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Original Research Article

Comparison of Trunk Control and Upper Limb Function in Children with Spastic Cerebral Palsy: A Cross-Sectional Observational Study

Seema V. Lad[1], Dhwanit S. Shah[2]

[1]MPT Student, Government Physiotherapy College, Surat, India,
[2]Senior Lecturer, Government Physiotherapy College, Surat, India

Corresponding Author: Dr. Seema V. Lad (PT)

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ABSTRACT

BACKGROUND: Cerebral palsy (CP) is the most common motor disability in childhood. Spastic cerebral palsy, the predominant subtype, presents with either unilateral or bilateral involvement of the extremities. Efficient trunk control and upper limb function are essential for performing activities of daily living. Understanding differences in trunk stability and upper limb functional performance among children with spastic CP is crucial for effective rehabilitation planning.
OBJECTIVE: To compare trunk control and upper limb function in children with spastic cerebral palsy.
METHODOLOGY: This cross-sectional observational study included 44 children with spastic cerebral palsy aged 6–15 years. Written informed consent was obtained from parents or guardians prior to participation. Trunk control was assessed using the Trunk Control Measurement Scale (TCMS). Upper limb function was evaluated using the Melbourne Assessment 2 (MA2) and the Jebsen–Taylor Hand Function Test (JTHFT).
RESULTS: Data were analyzed using IBM SPSS Statistics version 26 and Microsoft Excel 2016. The Shapiro–Wilk test confirmed non-normal data distribution. The Mann–Whitney U test revealed a highly significant difference in total TCMS scores between the groups ($p < 0.001$). Significant differences were observed across all JTHFT parameters ($p < 0.001$). Furthermore, MA2 subcomponents showed strong statistically significant differences, including range of motion ($U = 7.975$, $p < 0.001$), accuracy ($U = 35.0$, $p < 0.001$), dexterity ($U = 22.5$, $p < 0.001$), and fluency ($U = 8.351$, $p < 0.001$).
CONCLUSION: The results supported the alternate hypothesis. Children with hemiplegic cerebral palsy demonstrated better trunk control and fine motor hand function, whereas children with diplegic cerebral palsy showed superior performance in gross motor components of upper limb function, including range of motion, accuracy, dexterity, and movement fluency.
KEYWORDS: Trunk control, upper limb function, spastic cerebral palsy

INTRODUCTION

Cerebral palsy (CP) is described as "A Group of Permanent Disorders of Movement and Posture Development That Result in Activity Limitation and Are Caused by Non-Progressive Disturbances Occurring in the Developing Fetal or Infant Brain" (1). It is commonly associated with motor impairments such as reduced muscle strength, impaired coordination, and abnormal postural control, which adversely affect purposeful movements and the execution of activities of daily living (2).

Worldwide, the prevalence of cerebral palsy ranges from 1.5 to 4 per 1,000 live births. In the Indian population, the reported prevalence of cerebral palsy is approximately 2.95 per 1,000 live births (3).

Cerebral palsy arises from multiple etiological factors, including congenital, genetic, inflammatory, infectious, anoxic, traumatic, and metabolic causes. Damage to the developing brain may occur during prenatal, natal, or postnatal stages, with the prenatal period accounting for the majority of cases (4).

Preterm birth has been identified as the most prominent risk factor for cerebral palsy. Other recognized risk factors include congenital anomalies, fetal growth restriction, multiple pregnancies, intrauterine and neonatal infections, birth asphyxia, untreated maternal hypothyroidism, perinatal stroke, and thrombophilia (5).

Cerebral palsy can be categorized using three main classification systems: based on the distribution of limb involvement, the type of movement disorder, and the degree of severity. Topographical classification describes limb involvement and includes hemiplegia, diplegia, quadriplegia, triplegia, and monoplegia. Classification by movement disorder encompasses spastic, dyskinetic (including dystonia and athetosis), ataxic, and hypotonic types. Functional severity is commonly classified using the Gross Motor Function Classification System (GMFCS), a five-level scale that categorizes children according to their gross motor abilities (6).

The clinical manifestations of cerebral palsy include various neuromuscular impairments such as diminished selective motor control, altered muscle tone, imbalance between agonist and antagonist muscle groups, coordination deficits, sensory disturbances, and generalized muscle weakness. Trunk weakness along with spasticity of the extremities is frequently observed in children with cerebral palsy (7).

