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Trend analysis of the aquatic exercise effect in the walking abilities of cerebral palsy

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Abstract
Aquatic Training Program was designed for Children with Cerebral Palsy (CWCP) to test the Aquatic Walking trend, in which 9 children aged range of 7-11 years with CP were purposely selected for the study. The data was collected from a special school at Delhi, India and statistically analyzed by employing repeated measure. Scores were recorded in working sheet which was made by researcher to record the everyday performance. Findings indicate that there is positive change by nine week's duration of the training, and for long term benefits contentious intervention can help.

Keywords: Cerebral palsy (CP), walking trend, aquatic training program, especially abled population

Introduction
Walking is the basic way of locomotion for Human being (Byju's, 2019) [4]. For living we need food and for that basic locomotion or mobility is essential. Mobility means able to move (Rantanen, 2013) [13], it is seen that mobility is restricted in the Specially Abled Population. Especially abled children are dependent on others by many means. If the child cannot walk of his own on land then he/she is more likely to put on weight, unnecessary fat gain and lack of physical activity make that child prone to many diseases like obesity (Niddkd, 2016) [2], which will create more difficulty to them and the person they are dependent on. Aquatic activities are part of physical activity and since ancient age it is being practiced for recreation, competitive and therapeutic use as well. Because it has lots of physical, mental and emotional benefits. This is particularly a good way to relax body and soothing mind. Thereby it reduces anxiety and useful for the brain and the mental health of individual as it drops down the dimensions of nervousness. It triggers the arrival of cerebrum that accelerates the development of nerve cells (Deniel Nelson, 2017) [5]. Among five major types of disabilities, Physical Disability is one, caused by: Acquired brain injury, amputation, cerebral palsy, muscular dystrophy. Mostly they face difficulty in mobility, work/load tolerance, self-care, communication and expression of thoughts. With such reference cerebral palsy, children were provided Aquatic Activities by making them improve their walking skills and make them independent to some extent and to help them achieve improved confidence and self-esteem (Hall J. J., 2013) [8]. With such references, it was conceptualized that with the help of aquatic activity people with cerebral palsy can have a better improved quality of life due to better mobility. With this concept aquatic training program is prepared to see the walking trend among these children.

Research question
- To understand the walking trend in water of CP children through the intervention of nine weeks aquatic training program.

Methodology
Participants
A total of nine children age range 7 to 11 from a special school at Delhi, India in summer 2018, years were purposely identified as the participants for this study.

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Criterion measure
Working sheet
Of each child. Each session consists of walking patterns and it is further categorized in five levels, namely not walking/ not willing/ cannot walk, Walk holding instructors hand Walk holding railing, walking on heels and walking on toes.

Preparation of training program
Aquatic Training Program: This was a continuous activity three days in a week. It is being developed after repeated discussion about the training program with experts. A gradual increment in repetition and difficulty level was being added after every two weeks. Further expert advice was again sought for the finalization of the Aquatic Training Program.

Administration of the structured aquatic training program
Structured Aquatic Training Program: Nine week program was administered which consist of 27 sessions, every alternate days of week. Each session for 40 minutes per child per day. One session was having two subjects and two coaches. They were split into two batches of 5 and subjects who attended the training in alternative days. The researcher recorded each session performance on Working Sheet in daily basis.

Statistical analysis
In this study repeated measure is used to analyze the walking trend of the subjects from the Aquatic Training program.

Results
The participants followed the instruction of the scholar and practiced in the walking skill as a part of the Aquatic Training Program, for nine weeks. But the following analysis is to understand the trend of walking pattern among the cerebral palsy participants.

Table 1: Descriptive statistics of Aquatic Walking for nine weeks.

Weeks	MESN	SD	N
Weeks 1	1.37	.58	9
Weeks 2	1.74	.66	9
Weeks 3	2.48	.68	9
Weeks 4	2.66	.70	9
Weeks 5	3.00	.86	9
Weeks 6	3.40	.94	9
Weeks 7	3.88	.92	9
Weeks 8	3.92	.93	9
Weeks 9	4.14	.95	9

This table represents the Mean and Standard deviation of aquatic walking on the nine weeks training. Gradual improvement in the scores from first day to last day of Aquatic Walking was found. Numerical representation of the data, day 1 (M, 1.37±58), day 2 (M,1.74±.66), day 3 (M, 2.48 ±.68), day 4 (M, 2.66 ±.70), day 5 (M, 3.00 ±.86), day 6 (M, 3.40 ±.94), day 7 (M, 3.88±.94), day 8 (M,3.92±.93), and day 9 (M, 4.14 ±.95).

