

Effects of Task-Oriented Approach to Improve Grip Strength and Pinch Strength Among Children with Autism Spectrum Disorder

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Publication Date: 2026/09/16

Abstract:

➤ *Background:*

Autism Spectrum Disorder is a neurodevelopmental disorder characterized by persistent deficits in social communication and social interaction across multiple contexts, together with restricted, repetitive patterns of behaviour, interests, or activities. Poor Grip strength and Pinch strength in children with Autism spectrum disorder hinders to perform their everyday activities and school related activities like writing. These challenges affect their academic performance and other ADL activities which in turn affect their quality of life. Recent studies suggest that Task-oriented training can effectively improve Grip strength and Pinch strength.

➤ *Aim:*

The study aimed to determine the effects of Task- oriented approach to improve Grip strength and Pinch strength in children with Autism spectrum disorder.

➤ *Method:*

The study is a Quasi-experimental (Two group pretest-posttest) design, randomized controlled trial was adopted for the study. The participants of the study were screened using ISAA scale to include mild and moderate Autism. Total of 30 participants included in the study who fulfilled the inclusion and exclusion criteria.

The children's grip strength and pinch strength were assessed using Dynamometer and Pinch gauge respectively. Later the sample population is divided into Experimental group (B) and Control group (A). The purpose and procedure of the study was priorly explained to the parents of the participants. Then 8 weeks of intervention given with 3 sessions per week and each session of 15-20 minutes. Then using Dynamometer and Pinch gauge reassessment was done for all 30 participants.

The collected data were statistically analyzed by comparing the pre-test and post-test scores to determine the effects of Task-oriented training to improve grip strength and pinch strength among children with Autism Spectrum Disorder.

➤ *Results:*

The data analysis was carried out using paired sample t-test. Based on the analysis, (right: $p = 0.521$; left: $p = 0.412$) there is no significant improvement in the post test scores of Grip strength and pinch strength as there is no significant difference between control and experimental group.

➤ *Conclusion:*

The study concluded that there is no significant improvement in Grip strength and Pinch strength after providing Task oriented approach in children with Autism Spectrum Disorder as there is no significant difference between control and experimental groups.

Keywords: Autism Spectrum Disorder, Grip Strength, Pinch Strength, Task Oriented Approach.

How to Cite: Benielraja Gnanadurai R.V.; Shrinidhi G. (2026) Effects of Task-Oriented Approach to Improve Grip Strength and Pinch Strength Among Children with Autism Spectrum Disorder. *International Journal of Innovative Science and Research Technology*, 11(8), 3613-3622. <https://doi.org/10.38124/ijisrt/26aug1146>

I. INTRODUCTION

➤ Autism Spectrum Disorder

A neurodevelopmental disorder characterized by persistent deficits in social communication and social interaction across multiple contexts, together with restricted, repetitive patterns of behavior, interests, or activities. These symptoms must be present in the early developmental period, cause clinically significant impairment in social, occupational, or other important areas of current functioning, and are not better explained by intellectual disability or global developmental delay (1).

“According to the study from the rural setting of India showed a pooled percentage prevalence of 0.11 [95% confidence interval (CI) 0.01–0.20] in children aged 1-18 years; and, four studies conducted in the urban setting of India showed a pooled percentage prevalence of 0.09 (95% CI 0.02–0.16) in children aged 0-15 years (2).

Although an ASD diagnosis is defined by these 3 core features, other issues related to more physical health are associated with an ASD diagnosis. Examples of physical impairments include Fine and Gross motor problems, deficits in movement/motor skills, balance problems, differences in gait pattern, abnormal posture and muscle tone, and hypotonia. Another aspect that may be reflective of issues in general physical condition is muscle weakness in ASD (3).

Findings suggest that the motor deficits observed in ASD may not be related to structural abnormalities of the basal ganglia, and other brain regions, such as the cerebellum and the frontal lobe, may be involved in the pathophysiology of motor disturbances in Autism (4).

➤ Impact of Occupational Therapy in Autism Spectrum Disorder

In the early intervention, the Occupational Therapist assumes an important role as they intervene directly on the autonomy and independence of children and adolescents with Autism Spectrum Disorder in different settings such as home and school. Professionals use Occupation and meaningful activity in this population which can be playing in a structured way as a means of rehabilitation and they develop the intervention considering the preferences, needs and abilities of people with Autism Spectrum Disorder (5).

➤ Grip and Pinch Strength

Grip strength and Pinch strength provides an objective score for the evaluations of hand function. Measurement of Grip strength helps to grade the level of motor development, degree of disability and effectiveness of therapy. Hand Grip strength is influenced by nutritional factors, demographic factors and anthropometric factors such as age, gender and body size (6).

➤ Autism Spectrum Disorder- Grip and Pinch Strength

The Hand Grip and Pinch strengths of ASD children are lower than those of Typically developing children. Researchers have identified a reduction in skeletal muscle strength as a potential indicator of physical difficulties associated with ASD. A limited number of studies have been suggested that the skeletal muscles of children with Autism Spectrum Disorder may be weaker than those of typically developing children of a similar age and gender (7).