The trunk serves as the central component of the body and is essential for maintaining postural stability, balance reactions, and the execution of functional movements. Effective trunk control is required to enable controlled and coordinated movements of the head and limbs (8). In children with spastic cerebral palsy, trunk control is often compromised due to reduced trunk muscle strength, impaired neural control, and altered proprioceptive input. Trunk dysfunction is a common feature of spastic CP and negatively influences upper and lower limb motor performance. Inadequate trunk stability leads to compensatory muscle activity to maintain upright posture, highlighting the critical role of the trunk in postural control (9).

Upper limb impairment is highly prevalent in children with cerebral palsy, with reported rates ranging from 57% to 83%. Limitations in upper limb function can restrict participation in activities of daily living, particularly in later stages of life. Most daily tasks require coordinated use of both hands, with the dominant and non-dominant hands performing different functional roles. In children with CP, the more-affected hand is primarily used as an assisting hand during bimanual tasks, whereas the less-affected hand is used for tasks requiring unilateral hand use. Functional differences between the two hands therefore influence independence in daily activities (10).

Previous research has examined the relationship between trunk control and upper extremity function. Ayse Yildiz et al. (2018) reported a significant positive association between trunk control and upper limb function in children with cerebral palsy; however, the study was limited by reliance on the Quality of Upper Extremity Skills Test (QUEST), which does not adequately assess movement speed, movement quality, fine motor performance, or functional skills (11). Lieve Heyrman et al. (2012) observed that children with hemiplegic and diplegic cerebral palsy demonstrated minimal difficulty with static trunk control, whereas children with quadriplegic cerebral palsy showed impairments in both static and dynamic trunk control. Limitations of this study included the inclusion of children classified as GMFCS level IV and a wide age range of 8–15 years (8). Additionally, Do Hyun Kim et al. (2018) emphasized the importance of assessing trunk control when evaluating upper limb function in children with cerebral palsy; however, the small sample size limited the generalizability of the findings and highlighted the need for further comparative studies between children with hemiplegic and diplegic cerebral palsy (2).

Considering the limitations identified in previous studies, the present study aims to compare trunk control and upper limb function in children with spastic cerebral palsy.

MATERIALS & METHODS

This cross-sectional observational study was conducted among children diagnosed with spastic cerebral palsy to evaluate relevant clinical variables. The study was carried out over a six-month period, from June 2024 to November 2024, across multiple hospitals and physiotherapy clinics in Surat city. A total of 44 participants were included in the study. The sample size was determined using OpenEpi Version 3 software, based on a 95% confidence interval and a prevalence rate of cerebral palsy of 2.95 per 1,000 live births in India in 2019 (3). Participants were recruited using a convenience sampling method.

The study population consisted of children aged 6–15 years of either gender who were diagnosed with spastic cerebral palsy by a neurophysician. Inclusion criteria required participants to be classified within Gross Motor Function Classification System (GMFCS) levels I to III, have the ability to understand and follow verbal instructions, and exhibit spasticity graded as ≤2 on the Modified Ashworth Scale (MAS). Children were excluded if they had visual or hearing impairments; a history of neurological, medical, musculoskeletal, or cardiac conditions; or were receiving medications such as antiepileptic or antiseizure drugs that could affect performance. Additional exclusion criteria included administration of neural blocking agents such as botulinum toxin or phenol within the previous six months, intrathecal baclofen pump implantation, or any musculoskeletal surgical intervention within the last six months.

Outcome measures employed in this study included the Trunk Control Measurement Scale (TCMS) (12), the Melbourne Assessment 2 (MA2) (13–15), and the Jebsen–Taylor Hand Function Test (JTHFT) (16–18).

The study procedure was conducted as follows.

Ethical approval was obtained from the Human Research Ethics Committee of Government Physiotherapy College, Surat.

Participants were screened and recruited from various hospitals and physiotherapy clinics in Surat based on the predefined inclusion and exclusion criteria.

Spasticity assessment was performed using the Modified Ashworth Scale, and functional classification was determined using the GMFCS.

Children with MAS scores greater than 2 or GMFCS levels above III were excluded from the study.

Detailed information regarding the study procedures was provided to participants and their parents or guardians, and written informed consent was obtained prior to data collection.

All assessment procedures were explained thoroughly before commencement.

Trunk control was assessed using the Trunk Control Measurement Scale (TCMS), which evaluates static and dynamic sitting balance. The total score ranges from 0 to 58, with higher scores indicating better trunk control performance.

Upper limb function was assessed using two tools. The Melbourne Assessment 2 (MA2) was used to evaluate the quality of upper limb movements, with scoring based on a 3-, 4-, or 5-point scale, where higher scores represent better performance.