To test if there is a significant difference among the aquatic walking session scores repeated measure was computed and the results are presented in below table no. 2.

Table 2: Mauchly's Test

Within Subjects Effect	Mauchly's	Approx. chi-Square	DF	Sig.	Epsilon Greenhouse-Geyser	Huynth Feldt	Lower-Bound
Aquatic walking (9 weeks)	.00	73.94	35	.01*	.28	.40	.12

*p<0.05

Table reveals that, there is significant difference because the value is less than 0.05, W=.00, X^2 =73.94, p<.05. Therefore, we have used Epsilon Greenhouse-Geisser to adjust f score and the conservation Epsilon should be used to adjust the DF.

Further F test was computed by considering the epsilon of greenhouse-Geisser adjusted to check the difference at 0.05 between the aquatic walking sessions for nine weeks.

Table 3: Repeated Measure ANOVA for Comparison of Means during Nine weeks Walking Training.

Source	Greenhouse-Geyser	SS	DF	MS	F	Sig.
Aquatic Walking		708.92	1	708.92	208.30	.00*
	Error	27.22	8	3.40		

*p<0.001

This table shows the repeated measure ANOVA calculations, showing that there is significant improvement in the score of Aquatic Walking during the nine weeks training as obtained F=208.30 at p<0.01. It means that ability to walk in water has significant improvement. So, there is influence of aquatic exercise.

The pairwise comparisons for the main effect of training corrected, using a bonferroni adjustment was further computed. The results are presented in the table below.

Table 4: Pairwise Comparison among Nine Weeks Session of Aquatic Walking Training

(I) Group	(I) Group	MD (I-J)	Std. Error	Sig.	95% Confidence Interval For Difference Lower Bound	Upper Bound
Week 1	Week 2	-0.37	0.29	1.00	-1.78	1.04
	Week 3	-1.11	0.28	0.17	-2.48	0.26
	Week 4	-1.29	0.31	0.12	-2.81	0.21
	Week 5	-1.63	0.39	0.12	-3.53	0.27
	Week 6	-2.03	0.41	0.04*	-4.03	-0.04
	Week 7	-2.51	0.45	0.02**	-4.69	-0.34
	Week 8	-2.55	0.45	0.01**	-4.74	-0.36
	Week 9	-2.77	0.46	0.01**	-4.96	-0.58
Week 2	Week 3	-.74	.19	0.16	-1.65	.17

	Week 4	-.92	.24	0.20	-2.11	.25
	Week 5	-1.26	.25	0.04*	-2.50	-.01
	Week 6	-1.66	.27	0.01**	-2.97	-.36
	Week 7	-2.14	.32	0.00**	-3.70	-.59
	Week 8	-2.18	.32	0.00**	-3.71	-.65
	Week 9	-2.40	.32	0.00**	-3.95	-.86
Week 3	Week 4	-.18	.14	1.00	-.89	.52
	Week 5	-.51	.18	0.82	-1.40	.36
	Week 6	-.92	.21	0.08	-1.94	.09
	Week 7	-1.40	.28	0.03*	-2.75	-.06
	Week 8	-1.44	.26	0.02**	-2.71	-.17
	Week 9	-1.66	.26	0.00**	-2.93	-.39
Week 4	Week 5	-.33	.16	1.00	-1.13	.46
	Week 6	-.74	.21	0.30	-1.76	.28
	Week 7	-1.22	.27	0.08	-2.55	.10
	Week 8	-1.25	.25	0.04*	-2.49	-.01
	Week 9	-1.48	.26	0.01**	-2.75	-.20
Week 5	Week 6	-.40	.15	1.00	-1.14	.33
	Week 7	-.88	.20	0.07	-1.84	.06
	Week 8	-.92	.18	0.03*	-1.79	-.05
	Week 9	-1.14	.19	0.01**	-2.06	-.22
Week 6	Week 7	-.48	.15	0.57	-1.23	.27
	Week 8	-.51	.14	0.29	-1.22	.19
	Week 9	-.74	.20	0.25	-1.72	.24
Week 7	Week 8	-.03	.03	1.00	-.21	.13
	Week 9	-.25	.13	1.00	-.89	.37
Week 8	Week 9	-.22	.11	1.00	-.75	.30

