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Original Article

Effects of Functional Strength Training Using Universal Exercise Unit on Spasticity of Lower Extremities Among Children with Cerebral Palsy; A Quasi-Experimental Study

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ABSTRACT

Background: Cerebral palsy is a non-reversible disorder of movement and posture. Its incidence is very high globally with 2 to 2.5 per 1000 live births. In Pakistan, spastic type of cerebral palsy is most common and major reason for disability among children. **Objective:** To find out the effects of functional strength training in a universal exercise unit on spasticity of lower extremities among children with cerebral palsy. **Methods:** A quasi-experimental study was conducted from July to December 2020 at Khawaja Arshad Hospital, Sargodha, Pakistan on 15 spastic diaplegic children with cerebral palsy that were collected by simple purposive sampling. A baseline measurement was done by using the Modified Ashworth Scale. Intervention includes two sessions of universal exercise unit on alternate days with functional strength training exercises in between. A specially designed treatment approach was given in the universal exercise unit for 8 consecutive weeks after that; post-treatment assessment was done. Data was analyzed by way of the usage of SPSS version 21 and Wilcoxon signed rank test was used. **Results:** The study comprised 15 participants, where 10 (66.6%) were male and 5(33.3%) were female. About 12 (80%) were of age <5 and 3(20%) years. In this study, the Modified Ashworth scale is used to assess any changes in the spasticity of children who were having treatment sessions in a universal exercise unit. The mean spasticity score was 3.4±0.5 and 1.46±0.99 pretest posttest respectively. In the results mentioned, there is a clinical significance of 0.001 that showed that there is a significant difference in spasticity pre and post-treatment. Results were taken by applying the Wilcoxon signed-rank test. **Conclusion:** Universal exercise unit has positive effects on lower extremity functional outcomes among children with cerebral palsy. It may decrease the spasticity of joints in the lower extremity so there is a need for more studies to be done.

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INTRODUCTION

Cerebral palsy (CP) is a non-reversible disorder of movement and posture, that results in non-progressive activity restrictions resulting from any injury that affects the immature brain.[1] Incidence of cerebral palsy is very high globally which is 2 to 2.5/1000 live births.[2] In Pakistan spastic type of CP is the most common and the major risk factors for cerebral palsy children are cousin marriages, home delivery and infections of the mother during conception. Etiological factors that seem to have a great impact are preterm labor or premature birth, mother ailments during pregnancy, birth asphyxia and brain damage due to any injury during delivery.[3] Motor deficits in children with cerebral palsy are due to muscular weakness, spasticity, contractures and lack of selective motor control.[4] If spasticity is neglected in children with cerebral palsy it leads to contractures of muscles, ligaments and tendons which in turn has adverse effects on the functionality of these children.[5] CP with spastic diplegic have limitations in spinal, pelvic and hip joint movement which leads to asymmetric pelvic tilt/rotation during the swing phase of the gait. The hip remains in a flexed position and it is difficult to achieve full hip extension while the knees remain either flexed or in a hyperextended position during the stance phase of the gait cycle, feet remain in heel-off position in most cases.[6] When it comes to the treatment of a CP child, there are multiple domains and multiple healthcare professionals involved in dealing with a CP child while physiotherapy plays a very important role in dealing with this disabling condition.[7] In general, CP treatment is aimed at preventing deformities, improving functionality, and providing appropriate treatment, tools and environment that help them to achieve optimal function.[8] Many physical therapy techniques are used in managing cerebral palsy, but the most effective technique is not yet known. Intensive physical therapy techniques in the form of universal exercise unit (UEU), thera suits, thera togs with other physical therapy techniques are now in trend. At least two sessions of aggressive physical therapy sessions seems to be well tolerated by these children and motor performance did not decline during the rest period of therapy.[9]

The basic concept of using UEU in CP children is to unload the weak musculature against gravity and to perform the movement of weak body parts. It activates the child's proprioceptive and somatosensory systems and sends signals to the brain that may help the child learn the correct pattern of movement.[10] According to my knowledge, limited data is available on the effectiveness of UEU specifically, on lower limbs in children with spastic CP and stretching is the only treatment approach that is used so far for spasticity, while no other physical therapy treatment is studied for its effectiveness. In Pakistan, there are only a few centers where UEU is being used for the training of CP children. The purpose of this study was to find out the effectiveness of UEU on the spasticity of lower extremities among children with CP.

METHODS

It was a quasi-experimental study that was conducted at Khawaja Arshad Hospital, Sargodha, Pakistan for six months. The population for this study was collected by using a simple purposive sampling procedure. Only 15 children with age 4-10 years, spastic diaplegic CP and children with enough cognition to follow task directions were selected for the study. While, children undergoing orthopedic surgery, uncontrolled seizures, disabilities like; fractures and following a botox regime for spasticity were excluded from the study.[11] Informed consent was taken from parents before starting intervention. Baseline measurement was taken by using the Modified-Modified Ashworth scale. This tool has good validity and

reliability in measuring spasticity among children with CP.[12] This tool has five scales on which spasticity is measured that range from 0-4; 0 means no increase in tone of muscles and 4 means the affected part is unable to move and rigid in flexion or either in extension.[13] After baseline assessment a treatment approach is selected and treatment is started for 8 weeks. A selected treatment approach was given for two days a week on alternate days in between this functional strength training is given. Therapy sessions are given for 40 minutes 2 days a week. Treatment includes a 30-minute session in the UEU with pre and post-5 minutes of stretching. Warm-up included 10 repetitions of stretching hamstrings, quadriceps, hip adductors and Achilles tendon with frequency of 5. The exercise included sitting, quadruped, a quadruped with reaching, kneeling, half kneeling left and right, sit to stand, leg press while standing, loaded sit to stand and forward step up, left and right, lateral step up and right left jumping (Table I). The same treatment is given to all children included in the study. After giving treatment for 8 consecutive weeks post treatment assessment was taken. Data was analyzed by way of the usage of SPSS version 21 and Wilcoxon signed rank test was used.

