IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Evaluation Of The Effectiveness Of Sensory Integration Therapy In Improving Gross Motor Skills Among Children With Developmental Delay

[1]Fahmitha Fathim, [2]Samuel Dinakaran S

[1] Occupational Therapy Intern, [2] Assistant Professor, (MOT Mental Health)

[1] College of Occupational Therapy- Department of Therapeutics

[1] National Institute for Empowerment of Persons with Multiple Disabilities (NIEPMD), Chennai, India

***ABSTRACT*:** The purpose of the study is to determine the effectiveness of Sensory Integration Therapy in improving Gross motor skills among children with Developmental Delay. Method: The study is a Quasi-experimental design with non-equivalent group. A total of 20 samples were divided into experimental and control groups each with 10 participants through convenience sampling. Gross motor skills of the participants were assessed (pre-test) using the Peabody Developmental Motor Scales, 2nd edition (PDMS-2). The experimental group underwent intervention for 30-35 minutes per session for 5 days in a week for 12 weeks. The participants in both groups were reassessed (post-test) using the Peabody Developmental Motor Scales, 2nd edition (PDMS-2) for the gross motor skills. The pre-test and post-test gross motor skills were analysed and interpreted. Results: This study results shows that there is slight improvement in sum of Standard Scores (SS)and Gross motor quotient (GMQ) in the experimental group before and after intervention with sig.(2 tailed) 0.004. Using the Paired t-test, on comparing the experimental and control groups there is no significant improvement in the experimental group (sig.2 tailed >0.05) providing sensory integration. Conclusion: The study concludes that there is no significant improvement of gross motor skills in children with developmental delay by providing Sensory Integration Therapy.

KEYWORDS: Developmental delay, Sensory integration, Gross motor skills

I. INTRODUCTION

Human development is one of complex process. It starts even before birth which is called as the prenatal period, further the process continues after birth (postnatal) throughout the lifespan as growth and development.(1) There are five significant phases in development such as, infancy, toddler, childhood, adolescence, and adulthood. (2)

In childhood development growth can be defined as a constant increase in size that is irreversible or rather physical and biological changes in the body. Development can be defined as a growth in the psycho-motor capacity or rather behavioral and functional changes in the body. (2) Growth are quantifiable changes whereas developments are qualitative changes happening in a human body. The growth can be in height, weight, body mass index etc. Development happens mainly in the physical, cognitive and psycho-social areas.

The typical development of children is indicated by some markers named as developmental milestones. Developmental milestones are stages that children are expected to achieve as they develop. The areas of developmental milestones are categorized into motor skills, speech and language skills, cognitive skills, and socio-emotional skills.(3) The children attain particular skills in each domain at the particular age, thus indicate a typical development. Although there are children in which there is a variation in the typical development which can be caused by different factors such as parental health, genetics, nutrition, exposure, environment, socioeconomic, family etc.(2)

DEVELOPMENTAL DELAY:

According to WHO (2012), developmental delay is defined as a deviation of development from the normative milestones in the areas of cognitive, language, social, emotional and motor functioning. (5)A significant delay is when an individual performs on age-appropriate standardized norm-referenced tests two or more standard deviations below the mean.(4) While the World Health Organization (WHO) estimates that 15% of the world's population lives with a disability, the prevalence of developmental delay in children is considered to be between 1- 3% worldwide. (6) In India, around 10% of children have developmental delay and this number rises significantly for those who get discharged from sick newborns unit.(7)

TYPES OF DEVELOPMENTAL DELAY:

Based on the number of domains involved developmental delay is classified as follows:

i. Isolated developmental delay-single domain involved
ii. Multiple Developmental Delay- two or more domains are involved.
iii. Global developmental delay (GDD)- delay in most developmental domains.(1)

Development requires motor skills. Infants use their motor skills in all activities they do, including their postural, locomotor, and manual movements as well as their exploratory, social, and object-related behaviors. In other words, because all behavior involves motor behavior, the development of motor skills and behavioral development are synonymous.[8]The motor and sensory development phases of early childhood and infancy overlap. Reaching and grasping are among the functions that are developed through sensory-motor experiences [9]. Mechanoreceptors in the skin and joints give tactile feedback, which is essential for dynamically adjusting fine motor skills like gripping and large motor skills like walking throughout early development and adulthood. [10,11] The isolated developmental delay in the motor skills' domain can be either in gross motor or fine motor development, which involves large muscles movement and the use of small muscles, respectively.

