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EFFECTS OF SENSORY INTEGRATION THERAPY (SIT) ON POSTURAL INSTABILITY, SPASTIC DIPLEGIC CEREBRAL PALSY (CP) IN DEVELOPMENTAL AGE.

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Abstract

BACKGROUND- Cerebral Palsy (CP) is a developmental neurological condition or physical disability that primarily affects movement, balance, and posture in individuals. This neurological condition results from brain damage that occurs in the developing fetus or during birth. CP is known to be the most common motor disability in childhood. There are four types of Cerebral Palsy: Spastic CP, Ataxic CP, Dyskinetic CP, and Mixed CP. The goal of CP treatment is to manage symptoms, improve limitations, relieve pain, prevent complications, and maximize independence. A significant number of children with CP also experience sensory impairment.

MATERIALS & METHODS- For this study, 30 children were included after meeting the inclusion and exclusion criteria. Each participant was required to attend an 8-week treatment program. To participate in the research, participants signed a consent form and provided demographic information. Several clinical tools were used before, during, and after the treatment program to monitor their progress. MS Excel and MS Word were used to store the data collected.

RESULTS- Our findings showed a significant difference in postural control between sitting positions before and after the intervention ($t(29) = -2.703$, $p = 0.011$). Additionally, postural control in the supine position showed significant improvement after the intervention ($t(29) = -2.246$, $p = 0.033$). However, no significant differences were found in gross motor function ($t(29) = 1.725$, $p = 0.095$), upper limb muscle tone ($t(29) = 0.000$, $p = 1.000$), lower limb muscle tone ($t(29) = 0.000$, $p = 1.000$), trunk muscle tone ($t(29) = 0.571$, $p = 0.573$), standing postural control ($t(29) = -1.809$, $p = 0.081$), and prone postural control ($t(29) = -1.464$, $p = 0.154$) after the intervention..

CONCLUSION- As This research indicates that the two groups did not differ significantly in terms of muscle tone (MAS UL, MAS LL, MAS Trunk) and standing/lying postural control (PPAS STANDING, PPAS SUPINE, PPAS PRONE). However, significant differences were observed between the groups in gross motor function (GMFCS) and certain postural control measures after the intervention (POST GMFCS, POST PPAS SITTING, POST PPAS SUPINE, POST PPAS PRONE).

Introduction

Cerebral palsy (CP) is a complex group of permanent motor impairments caused by non-progressive

INTRODUCTION

The term *cerebral* refers to the brain (cerebrum), and *palsy* refers to weakness or problems with muscle use. Cerebral Palsy (CP) is a developmental neurological condition or physical disability that primarily affects movement, balance, and posture. This condition results from brain damage in the developing fetus or during birth. Boys are generally more affected than girls. There are four types of Cerebral Palsy: **Spastic CP** is the most common type, caused by damage to the cerebral cortex, resulting in increased muscle tone, muscle tightness, jerky movements, and joint stiffness. Spasticity can be seen in the following forms:Spastic Diplegia/Diparesis, Spastic Hemiplegia/ Hemiparesis, Spastic Quadriplegia/ Quadriparesis. **Ataxic CP** results from damage to the cerebellum (responsible for balance and coordination), causing balance and coordination issues. **Dyskinetic CP** occurs due to damage to the basal ganglia (responsible for motor control), leading to uncontrollable muscle movements, with muscle tone fluctuating from too loose to too tight. **Mixed CP** occurs when multiple parts of the brain are damaged**. Signs & Symptoms:** Stiff muscles (hypertonia), Excessive drooling, Dysphagia (difficulty swallowing), Dysarthria (difficulty speaking), Involuntary movements, Poor balance and coordination, Delayed physical growth, Visual and hearing impairment, Cognitive impairment, Abnormal reflexes, Walking on tiptoes, Seizures, Scissoring gait, Flexion at elbows, wrists, and fingers, Joint contracture, spinal and joint deformities, Breathing difficulties, Difficulty with activities of daily living (ADLs), Lack of bladder and bowel control. The goal of CP treatment is to relieve pain, prevent complications, and maximize independence. Common treatment approaches for CP include the Bobath concept/Neurodevelopmental treatment (NDT), goal attainment therapy, strength training programs, and Sensory Integration Therapy (SIT). **Sensory Integration Therapy (SIT):** The concept of Sensory Integration was first described and developed by Dr. A. Jean Ayres in the 1970s. Ayres defined Sensory Integration (SI) as: "The neurological process that organizes sensation from one's own body and the environment, making it possible to use the body effectively with the environment" (1972). SIT is also known as sensory-based treatment or intervention. The primary aim of SIT is to improve self-regulation, enhance internal sensory processing, develop adaptive functioning skills, and help the child successfully engage in day-to-day activities. Sensory information is received from various senses: **Sight** (vision), **Hearing** (auditory system), **Touch** (tactile system), **Taste** (gustatory system), **Smell** (olfactory system), **Proprioception** (body awareness and position), **Vestibular** (awareness of movement, balance, and coordination) Individuals may be over-sensitive to sensory input, under-sensitive, or experience both. In 2015, Parham and Mailloux identified four categories of sensory integration difficulties: **Sensory Modulation Problems** – Occur when the brain either over-responds or under-responds to sensory information. **Sensory Discrimination & Perceptual Problems** – When the brain has difficulty making sense of sensory information. **Vestibular Bilateral Functional Problems** – Result from issues with the vestibular sense, causing poor balance and difficulty coordinating both sides of the body. **Praxis Problems** – Refers to difficulties in planning and executing unfamiliar movements.