Manual dexterity was assessed using the Jebsen–Taylor Hand Function Test (JTHFT), in which shorter task completion times indicate superior hand function.

Statistical Analysis

Following data collection, the dataset was reviewed and cleaned to remove errors and inconsistencies. The finalized data were entered into Microsoft Excel and subsequently analyzed using IBM SPSS Statistics version 26. Qualitative variables were summarized using frequencies and percentages and were analyzed using the chi-square test. Quantitative variables were expressed as mean and standard deviation and analyzed using the Mann–Whitney U test. A p-value of less than 0.05 was considered statistically significant.

Data normality was assessed using the Shapiro–Wilk test, which indicated that while some variables followed a normal distribution, others did not. Accordingly, the non-parametric Mann–Whitney U test was applied to determine statistically significant differences between variables.

RESULT

This study set out to compare trunk control and upper limb function in children with spastic cerebral palsy. Table 1 represents among the study participants, 20 were female and 24 were male. According to table 2 total 44 participants were taken among which 22 were hemiplegic and 22 were diplegic cerebral palsy.

Table 1. Gender wise distribution of study participants

SEX	Frequency	Percentage (%)
FEMALE	20	45.5
MALE	24	54.5
Total	44	100.0

Table 2. Distribution of Type of cerebral palsy among study participants

Type of CP	Frequency	Percentage(%)
DIPLEGIC	22	50.0
HEMIPLEGIC	22	50.0
Total	44	100.0

Table 3. Comparing score of TCMS and component of TCMS

Measure	Type of CP	Min	Max	Mean	Std. Dev.
Static Sitting Balance (20)	Diplegic	11	20	17	2.41
	Hemiplegic	9	20	17.364	2.517
Dynamic Sitting Balance (28)	Diplegic	14	23	17.182	2.612
	Hemiplegic	14	22	18.818	2.538
Dynamic Reaching (10)	Diplegic	5	10	6.682	1.644
	Hemiplegic	5	10	7.455	1.711
Total TCMS (58)	Diplegic	30	47	39.32	4.79
	Hemiplegic	35	49	44.82	4.12

The above table 3 compares the performance of participants with Diplegic and Hemiplegic types of cerebral palsy (CP) across various measures. In Static Sitting Balance, both groups perform similarly, with Hemiplegic individuals showing a marginally higher mean score (17.364) compared to Diplegic individuals (17.000). However, in Dynamic Sitting Balance and Dynamic Reaching, Hemiplegic individuals demonstrate better outcomes, with mean scores of 18.818 and 7.455, respectively, compared to 17.182 and 6.682 for Diplegic individuals. Additionally, the overall Total TCMS (Trunk Control Measurement Scale) scores indicate that Hemiplegic individuals achieve a higher average (44.82) compared to Diplegic individuals (39.32). These findings suggest that Hemiplegic individuals may exhibit better trunk control and dynamic balance abilities than those with Diplegic CP, potentially influencing their functional mobility and stability.

Table 4: Test-Statistics to compare both types of CP

	Mann-Whitney test	p-values
STATIC SITTING BALANCE (20)	264.5	0.588
DYNAMIC SITTING BALANCE (28)	329.5	0.038
DYNAMIC REACHING (10)	303.5	0.140
TOTAL TCMS (58)	393.5	0.000*

***Correlation is significant at 0.05 level (2-tailed); ** The result is significant at p<0.05.**

We can conclude using table 4 that there was no statistically significant difference between groups for Static Sitting Balance (p=0.588) or Dynamic Reaching (p=0.140). However, a significant difference was observed for Dynamic Sitting Balance (p=0.038), and a highly significant difference was found for Total TCMS (p=0.000). These findings suggest notable group differences in trunk control.

So, the null hypothesis is rejected and alternate hypothesis is accepted because there was significant difference in trunk control in children with hemiplegic and diplegic cerebral palsy.

Table-5: Comparing score of JTHFT and MA2 SCORE in both groups.