Hand Grip requires interaction between fingers and wrist joint and it also requires a good function of the upper limb, and it needs appropriate activation of muscles in a proper sequence with the proper muscle strength (8)

➤ Role of in Grip and Pinch Strength

Occupational Therapy is designed to help promote and improve functional independence of the individuals. The results showed that a course of Occupational therapy for people with some of the injuries may result in increased functional independence as well as Grip strength (9).

In one of the study, results demonstrated that compared to the control group, patients in the intervention group which received multimodal Occupational Therapy displayed significantly greater improvement in Grip strength (10).

➤ Task-Oriented Approach

Task-Oriented Approach (TOA) focuses on repeated training of functional activities which is structured and goal directed. It involves the training individuals with realistic tasks in the natural environment which is cost-effective (11).

Muscle strength training is a component of Task Oriented Training which helps to improve the strength of muscle, functional capacity, and quality of life. According to Labott et al., TOT provides an appropriate stimulus to improve hand Grip strength (11).

Task-oriented training has been used to improve functional improvement of the musculoskeletal and neuromuscular systems. It has been reported that Task-Oriented Training can also result in improvements in movement, and task performance ability in Stroke patients (12).

➤ Definition

• Conceptual Definition:

✓ Grip Strength:

Grip strength is the maximal force generated by the coordinated muscles of the forearm, fingers, and the thumb to grasp or hold an object. (Eliza Hogarth,2022).

✓ *Pinch Strength:*

Pinch strength is the force exerted when the thumb is brought into contact with the fingers, typically measured in various types of pinches-such as lateral, three-jaw chuck, and tip pinch to assess hand function". (Virgil Mathiowetz,1984).

✓ *Task Oriented Approach:*

Task-oriented Approach is a rehabilitation approach that focuses on the repeated practice of structured, goal-directed, and functional activities that are relevant to activities of daily living. It involves training realistic tasks in a natural environment, emphasizing active participation, skillful task performance, and motor learning principles to improve functional abilities. (Mathews S,2024).

• *Operational Definition:*✓ *Grip Strength:*

Grip strength is defined as the amount of strength the child is having while gripping an object. Children with Autism Spectrum Disorder has low grip strength.

✓ *Pinch Strength:*

Pinch strength is defined as the amount of strength the child is having while pinching an object. Children with Autism Spectrum Disorder has low pinch strength.

✓ *Task Oriented Approach:*

Task oriented approach is the set of intervention used in this study to improve Grip strength and Pinch strength.

➤ *Aim and Objectives*• *Aim:*

✓ To determine the effects of Task-Oriented Training to improve Grip strength and Pinch strength among children with Autism Spectrum Disorder.

• *Objectives:*

- ✓ To determine the effectiveness of task-oriented training in improving grip strength among children with Autism Spectrum Disorder (ASD).
- ✓ To determine the effectiveness of task-oriented training in improving pinch strength among children with ASD.
- ✓ To compare the pre-test and post-test grip strength scores between the experimental and control groups.
- ✓ To compare the pre-test and post-test pinch strength scores between the experimental and control groups.
- ✓ To evaluate the overall impact of an 8-week task-oriented intervention program on hand function (grip and pinch) among children with mild to moderate ASD.

➤ *Hypothesis*• *Null Hypothesis:*

There is no significant improvement in Grip strength and Pinch strength using TaskOriented Training among children with Autism Spectrum Disorder.

• *Alternate Hypothesis:*

There is a significant improvement in Grip strength and Pinch strength using Task-Oriented Training among children with Autism spectrum disorder.

➤ *Need of the Study*

Prevalence of Autism Spectrum Disorder is increasing day by day, and in recent study it has been found there is decreased Pinch and Grip strength in children with Autism Spectrum Disorder (3). Grip strength and Pinch strength is important component in handwriting, grasp and other Activities of Daily Living (7). Low Hand Grip strength and Pinch strength is predictor of future disability (20). In recent study it has been found that the hand Grip and Pinch strengths of Autism Spectrum Disorder children are lower than those of typically developing children and they have also mentioned to encourage rehabilitation program for ASD enhancing Grip strength and Pinch strength and they have also mentioned future research should investigate alternative approaches to standardize effort further such as incorporating gamified tasks or objective measures of engagement (7).

II. REVIEW OF LITERATURE

Olfat Ibrahim ali et al., (2025) conducted a study on "Assessment of Hand Grip and Pinch Strengths in Children with Autism Spectrum Disorders". The existing research indicates that children with Autism Spectrum Disorder (ASD) often exhibit lower hand Grip and Pinch Grip strengths compared to typically developing children. This is consistent with previous studies that have reported motor difficulties and impairments in hand and finger functions in children with ASD. The literature suggests that the evaluation and rehabilitation of children with ASD should include assessments and interventions targeting hand Grip and Pinch strength. Previous studies have explored the use of sensorimotor interventions, such as sensorimotor room training, to improve sensory and motor skills in children with ASD (7).

Janet K Kern et al., (2013) conducted a study on "Handgrip strength in Autism Spectrum Disorder compared with controls". Investigates muscle strength differences between children with Autism Spectrum Disorder (ASD) and neurotypical peers. This study indicated that children with ASD have weaker grip strength, with severity of weakness correlating with autism symptom severity. Using a handheld Dynamometer, a validated tool for measuring overall muscle strength and the authors measured handgrip strength in 33 children with ASD and 33 matched neurotypical controls. Results revealed that the ASD group had significantly lower mean handgrip strength (39.4 ± 17.7 kPa) than controls (65.1 ± 26.7 kPa, $p < 0.0001$). The study emphasizes that physical aspects of ASD, such as muscle strength, should be considered in clinical care and that muscle strengthening interventions may improve functional outcomes. Overall, the research highlights the need for further studies to explore the extent, causes, and potential treatments of muscle weakness in ASD (3).