METHODOLOGY:

Type of study: Experimental study.
Sampling: Simple Random Sampling.

- No of Sample: 30
- A group of 30 children with Spastic CP & Postural instability was selected for the study.
- Age: Developmental age between 4 to 12 years
- Gender: Male & Female
- Treatment Selected- Sensory Integration Therapy (SIT)
- Duration of the Treatment – 8 weeks

Inclusion criteria:

Children diagnosed with spastic diplegic cerebral palsy.
Children of developmental age group 4-12 years.

Exclusion criteria:

A child having other associated chronic medical conditions.
A child diagnosed with severe intellectual disability.

Instrumentation:

1. PPAS [Posture & Postural Ability Scale]
2. MAS [Modified Ashworth Scale]

3.GMFCS-E&R [Gross Motor Function Classification System- Expanded & Revised]

RESULTS:

Levene's test was used to assess whether the variances of the two groups were equal. For all variables (GMFCS, MAS UL, MAS LL, MAS Trunk, PPAS SITTING, PPAS STANDING, PPAS SUPINE, and PPAS PRONE), the p-values from Levene's test were non-significant (all $p > .05$). Therefore, we assume equal variances for the independent t-tests. t-test for Equality of Means: The independent t-test was performed to determine whether there were significant differences in the means of the motor-related variables between Group 1 and Group 2. The results indicated that there were no significant differences between the two groups for the following variables: MAS UL ($t(28.000) = -0.323$, $p = .749$), MAS LL ($t(27.991) = 0.357$, $p = .724$), MAS Trunk ($t(28.000) = 0.000$, $p = 1.000$), PPAS SITTING ($t(24.353) = 0.539$, $p = .594$), PPAS STANDING ($t(21.296) = 0.793$, $p = .435$), PPAS SUPINE ($t(20.864) = 0.932$, $p = .359$), and PPAS PRONE ($t(27.739) = 0.557$, $p = .582$).
However, there were significant differences between the two groups for the following variables: GMFCS ($t(27.996) = 0.574$, $p = .571$), POST GMFCS ($t(20.839) = 1.099$, $p = .281$), POST PPAS SITTING ($t(25.751) = 2.694$, $p = .012$), POST PPAS SUPINE ($t(20.451) = 1.138$, $p = .265$), and POST PPAS PRONE ($t(19.692) = 1.600$, $p = .121$). Post-hoc analyses for the variables with significant differences revealed that Group 1 had significantly higher mean scores on GMFCS, POST GMFCS, POST PPAS SITTING, POST PPAS SUPINE, and POST PPAS PRONE compared to Group 2. In summary, the two groups did not differ significantly in terms of muscle tone (MAS UL, MAS LL, MAS Trunk) and standing/lying postural control (PPAS STANDING, PPAS SUPINE, PPAS PRONE). However, there were significant differences between the groups in gross motor function (GMFCS) and certain postural control measures after the intervention (POST GMFCS, POST PPAS SITTING, POST PPAS SUPINE, POST PPAS PRONE). The sample consisted of 30 individuals who were assessed on different measures. Results revealed that there was a significant difference in postural control between sitting positions before and after the intervention ($t(29) = -2.703$, $p = 0.011$). Additionally, postural control in the supine position also showed significant improvement after the intervention ($t(29) = -2.246$, $p = 0.033$). However, no significant differences were found in gross motor function ($t(29) = 1.725$, $p = 0.095$), upper limb muscle tone ($t(29) = 0.000$, $p = 1.000$), lower limb muscle tone ($t(29) = 0.000$, $p = 1.000$), trunk muscle tone ($t(29) = 0.571$, $p = 0.573$), standing postural control ($t(29) = -1.809$, $p = 0.081$), and prone postural control ($t(29) = -1.464$, $p = 0.154$) after the intervention.

