

## Effect of Neurodevelopmental Movement Sequence (NDMS) Therapy on Speech-Language and Communication Skills of Autism Spectrum Disorder (ASD): A Case Study

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### ABSTRACT

Although the importance of neurodevelopmental movement sequence in the development of speech language and communication in autism spectrum disorder is overlooked, it allows children with autism spectrum disorder (ASD) to learn about the environment. The purpose of this study is to assess the effects of neurodevelopmental movement sequence (NDMS) therapy on speech language and communication abilities of children with autism spectrum disorder (ASD). A single group participatory pre-post case study design with mixed approach of quantitative measurements and qualitative insights was implemented for this study to investigate the connection between neurodevelopmental movement sequence therapy and the speech-language and communication abilities of people with autism spectrum disorders by using Indian Scale for Assessment of Autism (ISSA). Total six (n=6) autistic children age between 6 to 15years with neurodevelopmental mobility issues were thoroughly researched with the quantitative approach and pre- and post-assessment results were compared. The study's findings indicate that neurodevelopmental movement sequence (NDMS) therapy significantly improves the speech language and communication abilities of autistic children. The neurodevelopmental movement sequence (NDMS) therapy program fosters self-awareness as well as empathy for other people, adapting social, emotional, behavioral, and cognitive skills, as well as the ability to shape and restructure the brain's neurological connections to the environment. According to the post-assessment results in the ISAA rating scales, the therapy did improve the targeted speech language and communication skills. On the basis of the findings, conclusions and suggestions for additional study were made. The present study offers critical insights to both readers and the broader community. For readers, particularly therapists, healthcare professionals, and caregivers, this knowledge provides a promising avenue for tailored interventions.

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One of the most frequently seen childhood disorder is autism spectrum disorder, a set of Autism Spectrum Disorder (ASD) stands as one of the prevalent childhood neurodevelopmental conditions, affecting social interaction, communication, and behavior (American Psychiatric Association, 2000). Recent findings from the Centers for Disease Control and Prevention (CDC) indicate that approximately 1 in 68 children, with higher prevalence in boys, are diagnosed with ASD (CDC, 2014). In India, a country with a vast population, an estimated 2 million individuals could be affected by ASD, marking it as a critical public health concern. Assessing the severity of ASD is crucial for effective therapeutic interventions (Chauhan et al., 2019). Although not considered a core symptom, motor impairments significantly impact social development and quality of life in ASD, affecting 21 to 100 percent of children with ASD (Green et al., 2009; Pan, 2009). This underlines the importance of addressing motor challenges in this population despite their diverse nature.

Infants enter the world with innate mobility, progressing through predictable movement patterns called developmental milestones. Each movement stage provides crucial sensory-motor input for subsequent milestones, fostering strength and coordination. However, children with neurodevelopmental deficits, especially in motor skills, might diverge from typical developmental progressions in social, emotional, behavioral, sensory, speech, and cognitive aspects, often observed in autism spectrum disorders (ASDs) (source: neurodevelopmentalmovement.org). Better motor skills in newborns are linked to improved language development (Iverson, 2010). Bodywork and movement significantly enhance brain function and learning (Soezin Krog & Krüger, 2011). As infants gain motor abilities like sitting up, they experience their environment differently, refining skills vital for language and communication. Infants' improved posture allows better breathing, important for speech production (Iverson, 2010). Early object manipulation and attention to surroundings influence language development (Needham, Barrett, & Peterman, 2002), impacting cognitive growth, particularly in early childhood.

Neurodevelopmental movement pumps required amount of Cerebro-Spinal Fluid (CSF) to the brain and helps to develop Speech language in a sequential manner. The cerebro-spinal fluid (CSF), which flows from inside the spinal canal to the brain, is known to give the appropriate amount of nutrients the brain needs for survival, such as oxygen, glucose, and neurotrophies (nutrients that keep neurons strong). A CSF pump is used to transfer this fluid from the spine to the brain, and each movement has its own advantages for the body's physical and mental health. Helping kids maintain their composure will enhance their cognitive abilities, decrease behavioral issues, improve their memory, attention, and language skills, and it will also create the groundwork for more advanced motor, thinking, and learning abilities. Movement stimulates and fosters the development of speech and language, which is related to speech, language, and communication as well as physical activity. (www.ctchiropractic.org). Neurodevelopmental movements stimulate vestibular system and develops speech language & communication. The vestibular system, a sensory system that gives us a sense of balance, stabilizes our body and head, and coordinates movement and motor planning, is stimulated by each movement. It takes the coordination and action of numerous small muscles just to utter one word. Speech is the physical generation of sound. It might be challenging for a kid to comprehend the movement of the

