



Effectiveness Of Pelvic Proprioceptive Neuromuscular Facilitation Techniques On Balance And Gait Parameters In Children With Spastic Quadriplegic Cerebral Palsy

Swamini Sudhakar Bhoir¹, Priyanka Basant Tripathi², Vikrant Girish Salphale^{3*}, Javeria Jafar Shaikh⁴, Sathi Biswajit Maity⁵, Mercy Michael Nadar⁶,

¹Intern, MGM School of physiotherapy, Aurangabad, a constituent unit of MGMIHS, Navi Mumbai, Maharashtra, India,

ORCID: <https://orcid.org/0000-0001-5928-3453>

²Intern, MGM School of Physiotherapy, Aurangabad, a constituent unit of MGMIHS, Navi Mumbai, Maharashtra, India,

ORCID: <https://orcid.org/0000-0002-3818-1367>

^{3*}Assistant Professor, Department of Neuro Physiotherapy, MGM School of Physiotherapy, Aurangabad, a constituent unit of MGMIHS, Navi Mumbai, Maharashtra, India, Email: vikrantsalphale1997@gmail.com, ORCID: <https://orcid.org/0000-0001-8942-4376>

⁴BPT, Student, MGM School of Physiotherapy, Aurangabad, a constituent unit of MGMIHS, Navi Mumbai, Maharashtra, India.

⁵BPT, Student, MGM School of Physiotherapy, Aurangabad, a constituent unit of MGMIHS, Navi Mumbai, Maharashtra, India.

⁶BPT, Student, MGM School of Physiotherapy, Aurangabad, a constituent unit of MGMIHS, Navi Mumbai, Maharashtra, India.

***Corresponding Author:** Vikrant Salphale

^{*}Assistant Professor, Department of Neuro Physiotherapy, MGM School of Physiotherapy, Aurangabad, a constitute unit of MGMIHS, Navi Mumbai, Maharashtra, India, Email: vikrantsalphale1997@gmail.com, ORCID: <https://orcid.org/0000-0001-8942-4376>

Citation: Vikrant Girish Salphale et al. (2024), Effectiveness Of Pelvic Proprioceptive Neuromuscular Facilitation Techniques On Balance And Gait Parameters In Children With Spastic Quadriplegic Cerebral Palsy, *Educational Administration: Theory And Practice*, 30(4), 3766-3771

Doi: 10.53555/kuey.v30i4.2121

ARTICLE INFO

ABSTRACT

Background: In Spastic Quadriplegic variant of Cerebral Palsy children usually manifest themselves with an impedance in walking due to pelvic mal-congruency. Several treatment manoeuvres of Physical Therapy are used in Spastic Quadriplegic Cerebral Palsy. This research emphasizes on the Efficiency of Pelvic Proprioceptive Neuromuscular Facilitation (PNF) techniques on Balance and Gait parameters in Children with Spastic Quadriplegic Cerebral Palsy.

Objectives: To Investigate the Effect of Pelvic Proprioceptive Neuromuscular Facilitation Techniques in Normalizing the Pelvic Congruency, Balance and gait parameters in Children with Spastic Quadriplegic Cerebral Palsy.

Methods: In this clinical trial, 22 participants diagnosed with Spastic Quadriplegic Cerebral Palsy will be chosen and divided into two groups with a 1:1 allocation ratio. The experimental group will undergo Pelvic PNF techniques, including Rhythmic Stabilisation, Rhythmic Initiation, and Slow Reversal, along with Task-Oriented training which will involve Trunk exercises and Conventional Training for the Upper Limb, including Static Stretching. The control group, on the other hand, will receive Task-Oriented training for 4 weeks and Conventional Training for the Upper Limb following baseline and post treatment assessments.

Results: Data will be entered in MS Excel for the purpose of master chart and the pre and post findings will be compared and the result will be documented.

Conclusion: The research depicted the effectiveness of Pelvic PNF techniques on Balance and Gait Parameters in children with Spastic Quadriplegic Cerebral Palsy.

Key Words: Pelvic Proprioceptive Neuromuscular Facilitation techniques, Spastic Quadriplegic Cerebral Palsy, Paediatric Balance Scale, Gross Motor Function Classification System, Modified Ashworth Scale, Gait Parameters.