LIST OF TABLES:

Independent Samples Test

		F	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
GMFCS	Equal variances assumed	.120	.571	.133	.232	-.343	.609
	Equal variances not		.571	.133	.232	-.343	.609
MAS UL	assumed	.493	.749	-.067	.206	-.489	.356
	Equal variances not		1	-.067	.206	-.490	.357
MAS LL	assumed	0.41328413	0.724	.067	.187	-.316	.449
	Equal variances not		1	.067	.187	-.316	.449
MAS Trunk	assumed	0	1.000	.000	.189	-.386	.386
	Equal variances not		1	.000	.189	-.386	.386
PPAS	assumed	1.40625641	0.594	.267	.494	-.746	1.279
SITTING	Equal variances not		1	0.267	0.494	-.753	1.286
PPAS	assumed	10.2987727	0.435	0.400	0.505	-.634	1.434
STANDING	Equal variances not		0	.400	.505	-.648	1.448
	assumed	5.01994073	0.359	.467	.501	-.559	1.492

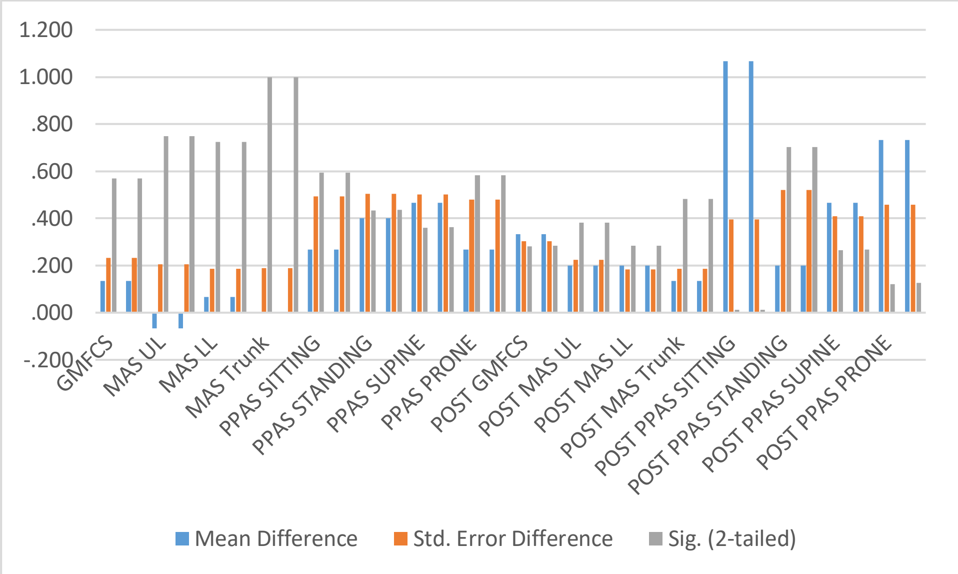
PPAS SUPINE	Equal variances not assumed		0	.467	.501	-.575	1.509
PPAS PRONE		0.22793878	0.582	.267	.479	-.714	1.247
	Equal variances not assumed		1	.267	.479	-.714	1.248
POST GMFCS		12.6743649	0.281	.333	.303	-.288	.955
	Equal variances not assumed		0	.333	.303	-.298	.965
POST MAS UL		0.60351251	0.382	.200	.225	-.262	.662
	Equal variances not assumed		0	.200	.225	-.262	.662
POST MAS LL		1.54364472	0.285	.200	.183	-.176	.576
	Equal variances not assumed		0	.200	.183	-.176	.576
POST MAS Trunk		0.41328413	0.481	.133	.187	-.249	.516
	Equal variances not assumed		0	.133	.187	-.249	.516
POST PPAS SITTING		1.79231333	0.012	1.067	.396	.255	1.878
	Equal variances not assumed		0	1.067	.396	.252	1.881
POST PPAS STANDING		1.7712481	0.703	.200	.519	-.864	1.264
	Equal variances not assumed		1	.200	0.519	-.867	1.267
POST PPAS SUPINE		5.1188574	0.265	.467	0.410	-.374	1.307
	Equal variances not assumed		0	.467	.410	-.388	1.321
POST PPAS PRONE		7.53985351	0.121	.733	.458	-.206	1.672
	Equal variances not assumed		0	.733	.458	-.224	1.691

Table 1: displays the results of Levene's test for equality of variances and the t-test for equality of means.

