Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(2), 1367-1371 | ISSN:2251-6727

A Study to Compare the Effect of Water Walking Performed at Different Water Depths on Balance in Spastic Diplegic Cerebral Palsy: An Comparative Study

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(Received: 07 January 2024 Revised: 12 February 2024 Accepted: 06 March 2024)

KEYWORDS

Spastic Diplegic Cerebral Palsy, Aquatic Therapy, Balance, Pediatric balance scale

ABSTRACT:

BACKGROUND: CP is a neurological non-progressive static disorder of the brain that results from brain insult or injury during any of the antenatal, perinatal and postnatal stages. Spastic diplegia (SD) is a motor impairment in the upper extremities as well as the lower extremities, even though the upper extremities less affected than the lower one. Aquatic therapy includes buoyancy, hydrostatic pressure, and hydrodynamic force which may allow children with Spastic Diplegic Cerebral Palsy to exercise in the water with more freedom than on land. Water viscosity also offers resistance, which is often used in aqua therapy programs.

OBJECTIVE: To compare the effect of water walking performed at different depths (i.e. Nipple Level & ASIS Level) on balance in Spastic Diplegic Cerebral Palsy.

METHODOLOGY: A total of 30 Subjects were included in study according to selection criteria. They were divided into 2 groups, 15 Subjects in each group, in group A, water walking performed at water depth at nipple level and in group B, water walking performed at water depth at ASIS level. The balance was assessed with pediatric balance scale. Outcome Measures were taken on day 1 and after 6 weeks.

RESULTS & CONCLUSION: Balance improves in both groups, but in group A improvement is significant more than in group B. That means, water walking performed at water depth at nipple level showed significantly more improvement in balance than water walking performed at water depth at ASIS level.

1. Introduction

Cerebral palsy (CP) is a well-recognized neurodevelopmental condition beginning in early childhood & persisting through the lifespan.[1] Cerebral palsy (CP) defines as a group of disorders which affects posture and movement, which leads to activity limitation. It is known to non-progressive neurological conditions that happened in the early state of infant brain or fetal. The motor disorders of CP are often associated with the symptoms of higher mental functions like communication, sensation, perception, cognition and behavior changes, and other problems related to musculoskeletal problems.[2]

Spastic diplegia (SD) is a motor impairment in the upper extremities as well as the lower extremities, even though the upper extremities less affected than the lower one. Marked weakness in the trunk and hypertonia of the extremities are seen. [3] The spastic CP type is described by exaggerated deep tendon reflexes, increased muscle tone, muscle weakness, and gait affection. Nearly 70–77% of CP cases were spastic CP.[4]

A child with Spastic diplegia assumes standing with flexion, adduction and internal rotation of the hip, with excessive flexion of the knee and equines foot. The constrained capacity to generate force result in activity limitation more than the spasticity did.[5]

In spastic diplegic cerebral palsy, atypical gait patterns can result from a disorder of balance, muscle weakness, spasticity and skeletal abnormalities.[6,7,] This atypical gait pattern is characterized by lack of mobility in the lumbar spine, pelvis, hip joints and appearance of asymmetric pelvic movement during walking. A lot of the

Journal of Chemical Health Risks

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JCHR (2024) 14(2), 1367-1371 | ISSN:2251-6727

ambulatory children with spastic diplegia were able to manage a walk in the form of a crouch gait with flexed hips, knees and ankles.[8] The overall prevalence of cerebral palsy survival rate is 2.95 per 1000 children. Analysis for rural, urban and mixed rural-urban prevalence is 1.83, 2.29 and 4.37 respectively.[9]

There are various physical therapy approaches used for children with Cerebral Palsy like Sensory Integration, NDT, strength training, functional physical therapy, electrical stimulation, water-based (aquatic) exercises. Water-based (aquatic) exercises are one of the physical therapy interventions used for kids with Cerebral Palsy. Postural strength improves by decreasing the effect of the gravitational force by using water; facilitating the Cerebral Palsy child to exercise more smoothly than on land.[10-14]