GROSS MOTOR SKILL:

Gross motor skills are one of the essential components in child development. It involves use of large muscles in the body and can be divided into locomotor skills, object control skills, and stability skills. Locomotor skills are the movements that transport the body through space such as run, jump, and gallop. Object control skills, also called as object manipulation skills, are movements that control and manipulate an object through space such as kick, throw, and catch. Stability skills or stationary skills are the ability to sense and adjust to shifts in the relationship between body parts that alter one's balance.[14]

SENSORY INTEGRATION THERAPY:

Sensory Integration as defined by Jean Ayres (1972) is the neurological process that organizes sensation from one's own body and from the environment and makes it possible to use the body effectively within the environment.SI postulates that decreased ability to process and integrate sensation may result in difficulty producing appropriate actions, which interfere with learning and behavior. Sensory integration therapy (SIT) is one of the intervention to improve the developmental and learning problems in children.[16]

Sensory integration is primarily used as a therapy for children with developmental and behavioral disorders. The activities in SI deliver vestibular, proprioceptive, auditory, and tactile stimuli, helping to organize the sensory system. These stimuli are provided through play with tools such as brushes, swings, trampolines, balls, and other equipment designed to challenge proprioceptive, tactile, and vestibular senses. Activities may also include techniques like deep pressure, joint compression, oral motor exercises, and body massage to help regulate arousal levels. Often, these activities engage multiple sensory systems simultaneously, stimulating muscle and joint proprioceptors, inner ear receptors, and auditory, visual, and tactile receptors in the skin.[17]

Ayres Sensory Integration interventions are based on the concept of neuroplasticity, which seeks to shape the nervous system through experiences. Participating in sensorimotor activities during play can trigger neuroplastic changes, fostering adaptive behaviors as a result of the experiences provided during

the intervention. This approach is grounded in the belief that neural networks are created through experience. Research has supported the principle of neuroplasticity in Ayres Sensory Integration, showing that rodents raised in enriched environments undergo changes in brain structure and organization, highlighting how the brain forms connections through environmental influences and learning.[17]

II. AIM AND OBJECTIVES

AIM:

- To find out the effectiveness of sensory integration therapy in improving gross motor skills among children with developmental delay.

OBJECTIVES:

- To assess (pre-test) the gross motor skills in children with developmental delay using Peabody Developmental Motor Scales, 2nd edition (PDMS-2).
- To provide intervention using Sensory Integration therapy.
- To reassess (post-test) the gross motor skills in children using the Peabody Developmental Motor Scales, 2nd edition (PDMS-2) after providing intervention.
- To compare pre-test and post-test scores of the gross motor skills to determine the effectiveness of Sensory Integration therapy.

HYPOTHESIS:

NULL HYPOTHESIS:

There is no significant improvement of gross motor skills in children with developmental delay by providing Sensory Integration Therapy.

ALTERNATE HYPOTHESIS:

There is significant improvement of gross motor skills in children with developmental delay by providing Sensory Integration Therapy

III. METHODOLOGY

Research design:

Quasi-experimental design.

Study setting:

The study was conducted at department of Cross Disability Early Intervention Centre (CDEIC)-Occupational Therapy, NIEPMD, Chennai.

Sampling technique:

Convenience sampling was used for the study

Sample population:

Children with Developmental Delay

Sample size:

20

Duration of study:

The duration of the study was 6 months. The intervention was given for 12 weeks. Each session was for 30-35 minutes, and 5 sessions were given in a week. Total 60 sessions were given.

VARIABLES:

Independent variable – Sensory Integration Therapy

Dependent variable – Gross motor skills

SELECTION CRITERIA:

Inclusion criteria:

- Children diagnosed with developmental delay.
- Both genders between age 2 years to 5 years who are able to sit without support.

Exclusion criteria:

- Co-morbities such as cerebral palsy, severe neurological (seizure disorder) and orthopedic conditions, autism
- Recovering from any surgeries
- Chronic cardiopulmonary conditions.