*P<0.05 **p<0.01

The table indicates that the main effect reflects a significant difference p<.05 of Week 1 with week 6 week 7 week 8 week 9. Week 2 with week 5, week 6, week 7, week 8, week 9. Week 3 with week 7, week 8, week 9. In week 4 and Week 5 with week 8 & week 9 has significant difference.

Further, the repeated measure within subject was analyzed to check the linear trend by calculating the data. The finding is presented in the table below.

Table 5: Repeated Measure with subject analysis of Nine Weeks Sessions of Aquatic Walking Training.

Source of variance		SS	DF	MSS	F	Sig.
Two weeks session	Linear	67.53	1	67.53	44.14	.00**
	Quadratic	1.30	1	1.30	3.64	.09
	Cubic	.01	1	.01	.08	.77
Error (Nine weeks session)	Linear	12.23	8	1.53		
	Quadratic	2.87	8	.35		
	Cubic	1.61	8	.20		

There is significant main linear effect of training f (1, 8) = 63.34 p< 0.01. In quadratic effect insignificant at p> 0.05. It can be concluded that nine weeks aquatic training had a linear effect of improvement in the walking pattern. Hence the no of training session in nine weeks could improve the aquatic walking significantly. The graphical presentation of the mean values of nine weeks Aquatic Walking training sessions using attention grid is presented in table below.
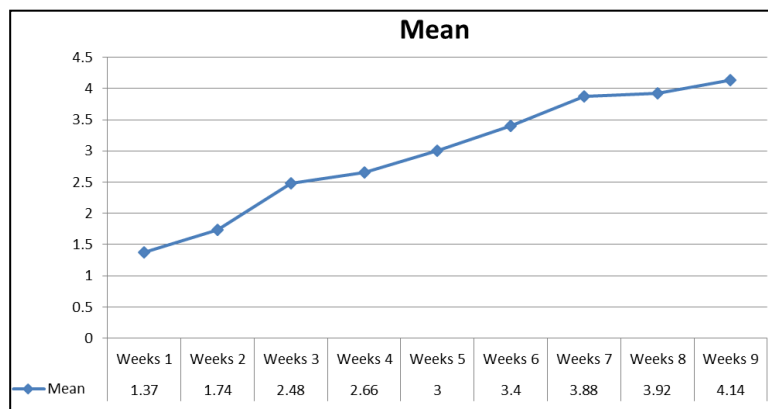

Mean

	Weeks 1	Weeks 2	Weeks 3	Weeks 4	Weeks 5	Weeks 6	Weeks 7	Weeks 8	Weeks 9
Mean	1.37	1.74	2.48	2.66	3	3.4	3.88	3.92	4.14

Fig 1: Graphical representation of mean values of nine weeks aquatic walking training

This graphical representation of the mean values of nine week's aquatic walking scores depicts a significant linear improvement in the walking of the subjects with C.P.

Discussion of findings
In this study there was prominent difference in the mean and standard deviation of Aquatic Walking performances in nine

weeks. Also the pairwise comparison shows that there are changes. Considering the 1st week as pre data, first changes found after 6th week, only after 18 sessions positive effects are observed. Other studies with aquatic exercise find that it is helpful frequently to these C.P. children (Hall j. G. 2013) [8]. (Dubois, may 2011) [7]. There is change in the condition of child in nine weeks then a longer duration training can provide a permanent improvement (Hall j. G., 2013) [8] (J. W. Gorter, Oct 2011) [10]. Many researchers say that through aquatic activity many things can be improved in a training program. Hence we can conclude that through Aquatic exercise the children with Cerebral Palsy has improved their skill of walking in water

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