III. METHODOLOGY

➤ Research Design:

- The Quasi - experimental study design.

➤ Study Setting:

- The study was conducted at Occupational Therapy Department, Department of Therapeutics, NIEPMD, Tamil Nadu.

➤ Sampling Technique:

- Computerized Randomized Controlled Trial.

➤ Study Population:

- Children diagnosed with Autism Spectrum Disorder.

➤ Sample Size:

n=30.

➤ Duration of the Study:

The duration of the study was for 6 months. Intervention was given for 8 weeks with each session 15-20 minutes, 3 sessions per week.

➤ Variables:

• Independent Variables:

- ✓ Task oriented training, Autism Spectrum Disorder.

• Dependent Variables:

- ✓ Grip strength, Pinch strength.

➤ Selection Criteria

• Inclusion Criteria:

- ✓ Both Male and Female.
- ✓ Children aged between 6 – 12 years.
- ✓ Autistic children with low grip and pinch strength (less than normative data in dynamometer and Pinch Gauge).
- ✓ Children who follows simple commands.
- ✓ Children with Mild and Moderate Autism Spectrum Disorder screened using ISAA (Indian Scale for Assessment of Autism).

• Exclusion Criteria:

- ✓ Children with any physical disabilities and other Neuro - Developmental Conditions.
- ✓ Children with other co-morbid conditions.
- ✓ Children with more sensory and behavioral issues (based on ISAA scale).

➤ Tools Used

- Indian Scale for Assessment of Autism (ISAA) – This scale is used for screening purpose, children with mild and moderate autism are taken as sample population.
- Hand dynamometer- Dynamometer tool is used for assessing the grip strength of the sample population.
- Pinch gauge- Pinch gauge tool is used for assessing the pinch strength of the sample population

➤ Intervention Protocol

Table 1 Intervention Protocol

WEEK-1	Shifting empty plastic bottle with each hand in drinking position (20 repetitions).
	Squeezing sponge ball.
	Plastic clothespin activity.
	Basic squeeze Thera putty(white).
WEEK-2	Shifting bottle with half-filled in drinking position.
	Squeezing jumping ball.
	Wooden clothespin activity.
	Pinching Thera putty (Yellow).
WEEK-3	Shifting bottle with fulfilled in drinking position.
	Squeezing tennis ball.
	Metal clothespin activity.
	Finger spread using Thera putty.
WEEK-4	Shifting bottle with fulfilled in drinking position.
	Metal clothespin activity.
	Thera putty squeezing and rolling and twisting putty.
WEEK-5	Squeezing sponge with water (Both hands together).
	Opening and closing of lid of plastic jar.
	Buttoning (large).
WEEK-6	Squeezing sponge with water (single hand).
	Opening and closing of lid of glass jar.
	Thera band (minimum resistance).
	Buttoning (Medium).

WEEK-7	Thera band (Moderate resistance).
	Velcro activities.
	Push pins in bulletin boards.
	Buttoning (small).
WEEK-8	Thera band (Maximum Resistance)
	Pressing Bubble wraps
	Velcro activities in shirt
	Push pins in Bulletin board.

