

Effect of Aquatic Exercises on Balance and Quality of Life among Cerebral Palsy

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Abstract

Cerebral Palsy (CP) is a common neurodevelopmental disorder of non-progressive brain lesion that occurs during infancy or up to the age of five years and the disability persists lifelong that increases the socioeconomic burden on family and society both. Hence the objective of this study is to determine the efficacy of aquatic exercises on balance and quality of life among spastic Cerebral Palsy GMFCS level III and IV children. A single-blinded Randomized Controlled Trial was conducted at tertiary care hospital with Spastic Diplegic CP Children with GMFCS III and IV Level.

A total sample of 54 Cerebral Palsy children were selected for the study using envelope method and after initial assessment 8 participants lost the study and remaining 46 participants were randomly divided into Group A (n=24) Aquatic Exercises and Group B (n=22) Land-based exercises. Each group exercised 3 times per week for 16 weeks and their pre and post balance and quality of score were measured using PBS and PedsQL respectively. The results were drawn between participant's 8.70 ± 2.021 years and 9.50 ± 1.81 years in Group A and B respectively. The result showed significant difference in improving balance in the aquatic group (A) when compared with the land based exercises. However the quality of life is significantly improved in both groups A and B. The study concluded 16 weeks of aquatic therapy was found to be effective managing the balance and improving QOL among spastic cerebral palsy GMFCS III and IV hence further studies with large sample size should be done for the generalizability of the results.

Index Terms: Cerebral Palsy, Gait, Health-Related Quality Of Life, Motor Skills Physical Activity, Spastic Diplegia

1 INTRODUCTION

Cerebral Palsy (CP) is a common neurodevelopmental disorder caused by a non- progressive lesion of brain that develop at the time of infancy or up to the age of 5 years and the disability persists lifelong [1]. According to the International Research Foundation of Cerebral palsy, worldwide 17 million children suffer from the disease with the prevalence of 1.2 to 4 each 1000 live births [2]. In Pakistan, incidence of CP accounts for approximately 1.22 per 1000 live births [3]. Although this number is low as compared to the world wide prevalence but actual number is expected to be much higher mainly because of lack of reporting of such cases and poor public health care infrastructure. Spastic CP being the common type among all the types of CP suffer the motor impairment in both upper and lower limbs, milder in upper limb while profound impairment in the lower limbs that ultimately leads to the impaired balance and coordination. Balance related problems in spastic cerebral palsy occur due to the muscle inactivation and loss of Proprioceptive mechanism in CP resulting impaired functional status. Physical inactivity in these children decreases their functional level, social interaction, community participation and ultimately compromising their QOL [4].

Several antenatal risk factors (maternal epilepsy, placental insufficiency and trauma), perinatal (prolonged or difficult labor, premature rupture of membrane, hypoxia and bradycardia) and postnatal (seizures, encephalitis, meningitis, neonatal hyperbilirubinemia and head trauma) are related to the etiology of the CP [5]. Intrauterine growth retardation subsequently develops the Preeclampsia is also been associated with the CP and literature revealed that maternal preeclampsia is a strong risk factor in the development of cerebral palsy. A continuous rise has been documented by many researchers regarding the context of CP related with birth asphyxia, neonatal jaundice and any head injury prior to the age of 2 years [6]. Although multiple therapeutic interventions are available for the CP management, number of studies demonstrated an existence of strong relationship between balance and QoL [7].

Therapeutic water training is diversely being used in the management of Cerebral palsy as hydro therapy being an effective method of rehabilitation used for CP management that helps the individuals to regain their mobility and daily activity and improving their QOL. Furthermore, exercising in water declines the act of gravitational force, improves postural support, decreases joint load and influence, and increases muscular and aerobic strength for individuals with CP thus water is found to be a favorable environment for rehabilitation of CP. Similarly, balance could be improved by reducing the act of the gravity by means of water and assisting the individuals with CP to exercise even better compared to land. Due to its buoyancy and resistance, the water acts as a physical support system. Furthermore, aquatic therapy improves walking speed as well as enhances ability

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to walk on uneven surfaces [8]. Moreover, walking in water, patient finds the environment attractive and enjoyable that improves the compliance to therapy session. The current literature states the exact time duration of aquatic therapy is still unclear and limited evidences is available for aquatic therapy in improving balance and participation in CP [9]. Therefore, further studies are required to evaluate whether aquatic exercises are efficient in improving balance and quality of life hence arising the need for more researches

2 METHODOLOGY

2.1 STUDY SETTING

The study was conducted at Tertiary Care Hospital in Pakistan.

2.2 TARGET POPULATION

Spastic Diplegic CP with GMFCS III or IV was selected for the study.