INTRODUCTION: -

Cerebral palsy (CP) is non -progressive disorder with motor dysfunction. Cerebral palsy (CP) is Classified into two different types such as Topographically and Motor dysfunction. According to Topographically it is categorized as Monoplegia, Diplegic, Quadriplegic, Hemiplegic and Paraplegic. According to Motor dysfunction it is categorized as Spastic, Athetoid, Ataxic, Flaccid and Mixed. There are numerous risk factors that are mentioned as follow that causes cerebral palsy are- low birth weight, Maternal -foetal infection, neonatal

seizures, preterm babies, in vitro fertilization, Genetic Susceptibility, Hypoxic – ischemic encephalopathy. The prevalence of cerebral palsy in India is around 2.95 per 1000 babies ⁽¹⁾.

It is frequently associated with global developmental delay, CP cannot be regarded as a "delay" since children do not "grow out of it"⁽²⁾. It is a neuromotor disorder that impairs movement, tone and posture⁽³⁾. CP is a progressive brain disorder that usually results into damage to central nervous system during prenatal, natal and postnatal period⁽⁴⁾. CP is a lifelong disability in children that persist throughout the lifespan. According to Peter Rosenbaum, he described cerebral palsy as a group of permanent disorder of movement and posture, causing activity limitation that are attributed to non-progressive disturbances that occurred in the developing foetal or infant brain. Motor disorders often result into disturbances of sensation, perception, cognition, communication and various musculoskeletal deformity⁽⁵⁾.

Causes of cerebral palsy depends on their types which is divided into 3 types such as Antenatal, perinatal, and postnatal causes⁽⁶⁾. Spastic Quadriplegic CP is the most severe form which is characterized by Spastic Weakness of all four limbs including trunk, this type of cerebral palsy encounters with highest risk of scoliosis which may cause certain complications to children such as back pain, poor balance, gait disturbances, and hinders the pelvic Stability which will lead to various deformity. In children with CP, Scoliosis is often associated with pelvic asymmetry which impacts on rate of progression in Spastic Quadriplegic cerebral palsy ⁽⁷⁾.

Cerebral palsy has the Prevalence of, 2 per 1000 live birth in developing countries. Spasticity is depends on velocity of movement which gives rise to the abnormal muscle tone which is associated with upper motor neuron paralysis⁽⁸⁾. The Prevalence of Spastic Quadriplegic Cerebral Palsy between the age group of 5-12 years is around 11% of the other variant of cerebral palsy ⁽⁹⁾. In Cerebral palsy children balance is affected due to impaired development of neural control mechanism that leads to poor postural balance and may cause musculoskeletal abnormalities. Balance helps one to align the centre of mass with the base of support so that the body remains in space⁽¹⁰⁾.

GMFCS is a five level classification that measures the gross motor function of the child who is suffering from cerebral palsy. Children with cerebral palsy can use GMFCS level to improve their daily activities and to participate socially. Gross motor Functional classification system has 5 level system which are as follows :-Level I :- Walks without Limitation .Level II :- Walks with Limitation (no Mobility aids by 4 years).Level III:- Walks with hand held mobility device. Level IV :- Self mobility with limitation, may use power. Level V :- Transported in manual wheelchair ⁽¹¹⁾.

In Cerebral Palsy children, the ambulation of the children is affected due to musculoskeletal defacement. In Spastic Quadriplegic Cerebral Palsy there is an appearance of pelvic obliquity due to muscle imbalance.⁽¹²⁾.

Spasticity is a common indication of neurologic conditions that causes loss of motion as well as discomfort with muscular spasms. This is because the upper motor neurons are responsible for exerting a controlling effect on the lower motor neurons⁽¹³⁾. According to earlier research, proprioceptive neuromuscular facilitation has been successful in improving trunk control and lower limb coordination in children with cerebral palsy⁽¹⁴⁾. According to many research this is concluded that pelvic PNF techniques is beneficial in improving pelvic malalignment in spastic cerebral palsy children⁽¹⁵⁾.

Cerebral Palsy is a prevalent neurodevelopmental disorder which is encountered in clinical setups. Majority of children with cerebral palsy manifests themselves with numerous musculoskeletal defacements such as pelvic asymmetry which ultimately hinders with the geometry of pelvis, as pelvis acts as a connecting structure in between the trunk and lower limbs therefore it is necessary to have an optimal control of the pelvis for a normal gait as the pelvis acts as an important determinant of gait. Prior researches were done on pelvic PNF techniques in spastic diplegic cerebral palsy in which a significant improvement has been noticed in the function of trunk as well as pelvis but there is a deficiency of literature regarding the delivery of pelvic PNF on spastic quadriplegic cerebral palsy.