TOOL USED:

The Peabody Developmental Motor Scales, 2nd edition (PDMS-2) is a criterion-referenced and norm-referenced developmental assessment that assesses motor skills in children from birth to five years of age. The scale includes six subtests that measure different motor abilities and they are Reflexes, Stationary, Locomotion, Object manipulation, Grasping and Visual motor integration. It takes 20-30 minutes to assess each motor related subtests. The subtests under gross motor skills are Reflexes(8 items), Stationary(30 items) , Locomotion(89 items), Object manipulation(24 items).The PDMS-2 provide

standard scores and motor quotients(gross motor quotient, fine motor quotient ,total motor quotient) with points on each items 2,1 or 0 indicating demonstrating mastery of specified criteria, partial performance with emerging skills and no attempt or skill emergence respectively.[31]

INTERVENTION PROTOCOL

WEEK 1 – 4(Proprioceptive-Vestibular-Visual for 35 minutes per session)

ACTIVITY	DURATION
Track walk/ crawl	10 minutes
Rolling (log roll, barrel roll)	10 minutes
Scooter board Tummy glide -prone	10 minutes
Visual perceptual activities (Block design, finding shapes in pictures, puzzles, matching geometric shapes and letters, numbers and classification)	5 minutes

(33,34)

WEEK 5 – 8(Proprioceptive-Vestibular-Visual-Tactile for 30 minutes per session)

ACTIVITY	DURATION
Pressure & posture	10 minutes
Rainbow pass and somersaults	5 minutes
Visual-motor coordination training (ocular-pursuit training, moving ball and pegboard activities)	5 minutes
Tactile perception (feeling various textures, touching boards and feeling shapes)	10 minutes

(33,34)

WEEK 9 – 12 (Proprioceptive-Vestibular-Visual-Tactile-Auditory for 30 minutes per session)

ACTIVITY	DURATION
Wall stepping	5 minutes
Astronaut training “upside down bowling”	10 minutes
Visual-motor coordination training (ocular-pursuit training, moving ball and pegboard activities)	5 minutes
Tactile perception (feeling various textures, touching boards and feeling shapes)	5 minutes
Body awareness (pointing to body parts, turning left and right side and awareness of the body parts through touch)	5 minutes

(33,34)

IV. PROCEDURE

The procedure of the study involved selection of participants who all met the inclusion criteria. A total of 20 participants were selected and written consents were obtained from their parents along with demographic data after explaining to the parents about the objectives and process of the study. The participants were assigned into control and experimental groups through convenience sampling. Gross motor skills of participants were assessed (pre-test) using the Peabody Developmental Motor Scales, 2nd edition (PDMS-2) before providing intervention. The experimental group were provided with intervention of Sensory Integration Therapy for 30- 35 minutes per session for five days per week for 12 weeks. The first 4 weeks focused on the proprioceptive-vestibular-visual activities followed by the next 4 weeks focused on proprioceptive-vestibular-visual-tactile activities. Last 4 weeks focused on proprioceptive-vestibular-visual-tactile-auditory activities. After intervention, both groups participants' Gross motor skills were reassessed (post-test) using the Peabody Developmental Motor Scales, 2nd edition (PDMS-2). The pre-test and post- test Gross motor skills were analysed and interpreted.

V. RESULTS

The main aim of the research is to find out the effectiveness of sensory integration therapy in improving gross motor skills among children with developmental delay. The previous chapter laid out the methodology employed for the current study. This chapter looks into the analysis of the results obtained. All analyses were carried out using SPSS software (version 21, IBM, Chicago, USA).

Table 1: Gender distribution in the Experimental Group

Gender			
		Frequency	Percent
Experimental Group	Male	6	60.0
	Female	4	40.0
	Total	10	100.0

Table 2: Gender distribution in the Control Group

Gender			
		Frequency	Percent
Control Group	Male	8	80.0
	Female	2	20.0
	Total	10	100.0

Table 3: Age (in months) of participants in Experimental Group

Age (Month)			
		Frequency	Percent
Experimental Group	24	2	20.0
	36	2	20.0
	38	1	10.0
	41	1	10.0
	43	1	10.0
	48	1	10.0
	53	1	10.0
	54	1	10.0
	Total	10	100.0

