval for this study was obtained from the Institutional Ethical Committee prior to the commencement of data collection. The research was carried out at the Ekta Vocational Training and Education Centre for Divyang Children. A total of 30 participants were selected, with the sample size calculated using Open-Epi software at a 95% confidence interval. The aims, objectives, and procedures of the study were clearly communicated to the participants and their parents or guardians in language that was easy to understand. Participants were screened according to predefined inclusion and exclusion criteria to ensure eligibility. Parents or guardians of eligible children who agreed to participate were provided with a detailed information sheet and asked to sign an informed consent form. Both participants and their guardians were informed of their right to withdraw from the study at any time, and such withdrawal was respected without any negative consequences. Prior to the intervention, baseline academic performance of each participant was assessed using the Academic Performance Scale (ASP) to establish pre-intervention scores for later comparison with post-intervention outcomes.

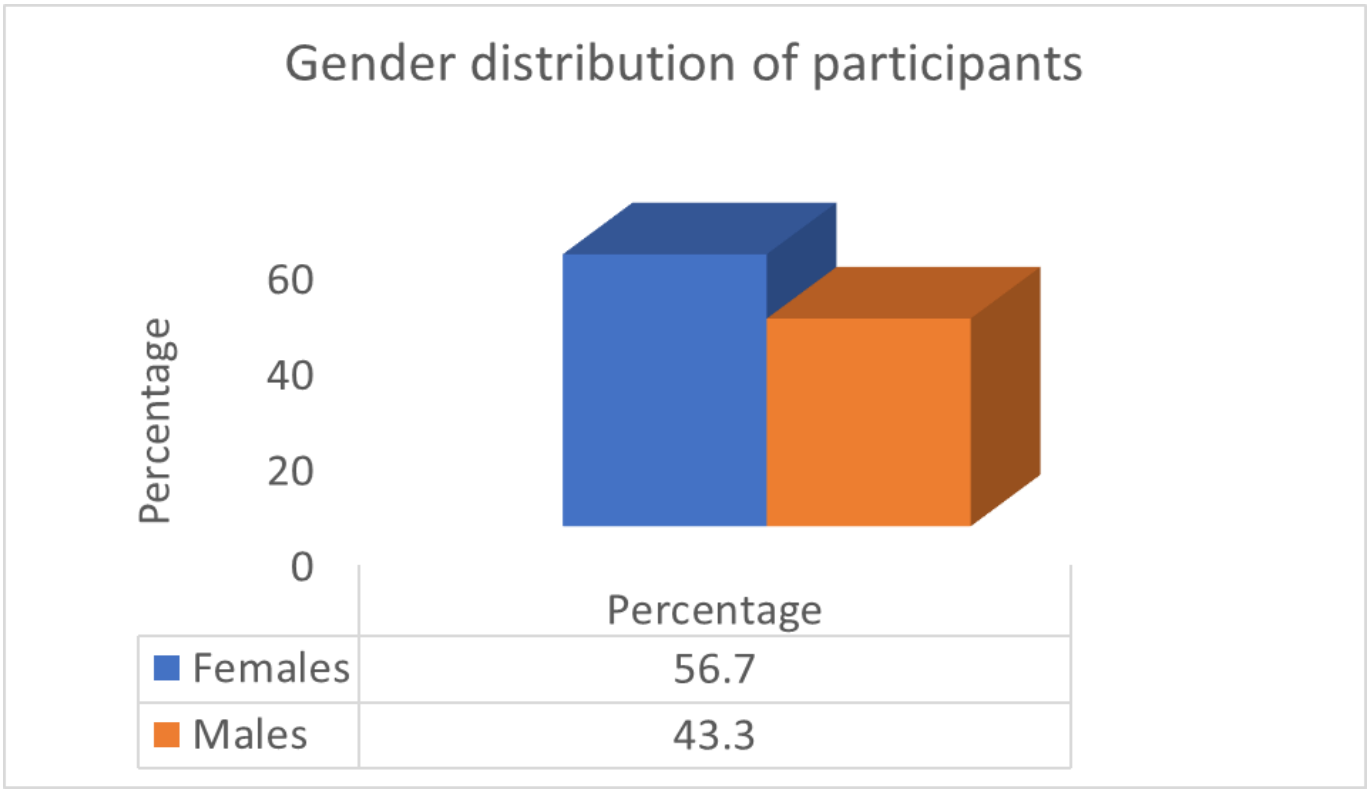
➢ *Outcome Measures*

The Academic Performance Scale (ASP) is a standardized tool used to evaluate the academic abilities and progress of children, particularly those with developmental challenges. It assesses various domains such as reading, writing, arithmetic, and comprehension skills to provide a comprehensive measure of a student's academic functioning. The scale is designed to be sensitive to the educational needs of children with intellectual and developmental disabilities, allowing educators and therapists to identify specific areas of strength and difficulty. By generating quantifiable scores, the ASP facilitates objective monitoring of academic progress over time, making it a valuable instrument for both baseline assessment and evaluating the effectiveness of targeted educational interventions. The ASP demonstrates strong reliability, with an intraclass correlation coefficient (ICC) value of 0.87, indicating excellent consistency in its measurements. Its ease of administration and clear scoring criteria make it suitable for use in special education settings like the one in this study.