Parameter	Group	Min	Max	Mean	Std. Dev.
JTHFT Score (Dominant)	Diplegic	70.9	82.9	76.2	3.27
	Hemiplegic	102.57	117.05	110	4.8
JTHFT Score (Non-Dominant)	Diplegic	39.25	56.4	50.1	3.54
	Hemiplegic	71.05	96.1	86.91	6.43
Range of Motion (ROM)	Diplegic	77.77	100	90.7	6.1
	Hemiplegic	55.55	96.29	73.56	8.02
Accuracy	Diplegic	72	100	91.45	7.12
	Hemiplegic	68	88	77.64	5.88
Dexterity	Diplegic	63.15	100	84.92	13.81
	Hemiplegic	36.84	68.42	58.37	6.48
Fluency	Diplegic	66.66	100	85.06	9.44
	Hemiplegic	42.85	76.19	62.98	8.04

The above table 5 compares motor function measures between individuals with diplegic and hemiplegic cerebral palsy (CP) across several parameters. For the JTHFT (Jebsen-Taylor Hand Function Test) scores, the dominant hand showed higher performance in the hemiplegic group compared to the diplegic group. Similarly, for the non-dominant hand, the hemiplegic group scored higher than the diplegic group. Regarding Range of Motion (ROM), Accuracy, Dexterity and Fluency the diplegic group had a higher mean than the hemiplegic group. Overall, the diplegic group performed better in ROM, accuracy, dexterity, and fluency, while the hemiplegic group demonstrated superior hand function in both dominant and non-dominant hands.

Table-6: Test-Statistics to compare both types of CP

	Mann-Whitney test	p-values
JTHFT SCORE Dominant	484	0.000*
JTHFT SCORE Non-Dominant	484	0.000*
ROM	7.975	0.000*
ACCURACY	35	0.000*
DEXTERITY	22.5	0.000*
FLUENCY	8.351	0.000*

***Correlation is significant at 0.05 level (2-tailed); ** The result is significant at p<0.05.**

We can conclude using table 6 that there are statistically significant differences between the groups across all measured parameters (p=0.000). For the JTHFT scores, both the dominant and non-dominant hands showed highly significant differences, with U-values of 484 for each. Range of Motion (ROM) also exhibited a strong significant difference (U = 7.975, p=0.000). Similarly, significant differences were observed for Accuracy (U = 35, p=0.000), Dexterity (U = 22.5, p=0.000), and Fluency (U = 8.351, p=0.000). These findings highlight consistent and substantial disparities in motor function and coordination between the groups.

DISCUSSION

The present study aimed to compare trunk control and upper limb function in children with spastic cerebral palsy. The findings demonstrated that total TCMS scores, JTHFT scores for both dominant and non-dominant hands were significantly lower in children with diplegic cerebral palsy compared to those with hemiplegic cerebral palsy. In contrast, parameters of movement quality assessed using MA2, including range of motion, accuracy, dexterity, and fluency, were significantly higher in the diplegic group than in the hemiplegic group.

Lieve Heyrman et al. (2012) assessed trunk control in children with cerebral palsy using the Trunk Control Measurement Scale and reported that trunk control was least impaired in children with hemiplegia, followed by diplegia, and most impaired in quadriplegia. Children with hemiplegia and diplegia showed minimal difficulties in static sitting balance, whereas children with quadriplegia demonstrated significant deficits in both static and dynamic trunk control. The authors concluded that trunk control impairments vary according to topographical involvement (8). These findings align with the present study, as no significant difference was observed between hemiplegic and diplegic groups for static sitting balance. However, children with hemiplegic cerebral palsy demonstrated superior dynamic sitting balance and dynamic reaching compared to diplegic children, resulting in significantly higher total TCMS scores.

Similarly, Hye-Rim Jung et al. (2019) reported that children with spastic diplegic and quadriplegic cerebral palsy exhibited reduced sitting balance and coordination, particularly during dynamic tasks involving trunk rotation, as measured using the Trunk Impairment Scale (19). These findings are consistent with the present study, which also observed greater difficulty in dynamic sitting balance and reaching tasks among children with diplegic cerebral palsy, despite the use of a different assessment tool.

Su-Fen Liao et al. (2003) found that children with diplegic cerebral palsy exhibited better static balance than dynamic balance during sitting tasks (20). This observation is consistent with the present study, where children with diplegic cerebral palsy performed better in static sitting balance compared to dynamic balance components.

Andrzej Szopa et al. (2024) reported poorer postural stability in children with diplegic cerebral palsy compared to those with hemiplegia, as indicated by greater center of pressure displacement during static postural assessment (21). These findings further support the present results, indicating superior trunk control in children with hemiplegic cerebral palsy.