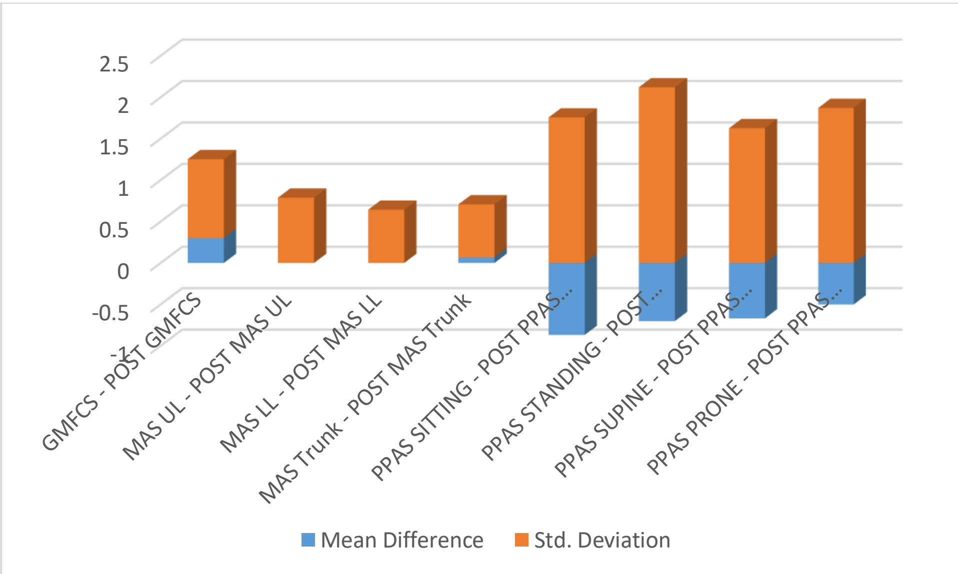
Pair	Variable Pair	Mean Difference	Std. Deviation	Std. Error Mean	95% CI Lower	95% CI Upper	t-value	df	p-value
1	GMFCS - POST GMFCS	0.3	0.952	0.174	-0.056	0.656	1.725	29	0.095
2	MAS UL - POST MAS UL	0	0.788	0.144	-0.294	0.294	0	29	1
3	MAS LL - POST MAS LL	0	0.643	0.117	-0.24	0.24	0	29	1
4	MAS Trunk - POST MAS Trunk	0.067	0.64	0.117	-0.172	0.306	0.571	29	0.573
5	PPAS SITTING - POST PPAS SITTING	-0.867	1.756	0.321	-1.523	-0.211	-2.703	29	0.011
6	PPAS STANDING - POST PPAS STANDING	-0.7	2.12	0.387	-1.492	0.092	-1.809	29	0.081
7	PPAS SUPINE - POST PPAS SUPINE	-0.667	1.626	0.297	-1.274	-0.06	-2.246	29	0.033
8	PPAS PRONE - POST PPAS PRONE	-0.5	1.871	0.342	-1.199	0.199	-1.464	29	0.154

Table 2: displays the mean differences, standard deviations, standard error of the mean, and 95% confidence intervals of the difference for each pair of variables.

LIST OF GRAPHS:



Graph-1



Graph- 2 Shows mean differences, standard deviations

DISCUSSION:

The study above shows there was a significant difference in postural control between sitting positions before and after the intervention. Additionally, postural control in the supine position also showed significant improvement after the intervention. However, no significant differences were found in gross motor function, UL muscle tone, LL muscle tone Trunk muscle tone, standing postural control, and prone postural control, after the intervention. An independent samples t-test was conducted to compare the means of various motor-related variables between the two groups. Group 1 and Group 2 were compared on different measures Levene's test was used to assess whether the variances of the two groups were equal. For all variables (GMFCS, MAS UL, MAS LL, MAS Trunk, PPAS SITTING, PPAS STANDING, PPAS SUPINE, and PPAS PRONE), the p-values from Levene's test were non-significant (all $p > .05$). Therefore, we assume equal variances for the independent t-tests. The independent t-test was performed to determine whether there were significant differences in the means of the motor-related variables between Group 1 and Group 2. The results indicated that there were no significant differences between the two groups for the following variables: MAS UL, MAS LL, MAS