METHODOLOGY: -

STUDY SETTING: - :

- Paediatric OPD & IPD, Primary Health Care Centre.
- MGM Rehabilitation and fitness centre, Aurangabad.

STUDY DESIGN AND SAMPLE SIZE: -

In this Randomized Clinical Trial. The number of subjects enrolled in the experimental study will be 22 (n=22).

STUDY POPULATION: -

Subjects having Spastic Quadriplegia.

SAMPLE SIZE CALCULATION: - For Calculation of Sample size for Present study, G. Power Software is used. Alpha = α =0.07, Power =0.80, large effect was Consider=0.8. Using G*Power software Sample size will found to be 11 samples / patients in each group .

$$\begin{aligned}x &= Z(c/100)2r(100-r) \\n &= N x / ((N-1)E^2 + x) \\E &= \text{Sqrt}[(N - n)x / n(N-1)].\end{aligned}$$

SAMPLING TECHNIQUE:

Simple Random sampling
(Computer Generated Number table / Lottery method).

SAMPLE SIZE:- 22.**INCLUSION CRITERIA**

1. Children with Spastic Quadriplegic Cerebral Palsy.
2. Children between the Age of 5 to 12 years.
3. Male and Female Child with Spastic Quadriplegic Cerebral Palsy.
4. Children ranging from GMFCS Stage I to Stage III.
5. Children coming under MAS grade with 1 or 1

EXCLUSION CRITERIA:

1. Children who have had any kind of lower limb or spine surgery.
2. Children coming in GMFCS scale Stage IV and Stage V.
3. Children with other Variant of Cerebral palsy.
4. Children below the age of 5 years and more than 12 years.
5. Children having MAS grade more than 1+.

PARTICIPANT TIMELINE: -

The study will run for six months, including a four-week intervention. Participants will be enrolled within the first four months of the trial to ensure a successful completion of the four-week intervention. On the first day, a gait parameter assessment utilizing PBS would be conducted.

IMPLEMENTATION: -

The procedure of randomization will be supervised by the principal investigator and research coordinator. The recruiting process for either group will require participants to manually choose the sealed envelope group allocation.

BLINDING: - The assessor should remain anonymous while allocating the subjects to the groups. It will be mandatory for individuals to withhold any information about their therapy from the assessor in order to guarantee blindness.

SAMPLE SIZE CONSIDERATION: - The Purpose of this Randomized Clinical Trial is to assess the effects of Pelvic PNF Techniques on gait and balance metrics in children with spastic quadriplegia using an experimental two-group design. 22 participants in total will be recruited, and they will then be randomly assigned.

PROCEDURE: - From the MGM Paediatrics OPD and IPD , Primary Health care Centre, Paediatrics Centre in Aurangabad, 22 subjects with pelvic asymmetry and spastic quadriplegia will be chosen and divided into two groups.

GROUP A- Experimental Group

GROUP B- Comparator Group.

GROUP A:- Group A will Receive Pelvic Proprioceptive Neuromuscular Facilitation (PNF), Task oriented Training with Trunk exercises And Conventional Training for upper extremity with static stretching . Using the paediatric balance scale , gait parameters, and Modified Ashworth Scale (MAS) the participants' pre-treatment evaluation will be documented.

Pelvic Proprioceptive Neuromuscular Facilitation techniques will include Rhythmic Stabilisation, Rhythmic Initiation and Slow Reversal technique, Task oriented training will include trunk exercises and Conventional Training For Upper Extremity will include Static Stretching.

Rhythmic Stabilisation – In this technique the therapist provides the stability while performing the movement. Isometric Co-contraction of Agonists than Antagonist is performed with the instruction of not to allow the therapist to move during movement.