➤ *Schematic Representation of the Procedure*

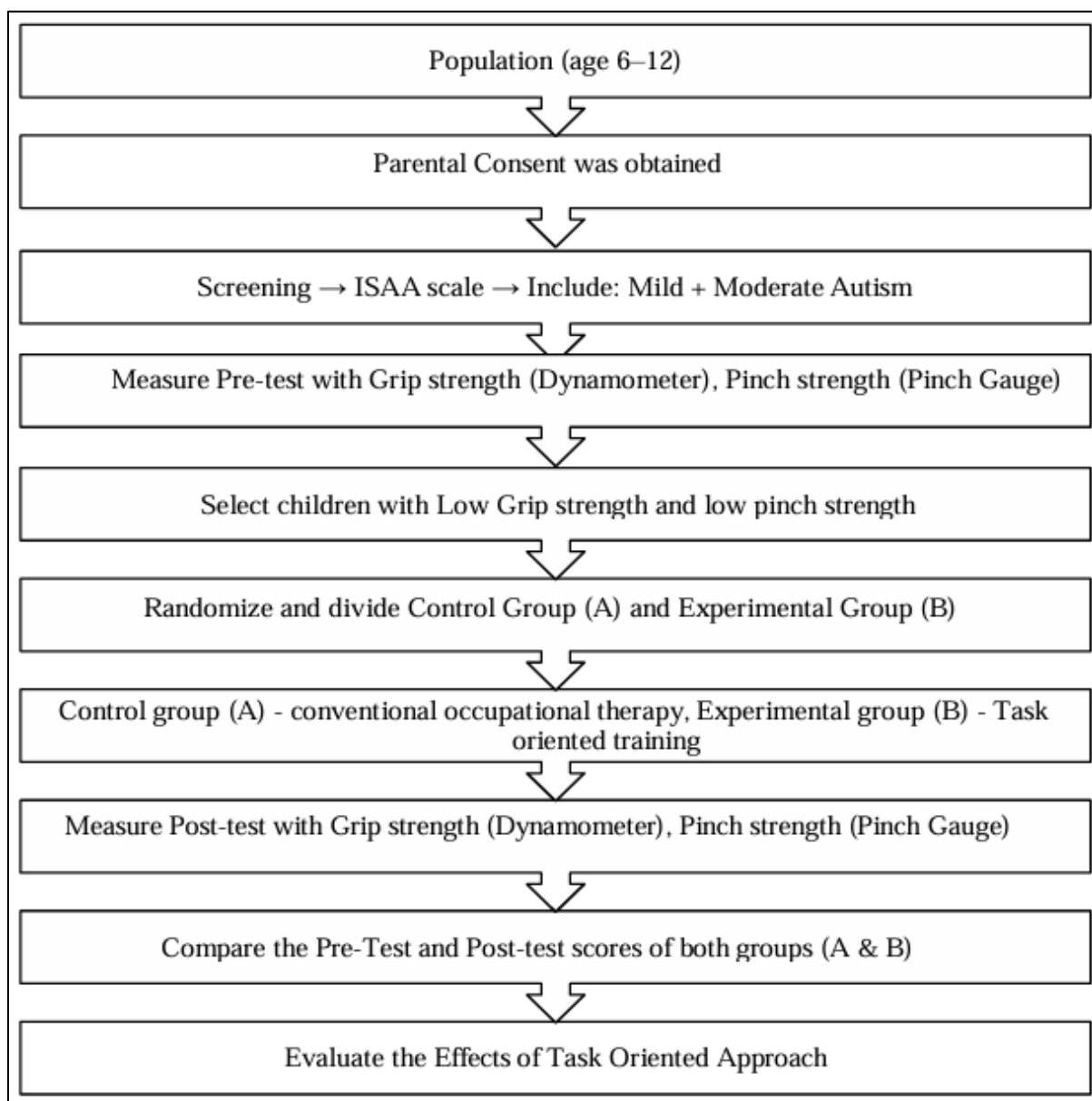


Fig 1 Schematic Representation of the Procedure

IV. RESULTS

Table 2 Pre and Post-Test of Grip Strength Among Experimental Group

Grip strength	Pre-test	Post test	Mean difference (95% CI)	p value
	Mean (SD)	Mean (SD)		
Right	6.12 (1.99)	9.76 (2.68)	3.65 (2.61, 4.69)	<0.001
Left	5.10 (1.34)	8.82 (2.40)	3.72 (2.66, 4.79)	<0.001

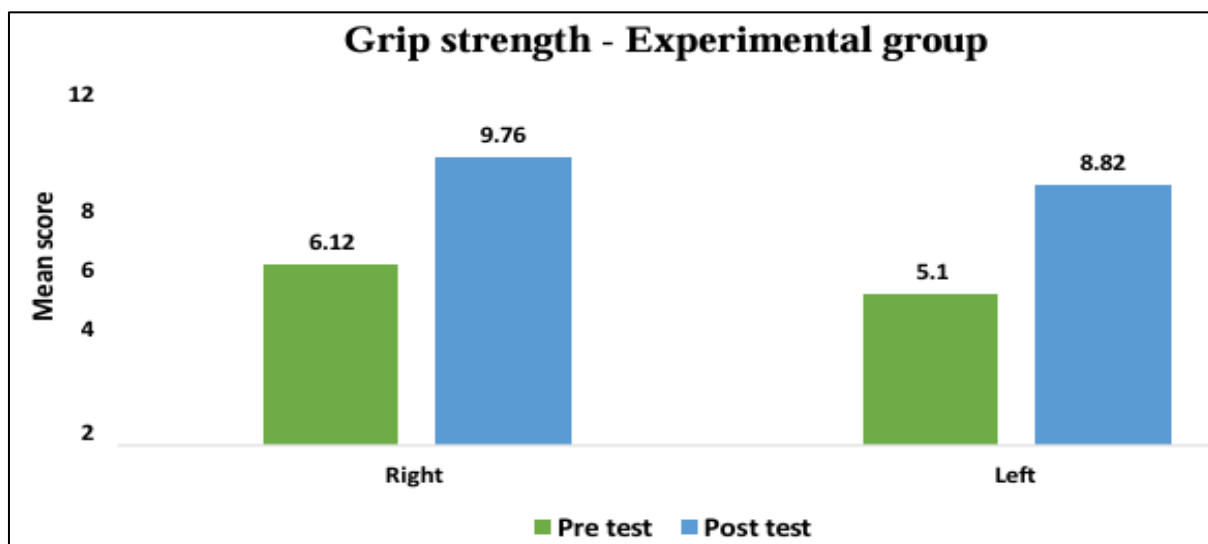


Fig 2 Pre and Post-Test Mean Score of Grip Strength Among Experimental Group

Table 2 and figure 2 shows the Pre- and Post-test comparison of Grip strength in the Experimental group. A statistically significant increase in grip strength was observed for both hands following the intervention. Right-hand grip strength improved from a pre-test mean of 6.12 ± 1.99 to a post-test mean of 9.76 ± 2.68 , with a mean difference of 3.65

(95% CI: 2.61– 4.69; $p < 0.001$). Similarly, left-hand grip strength increased from 5.10 ± 1.34 at pre-test to 8.82 ± 2.40 at post-test, showing a mean difference of 3.72 (95% CI: 2.66–4.79; $p < 0.001$). These results indicate that the intervention led to a significant improvement in bilateral grip strength among the Experimental group.