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muscles involved in speech. The ability to speak depends on the tongue, lips, and jaw muscles all working together smoothly. Developmental Delay Resources states that the vestibular system "influences motor control and motor planning, which are necessary to employ those fine muscles to produce meaningful speech" (DDR). <https://firstwordstherapy.com/> As the foundation of newborns' (and adults') daily movements and interactions, motor skills influence later perceptual, cognitive, and social development (Gibson, 1988; Bushnell and Boudreau, 1993). According to Piaget (1952), there is a link between motor and cognitive development. He also emphasized that infants' own activities and the sensorimotor experiences they have as a result are essential to their ability to learn about their surroundings and the items that are found there. Since Piaget's first observations, a number of studies have found evidence of links between motor skills and development in a variety of seemingly unrelated areas, including object perception, face processing, and language abilities. For instance, it has been discovered that in newborns as young as three months, object exploration skills help in object segregation (Needham, 2000). Early successful reaching experiences have been shown to encourage newborns to focus on faces rather than objects at the same age (Libertus and Needham, 2011). Similar to this, the starting of independent sitting at roughly 5-7 months has been linked to enhanced 3-D object completion (Soska et al., 2010). and a brief disturbance in an infant's holistic face processing abilities (Cashon et al., 2013). The initiation of independent walking and language development in 10- to 14-month-old newborns have been linked in two studies, with walking infants having bigger vocabularies than crawling infants (Walle and Campos, 2014). Together, these results show that infants' concurrent abilities in the perceptual, cognitive, or social domains are affected when they learn a new motor ability, such as reaching, sitting, or walking. Other developmental disorders like specific language impairment have also been linked to early motor deficits (Hill, 2001; for review see Leonard and Hill, 2014). Therefore, it's possible that early motor development also predicts later language development in kids with typical development.

Research links between motor and communicative development in autism spectrum disorder (ASD) indicate earlier motor issues alongside linguistic impairments (Teitelbaum et al., 1998; Provost et al., 2007; Lloyd et al., 2013). High familial risk infants for ASD show delayed posture and fine motor skills, potentially affecting social and language development (Libertus et al., 2014; Nickel et al., 2013; Bhat et al., 2011). Fine motor skills at 12-18 months predict language ability in HR infants at 36 months (LeBarton and Iverson, 2013). Motor skills' impact on neurosensory-motor integration affects brain development and communication (SK et al., 2016). Early motor development, influenced by brain and external factors like parental support, shapes a child's understanding of the world (Piaget 1953; von Hofsten 2004; Berk, 2006). The "dynamic systems" concept explains how disruptions in interconnected systems affect multiple domains like social cognitive development and motor skills (Thelen & Smith, 2003). Neurological disruptions in specific areas could underlie diverse developmental difficulties (Gilge & Kaplan, 2001). Independent sitting and walking predict language development in infants (Oudgenoeg-Paz et al., 2012). Large-scale studies link motor skills at 18 months to language development at 36 months (Wang et al., 2014).

The current study will examine how motor and speech development relate to one another before concentrating explicitly on neurodevelopmental disorders, such as autism spectrum disorders (ASD). Parents view the attainment of motor milestones as a significant turning point in their child's development, but it hasn't always been understood how critical these

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milestones are for the growth of other crucial abilities. However, only a small number of research have looked at early motor/ movement development and verbal correlations across time in children with autism spectrum disorder development. Therefore, researchers are highlighting this relationship between neurodevelopmental movement sequence and those who have been diagnosed with a neurodevelopmental disorder like autism spectrum disorder, and they are becoming more aware of the impact that developmental movement sequence skills have on other areas of development, such as social and cognitive abilities. The study investigates the relationships between early-emerging neurodevelopmental movement skills and later language development, by assessing the impact of NDMS therapy on speech-language and communication using Indian Scale for Assessment of Autism (ISSA) tool, this research seeks to provide insights that can inform interventions, training programs, and policies aimed at optimizing NDMS effectiveness for children with autism spectrum disorder.