Water-based (aquatic) therapy has physiological sound effects that classify into thermal & mechanical effects. Mechanical effects include hydrodynamic and hydrostatic effects. The mechanical effects of water-based (aquatic) therapy comprise of hydrostatic pressure, buoyancy, and hydrodynamic force. Buoyancy cuts the influence of gravitational force and enables kids with cerebral palsy to execute actions they cannot perform straight forwardly on land. Hydrostatic pressure contributes to muscle training and hydrodynamic forces assist in balance and posture training. Thermal properties can diminish pain and spasticity in kids with cerebral palsy.15

Water-based (aquatic) therapy exercises are more suitable for Cerebral Palsy children because of the unique properties of water and it may be further attention-grabbing and inspiring for kids than land-based exercises. Buoyancy creates water-based (aquatic) therapy stress-free for kids who have moderate to severe limitations in mobility to move in the water linked with moving and exercising on land. For kids who have minor mobility limitations, buoyancy enhanced joint configuration during walking and movements that are challenging on land, such as hopping, running and jumping with hardly any influence on joints. Walking in the water stand to water resistance which may help in strengthening muscles as well as aerobic exercises. Subsequently, oxygen cost for walking in water has been superior to on land for adolescents.[1]

Water-based (aquatic) therapy defends joint properties more than land-based exercises and has evidenced useful in enlightening gross motor function[16, 17] decreasing muscle spasticity, increasing aerobic endurance[18,19] vital capacity, and refining gait in kids with spastic diplegic cerebral palsy.[16,19]

Water walking can be performed at different depts such as Nipple level & ASIS level but there are few literatures comparing effect of water walking performed at different heights on balance in spastic cerebral palsy. So, the aim of this study is to evaluate the effect of water walking on balance in Spastic Diplegic Cerebral Palsy and to standardize the appropriate depth of water walking for improvement of balance in a patient with Spastic Diplegic Cerebral Palsy.

2. Objective

To compare the effect of water walking performed at different depths (i.e. Nipple Level & ASIS Level) on balance in Spastic Diplegic Cerebral Palsy.

3. Methods

Thirty patients were selected according to selection criteria by convenient sampling. Detailed procedure was explained to parents in their own language and Institutionally approved Inform Consent was taken from the parents, who were willing to allow their child to participate. These subjects divided into 2 groups, group A & B (15 Subjects in each group).

Subjects were selected based on bellow mentioned criteria

Inclusion Criteria[20]–

•Pre-Diagnosed Spastic cerebral palsy, aged 6 to 10 years.

•Both Gender (Male & Female)

•Able to follow simple verbal instructions

•Gross Motor Function Classification System levels of I to III

• Willing to participate

Exclusion Criteria[20] –

•Receiving botulinum toxin injection

•Hospitalization in the last six months

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JCHR (2024) 14(2), 1367-1371 | ISSN:2251-6727

•Cardiovascular and respiratory dysfunction

•Severe renal disease

•Open wounds & Skin infections

•Bowel or bladder dysfunction

•Water and airborne infections or diseases

• Uncontrolled seizures

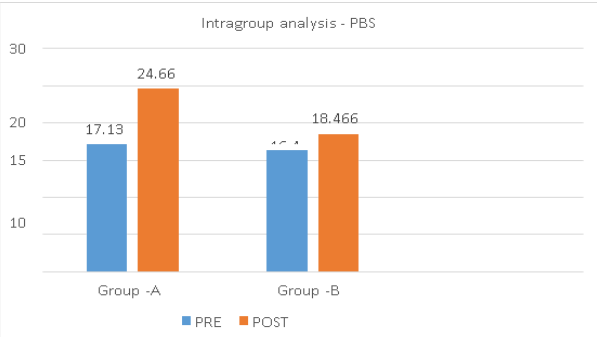
Treatment protocol of group A & B was 10 minutes poolside exercises including warming-up, active ROM exercises, and stretching. 25 minutes of walking in the water at a water depth of Nipple Level for group A & at ASIS level for group B and 5 minutes of cool-down (such as slow walking).