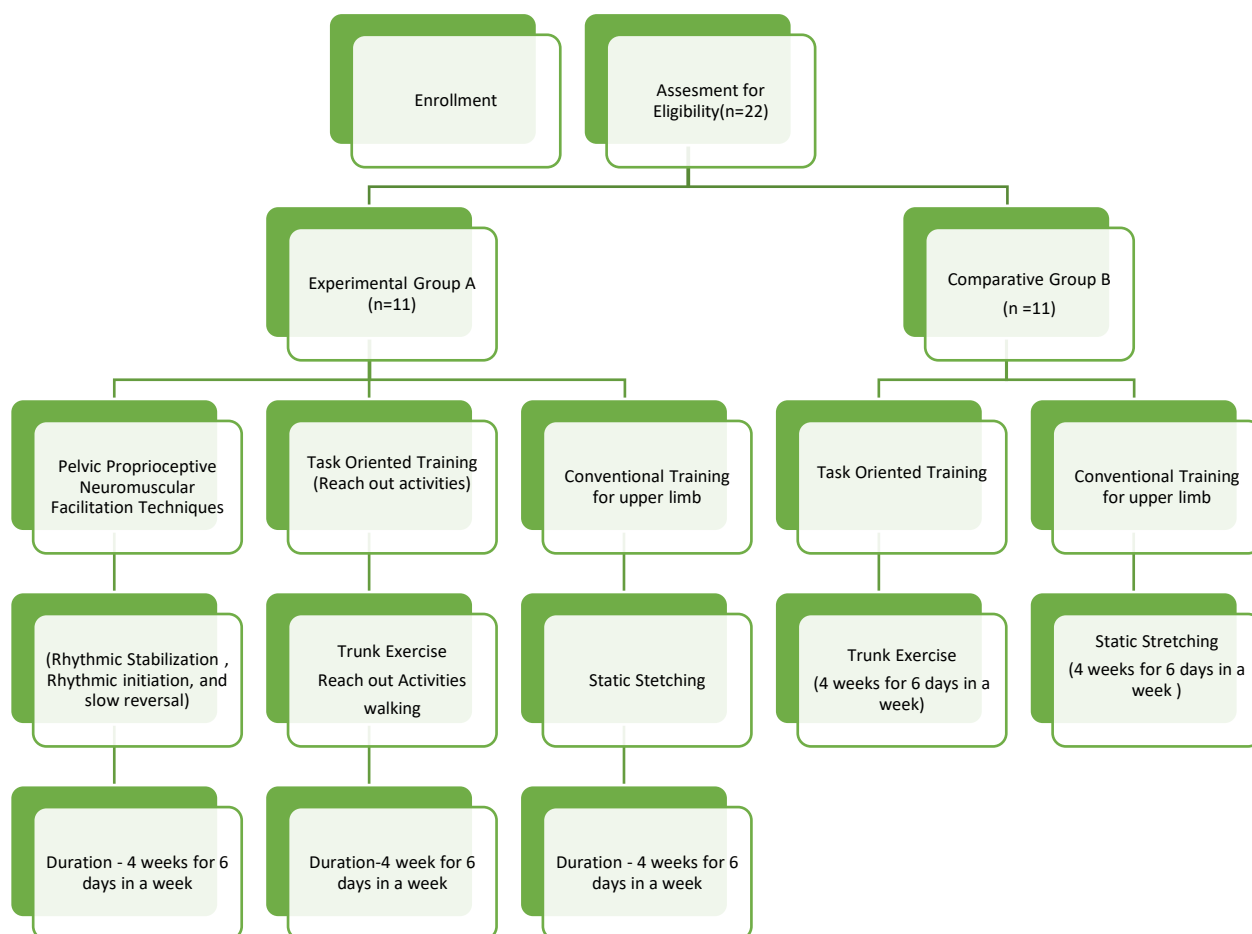
Rhythmic Initiation- Rhythmic Initiation: Using passive range of motion at first, followed by active-assisted, active-resisted, and finally active range of motion, the therapist will first guide the patient through a desired movement.

Slow Reversal- The agonist group contracts in an isotonic manner first, then in an isometric manner. Each active movement is concluded by a hold command.

Pelvic Proprioceptive Neuromuscular Facilitation will take place for 15 minutes on each sides, with task-oriented training for 15 minutes, six days a week, for a total of four weeks. and Conventional therapy for Upper extremity for 15 mins, 6 days per week for 4 week.

GROUP B: - Group B will Receive Task oriented Training with Trunk exercises And Conventional Training for upper extremity with static stretching For 30 mins ,6 days per week for 4 week . The individuals' pre-treatment evaluation will be documented using the Modified Ashworth Scale (MAS), the Gait Parameters, and the Paediatric Balance Scale.

The individuals' baseline evaluation will be conducted using the Modified Ashworth Scale, which measures spasticity, the Paediatric Balance Scale (PBS), and Gait Parameters (step length and cadence). Group B will get therapy for 30 minutes six days a week for a total of four weeks. Following the intervention, the individuals will be reassessed using the PBS, Gait parameters, and MAS that were previously mentioned in the baseline or pre-assessment.



OUTCOME MEASURES: -

Paediatric Balance Scale (PBS)

In order to evaluate functional balance abilities in school-aged children, the Paediatric Balance Scale modifies the Berg Balance Scale. The maximum score on the scale, which consists of 14 elements, is 56 points, with the lowest function receiving a score of 0 and the greatest function receiving a score of 4.