Understanding the potential correlation between movement sequences, neurological pathways, and the improvement of speech, language, and communication skills in individuals with ASD holds immense promise in refining therapeutic approaches. The findings of this study aim to contribute to the existing body of knowledge, providing evidence-based support for the utilization and refinement of NDMS therapy within ASD intervention strategies. Ultimately, these insights could pave the way for more effective therapies, fostering improved speech, language, and communication outcomes for individuals living with ASD.

### **PRESENT STUDY & METHODOLOGY**

#### ***Research Design***

A one group participatory, pre-post case study design, followed by mixed- method of research combining quantitative measurements and qualitative insights was implemented for this research to study the efficacy of NDMS therapy with extensive quantitative approach. Research requires the measurement of behavioral outputs (performance) with the use of standard assessment tools which present quantitative criteria. This study aimed to examine and compare the impact of developmental movement sequence (NDMS) therapy on the speech, language, and communication development of ASD.

#### ***Participants for the Study***

For the study, six (6) cases with ASD were selected from a Special school of Ganjam district, Odisha, India, with different age group, between 6 to 15 years with convenience sampling, which is both accessible and informative. The written approval from Parents and the headmaster of the subjects who took part in this study were received. Children with related disorders such seizures disorder, hearing loss, and vision impairment were not included in the study.

#### ***Tools Used***

The **DSM-5** tool was initially used to identify and diagnose the cases. Then Kids **Sense**, the developmental milestone checklist (developmental gross and fine motor milestone), **www.kidssatplay.act.gov.au**, **www.pathway.org** stools were used for selection of motor/ movement issues of ASD. The child with issues, at least three or more of the following neurodevelopmental movements- 1. Prone with head extension 2. lying; 3. rolling; 4. sitting; 5. creeping; 6. crawling; 7. standing; 8. walking; 9. running; 10. jumping, 11. skipping was selected for intervention. After that, the Indian Scale for Assessment of Autism

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(ISSA) was used to determine the severity levels (ISAA). In particular, the third domain of the ISAA scale i.e., "Speech-Language and Communication", which has 9 items ranging from items 15 to 23, was used for this investigation. In order to gather information for research purposes, the ISAA scale, which consists of 40 items in total and is divided into six domains, were observed and discussed with the child's primary care givers as well as other parties who are familiar with the child (such as school therapists, teachers, and child care providers).

### ***Procedure of Implementation of Tools and collection of Data***

The researcher and two special educators who have competence in testing procedures and teaching ASD along with the school therapists selected the students for therapeutic intervention. After that the school therapists and the assigned special educators did all pre-post intervention assessment tests in accordance with the instructional manual, provided in the ISAA scale, the III domain of the ISAA assessment instrument were documented as per the manual on the observation page of the record booklet. Children underwent NDMS therapy for 6 months.

### ***Statistical analysis for Implementation of Results***

The tools to be used are mainly the available tools used by professionals in the field of autism spectrum disorder. The speech language and communication development of ASDs children was reviewed in the light of the specific purpose of the present study and appropriate tools will be identified, developed, and administered. The data has been analyzed by adopting descriptive statistical analysis and inferential statistical analysis. The descriptive statistical analysis is shown in proper tabular forms. Statistical techniques such as percentages, Mean (M) & Standard deviation (S.D.) are used to test certain Hypotheses. The inferential statistical analysis includes testing of hypotheses keeping the objectives in mind.

## **TERAPEUTUTIC PROCESS**

### ***Parental Counseling***

The counselling was carried out just after diagnosis regarding the need of neuro developmental movement sequence therapy and its usefulness, parental involvement in treatment detailed information of the disorder and its consequences, the involvement of professionals and the assessment manual used for measurement of development of the child. For dealing with different issues and coping strategies to manage the child and sharing experiences with other parents by developing social support group.

### ***Baseline Rerecording of Target Behavior***

The baseline pre-intervention recording for this behavior i.e., "Speech -Language and Communication skills "was conducted using Indian Scale for Assessment of Autism (ISSA) tool.