III. DATA ANALYSIS

The data obtained in this study were processed using both descriptive and inferential statistical methods. For descriptive analysis, measures such as mean, standard deviation (SD), and standard error (SE) were calculated to summarize the pre- and post-test scores on the Academic Performance Scale (ASP). In addition, 95% confidence intervals (CI) were computed to assess the accuracy of the estimates.

To evaluate the effectiveness of Brain Gym exercises, a paired two-tailed t-test was applied to compare the ASP scores before and after the intervention, since the same group of participants was measured at two different time points. The significance level was set at $p < 0.05$.



Graph 1 The gender distribution of participants is depicted in the graph, with a higher percentage of girls (56.7%) than males (43.3%). This suggests that there were more female participants than male participants in the research sample.

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The Academic Performance Scale (ASP) mean and standard deviation are shown in the table both before (PRE) and after (POST) the intervention. While the mean POST score rose to 32.10 (SD = 4.47), the mean PRE score was 17.07 (SD = 4.18). This significant increase suggests that academic performance significantly improved after the intervention. The comparatively comparable standard deviations indicate that subjects performed consistently on both tests.

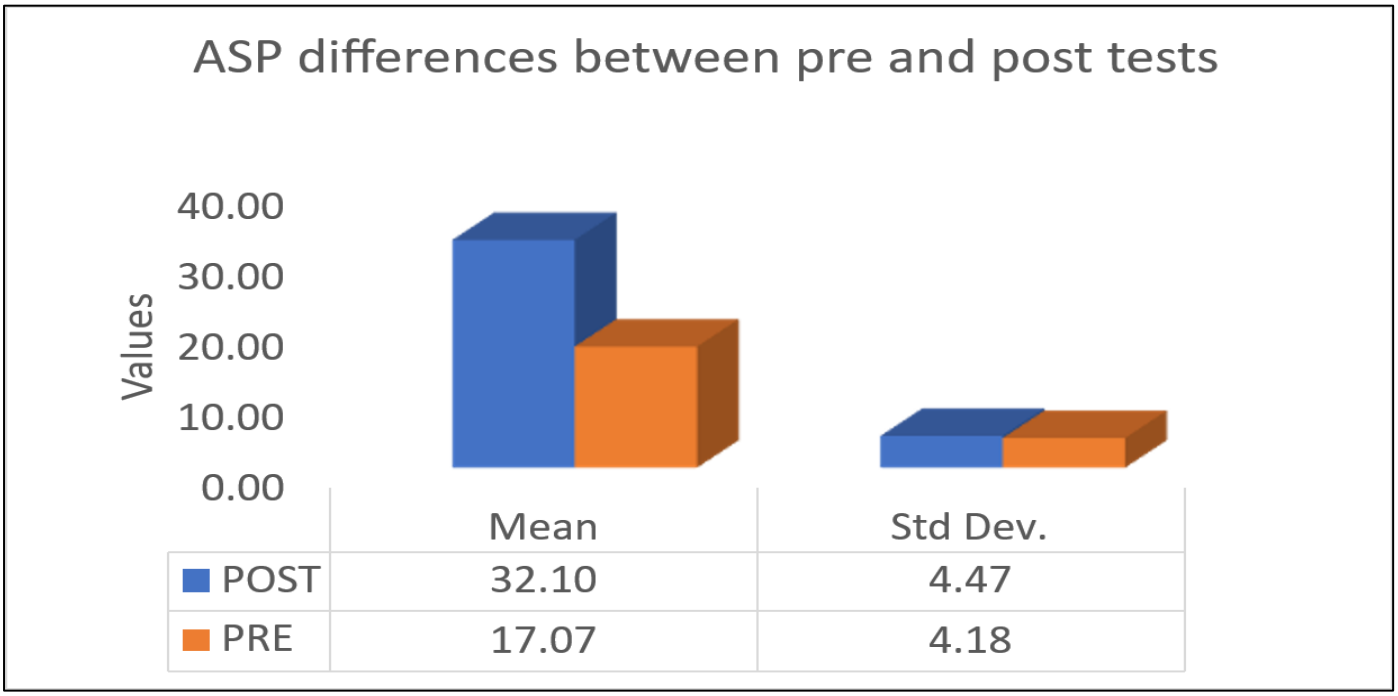
Table 1 ASP Differences Between Pre and Post Test

Variable	Mean	Std deviation
Post	32.10	4.47
Pre	17.07	4.18

Table 2 Descriptive data of ASP scores prior to and during the intervention are shown in the table. With tight 95% confidence intervals suggesting accurate estimations, the mean ASP-POST score (32.10, SD = 4.47) was significantly higher than the ASP-PRE score (17.07, SD = 4.18). This indicates that all 30 individuals' academic performance has improved consistently and significantly.