Table 3 Pre and Post-Test of Pinch Strength Among Experimental Group

Pinch strength	Pre-test	Post test	Mean difference (95% CI)	p value
	Mean (SD)	Mean (SD)		
Right	2.08 (0.79)	4.80 (1.73)	2.72 (1.98, 3.46)	<0.001
Left	2.19 (0.65)	4.23 (1.31)	2.04 (1.55, 2.54)	<0.001

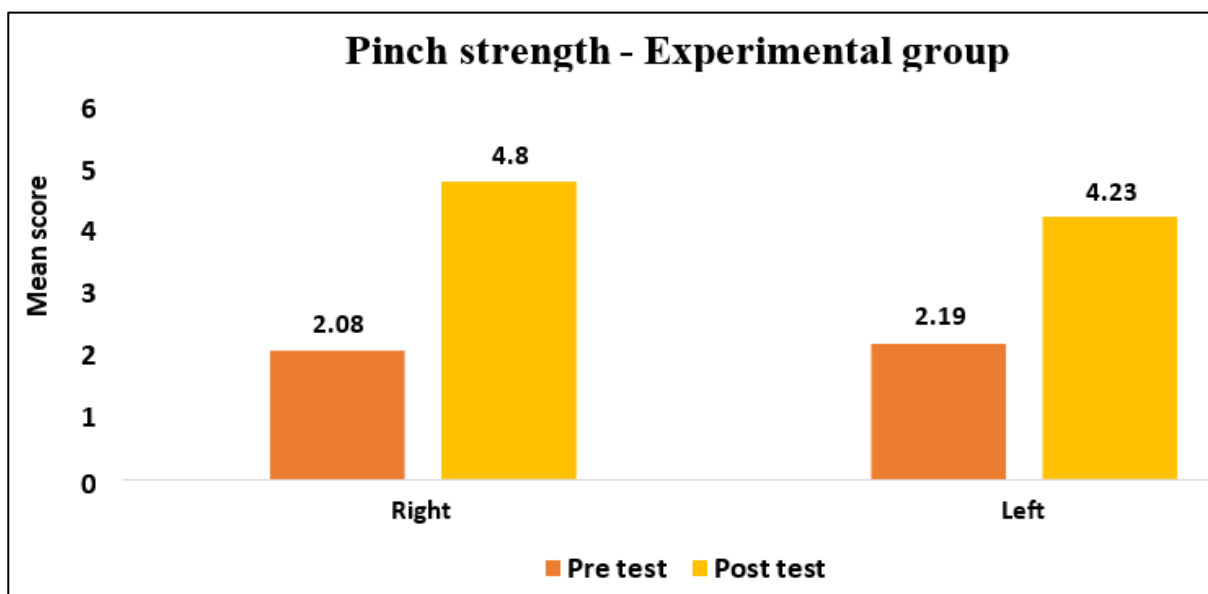


Fig 3 Pre and Post-Test Mean Score of Pinch Strength Among Experimental

Table 3 & figure 3 presents the pre- and post-test comparison of pinch strength in the experimental group. A statistically significant improvement in pinch strength was observed for both hands following the intervention. Right-hand pinch strength increased from a pre-test mean of 2.08 ± 0.79 to a post-test mean of 4.80 ± 1.73 , with a mean difference

of 2.72 (95% CI: 1.98–3.46; $p < 0.001$). Similarly, left-hand pinch strength improved from 2.19 ± 0.65 at pre-test to 4.23 ± 1.31 at post-test, yielding a mean difference of 2.04 (95% CI: 1.55–2.54; $p < 0.001$). These findings indicate a significant bilateral enhancement in pinch strength following the intervention.

Table 4 Pre and Post-Test of Grip Strength Among Control Group

Grip strength	Pre-test	Post test	Mean difference (95% CI)	p value
	Mean (SD)	Mean (SD)		
Right	6.88 (1.56)	9.14 (2.62)	2.26 (1.37, 3.15)	<0.001
Left	6.56 (1.85)	8.08 (2.50)	1.52 (0.89, 2.15)	<0.001