RESULTS

The study comprised 15 participants, where 10 (66.6%) were male and 5(33.3%) were female. 12 (80%) have age of <5 and 3(20%) with 5 years of age. In this study, the Modified Ashworth scale is used to assess any changes in the spasticity of children who were having treatment sessions in a universal exercise unit. The mean spasticity score was 3.4±0.5 and 1.46±0.99 pretest posttest respectively (Table II). In the results mentioned, there is a clinical significance of 0.001 that showed that there is a significant difference in spasticity pre and post-treatment. Results were taken by applying Wilcoxon signed rank test (Table III)

DISCUSSION

Despite having a great role of lower extremity control in functional abilities, very little emphasis is given to the assessment of lower extremities among children having CP and there is a huge literature gap to find out the effectiveness of UEU on balance and control of lower extremities among children having CP and there were insignificant researches performed to prove its efficiency; thus there is a need for more research studies in this field. In the present study effectiveness of UEU was assessed in reducing the spasticity of lower extremities among children with CP. This unit seems to decrease neurological and pathological reactions that affect mobility.[14] As stated by Ahmed K and his colleagues revealed UEU might consider being an efficient method in improving standing balance among spastic CP that is also in favor of this study because of decreasing spasticity there is an improvement in lower extremity function and balance.[15] In a recent study treatment by using UEU along with stretching revealed a significant improvement in spasticity (p=0.001). That shows that functional strength training using UEU along with stretching decreases spasticity in children with CP. In the present study, we use UEU along with stretching and there may be an improvement in spasticity due to stretching exercises.[16] Damiano stated that there is no scientific evidence that shows that functional strength training increases spasticity while in some cases it might decrease spasticity so this study is also in favor.[17] Results of the current study about improvement in functional strength of lower extremities in children with CP also come in agreement with the study done by Ahmed and Hebatallah et al., may be due to the same study population of spastic diplegic and both studies focusing on the lower extremities only. According to their study, UEU can be an effective way of treatment for improving functional strength in the lower extremity of children with spastic

Table 1: Treatment Approach

Sr. #	Intervention	Rep	Frequency
1	**Warm Up** Stretching of hamstrings Quadriceps, Hip Adductors Achilles tendon	10 Reps	5 Minutes
2	**Exercises** Sitting, Quadruped Quadruped with Reaching Kneel and Half kneel Left and right sit to stand Leg Press while standing Loaded sit-to-stand Forward step up Left and Right Lateral step-up Left and Right Jumping	5 Reps	2 Sessions per week
3	**Cool Down** Walking or Stretching		5 Minutes

diplegic CP when compared with functional resisted exercises.[18] The significant improvement in post-intervention outcomes might be due to the selected physical therapy treatment plan that is directly linked to inhibiting abnormal reflexes and abnormal postural tone that is due to resisted functional training as demonstrated by Blundell et al. that training of specific brain areas leads to long-lasting cortical reorganization.[19] A systemic review by Shital and colleagues that was based on a review of 11 articles stated that a spider cage is an effective system of treatment for CP children. It is found to have a great improvement in balance and motor functions in children with CP which is also in favor of our study as improvement in spasticity has a great impact on motor function and balance of children with spastic cerebral palsy.[20]

Table 2: Pre and Post-intervention Description of Spasticity using Modified Ashworth Scale

Variable	Time of intervention	No of children	Mean ±S.D
Spasticity	Pre-intervention	15	3.4±0.5
	Post-intervention	15	1.47±0.99

The current study has limitations in that children may be receiving any other intervention besides physical therapy or the improvement that is seen in spasticity is because of stretching. So, for future studies, I recommend exclusive training in the universal exercise unit without adding stretching as an intervention to see its effects on spasticity.

CONCLUSION

In children with spastic CP, training using a universal exercise unit seems to be an effective way of decreasing spasticity, but its effects vary from child to child and the degree of spasticity they have. Universal exercise unit has positive effects on lower extremity functional outcomes among children with cerebral palsy. It may decrease the spasticity of joints in the lower extremities there is a need for more studies to be done that can find its effectiveness according to the degree of spasticity they have.

DECLARATIONS

Consent to participate: All methods were performed following the relevant guidelines and regulations.

Availability of data and materials: Data will be available on request. The corresponding author will submit all dataset files.

Competing interests: None

Funding: No funding source is involved.

Table 3: Related-Samples Wilcoxon Signed Rank Test Summary of Modified Ashworth scale

Total sample	15
Test Statistic	.000
Standard Error	17.255
Standardized Test Statistic	-3.477
Asymptotic Sig.(2-sided test)	.001

Authors' contributions: All authors read and approved the final manuscript.

CONSORT Guidelines: All methods were performed following the relevant guidelines and regulations.

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