Trunk, PPAS SITTING, PPAS STANDING, PPAS SUPINE and PPAS PRONE. However, there were significant differences between the two groups for the following variables: GMFCS, POST GMFCS, POST PPAS SITTING, POST PPAS SUPINE and POST PPAS PRONE. Post-hoc analyses for the variables with significant differences revealed that Group 1 had significantly higher mean scores on GMFCS, POST GMFCS, POST PPAS SITTING, POST PPAS SUPINE, and POST PPAS PRONE compared to Group 2. In summary, the two groups did not differ significantly in terms of muscle tone (MAS UL, MAS LL, MAS Trunk) and standing/lying postural control (PPAS STANDING, PPAS SUPINE, PPAS PRONE). However, there were significant differences between the groups in gross motor function (GMFCS) and certain postural control measures after the intervention (POST GMFCS, POST PPAS SITTING, POST PPAS SUPINE, POST PPAS PRONE). A paired samples t-test was conducted to examine the differences in various motor-related variables before and after the intervention. The sample consisted of 30 individuals who were assessed on different measures. Results revealed that there was a significant difference in postural control between sitting positions before and after the intervention. Additionally, postural control in the supine position also showed significant improvement after the intervention. However, no significant differences were found in gross motor function, upper limb muscle tone , lower limb muscle tone, trunk muscle tone, standing postural control and prone postural control after the intervention. The goal of this research was to determine the effectiveness of SIT on postural instability among the spastic diplegic CP in developmental age. We treated patients using sensory integration therapy, along with manual physiotherapy. Also, 3 different clinical tools were used to check the spasticity grade, gross motor level, posture & postural ability of the child with spastic diplegic CP. This study could be comparable with Tanushree Deshmukh et al 2022, and Jiří Kantor et al 2022.

LIMITATIONS OF THE STUDY:

1}The sample size included in the study could have been more.
2}Different conditions associated with cerebral palsy could have been compared.

FUTURE RESEARCH:

1}Comparison of different conditions associated with CP for a more improved treatment program.
2}Further research can be done with a properly structured treatment program.

CONCLUSION:

We may infer from this research that there was a significant difference in postural control between sitting positions before and after the intervention. Levene's test was used to assess whether the variances of the two groups were equal. For all variables (GMFCS, MAS UL, MAS LL, MAS Trunk, PPAS SITTING, PPAS STANDING, PPAS SUPINE, and PPAS PRONE), the p-values from Levene's test were non-significant (all $p > .05$). Therefore, we assume equal variances for the independent t-tests. The independent t-test was performed to determine whether there were significant differences in the means of the motor-related variables between Group 1 and Group 2.The results indicated that there were no significant differences between the two groups for the following variables: MAS UL ($t(28.000) = -0.323$, $p = .749$), MAS LL ($t(27.991) = 0.357$, $p = .724$), MAS Trunk ($t(28.000) = 0.000$, $p = 1.000$), PPAS SITTING ($t(24.353) = 0.539$, $p = .594$), PPAS STANDING ($t(21.296) = 0.793$, $p = .435$), PPAS SUPINE ($t(20.864) = 0.932$, $p = .359$), and PPAS PRONE ($t(27.739) = 0.557$, $p = .582$). However, there were significant differences between the two groups for the following variables: GMFCS ($t(27.996) = 0.574$, $p = .571$), POST GMFCS ($t(20.839) = 1.099$, $p = .281$), POST PPAS SITTING ($t(25.751) = 2.694$, $p = .012$), POST PPAS SUPINE ($t(20.451) = 1.138$, $p = .265$), and POST PPAS PRONE ($t(19.692) = 1.600$, $p = .121$). Post-hoc analyses for the variables with significant differences revealed that Group 1 had significantly higher mean scores on GMFCS, POST GMFCS, POST PPAS SITTING, POST PPAS SUPINE, and POST PPAS PRONE compared to Group 2. In summary, the two groups did not differ significantly in terms of muscle tone (MAS UL, MAS LL, MAS Trunk) and standing/lying postural control (PPAS STANDING, PPAS SUPINE, PPAS

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