Regarding upper limb function, Carlyne Arnould et al. (2007) reported that children with diplegic cerebral palsy exhibited bilateral impairments in fine finger dexterity, while hemiplegic children also demonstrated impairments in the non-paretic hand. However, no significant difference in overall manual ability was found between diplegic and hemiplegic groups (22). In contrast, the present study demonstrated that children with diplegic cerebral palsy showed better movement quality in terms of range of motion, accuracy, dexterity, and fluency, whereas children with hemiplegic cerebral palsy performed better on functional hand tasks assessed using JTHFT.

Carlyne Arnould et al. (2014) further reported greater impairment in the non-dominant hand compared to the dominant hand in children with cerebral palsy (23). These findings are consistent with the present study, where higher JTHFT scores were observed in the hemiplegic group for both dominant and non-dominant hands.

Van Zelst et al. (2006) highlighted significant motor and process skill deficits in children with hemiplegic cerebral palsy, despite their ability to function alongside typically developing peers (24). Similarly, the present study demonstrated superior JTHFT performance in children with hemiplegic cerebral palsy, although movement quality parameters such as ROM, accuracy, dexterity, and fluency were reduced.

Yun-Huei Ju et al. (2010) reported fragmented and less coordinated reaching movements in children with cerebral palsy compared to typically developing children (25). These findings support the present results, which revealed significant differences in movement quality parameters between diplegic and hemiplegic cerebral palsy groups.

Asmaa Ahmed Abd El-samad et al. (2021) reported impairments in fine motor control and pinch strength in children with diplegic cerebral palsy (26). Despite these impairments, the present study demonstrated better performance in movement quality parameters among the diplegic group.

Andrea Burgess et al. (2020) observed that children with bilateral cerebral palsy experienced greater motor challenges compared to those with unilateral involvement (27). These findings are consistent with the present study, which identified distinct differences in trunk control and upper limb function between diplegic and hemiplegic cerebral palsy.

Hanaa Mohsen Abd-Elfattah et al. (2021) reported significant upper limb motor impairments in children with hemiplegic cerebral palsy, affecting participation in daily activities (28). In agreement with these findings, the present study demonstrated reduced movement quality in the hemiplegic group, despite higher functional hand performance.

The present study contributes valuable insights into differences in trunk control and upper limb function between hemiplegic and diplegic cerebral palsy, emphasizing the need to target movement quality parameters such as accuracy, dexterity, and fluency during rehabilitation. However, the study has limitations, including a wide age range (6–15 years), a relatively small sample size (n = 44), and inclusion of only two spastic cerebral palsy subtypes.

CONCLUSION

The study confirmed significant differences in trunk control and upper limb function between children with spastic hemiplegic and diplegic cerebral palsy, thereby supporting the alternate hypothesis. Trunk control and fine motor hand function in both dominant and non-dominant hands were better in the hemiplegic group, while the diplegic group demonstrated superior gross motor performance in terms of range of motion, accuracy, dexterity, and fluency.

Declaration by Authors

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REFERENCES

1. Kallem Seyyar G, Aras B, Aras O. Trunk control and functionality in children with spastic cerebral palsy. Developmental neurorehabilitation. 2019 Feb 17;22(2):120-5.
2. Kim DH, An DH, Yoo WG. The relationship between trunk control and upper limb function in children with cerebral palsy. Technology and Health Care. 2018 Jan 1;26(3):421-7.
3. Chauhan A, Singh M, Jaiswal N, Agarwal A, Sahu JK, Singh M. Prevalence of

cerebral palsy in Indian children: a systematic review and meta-analysis. The Indian Journal of Pediatrics. 2019 Dec; 86:1124-30.