2.3 STUDY DESIGN

A single blinded Randomized Controlled Trial

2.4 SAMPLING TECHNIQUE

Simple Random Sampling Technique through envelope method

2.5 INCLUSION/ EXCLUSION CRITERIA

Diagnosed case of cerebral palsy aged between 6-12 years with no or mild cognitive impairment (MoCA score 18-26), having a spasticity of Grade 1 to 2 on Modified Ashworth Scale. Individual with no visual or auditory disorder with GMFCS level III-IV and with ability to follow instructions and adhere to the exercise program were selected for the study Children with fixed contractures, open wound or infective skin disease, previous lower limb surgical intervention in 6 months and with hydrophobia were excluded from the study.

2.6 INTERVENTIONAL STRATEGIES

All recruited participants were clearly briefed about the objective of the research. Informed consent from parents/guardian was taken before starting the session. Total number of 54 children diagnosed with spastic CP were recruited and their demographic data regarding age and gender was documented. The patients balance and QOL was evaluated using the PBS and pedsQL respectively prior to the intervention. The participants were randomized using envelope method into two groups, each n=27. Group A was assigned aquatic exercise program whereas Group B was assigned land-based exercises program. Both groups received exercises for 3 times in a week for continuously 16 weeks, total 48 sessions of interventions. Following the end of total 16 weeks of interventions, their post reading for balance and quality of life was measured.

2.7 ASSESSMENT TOOLS

Balance of participants was measured using pediatric balance scale before start of first session and at the end of 16th week. Pediatric balance scale is a reliable tool for the assessment of balance in children. PBS is a 14-item scale with the grading from 0 point (lowest function) to 4 points (highest function), and maximum score is 56 points. When a participant scores 56 it denotes perfect balance, any score less than 45 suggests great risk of falling.

QoL of the participants was assessed using pedsQL that is the reliable tool to measure the health-related QOL in children, composed of 23 items comprising 4 dimensions that include 8 items of physical functioning, 5 items of emotional, social and school functioning 5-point scale 0- 4 (0=100, 1=75, 2=50, 3=25,

4=0) and 3-point likert scale 0 (not at all), 2(sometimes), 4(a lot), any score less than 60% reflected poor quality of life.

2.9 ETHICAL CONSIDERATION

After receiving the approval from the ERC, informed consent was taken from participant's parent/guardian to ensure that participants must not be exposed to harm in any manner. The protection of the privacy of research participants was ensured.

3 RESULTS

A total sample size of 46 participants with Group A (n=24) Aquatic Exercise and Group B (n=22) Land Based Exercise were recruited in the study. Total 18 male and 6 female participants in Group A while 12 males and 10 females in Group B. Furthermore, the demographic detail revealed mean age of participants 8.70±2.021 and 9.50±1.81 in Group A and B respectively. Participants in the study were screened on the basis of GMFCS level, MAS grade and MoCA score. The detailed description is depicted in table-1

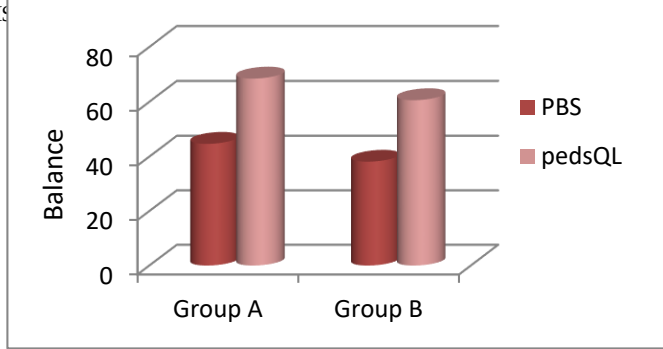
Groups	Group-A (n=24)	Group B (n=22)
Gender	18 Male (75%)	12 Males (54.5%)
Age	8.79±2.0	9.50±1.8
Weight	16.79±2.70	23.05±2.08
GMFCS	GMFCS III 9 (37.5%)	GMFCS III 12 (54.55%)
	GMFCS IV 15 (62.5%)	GMFCS IV 10 (45.5%)
MAS	2.92±0.71	3.14±0.83
MoCA	21.67±2.27	22.14±1.98
Age	8.79±2.0	9.50±1.8
Weight	16.79±2.70	23.05±2.08

Paired t-test was applied for within the group analysis for Group A and B on PBS and PedsQL. The results revealed that average mean score of PBS in Group-A was significantly improved to 44.6±2.54 after 16 weeks of exercises (p<0.05) whereas in Group B the average mean score was 38.14±2.47 (p>0.05). Similarly, PedsQL score in Group-A significantly improved to 68.468±2.572 (p<0.05) whereas in Group-B average mean was 56.23±1.98 before the exercises that also significantly improved after 16weeks of training but scores were less as compared to Group-A as shown in Table-2.