Patients were evaluated for balance on Pediatric Balance Scale Day 1 & After 6 weeks.

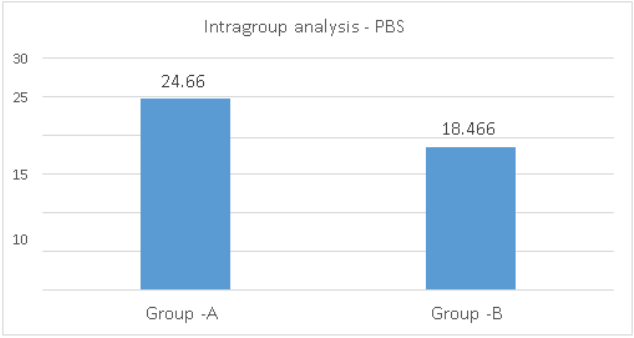
4. Results

Statistical Package for Social Sciences (SPSS) version 21.0 for windows was used for statistical analysis. Microsoft excel was used to create graphs. Measuring variables of the pretreatment mean values in both groups showed non-significant differences, these findings demonstrated the homogeneity between both groups before starting the study. Within group analysis was done to check the effectiveness in both the groups. Pre and post data in group A & Group B were analysed using Wilcoxon signed- rank test. Between group analysis was performed to compare the effect of both groups. Data was analysed using Mann-Whitney U Test for Paediatric Balance Scale.

Graph 1 shows within group pre & post comparison analysis for paediatric balance scale



Graph 2 shows between group A & B analysis for pediatric balance scale



In within group comparison water walking at nipple level as well as ASIS level shows improvement in balance of spastic cerebral palsy. More improvement was found within Water Walking Performed at Water Depth at Nipple Level.

5. Discussion

Our results showed that water walking at nipple level as well as ASIS level shows improvement in balance of spastic cerebral palsy. This is because of the unique properties of water that may reduce risks associated with joint loading, and may allow a child to engage more easily in aerobic activity than land-based exercise. The resistive forces of buoyancy and viscous drag which permits a variety of aerobic and strengthening activities on lower extremities that can be easily modified to accommodate the full range of motor abilities of children with CP. [20]

Our findings are consistent with Saeid Fatorehchy et al who concluded that water-based program increases functional balance on a pediatric balance scale and walking capacity on 1-minute walk test in kids with cerebral palsy.[20]

Wanees m. BADAWY et al., made a comparison between the effects of water- based exercises and land-based exercises on balance and locomotion in spastic diplegic cerebral palsy kids and concluded that both water-based (aquatic) and land-based training may benefit children with CP by improving balance and locomotion in short duration.[21]

By reducing joint compression, providing three-dimensional resistance, and dampening perceived pain, immersed strengthening exercises may be safely initiated earlier in the rehabilitation program than traditional land strengthening exercises. Both manual and mechanical

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JCHR (2024) 14(2), 1367-1371 | ISSN:2251-6727

immersed strengthening exercises typically can be done in waist-depth water. However, some mechanical strengthening exercises may also be performed in deep water. Frequently, immersion alters the mechanics of active motion. For example, the vertical forces of buoyancy support the immersed upper extremity and alter the muscular demands on the shoulder girdle.

The post average means of Pediatric Balance Scale in group A and group B were 24.66 and 18.46 respectively. More improvement was found within Water Walking Performed at Water Depth at Nipple Level. It is because of the difference in the level of immersion. Immersion improves balance abilities by increasing proprioceptive input to the immersed body and provides it with greater body alignment and stability.[21] Sensory feedback may also increase, thus increases the sensory output to the muscles to contract to stabilize postural alignment because resistance to movement through a viscous fluid like water is more significant than resistance through the air.

Concerning the depth of immersion, the greater it is, the weaker it will be the ground reaction force (GRF) in the vertical plane. However, the GRF in the anterior-posterior plane will be greater as the depth of immersion increases, as more force is required to move the body forward against water resistance. So that strength also improves more with increased immersion.[22]

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