Table 4: Age (in months) of participants in Control Group

Age (Month)			
		Frequency	Percent
Control group	24	2	20.0
	26	1	10.0
	27	1	10.0
	32	1	10.0
	48	1	10.0
	56	1	10.0
	59	1	10.0
	60	2	20.0
	Total	10	100.0

Table 5: Comparison of Mean scores of Sum of standard scores and Gross motor quotient in Experimental and Control groups (Pre-test and Post-test)

Tests	Mean	N	Std. Deviation
Experimental Group vs Control Group			
Sum of Standard Scores - Pre-Test	6.50	10	1.354
Sum of Standard Scores - Pre-Test	7.10	10	2.025
Sum of Standard Scores - Post Test	7.40	10	1.647
Sum of Standard Scores - Post Test	7.30	10	2.263
GROSS MOTOR QUOTIENT - Pre-Test	49.20	10	3.553
GROSS MOTOR QUOTIENT - Pre-Test	50.40	10	4.881
GROSS MOTOR QUOTIENT - Post Test	51.30	10	3.917
GROSS MOTOR QUOTIENT - Post Test	50.80	10	5.350

Table 6: Comparison of pre and post-test for Sum of Standard Scores and Gross Motor Quotient (GMQ) in experimental group and control group

Groups	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval				
				Lower	Upper			
SS- Pre-Test - SS-Post Test	-.900	.738	.233	-1.428	-.372	-3.857	9	.004
GMQ-Pre-Test - GMQ-Post Test	-2.100	1.729	.547	-3.337	-.863	-3.841	9	.004
SS- Pre-Test - SS-Post Test	-.200	.422	.133	-.502	.102	-1.500	9	.168
GMQ-Pre-Test - GMQ-Post Test	-.400	.843	.267	-1.003	.203	-1.500	9	.168

Paired t-test was used for testing the pre and post test scores of the experimental and control groups. (sig.2-tailed <0.05-statistically significant)

Table 7: Comparison of Experimental and Control groups (Sum of Standard Scores and Gross Motor

Groups	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval				
				Lower	Upper			
SS- Pre-Test - SS- Pre-Test	-.600	2.633	.833	-2.484	1.284	-.721	9	.489
SS-Post Test - SS-Post Test	.100	3.143	.994	-2.148	2.348	.101	9	.922
GMQ-Pre-Test - GMQ-Pre-Test	-1.200	6.286	1.988	-5.697	3.297	-.604	9	.561
GMQ-Post Test - GMQ-Post Test	.500	7.169	2.267	-4.628	5.628	.221	9	.830

Quotient- Pretest and Post test)

Paired t-test was used to compare scores of the experimental and control groups. (sig.2-tailed <0.05-statistically significant)

VI. DISCUSSION

This chapter discusses about the results of the study interpreted from the statistical analysis. The present study was conducted to find out the effectiveness of sensory integration therapy in improving gross motor skills among children with developmental delay. Based on the inclusion criteria, 20 participants were selected by convenience sampling and were divided into experimental and control groups.

Table 1 and 2 shows the gender distribution of participants in the experimental group and control group respectively. In the experimental group, out of 10 participants 6 were male and 4 were female. In the control group, out of 10 participants 8 were male participants and 2 were female participants. The number of male participants are more compared to the female participants in both groups.

Table 3 shows the age (in months) of participants in the experimental group. Among the 10 participants, 2 were 24 months old, 2 were 36 months old, and 1 participant each were present in the ages 38 months, 41 months, 43 months, 48 months, 53 months, and 54 months.

Table 4 shows the age (in months) of participants in the control group. Among the 10 participants, 2 were 24 months old, 2 were 60 months old, and 1 participant each were present in the ages 26 months, 27 months, 32 months, 48 months, 56 months, and 59 months.

Table 5 shows findings of comparison of mean scores of pre test and post test scores of sum of Standard Scores and Gross Motor Quotient of experimental and control groups. In the experimental group, the "Sum Standard Scores (SS)" changed from 6.50 to 7.40 and the "Gross motor quotient (GMQ)" increased from 49.20 to 51.30. In the control group, the "Sum of Standard Scores (SS)" changed from 7.10 to 7.30 and the "Gross motor quotient (GMQ)" increased from 50.40 to 50.80. These findings reveals that the sum of Standard Scores and Gross motor quotient of experimental group has slight improvement.