Gait Parameters

Following will be included :-

- Cadence
- Step length.

Gross Motor Function Classification System (GMFCS)

This is a 5-level classification system of gross motor function. It is mostly designed for children with cerebral palsy. Wheeled mobility, walking, and sitting are the main focus of this five-level categorization system. A child is classified based on their level of proficiency in doing particular functional tasks and whether they require the use of assistive technology (walkers, crutches, or canes) or wheeled mobility.

Modified Ashworth Scale (MAS)

Modified Ashworth Scale is used to measure the extent of spasticity in children with Spastic variants of Cerebral Palsy. Spasticity is usually graded by the therapists in six different grades ranging from 0, 1, 1+, 2, 3 and 4 in which 0 depicts no increment in the tone and 4 depicts a rigid limb in a particular position.

DATA COLLECTION AND MANAGEMENT: - The individuals' data will be gathered using the Modified Ashworth Scale, the Paediatric Balance Scale, and gait parameters both before and after the intervention or treatment.

STATISTICAL ANALYSIS:

Microsoft Excel will be used to enter data, and SPSS version 24.0 will be used for analysis. For quantitative variables, the mean and standard deviation will be determined, and for categorical variables, the proportions. Additionally, data will be shown visually using bar diagrams and other similar formats. To determine whether there is a significant difference between the two groups, an unpaired test will be used. The chi-square test will be utilized to examine the correlation between various qualities. A P-value of less than 0.07 will be regarded as statistically significant.

DISCUSSION:

In order to assess the effectiveness of pelvic PNF techniques on balance and gait parameters in children with spastic quadriplegia, a randomised clinical trial research study has been conducted. A literature review on the effect of Pelvic PNF on Pelvic Asymmetry in Children with Spastic Quadriplegic Cerebral Palsy will also be provided by this study. Numerous studies have demonstrated the beneficial effects of Pelvic Proprioception Neuromuscular Facilitation on trunk function and lower extremity function in individuals with cerebral palsy and seemed to be in resemblance with the current study.

LIMITATIONS:

1. Small sample size has been taken for the study
2. As it is a time bound research so it is devoid of the follow up

FUTURE SCOPE: The same study can be planned using a large sample.

CONCLUSIONS: -

The goal of this study is to determine how well Pelvic PNF approaches are effective on balance and gait parameters in individuals with spastic quadriplegic Cerebral Palsy.

CONFIDENTIALITY: -

The participant will get an explanation of the research program, and the principal investigator will document any subjective data. The patient, primary investigator, and witnesses will all sign the permission form along with a confidentiality declaration. In the event that the patient is required to divulge any information for the study, consent will be obtained with full assurance of his privacy.

FUNDING: -

The MGM School of Physiotherapy in Aurangabad, a component of MGMIHS in Navi Mumbai, Maharashtra, India, will supply funding through the Research Cell.

CONSENT: -

The principal investigator will get the participants' signed written informed consent and accent forms on a printed form in the local language, together with the participants' evidence of confidentiality. Data will be kept once the study is over and the results are published.

ETHICAL APPROVAL: -

The study will go on after the MGM School of Physiotherapy, Aurangabad, an affiliate of MGMIHS, Navi Mumbai, Maharashtra, India, has given its institutional ethical committee clearance.

CONFLICT OF INTERESTS: - No conflicting interests are stated by the authors.