### ***Developmental Movement Assessment child***

#### **a. Identification of Movement Problems and Hierarchy**

By using Kids sense developmental gross and fine motor checklist, [www.kidsatplay.act.gov.au](http://www.kidsatplay.act.gov.au) (guide for active play development) and [www.pathway.org](http://www.pathway.org) tools, the following neuro developmental movements Problem were identified and by keeping in mind the severity and occurrence of the problem and the hierarchy was made in consultation with concerned class teacher and school therapists i.e., prone head extension, Laying, Creeping, Sitting, Crawling,

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Standing , Running, Jumping, hopping, bouncing, skipping etc. The observations made by the investigator and others suggested that the most frequent developmental movement problems were targeted for management

### **b. Selection of Target movements sequence**

lying, creeping sitting crawling.....

### **c. Selection of Movement vocabulary:**

The children received therapy in the form of developmentally age-appropriate movement activities with respect to movement vocabulary i.e., 1. **Space** (place, size, level, direction, pathway, focus), 2. **Time** (Speed, Rhythm), 3. **Force** (energy, weight, flow) 4. **Body** (parts, relationship, shapes, balance).

### **d. Preparation of lesion plan:**

The lesion plan was followed by 1. **Establishing rapport**. 2. **Warm-up**, 3. **Movement activities**.4. **Reflection** and 5. **Closing**.

### **e. Selection of therapeutic approach of intervention:**

Generally, the therapist followed the bottom- up approach in therapeutic process but sometimes as per the child's needs and easiness of the therapeutic process the therapist may use top- down approach in skill training.

### **f. Reinforcer Identified:**

**Material rewards** like- toffee, chocolates, biscuits, mixture were identified on the basis of liking of the subject. **Social Rewards** like- patting on the back, encouraging words like good, very good, well done, excellent etc. were also identified.

### **g. Selection of prompting:**

Physical prompting (PP), Verbal Prompting (VP), Gestural (GP) and Modeling (M)

### **h. Therapy materials and equipment needed in NDMS therapy:**

Foam bad, balance board, rocker, seesaw, truck tube, chair, tool, creeping /crawling mat, therapy ball and hop ball, hopscotch plays mat and ring for agility training, scooter, swinging bar, monkey bar, jumping rope, roller skating, climbing ladder swinging bar etc.

### ***Intervention program***

After identification of each child's relevant neurodevelopmental movement weaknesses for intervention the assigned special educator worked to strengthen those movement abilities that were preventing the child from navigating daily life situations. The intensive therapeutic intervention of NDMS therapy was given by the trained school special educator with the supervision of the school therapists. While receiving therapy the educator followed the principles of child development and different strategies of teaching and learning at his best levels. The therapy was continued for 6 sessions per week for 6months (i.e., 144 sessions) and each session was 1 hour only. The children received therapy in the form of developmentally age-appropriate movement activities in bottom- up and top- down approach with sufficient exposure to different therapeutic materials and movement vocabularies and provide appropriate prompting and reinforcements for each movement skills to be master.

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### TERMINATION AND OVERALL EVALUATION

After the implementation of NDMS therapy, the post intervention assessment was conducted and the observations were recorded in the booklet as per instruction given in the manual respectively. The effectiveness of neurodevelopmental movement sequence therapy on target behavior skills i.e., “Speech -Language and Communication” skills was evaluated on the basis of baseline and post intervention program in terms of severity and frequencies of occurrence. The recording is given the Table-2 and Figure-1.

It has been found that after 6 months of NDMS therapy, the children with autism reduced their difficulty level in speech language and communication, and able to use non-verbal language or gesture, reduced their repetitive use of language, reduce their unusual noise, says some meaning full words try to grasp pragmatics of communication some try to initiate and sustain conversation with others and some try to give sensible answer of the simple questions etc.

#### *Follow up*

As intervention for autism spectrum disorders need long process and long duration parents, teachers were asked to continue the Neurodevelopmental Movement Sequence (NDMS) Therapy at intervention Centre, home and school.

### RESULT AND DISCUSSION

In the present chapter the results have been interpreted and discussed. The current research topic “effect of neurodevelopmental movement sequence (NDMS) therapy on children with autism spectrum disorder in “speech language and communication” includes six autistic children, majorly having significant language delays restricted social communication and limited engagement in socially reciprocal activities, repetitive play patterns, resistance to change and difficulty in emotional responsiveness.