Table 6 shows findings of the pre-intervention and post-intervention sum of Standard scores (SS) and Gross motor quotient (GMQ) of experimental group and control group. Paired t-test was used to determine the statistical significance. In the control group, the SS and the GMQ (pre-test and post- test) showed sig. (2-tailed) > 0.05. Thus there is no significant improvement in the control group comparing pre-test and post-test. However, in the experimental group the SS and the GMQ (pre-test and post- test) showed sig. (2-tailed) < 0.05. Thus there is a significant improvement in the experimental group comparing the pre- test and post-test. These findings are consistent with the study done in 2024 which showed significant improvement in the motor skills[35].This can be due to the active participation of the children in exploring the sensory experiences. This is supported in a study done in 2009 which stated that children seek out the activities that provide sensory experiences which will be beneficial in their development. This active involvement and exploration enable child to become a more mature, efficient organizer of sensory information[34]

Table 7 shows the findings of comparison of the experimental group and control group, Sum of Standard Scores (SS) and Gross motor quotient (GMQ) using Paired t-test.The findings reveal that there is no significant improvement in the experimental group (SS and GMQ) with sig. (2 tailed) > 0.05 compared with the control group (SS and GMQ). This is because the post-test scores of experimental group which underwent Sensory Integration Therapy and control group which underwent conventional therapy are nearly similar. Hence, the Sensory Integration Therapy and conventional therapy has same effect on gross motor skills.

VII. CONCLUSION

The present study aimed to determine the effectiveness of sensory integration therapy in improving gross motor skills among children with developmental delay. The findings of the statistical analysis indicate that there is no significant improvement in the experimental group when compared with the control group. Hence, this study concludes that there is no significant improvement of gross motor skills in children with developmental delay by providing Sensory Integration Therapy.

VIII. LIMITATIONS

- The study population had unequal gender distribution.
- The study was conducted only at one place.

IX. RECOMMENDATIONS

- Duration of the study can be increased
- Further studies can be done in exploring other domains like fine motor skills etc.

X. ACKNOWLEDGEMENT

With the completion of this thesis, I'm grateful to many people who have helped me with their efforts, knowledge, love, encouragement, prayers and valuable time. First and foremost, I am deeply indebted to God Almighty for his abundant grace, unseen guidance, and ceaseless blessings bestowed upon me all the time. I would like to thank my parents Mr. Hamid Ali P A and Mrs. Aysha P and family for providing me with unfailing support and continuous encouragement throughout my years of study and my research process. I would like to express my deep gratitude to my guide Mr. Samuel Dinakaran S, MOT (Mental Health), Assistant Professor, College of Occupational Therapy, NIEPMD for his valuable guidance, suggestions and allowing me to do my thesis with full freedom and concern throughout for the successful completion of this dissertation. I would like to extend my heartfelt thanks to Mr. Kurinji Chelvan S, MOT(DD)., PGDCBR., MBA., Principal, College of Occupational Therapy, NIEPMD for his extensive support and guidance for the successful completion of this dissertation. I'm deeply thankful to Smt. Sobhiyavani, HoU, CDEIC, NIEPMD for the support and allowing me to conduct the study in the department and providing a conducive environment that facilitated the completion of this dissertation. I would like to express my sincere thanks to clinical staffs Smt. R Suganya, Occupational Therapist, CDEIC, NIEPMD and Mr. Gobikrishnan. D, Physiotherapist, CDEIC, NIEPMD for their support and efforts throughout my study. Finally, I'm indebted to all the children and their parents who participated in

the study for their cooperation, valuable time and participation. I owe my heartfelt gratitude to everyone who helped directly or indirectly for the successful completion of the study.