		Pre	Post	MD	P-value
Group A	PBS	37.18±2.6	44.67±2.5	7.49±0.1	<0.05
	PedsQL	56.45±1.9	68.46±2.5	12.01±0.6	<0.05
Group B	PBS	37.18±2.4	38.14±2.4	0.98±0.0	>0.05
	PedsQL	56.23±1.9	60.58±2.9	4.35±1.0	<0.05

*Mean Difference

Moreover, difference between group A and B was determined using independent t-test after 16 weeks of training. In general Both Group showed significant improvement (p<0.05) on balance and QOL, however Group A showed more significant improvement in balance on PBS as shown in figure-1



4 DISCUSSION

The result of present study revealed that aquatic exercises had efficacy in management of QoL and balance among spastic diplegic cerebral palsy GMFCS III and IV. Aquatic group presented significant improvement in balance as compared to the LB exercises while QoL was improved in both groups.

The results of this study was similar to Wanees et al in 2016 who compared the aquatic and LB therapy on walking and balance in spastic CP GMFCS II & III children and concluded that aquatic exercises had significant improvement ($p < 0.05$) in increasing balance and stability but they had focused only on physical components of CP while psychosocial components were missing that are important in the management of CP while in our study both physical and psychosocial components were analyzed [11]. Similarly a RCT was conducted by Akinola et al in 2019 determining the benefits of aquatic therapy on functions and concluded that GMFCS score significantly improved ($p < 0.05$) in Aquatic group in some domains while in running and jogging the mean difference was not significant whereas in our study overall GMFCS score was improved ($p < 0.05$) [12].

Another research conducted by Adar et al in 2017 compared the aquatic exercise with LB exercises on motor function, spasticity and QoL among CP children. Same as in our study they used GMFCS (motor function) and pedsQL (QoL) and the result showed that GMFCS score significantly improved in both groups but the mean score of pedsQL was improved more in aquatic group over land-based group similar to current study [7]. Multiple researches have also documented the helpful effects of aquatic therapy functional status such as Roostaei et al in 2017 conducted a research on effectiveness of aquatic therapy concluded that aquatic therapy had potential in improving the GMFCS score in CP. The results of this study were in favor of current study [8].

On the other hand, conflicting results related to the efficacy of aquatic exercise on balance, stability and quality of life were also documented. Some studies have revealed the negative effects of the aquatic therapy among CP children and concluded that aquatic therapy alone is not helpful in the treatment of CP and it should be combined with other traditional exercises for the better results [13]. While research done in 2017 concluded that exercises performed in water are more convenient to the children. As this study revealed that aquatic exercises had more compliance towards the children and proved beneficial in CP management because water reduces the act of gravity. Due to its properties such as buoyancy effect and hydrostatic pressure, water act as physical support system and improves the overall body function. Furthermore water creates an enjoyable environment for the patients as water decreases the joint

loading helps in improving the joint function and reducing the spasticity [14].

The QoL in our study was measured using pedsQL and result showed that QoL was substantially improved in the aquatic group as compared to the LB exercises however in contrast to this Jorgic et al in 2014 revealed in his study that aquatic therapy has efficacy in managing the QoL as compared to the LB exercises. Participants included in our study that average mean of PBS score in aquatic was 37.18 ± 2.61 that significantly improved to 44.67 ± 2.5 after 16 weeks of exercises ($p < 0.05$) showed significant improvement in balance in aquatic group like to the research of Declerck et al in 2016 who concluded their result that aquatic protocol are beneficial in managing balance, gait and stability in CP children [15].

On contrast to their results Grecco et al in 2017 revealed in his RCT that LB exercises are more significant in improving the balance in cerebral palsy and for this he recruited 15 children aged 12 and performed gait training on ground to Group-A and gait training on treadmill for Group-B and after seven weeks the assessed the balance of participants through using PBS like our study and concluded that treadmill training improved balance of participants more significantly and also reduced the mediolateral perturbation. Furthermore, Emara et al 2014 also conducted a study that land-based balance training on treadmill is beneficial in maintaining the balance and stability related problems [16]. The findings of present study had also revealed similar type of observations as were reported in previous studies and also encourages the concept of engaging cerebral palsy children into the aquatic therapy program along with the other traditional exercise protocols to help the CP children in improving their balance, coordination, spasticity and quality of life. As per current study aquatic exercises are effective in management of the balance and QOL in spastic Diplegic CP GMFCS level III and IV children. The study serves as the basis of future randomized controlled trial to be conducted on efficacy of aquatic exercises on balance and QOL among CP on large sample size for the generalizability of the research.

5 CONCLUSION

The study concluded that sixteen weeks of aquatic exercises program is found to be effective in improving the balance and QOL among spastic diplegic CP. Hence, aquatic exercises are also beneficial in improving the psychosocial aspects of CP. However multicenter trials are recommended to analyze the effectiveness of these therapies on communal health outcomes.

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