4. Pattar R. Clinical Spectrum and Risk Factors of Cerebral Palsy in Children. Medica Innovatica. 2015;4.
5. Stavsky M, Mor O, Mastrolia SA, Greenbaum S, Than NG, Erez O. Cerebral palsy—trends in epidemiology and recent development in prenatal mechanisms of disease, treatment, and prevention. Frontiers in pediatrics. 2017 Feb 13; 5:21.
6. Martin ST, Kessler M. Neurologic Interventions for Physical Therapy. 4th ed. Philadelphia, PA: Elsevier - Health Sciences Division; 2020.
7. Emara HA. Effect of a new physical therapy concept on dynamic balance in children with spastic diplegic cerebral palsy. Egyptian Journal of Medical Human Genetics. 2015 Feb 3;16(1):77-83.
8. Heyrman L, Desloovere K, Molenaers G, Verheyden G, Klingels K, Monbaliu E, Feys H. Clinical characteristics of impaired trunk control in children with spastic cerebral palsy. Research in developmental disabilities. 2013 Jan 1;34(1):327-34.
9. https://mecsj.com/uplode/images/photo/Effect_of_trunk_control_changes_on_access_to_children_with_progressive_spastic_cerebral_palsy%E2%80%AC%E2%80%AC%E2%80%AC%E2%80%AC%E2%80%AC.pdf
10. Park H, Choi JY, Yi SH, Park ES, Shim D, Choi TY, Rha DW. Relationship between the more-affected upper limb function and daily activity performance in children with cerebral palsy: a cross-sectional study. BMC pediatrics. 2021 Dec; 21:1-8.
11. Yildiz A, Yildiz R, Elbasan B. Trunk control in children with cerebral palsy and its association with upper extremity functions. Journal of Developmental and Physical Disabilities. 2018 Oct; 30:669-76.
12. Heyrman L, Molenaers G, Desloovere K, Verheyden G, De Cat J, Monbaliu E, Feys H. A clinical tool to measure trunk control in children with cerebral palsy: the Trunk Control Measurement Scale. Research in developmental disabilities. 2011 Nov 1;32(6):2624-35.
13. https://www.rch.org.au/melbourneassessment/
14. https://www.rch.org.au/uploadedFiles/Main/Content/melbourneassessment/admin-guidelines.pdf
15. Gerber CN, Plebani A, Labruyère R. Translation, reliability, and clinical utility of the Melbourne assessment 2. Disability and rehabilitation. 2019 Jan 16;41(2):226-34.
16. Physiopedia contributors. Jebsen-Taylor Hand Function Test [Internet]. Physiopedia. 2022 Jan 3 [cited 2025 Jan 26]. Available from: https://www.physio-pedia.com/index.php?title=Jebsen-Taylor_Hand_Function_Test&oldid=290356
17. Tofani M, Castelli E, Sabbadini M, Berardi A, Murgia M, Servadio A, Galeoto G. Examining reliability and validity of the Jebsen-Taylor hand function test among children with cerebral palsy. Perceptual and motor skills. 2020 Aug;127(4):684-97.
18. https://scireproject.com/wp-content/uploads/2022/05/worksheet_jebsen-1-1.pdf
19. Jung HR, Choi YE. Comparison of Sitting Balance and Coordination in Children with Spastic Cerebral Palsy Using the Korean Version of Trunk Impairment Scale (K-TIS). Journal of the Korean Society of Physical Medicine. 2019;14(4):37-44.
20. Liao SF, Yang TF, Hsu TC, Chan RC, Wei TS. Differences in seated postural control in children with spastic cerebral palsy and children who are typically developing. American journal of physical medicine & rehabilitation. 2003 Aug 1;82(8):622-6.
21. Szopa A, Domagalska-Szopa M. Postural Stability in Children with Cerebral Palsy. Journal of Clinical Medicine. 2024 Sep 5;13(17):5263.
22. Arnould C, Penta M, Thonnard JL. Hand impairments and their relationship with manual ability in children with cerebral palsy. J Rehabil Med. 2007 Nov 1;39(9):708-14.
23. Arnould C, Bleyenheuft Y, Thonnard JL. Hand functioning in children with cerebral palsy. Frontiers in neurology. 2014 Apr 9; 5:48.
24. Van Zelst BR, Miller MD, Russo RN, Murchland S, Crotty MJ. Activities of daily living in children with hemiplegic cerebral palsy: a cross-sectional evaluation using the assessment of motor and process skills. Developmental medicine and child neurology. 2006 Sep;48(9):723-7.

25. Ju YH, You JY, Cherng RJ. Effect of task constraint on reaching performance in children with spastic diplegic cerebral palsy. Research in developmental disabilities. 2010 Sep 1;31(5):1076-82.
26. Abd El-samad AA, El-Meniawy GH, Nour El-Din SM, Mohamed NE. Pinch grip strength and fine manual control in children with diplegic cerebral palsy: a cross-sectional study. Bulletin of Faculty of Physical Therapy. 2021 Dec; 26:1-8.
27. Burgess A, Boyd RN, Chatfield MD, Ziviani J, Wotherspoon J, Sakzewski L. Hand function and self-care in children with cerebral palsy. Developmental Medicine & Child Neurology. 2021 May;63(5):576-83.
28. Abd-Elfattah HM, Aly SM. Effect of core stability exercises on hand functions in children with hemiplegic cerebral palsy. Annals of Rehabilitation Medicine. 2021 Feb 9;45(1):71-8.

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