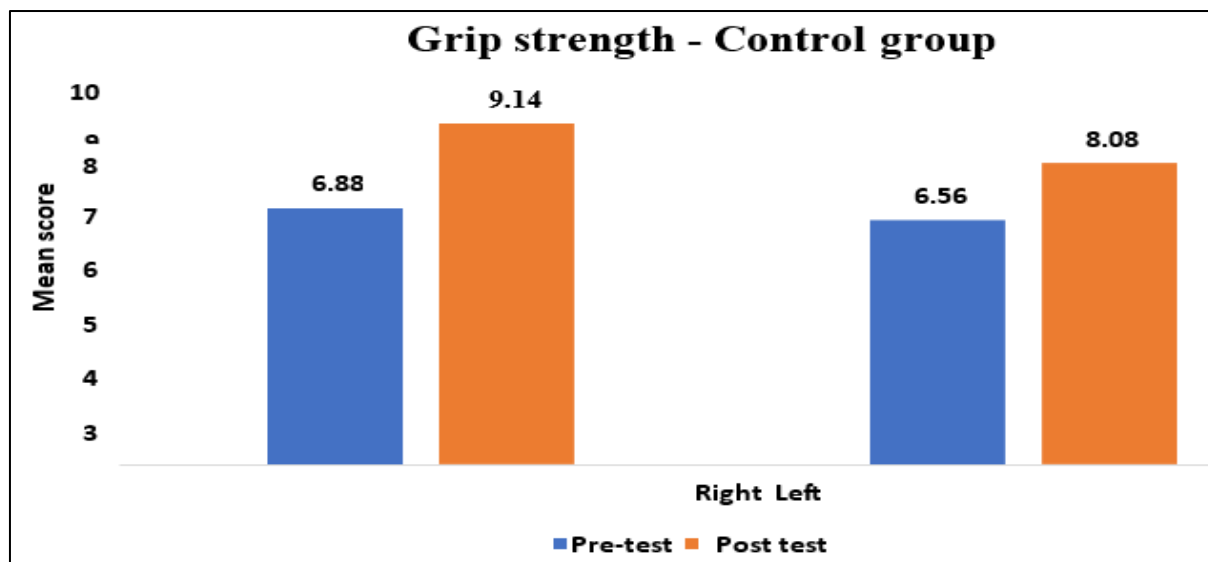


Fig 4 Pre and Post-Test Mean Score of Grip Strength Among Control Group

Table 4 & figure 4 illustrates the Pre-test and Post-test comparison of Grip strength in the Control group. A statistically significant increase in Grip strength was observed for both hands from Pre-test to Post-test. Right-hand Grip strength increased from a mean of 6.88 ± 1.56 at pre-test to 9.14 ± 2.62 at post-test, with a mean difference of 2.26 (95% CI: 1.37–3.15; $p < 0.001$). Similarly, left-hand Grip strength

improved from 6.56 ± 1.85 to 8.08 ± 2.50 , demonstrating a mean difference of 1.52 (95% CI: 0.89–2.15; $p < 0.001$).

These results indicate a significant improvement in bilateral Grip strength within the Control group over the study period.

Table 5 Pre and Post-Test of Pinch Strength Among Control Group

Pinch strength	Pre-test	Post test	Mean difference (95% CI)	p value
	Mean (SD)	Mean (SD)		
Right	2.68 (1.09)	4.11 (1.54)	1.42 (0.98, 1.86)	<0.001
Left	3.09 (1.31)	4.37 (1.55)	1.28 (0.81, 1.75)	<0.001

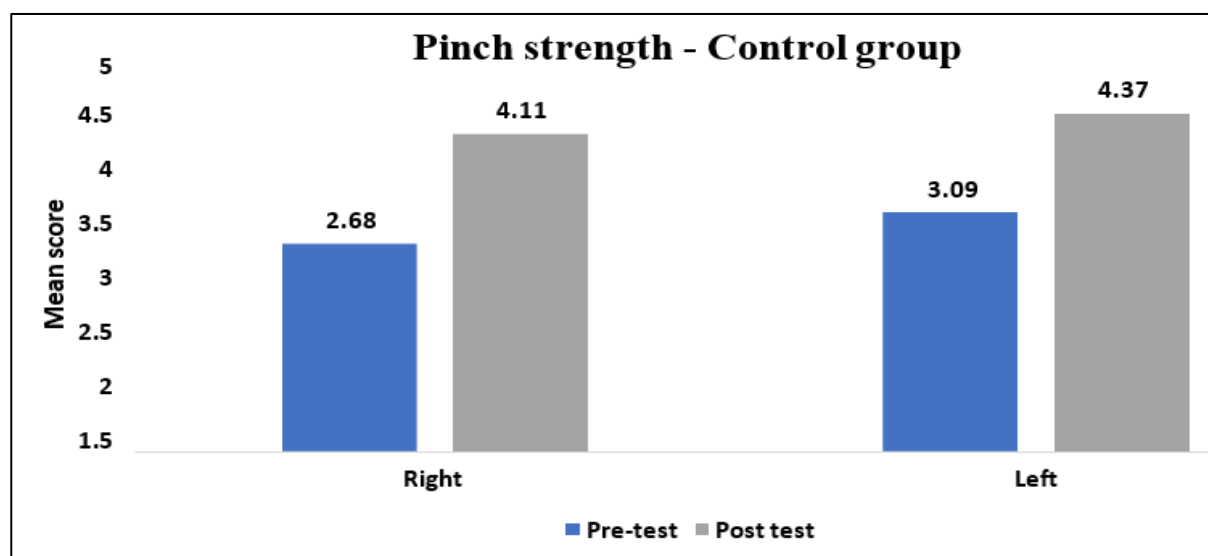


Fig 5 Pre and Post-Test Mean Score of Pinch Strength Among Control Group

Table 5 & figure 5 presents the Pre- and Post-test comparison of Pinch strength in the control group. A statistically significant improvement in Pinch strength was observed for both hands over the study period. Right-hand Pinch strength increased from a Pre-test mean of 2.68 ± 1.09 to a Post-test mean of 4.11 ± 1.54 , with a mean difference of

1.42 (95% CI: 0.98–1.86; $p < 0.001$). Similarly, left-hand Pinch strength improved from 3.09 ± 1.31 at Pre-test to 4.37 ± 1.55 at Post-test, yielding a mean difference of 1.28 (95% CI: 0.81–1.75; $p < 0.001$). These findings indicate a statistically significant bilateral improvement in Pinch strength within the control group.