Table 2 Descriptive data of ASP scores prior to and during the intervention

Variable	Mean	Std. dev.	Lower95%CI	Upper 95% CI	N
ASP Post	32.10	4.47	30.429	33.771	30
ASP Pre	17.07	4.18	15.507	18.626	30



Graph 2 The graph clearly shows a significant improvement following the intervention, with mean ASP scores rising from 17.07 (PRE) to 32.10 (POST). The standard deviations (4.18 pre, 4.47 post) show that subjects performed consistently on both tests.

Table 3 Tailed T Test

H0 diff	Mean diff	SE Diff	't' value	DF	'p' value
0.000	15.033	0.598	25.145	29.000	0.000
Significance					'p'<0.01

Table 3 The findings of a two-tailed paired t-test comparing ASP scores before and after the intervention are displayed in the table. An extremely high t-value of 25.145 at 29 degrees of freedom was obtained from the mean difference of 15.03 with a standard error of 0.598. The intervention significantly improved academic performance, as evidenced by the p-value (<0.01), which shows that the change is very significant. Therefore, it can be concluded that the intervention used is effective in increasing the ASP values.

IV. RESULTS

Over the course of 12 weeks, participants performed 20–30 minutes of brain gym activities three times a week, and the Academic Performance Scale (ASP) was used to measure academic performance both before and after the intervention. Of the participants, 56.7% were female and 43.3% were male, with an average age of 9.5 years (SD = 2.35). With post-intervention mean scores (32.1) significantly higher than pre-

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intervention means (17.07), the results showed a considerable increase in ASP scores, with a mean difference of 15.03. This difference was verified to be extremely significant by a paired t-test ($t = 25.15$, $p < 0.01$). Processing speed, memory, and attention all showed qualitative increases in addition to quantitative advances. These results offer compelling proof that brain gym exercises improved scholastic achievement and cognitive functioning in kids with mild to moderate ID.

V. DISCUSSION

This study examined the impact of Brain Gym exercises on academic performance in children with mild to moderate intellectual disability, revealing significant improvement in post-test Academic Performance Scale (ASP) scores (32.10 ± 4.47) compared to pre-test (17.07 ± 4.41) ($t = 25.145$, $p < 0.01$). These results suggest Brain Gym enhances key cognitive skills like attention, memory, and processing speed essential for learning. Supporting prior research, movement-based interventions have been shown to improve classroom engagement, mathematical abilities, and cognitive development across age groups with developmental disabilities. The exercises likely work by promoting cross-hemispheric communication and sensory-motor integration, optimizing brain function. While some studies show less benefit in older adults perhaps due to reduced neuroplasticity, Brain Gym appears well-suited for children with intellectual disabilities, aligning with broader evidence that physical activity supports cognition in this population. Thus, Brain Gym is a simple, affordable approach with therapeutic and educational value. This study examined the impact of Brain Gym exercises on academic performance in children with mild to moderate intellectual disability, revealing significant improvement in post-test Academic Performance Scale (ASP) scores (32.10 ± 4.47) compared to pre-test (17.07 ± 4.41) ($t = 25.145$, $p < 0.01$). These results suggest Brain Gym enhances key cognitive skills like attention, memory, and processing speed essential for learning. Supporting prior research, movement-based interventions have been shown to improve classroom engagement, mathematical abilities, and cognitive development across age groups with developmental disabilities. The exercises likely work by promoting cross-hemispheric communication and sensory-motor integration, optimizing brain function. While some studies show less benefit in older adults, possibly due to reduced neuroplasticity, Brain Gym appears well-suited for children with intellectual disabilities, aligning with broader evidence that physical activity supports cognition in this population. Thus, Brain Gym is a simple, affordable approach with therapeutic and educational value.

VI. CONCLUSION

This study shows that Brain Gym exercises significantly improve academic performance in children with mild to moderate intellectual disability by enhancing attention, memory, and learning. These simple, cost-effective exercises can be easily incorporated into classrooms and therapy. Brain Gym offers a practical intervention to support cognitive and educational challenges, potentially improving academic outcomes and quality of life. Further research with larger samples and longer follow-up is needed to confirm and expand these findings.

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