This investigation was designed to study improvement on Speech Language & Communication Skills in autistic children after receiving Neurodevelopmental Movement Sequence (NDMS) Therapy. The results of the investigation are reported as follows:

***Table-1. Pre –Assessment scores in all Domains to find out the severity level of autistic children before receiving Neurodevelopmental Movement Sequence (NDMS) Therapy in Indian scale for Assessment of Autism (ISAA).***

Samples	Domain I.	Domain II	Domain III.	Domain IV.	Domain V	Domain VI	Total score & category
Subject A	39	17	44	23	26	14	163 (Severe)
Subject B	41	21	43	31	20	17	173 (Severe)
Subject C	41	23	45	33	25	18	185 (Severe)
Subject D	43	25	33	28	25	13	168 (Severe)
Subject E	43	22	40	25	22	18	170 (Severe)
Subject F	35	19	42	25	21	14	156 (severe)

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**Indication of Domains:** - I. Social Relationship and Reciprocity. II. Emotional Responsiveness. III. Speech language and Communication. IV. Behavior pattern. V. Sensory Aspects. VI. Cognitive Component. **Indication of the ratings:** Rarely (upto20%) Score =1, Sometimes (21-40%) Score =2, Frequently (41-60%) score=3, Mostly (61-80%) score=4, Always (81-100%) score=5. The above table shows Subjects were sever category.

**Table 2: Shows the total ISAA Score of pre and post intervention of six autistic children in nine items of Domain III. “Speech language and Communication”**

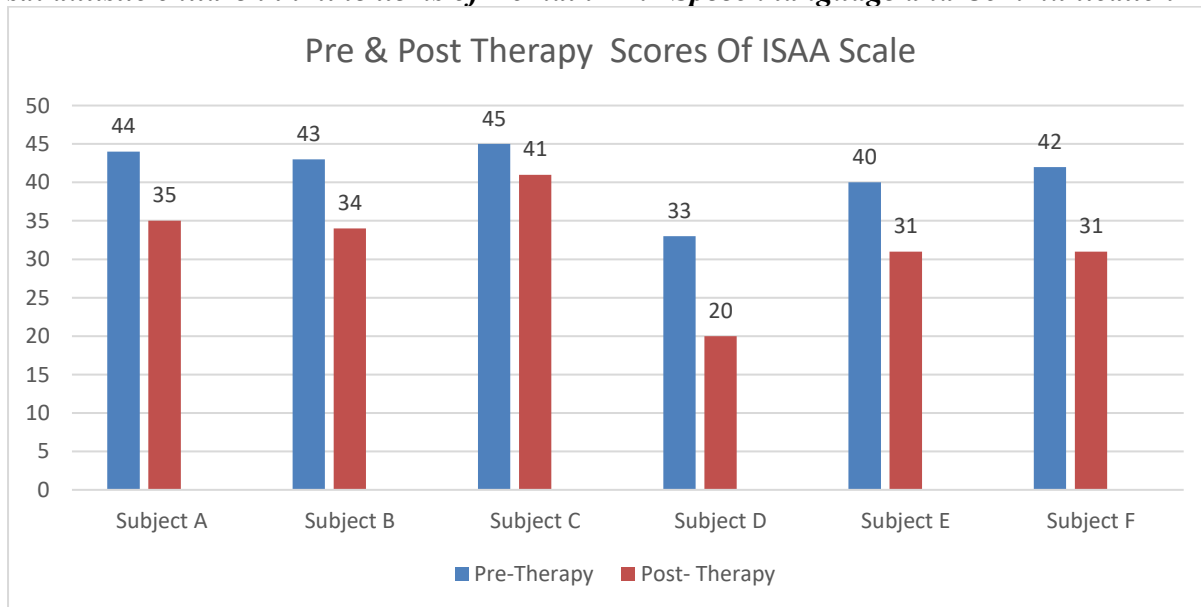
III. Domains	Subject A		Subject B		Subject C		Subject D		Subject E		Subject F	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
15. Acquired speech and lost it.	5	4	5	5	5	5	3	1	4	3	4	3
16. Has difficulty in using non-verbal language or gestures to communicate	4	3	4	2	5	4	4	2	4	3	5	3
17. Engages in stereotyped and repetitive use of language	5	4	4	3	5	5	4	3	4	3	5	3
18.Engages in echolalic speech	5	3	5	4	5	5	2	1	5	4	5	4
19. Produces infantile squeals/unusual noises	5	4	5	4	5	4	4	3	4	3	5	4
20. Unable to initiate or sustain conversation with others.	5	4	5	4	5	5	5	4	5	4	5	4
21.Uses jargon or meaningless words.	5	5	5	4	5	4	4	2	4	3	4	3
22.Uses pronoun reversals	5	4	5	5	5	5	2	1	5	4	4	3
23.Unable to grasps pragmatics of communication (real meaning)	5	4	5	3	5	4	5	3	5	4	5	4
Total Score	44	35	43	34	45	41	33	20	40	31	42	31