REFERENCES: -

1. Salphale VG, Kovala RK, Qureshi MI, Harjpal P. Effectiveness of Pelvic Proprioceptive Neuromuscular Facilitation on Balance and Gait Parameters in Children With Spastic Diplegia. *Cureus*. 2022 Oct;14(10):e30571.
2. McIntyre S, Morgan C, Walker K, Novak I. Cerebral Palsy—Don't Delay. *Dev Disabil Res Rev*. 2011 Nov;17(2):114–29.
3. Cerebral palsy in children: a clinical overview - PMC [Internet]. [cited 2023 Sep 5]. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7082248/>
4. Rajalaxmi V, Swetha P, Deepthi RNV, Sathya R, Omana S, Sivapragasam P. Efficacy of task-oriented training vs proprioceptive neuromuscular facilitation on mobility and balance in spastic cerebral palsy. *Biomedicine*. 2021 Jul 7;41(2):297–300.
5. Kumar C, Kataria S. Effectiveness of Task Oriented Circuit Training on Functional Mobility and Balance in Cerebral Palsy. *Indian J Physiother Occup Ther - Int J*. 2013;7(4):23.
6. Dahal T. The Endemic and Causes of Cerebral Palsy. 2022 Jul 14;10:901–8.
7. Legg J, Davies E, Raich AL, Dettori JR, Sherry N. Surgical Correction of Scoliosis in Children with Spastic Quadriplegia: Benefits, Adverse Effects, and Patient Selection. *Evid-Based Spine-Care J*. 2014 Apr;5(1):38–51.
8. Kovala R, Thakur A, Pamidigantam P, Sunjyoth H. Effect of PNF in improving Lower Extremity Function in Adolescent with Spastic Diplegic Cerebral Palsy. 2020 Jul 1;
9. A Cross-sectional Study Of Clinical Profile Of Cerebral Palsy Patients Visiting A Government Tertiary Care Hospital From Maharashtra, India, Paripex - Indian Journal Of Research(PIJR), PIJR | World Wide Journals [Internet]. [cited 2024 Feb 8]. Available from: <https://www.worldwidejournals.com/paripex/article/a-cross-sectional-study-of-clinical-profile-of-cerebral-palsy-patients-visiting-a-government-tertiary-care-hospital-from-maharashtra-india/MTQ5NTc=/?is=1&b1=229&k=58>
10. Said D, hussein Z, Ali M, Ali B. RESEARCHARTICLE EFFECT OF PELVIC STABILITY ON BALANCE IN CHILDREN WITH SPASTIC CEREBRAL PALSY. *Int J Multidiscip Res Rev*. 2021 Sep 16;7:5449–52.
11. Stability of the gross motor function classification system in children with cerebral palsy for two years | BMC Neurology | Full Text [Internet]. [cited 2023 Sep 5]. Available from: <https://bmcneurol.biomedcentral.com/articles/10.1186/s12883-020-01721-4>
12. Cloake T, Gardner A. The management of scoliosis in children with cerebral palsy: a review. *J Spine Surg*. 2016 Dec;2(4):299–309.
13. Frontiers | Spasticity Mechanisms – for the Clinician [Internet]. [cited 2023 Sep 14]. Available from: <https://www.frontiersin.org/articles/10.3389/fneur.2010.00149/full>
14. Kim Y, Lee BH. Clinical Usefulness of Child-centered Task-oriented Training on Balance Ability in Cerebral Palsy. *J Phys Ther Sci*. 2013;25(8):947–51.
15. Salphale VG, Kovala RK, Qureshi MI. Appraisal of the Effectiveness of Pelvic Proprioceptive Neuromuscular Facilitation Methods to Optimize Balance and Gait in an Eight-Year-Old Child. *Cureus* [Internet]. 2022 Sep 27 [cited 2023 Sep 17]; Available from: <https://www.cureus.com/articles/115154-appraisal-of-the-effectiveness-of-pelvic-proprioceptive-neuromuscular-facilitation-methods-to-optimize-balance-and-gait-in-an-eight-year-old-child>
16. Hassan D, Salim E, Bishay S, Fakharany M. Cobb angle measurement and pelvic inclination in children with spastic cerebral palsy: A cross-sectional study. *Ann Clin Anal Med*. 2021 May 15;12:15–9.
17. EBSCOhost | 145355851 | Effectiveness of Pelvic Proprioceptive Neuromuscular Facilitation on Trunk Control in Children with Spastic Diplegia: A Randomized Controlled Trial. [Internet]. [cited 2023 Sep 15]. Available from: <https://web.s.ebscohost.com/abstract?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09760245&AN=145355851&h=BWdNe6zeVB8cuHcaqmMHA%2bztMCn9pjnHstt6K9mOYVHRuKpEpiqjtiy%2bVcDAXOWT6WPAhcVRAw2AynP7csdkoA%3d%3d&crl=c&resultNs=AdminWebAuth&resultLocal=ErrCrlNotAuth&crlhashurl=login.aspx%3fdirect%3dtrue%26profile%3dehost%26scope%3dsite%26authype%3dcrawler%26jrnl%3d09760245%26AN%3d145355851>
18. ALIMIL E, KALANTARI M, NAZERI AR, AKBARZADE BAGHBAN A. Test-retest & Inter-rater Reliability of Persian Version of Pediatric Balance Scale in Children with Spastic Cerebral Palsy. *Iran J Child Neurol*. 2019;13(4):163–71.
19. Harb A, Kishner S. Modified Ashworth Scale. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 [cited 2023 Sep 14]. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK554572/>