XI. REFERENCES

1.Khan I, Leventhal BL. Developmental Delay. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 [cited 2024 Dec 9]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK562231/

2.Balasundaram P, Avulakunta ID. Human Growth and Development. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 [cited 2024 Dec 9]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK567767/

3.Misirliyan SS, Boehning AP, Shah M. Development Milestones. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 [cited 2024 Dec 31]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK557518/

4.Choo YY, Agarwal P, How CH, Yeleswarapu SP. Developmental delay: identification and management at primary care level. Singapore Med J [Internet]. 2019 Mar [cited 2024 Dec 31];60(3):119–23. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6441684/

5.Ertem IO, World Health Organization. Developmental difficulties in early childhood: prevention, early identification, assessment and intervention in low- and middle-income countries: a review [Internet]. Geneva: World Health Organization; 2012 [cited 2024 Dec 10]. 112 p. Available from: https://iris.who.int/handle/10665/97942

6.Incorporating Developmental Screening and Surveillance of Young Children in Office Practice [Internet]. [cited 2024 Dec 31]. Available from: https://indianpediatrics.net/aug2014/aug-627-635.htm

7.Sharma N, Masood J, Singh S, Ahmad N, Mishra P, Singh S, et al. Assessment of risk factors for developmental delays among children in a rural community of North India: A cross-sectional study. Journal of education and health promotion. 2020 Feb 3;8.

8.Adolph KE, Hoch JE. The Importance of Motor Skills for Development. Nestle Nutr Inst Workshop Ser. 2020;95:136–44.

9.Corbetta D, Snapp-Childs W. Seeing and touching: the role of sensory-motor experience on the development of infant reaching. Infant Behav Dev. 2009 Jan;32(1):44–58.

10.Metcalfe JS, McDowell K, Chang TY, Chen LC, Jeka JJ, Clark JE. Development of somatosensory-motor integration: an event-related analysis of infant posture in the first year of independent walking. Dev Psychobiol. 2005 Jan;46(1):19–35.

11.Soechting JF, Flanders M. Sensorimotor control of contact force. Curr Opin Neurobiol. 2008 Dec;18(6):565–72.

12.Diamond A. Close Interrelation of Motor Development and Cognitive Development and of the Cerebellum and Prefrontal Cortex. Child Development [Internet]. 2000 [cited 2024 Dec 31];71(1):44–56. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/1467-8624.00117

13.Chorna O, Solomon JE, Slaughter JC, Stark AR, Maitre NL. Abnormal sensory reactivity in preterm infants during the first year correlates with adverse neurodevelopmental outcomes at 2 years of age. Archives of Disease in Childhood - Fetal and Neonatal Edition [Internet]. 2014 Nov 1 [cited 2024 Dec 31];99(6):F475–9. Available from: https://fn.bmj.com/content/99/6/F475

14.Veldman SLC, Jones RA, Santos R, Sousa-Sá E, Okely AD. Gross motor skills in toddlers: Prevalence and socio-demographic differences. Journal of Science and Medicine in Sport [Internet]. 2018 [cited 2024 Dec 31];21(12):1226–31. Available from: https://linkinghub.elsevier.com/retrieve/pii/S144024401830135X

15.Scharf RJ, Scharf GJ, Stroustrup A. Developmental Milestones. Pediatrics In Review [Internet]. 2016 Jan 1 [cited 2024 Dec 31];37(1):25–38. Available from: https://publications.aap.org/pediatricsinreview/article/37/1/25/34907/Developmental-Milestones

16.Fisher: Sensory integration: Theory and practice - Google Scholar [Internet]. [cited 2024 Dec 31]. Available from: https://scholar.google.com/scholar_lookup?&title=Sensory%20integration%20theory%20and%20practice&publication_year=1991&author=Fisher%2CA&author=Murray%2CE&author=Bundy%2CA

17.Guardado KE, Sergent SR. Sensory Integration. In: StatPearls [Internet] [Internet]. StatPearls Publishing; 2023 [cited 2024 Dec 31]. Available from: https://www.ncbi.nlm.nih.gov/sites/books/NBK559155/

18.Lang R, O'Reilly M, Healy O, Rispoli M, Lydon H, Streusand W, et al. Sensory integration therapy for autism spectrum disorders: A systematic review. Research in Autism Spectrum Disorders [Internet]. 2012 Jul 1 [cited 2024 Dec 31];6(3):1004–18. Available from: https://www.sciencedirect.com/science/article/pii/S1750946712000074

19.Bumin G, Kayihan H. Effectiveness of two different sensory-integration programmes for children with spastic diplegic cerebral palsy. Disabil Rehabil. 2001 Jun 15;23(9):394–9.