The above table shows the total score of pre and post therapy in ISAA scale of Subject A, B, C, D, E, F. it is found that every subject, in “Speech language and Communication” domain score was reduced in post therapy, which indicates NDMS therapy is effective for children with ASD.



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**Figure- 1:** Shows the total ISAA Score of pre and post intervention comparison chart of six autistic children in nine items of Domain III. “Speech language and Communication”



**Fig-1:** The above graph shows the pre-post therapy total scores of six subjects separately in ISAA scale score. In pre therapy, their scores were 44,43,45,33,40 &42 which indicates the children had more difficulty in speech language and communication skills. In post therapy, the total scores were reduced to 35,34,41,20,31 & 31 respectively. Which indicates that the therapy had positive effects on speech language & communication skills in children with ASD.

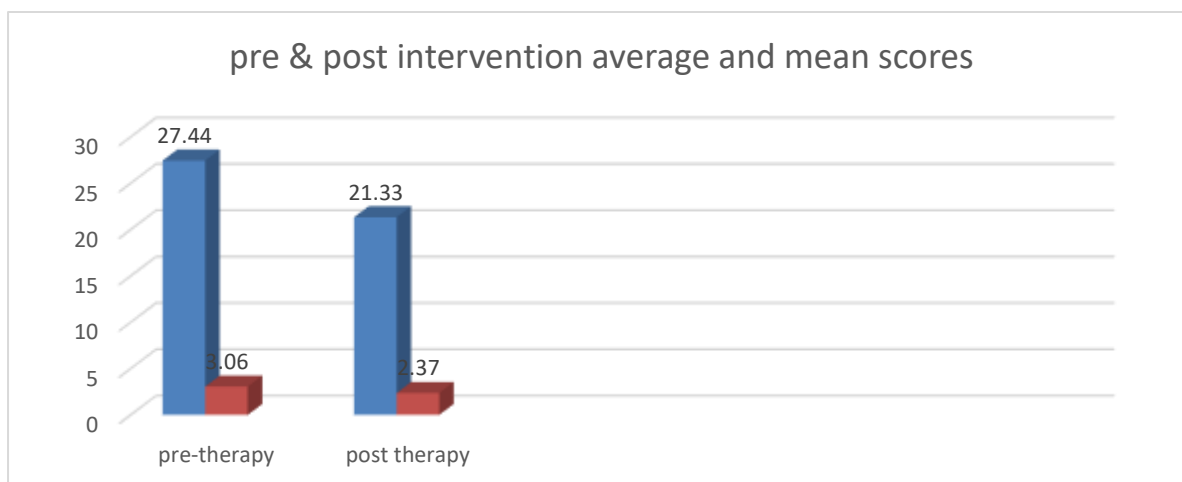
**Table 3:** Shows the total scores & mean scores of pre and post therapy of six autistic children in nine items of Domain III. “Speech language and Communication” Mean of pre -post therapy scores of six subjects, A, B, C, D, E, F

Samples/Mean Score	Pre-Total-score	Pre-Average Score	Pre-Mean score	Pre-Average mean score	Post-total score	Post-Average Score	Post - Mean score	Post-Average mean Score
Subject A	44		4.9		35		3.9	
Subject B	43		4.8		34		3.8	
Subject C	45	27.44	5	3.06	41	21.33	4.6	2.37
Subject D	33		3.7		20		2.2	
Subject E	40		4.4		31		3.4	
Subject F	42		4.7		31		3.4	
	247		27.5		192		21.3	

Table-3: The above table Shows the pre- therapy total average scores 27.44 &post therapy average score was 21.33. the average mean score of pre therapy was 3.06 and post therapy average mean score was 2.33 of six autistic children in nine items of Domain III. “Speech language and Communication”

Fig-2 Shows the total scores & mean scores of pre and post therapy of six autistic children in nine items of Domain III. “Speech language and Communication” Mean of pre -post therapy scores of six subjects, A, B, C, D, E, F.