Table 6 Independent Sample T Test for Comparing the Grip and Pinch Strength Among Experimental and Control Group

Variables	Experimental group (n=15)	Control group (n=15)	p-value
	Mean (SD)	Mean (SD)	
Grip strength pre-test Right	6.11 (1.99)	6.87 (1.55)	0.253
Left	5.09 (1.34)	6.56 (1.85)	0.019
Grip strength post test Right	9.76 (2.67)	9.14 (2.61)	0.521
Left	8.82(2.39)	8.08 (2.4)	0.412
Pinch strength pre-test Right	2.08 (.790)	2.68 (1.08)	0.093
Left	2.18 (.648)	3.09 (1.30)	0.023
Pinch strength post test Right	4.79 (1.73)	4.10 (1.54)	0.261
Left	4.23 (1.30)	4.37 (1.55)	0.793

Table 6 shows the independent sample t-test comparing Grip and Pinch strength between the Experimental and Control groups at Pre-test and Post-test. At baseline, no statistically significant difference was observed between groups for right-hand Grip strength ($p = 0.253$) and right-hand Pinch strength ($p = 0.093$). However, significant differences were noted for left-hand grip strength ($p = 0.019$) and left-hand pinch strength ($p = 0.023$), with the Control group demonstrating higher baseline values.

At Post-test, no statistically significant differences were found between the Experimental and Control groups for Grip strength (right: $p = 0.521$; left: $p = 0.412$) or Pinch strength (right: $p = 0.261$; left: $p = 0.793$). These findings suggest that although both groups demonstrated significant within-group improvements, the Post-intervention Grip and Pinch strength outcomes were comparable between the Experimental and Control groups.

➤ Statistical Analysis:

All statistical analyses were performed using [STATA Version 14.0]. Continuous variables were summarized as mean and standard deviation. The normality of data distribution was assessed using the Shapiro–Wilk test, and as the data were approximately normally distributed, parametric tests were applied. Within-group comparisons of Grip and Pinch strength (right and left hands) from Pre-test to Post-test in both Experimental and Control groups were analyzed using paired sample t-tests, with mean differences and 95% confidence intervals reported. Between-group comparisons at Pre-test and Post-test were performed using independent sample t-tests to assess baseline comparability and Postintervention differences. All statistical tests were two-tailed, and a p value of less than 0.05 was considered statistically significant.

V. DISCUSSION

The absence of statistically significant between-group differences at post-test indicates that the Task-Oriented Approach did not confer a distinct advantage over

conventional therapy in improving Grip and Pinch strength within the duration of the intervention.

Additionally, baseline differences observed in left-hand grip and pinch strength between groups may have influenced post-intervention comparisons. Despite these initial differences, post-test outcomes were comparable, further indicating that both interventions were equally effective in improving hand strength. Natural maturation, increased task exposure, and repeated assessment effects may have also contributed to improvements across both groups.

The present study demonstrated no statistically significant difference between the experimental and control groups following the Task-Oriented approach, indicating only a minimal difference in improvement of Grip strength and Pinch strength between groups. This finding is consistent with previous Task-Oriented intervention studies, Motohide Miyahara (2017) (20) and Carolee J. Winstein (2016) (27) which report that although task-specific training facilitates motor learning and functional performance, it does not always result in superior outcomes when compared with conventional or usual care interventions. Task-Oriented approaches emphasize repeated practice of functional tasks, which may also be inherently present in routine Occupational Therapy provided to the control group, thereby reducing observable between-group differences. Additionally, improvements noted in both groups may be attributed to natural motor development, increased task exposure, and therapist-guided practice rather than the intervention alone. Similar findings have been reported in task-oriented training studies, where both experimental and control groups showed comparable gains, leading to acceptance of the null hypothesis and Alternative hypothesis rejected. These results suggest that while task-oriented training is effective in improving motor performance, its advantage over conventional therapy may be modest, particularly in short-duration interventions and small samples.

VI. CONCLUSION

The findings revealed that there is no significant improvement in Grip strength and Pinch strength, as there is no significant difference between Control (A) and Experimental group (B) demonstrating non- effectiveness of Task-Oriented Approach.

VII. LIMITATIONS AND RECOMMENDATIONS

➤ Limitations:

The study was conducted at a single center (NIEPMD), limiting generalizability. Unequal gender and age distribution may have influenced the outcomes. The short intervention duration may have limited the observation of sustained changes in grip and pinch strength.

Lack of blinding may have introduced bias, while participants' regular therapy sessions may have influenced the study results.

➤ Recommendations:

Future studies could evaluate the Task-Oriented Approach in adults with Autism Spectrum Disorder and other neurodevelopmental conditions. Research may also examine its effects on other motor skills beyond grip and pinch strength. Incorporating gamified tasks and objective engagement measures may improve motivation and participation. Future studies could focus on specific ASD groups and compare different intervention strategies to identify the most effective approaches for improving grip and pinch strength.