20.Lu WP, Tsai WH, Lin LY, Hong RB, Hwang YS. The Beneficial Effects of Massage on Motor Development and Sensory Processing in Young Children with Developmental Delay: A Randomized Control Trial Study. Dev Neurorehabil. 2019 Oct;22(7):487–95

21.Warutkar VB, Kovela RK, Samal S. Effectiveness of Sensory Integration Therapy on Functional Mobility in Children With Spastic Diplegic Cerebral Palsy. Cureus. 2023 Sep;15(9):e45683

22.Fu T, Zhang D, Wang W, Geng H, Lv Y, Shen R, et al. Functional Training Focused on Motor Development Enhances Gross Motor, Physical Fitness, and Sensory Integration in 5-6-Year-Old Healthy Chinese Children. Front Pediatr. 2022;10:936799.

23.Lecuona E, Van Jaarsveld A, Raubenheimer J, Van Heerden R. Sensory integration intervention and the development of the premature infant: A controlled trial. S Afr Med J. 2017 Oct 31;107(11):976–82

24.Montgomery P, Richter E. Effect of sensory integrative therapy on the neurometer development of retarded children. Phys Ther. 1977 Jul;57(7):799–806

25.May-Benson TA, Koomar JA. Systematic review of the research evidence examining the effectiveness of interventions using a sensory integrative approach for children. Am J Occup Ther. 2010;64(3):403–14.

26.Humphries T, Wright M, Snider L, McDougall B. A comparison of the effectiveness of sensory integrative therapy and perceptual-motor training in treating children with learning disabilities. J Dev Behav Pediatr. 1992 Feb;13(1):31–40

27.Coello-Villalón M, López-Muñoz P, Palomo-Carrión R, Hidalgo-Robles Á, Merino-Andrés J. Short-Term Effects of Vestibular Training on Gross Motor Function in Children and Youth with Cerebral Palsy: A Systematic Review and Meta-Analysis of Randomized Clinical Trials. Phys Occup Ther Pediatr. 2024;44(5):615–25.

28.Yildiz R, Yildiz A, Zorlular R, Elbasan B. Relationship between sensory processing skills and motor skills in 12-month-old infants. Brain Behav. 2024 Sep;14(9):e70052

29.Kashefimehr B, Kayihan H, Huri M. The Effect of Sensory Integration Therapy on Occupational Performance in Children With Autism. OTJR (Thorofare N J). 2018 Apr;38(2):75–83.

30.Parham LD, Roley SS, May-Benson TA, Koomar J, Brett-Green B, Burke JP, et al. Development of a Fidelity Measure for Research on the Effectiveness of the Ayres Sensory Integration® Intervention. The American Journal of Occupational Therapy [Internet]. 2011 Mar 1 [cited 2024 Dec 31];65(2):133–42. Available from: https://doi.org/10.5014/ajot.2011.000745

31.Folio: Peabody developmental motor scales - Google Scholar [Internet]. [cited 2024 Dec 31]. Available from: https://scholar.google.com/scholar_lookup?&title=Peabody%20developmental%20motor%20scales-2&publication_year=2000&author=Folio%2CR&author=Fewell%2CR

32.Zhu Y, Hu J, Ye W, Korivi M, Qian Y. Assessment of the measurement properties of the Peabody Developmental Motor Scales-2 by applying the COSMIN methodology. Ital J Pediatr [Internet]. 2024 Apr 24 [cited 2024 Dec 31];50(1):87. Available from: https://doi.org/10.1186/s13052-024-01645-6

33.Tahir N. Effectiveness of Sensory Integration Therapy (Vestibular & Proprioception Input) on Gross Motor Functioning in Developmental Delayed and Spastic Diplegic CP Children.

34.Shamsoddini AR, Hollisaz MT. Effect of sensory integration therapy on gross motor function in children with cerebral palsy. Iranian Journal of Child Neurology [Internet]. 2009 [cited 2024 Dec 31];3(1):43–8. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-77953377172&partnerID=40&md5=00da3a6e16307c674849aaded0b5f023

35.(PDF) Effectiveness of sensory integration program in motor skills in children with autism. ResearchGate [Internet]. 2024 Oct 22 [cited 2025 Jan 17]; Available from: https://www.researchgate.net/publication/272891518_Effectiveness_of_sensory_integration_program_in_motor_skills_in_children_with_autism.