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**Fig 2:** The above graph gives the pre- post intervention average and mean scores in ISAA scale.

From the analysis of table 2 and figure 1, the improvement is found and from table 3 and fig 2 we found the average score of Subject A, B, C, D, E & F was 27.44 which was higher than that of the post- therapy average scores i.e., 21.33 or similarly the pre-therapy mean score was 3.06 which was higher than that of the post- therapy scores i.e., 2.37. which shows that the difficulties in speech language and communication were addressed with the NDMS therapy Intervention.

Following improvements were observed in respective subjects.

### **Subject-A.**

After six months of intervention **Subject A** demonstrated, increased in attending to other speech and facial expression, infrequent crying, cooling and smiling were reduced. Proficiency with acquired speech language, a decreased tendency to use stereotyped and repetitious language. Tried to use conversational gesture, and an increased attempt to communicate nonverbally and through gestures. A small amount of echolalic speech was eliminated, along with childish squeals and strange noises, the use of meaningless words, pronoun reversals, and an attempt to understand the other person's point of view while also trying to strike up a conversation.

### **Subject- B.**

Despite constantly losing the ability to speak, Subject B attempted to communicate by making gestures and nonverbal cues, frequently using cliched and repetitive language while paying attention to other people's speech and facial expressions. After therapy was put into practice, a small amount of echolalic speech was eliminated along with childish squeals and strange noises, the use of meaningless words, pronoun reversals, and an effort to understand the other person's point of view in an effort to increase conversation and understanding of instructions.

### **Subject C.**

**Subject C**, struggled more with speech, language, and communication, but still, gets less stereotyped and repetitive language, such as repeating words, phrases, or sentences. He or she also used less strange noises, such as infantile squeals, unusual smiling, and unintelligible crying, and he or she tried to pay attention to other people's speech and facial expressions to understand what other people are really saying. However, the child lost

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acquired speech and started speaking with echolalic speech and uses stereotyped repetitive language most of the time. The child's ability to strike up and maintain a conversation with others hadn't improved satisfactorily.

### **Subject D**

Following a six-month intervention, Subject D showed improved attention to other people's speech and facial expressions, as well as a decrease in infrequent crying, cooling, and smiling. proficiency with learned speech language and a reduced propensity to speak in repetitious and stereotyped ways. made a greater effort to communicate nonverbally and with gestures, as well as an attempt to employ conversational gestures. Pronoun reversals, childish squeals and strange noises, meaningless word usage was reduced, a small amount of echolalic speech, and an attempt to understand the other person's point of view while simultaneously trying to strike up a conversation were all eliminated.

### **Subject E.**

After six months, the **Subject E** showed post-intervention improvement. Subject E made progress in learning to speak, using gestures and nonverbal cues to communicate. The use of repetitive and stereotyped language, reversals of pronouns, echolalic speech, and the use of meaningless words and strange noises were all less prevalent. Improvements were made in the comprehension of instructions, new information, and the pragmatics of communication—that is, the true meaning of communication.

### **Subject F**

Subject F was improved in acquiring speech language, using nonverbal language or gesture to communicate, engaged in stereotyped and repetitive use of language skills. Try to initiate or sustain conversation with others. The understanding of instruction, novel information and grasping of pragmatics of communication i.e., real meaning of communication is improved. The engagement in echolalic speech uses of meaningless words, pronoun reversals, production of unusual noises were reduced. From the analysis of table 3 and figure 2, it is observed that the overall improvement was seen within different subjects in “speech language and communication” domain in ISAA Scale after 6 months of NDMS therapy.