➤ Declaration by Authors

- Ethical approval: . Ethical Approval has been obtained from NIEPMD. Vide Approval no.NIEPMD/R.D20(5)/2025-26/31.
- Acknowledgement: I sincerely thank my Guide Mr. Beniela Raja Gnanadurai R.V, for his invaluable guidance, expertise, and support, which have significantly shaped this research and granting me the freedom to conduct my thesis and for her continuous and insightful guidance.
- Source of funding: none
- Conflict of interest: The authors declare no conflict of interest.

REFERENCES

- [1]. Diagnostic and statistical manual of mental disorders: DSM-5. 5th ed. Washington: American psychiatric association; 2013.
- [2]. Chauhan Anil. Prevalence of autism spectrum disorder in Indian children: A systematic review and meta-analysis. Wolters Kluwer - Medknow. (2019).
- [3]. Kern JK. Handgrip strength in autism spectrum disorder compared with controls. 27(2013).
- [4]. Antonio Y. Hardan. Motor Performance and Anatomic Magnetic Resonance Imaging (MRI) of the Basal Ganglia in Autism. J Child Neurol. 18(5).
- [5]. S. Domínguez-Lucio. Occupational Therapy Interventions Using New Technologies in Children and Adolescents with Autism Spectrum Disorder: A Scoping Review. J Autism Dev Disord.
- [6]. Shetty M. Grip and pinch strength: Reference values for children and adolescents from India. J Pediatr Rehabil Med.
- [7]. Olfat Ibrahim Ali. Assessment of Hand Grip and Pinch Strengths in Children with Autism Spectrum Disorders: A Cross-Sectional Study. Child 2025. 12.
- [8]. Elserty N. Influence of shoulder stabilization exercises on hand grip strength in children with Down syndrome: randomized clinical trial.
- [9]. Ryan Lum A. A Retrospective Study of the Correlation Between Hand Grip Strength and Functional Outcomes for Clients with Shoulder Pain. 2(1).
- [10]. Tveter AT. Short-Term Effects of Occupational Therapy on Hand Function and Pain in Patients With Carpometacarpal Osteoarthritis: Secondary Analyses From a Randomized Controlled Trial. Wiley Period LLC. 74.
- [11]. Mathews S. Effect of Task-Oriented Training on Hand Dexterity, Grip Strength, and Function among Institutionalized Geriatric Population. Wolters Kluwer - Medknow 118. 18(3).
- [12]. Halford Erin. What is Task-Oriented Training? A Scoping Review What is Task-Oriented Training? A Scoping Review Erin. Stud J Occup Ther. 4(1).
- [13]. Yoo C. Impact of task-oriented training on hand function and activities of daily living after stroke. Soc Phys Ther Sci. 27(8).
- [14]. Eliza Hogarth. Grip strength, functional range and anthropometric dimensions, and indication on fulfilling occupations in the home and workplace: Across- sectional study. Br J Occup Ther. 85(10).
- [15]. Virgil Mathiowetz. Grip and pinch strength: Normative data for Adults. Arch Phys Rehabil. 66.
- [16]. Takashi Abe. Handgrip strength of young athletes differs based on the type of sport played and age. Am J Hum Biol. 36(5).
- [17]. Young Kang S. Relationship between low handgrip strength and quality of life in Korean men and women. Qual Life Res.
- [18]. Ahmed M. Azzam. Effect of Hand Function Training on Improvement of Hand Grip Strength in Hemiplegic Cerebral Palsy in Children. J Nov Physiother. 2(6).
- [19]. Sajjad Rostamzadeh. Analysis of hand-forearm anthropometric components in assessing handgrip and pinch strengths of school-aged children and adolescents: a partial least squares (PLS) approach. Rostamzadeh Al BMC Pediatr.
- [20]. Miyahara M. Task-oriented interventions for children with developmental coordination disorder (Review). John Wiley Sons Ltd. (7).
- [21]. Ajaya K. Sah. Effects of Task-oriented Activities Based on Neurodevelopmental Therapy Principles on Trunk Control, Balance, and Gross Motor Function in Children with Spastic Diplegic Cerebral Palsy: A Single-blinded Randomized Clinical Trial. J Pediatr Neurosci. 14(3).

- [22]. Brittany G. Travers. Longitudinal Development of Manual Motor Ability in Autism Spectrum Disorder from Childhood to Mid-Adulthood Relates to Adaptive Daily Living Skills. *Dev Sci*.
- [23]. Numan BULUT. The association of hand grip strength with functional measures in non- ambulatory children with Duchenne muscular dystrophy.
- [24]. Li Y. Effect of task-oriented training assisted by force feedback hand rehabilitation robot on finger grasping function in stroke patients with hemiplegia: a randomised controlled trial. *J NeuroEngineering Rehabil*.
- [25]. Tânia Silva-Santos. Hand Grip Force–Time Curve Indicators Evaluated by Dynamometer: A Systematic Review. *Nutr* 2024.
- [26]. Brittany G. Travers. Brainstem White Matter Predicts Individual Differences in Manual Motor Difficulties and Symptom Severity in Autism. *J Autism Dev Disord*.
- [27]. Carolee J. Winstein. Effect of a Task-Oriented Rehabilitation Program on Upper Extremity Recovery Following Motor Stroke. *JAMA*.