The present research has shown that early developmental movements, in general, can enhance treatment outcomes in “speech language and communication” for children with autism spectrum disorders, provide support and reinforce the social and language skills (Teitelbaum et al., 1998; Provost et al., 2007; Lloyd et al., 2013; Libertus et al., 2014; Nickel et al., 2013; Bhat et al., 2011. Furthermore, the present research also supports previous research that movement enhances neurosensory -motor and reflex integration which stimulates brain development and speech language and communication (SK, M., NK, A., L, S., P, S., & EA, A. 2016)

It is significant to remember that a variety of factors, such as the child's unique needs, the therapist's training and experience, and the degree of involvement and support, can affect how effective any therapy is. Therefore, in order to choose the most suitable and successful course of treatment for a child with autism spectrum disorder (ASD), it is best to consult with a qualified healthcare professional. The study did find, however, that NDMS therapy demonstrated an effective treatment model for children with ASD. Following the implementation of NDMS therapy, children with autism spectrum disorder enrolled in

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special schools showed a significant difference in their mean scores in "speech language and communication" skills.

"Research exploring the impact of Neurodevelopmental Movement Sequence (NDMS) therapy on children diagnosed with Autism Spectrum Disorder (ASD) revealed significant strides in speech, language, and communication. Studies by Libertus et al. (2014) and LeBarton and Iverson (2013) hinted at delays in posture and fine motor skills among high familial risk infants for ASD. Yet, following NDMS therapy, noteworthy enhancements emerged in expressive language capabilities, speech articulation, and social communication skills (SK et al., 2016). The therapy's emphasis on sensory-motor integration seemed pivotal in improving pragmatic language skills, aligning with the notion that motor development influences cognitive domains (Thelen & Smith, 2003). While these findings suggest a promising avenue for addressing language deficits in ASD, further research, such as that discussed by Oudgenoeg-Paz et al. (2012) and Wang et al. (2014), could illuminate the longitudinal effects and potential mechanisms underlying NDMS therapy's efficacy in fostering speech-language development."

The study investigating the impact of Neurodevelopmental Movement Sequence (NDMS) therapy on children with Autism Spectrum Disorder (ASD) unveiled promising outcomes in speech, language, and communication. Following NDMS therapy sessions, children with ASD demonstrated noticeable advancements in their speech articulation, language comprehension, and communication abilities. This improvement was particularly evident in enhanced social engagement, increased vocabulary, improved sentence formation, and better expression of thoughts and needs. The findings strongly suggest a positive correlation between NDMS therapy and the development of essential communication skills among children with ASD, potentially offering an avenue for more effective therapeutic interventions in addressing speech and language challenges associated with the condition.

### **CONCLUSIONS**

The study employed a mixed-methods approach, and focused on a group of autistic children from a special school in India, utilizing both quantitative evaluations and qualitative observations. Trained special educators administered tailored Neurodevelopmental Movement Sequence (NDMS) therapy using the ISAA assessment tool over a specific timeframe. The study then evaluated the outcomes to gauge the therapy's effectiveness.

By recognizing the role of neurodevelopmental movement sequence and addressing potential challenges, the proper understanding of therapy concepts and difficulties in reinforcing therapy goals at home, therapy center, and school settings, the effectiveness of NDMS therapy for children with autism spectrum disorder can be optimized. The outcomes of this study will hold substantial implications for designing interventions, training caregivers and teachers, and devising culturally relevant strategies within NDMS therapy programs. These research findings will offer valuable insights to therapists, educators, policymakers, and other stakeholders involved in planning and implementing therapies for children diagnosed with autism spectrum disorder.

The study findings suggest a positive impact of Neurodevelopmental Movement Sequence (NDMS) Therapy on enhancing specific aspects of speech-language and communication skills among individuals diagnosed with autism spectrum disorder (ASD). Participants undergoing NDMS Therapy demonstrated noticeable improvements in expressive language,

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receptive language, and social communication, as evidenced by standardized assessments and observed behavioral changes. While the results indicate promising outcomes, further research with larger sample sizes and longer follow-up periods is warranted to validate and ascertain the sustained efficacy of NDMS Therapy in fostering lasting improvements in the communication abilities of individuals with ASD

However, most teachers, parents, and students are not aware of the importance of neurodevelopmental movement patterns in the process of autism management. The daily functioning's of ASDs are becoming increasingly impaired day by day, a neuro developmental movement sequence program could improve the ASD child's existing level of abilities. The proper understanding of neurodevelopmental movement sequences the “building blocks” initially facilitates development, that subsequent learning is constructed. Secondly It also works as an effective tool for advance fundamental learning of ASDs. The results of this study highlight the need for more research on the relationship between speech-language- communication and neurodevelopmental movement sequence NDMS therapy in autism spectrum disorder.

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