

Table 1

Study	Study design	Sample	Sample groups	Treatment time	Outcome measures	Results	Conclusion
Jorgic et al. ⁶⁸	Pilot Study	7 children	-	45`, 2days/wk, 6weeks	GMFM-88 WOTA2	(p<0,001) in dimension E & total score T of GMFM & (p<0,001) in overall results in WTO of the WOTA2	Statistically significant change on development the overall GMF of children with CP after the swimming program.
Lai et al. ⁴⁴	Clinical Trial	24 children	11 children in PATG 13 children in CG	1h, 2days/wk, 12weeks	GMFM-66 MAS	(p<0,001) in GMFM-66 and MAS in PATG in post-treatment	CP children (included those with poor GMFCS) can benefit of an alternative therapy like, pediatric aquatic therapy.
Chrysagis et al. ³⁹	RCT	12 children	6 children in EXPG 6 children in CG	45`, 2days/wk, 10weeks	GMFM-66 MAS Goniometer	(p<0,001) in GMFM-66 in EXPG (p>0,05) in ROM in both groups (p<0,001) in spasticity in EXPG	An aquatic program might have a positive effect in GMF as well as in ROM and spasticity in students with spastic CP.
Getz et al. ⁴⁶ in press	Clinical Trial	49 children	-	30`, 40 sessions, 5months	AIM PEDI GMFM GMFCS	(p<0,001) between the total AIM & GMFM scores, as well as in PEDI self-care and mobility scores	Strongest connection to motor performance on land as measured by the GMFM and the PEDI, AIM was indicated from the water adjustment sub-scale.
Dimitrijevic et al. ⁴¹	Clinical Trial	27 children	14 children in EXPG 13 children in CG	55`, 2days/wk, 6weeks	GMFM-88 WOTA2	(p<0,001) in GMFM-88 & WOTA2 at the secondary assessment	GMF skills along with aquatic abilities show improvement in CP children after a 6-week aquatic intervention.
Getz et al. ⁴⁷	Clinical Trial	22 children	12 children in EXPG, 10 children in CG	30`, 2days/wk, 32 sessions	PEDI AIM PCC	(p<0,001) in post test on AIM & PEDI in EXPG (p>0,05) in PEDI & PPC between groups	Caregivers refer that aquatic therapy appears improvement on perceived social acceptance and social function.
Retarekar et al. ⁴⁵	Single-Subject Report	1 children (5 y.o. girl)	-	50`, 3days/wk, 12weeks	COPM GMFM-66	(p<0,001) in GMFM and COPM after the treatment program	Effectiveness on this child with CP was found by this aquatic aerobic exercise program.
Olama et al. ⁴⁰	RCT	30 children	15 children in EXPG 15 children in CG	45`, 2days/wk, 20 sessions in EXPG	Computerized EMG apparatus Electrogoniometer	(p<0,001) in all measure variables comparing pre and post values in favor of EXPG	Significant change on reducing the H-reflex in spastic hemiplegic CP was found by the combination of exercise program and aquatic exercise program.
Hiller et al. ³⁸	RCT (Pilot)	12 children	6 children in EXPG 6 children in CG	30`, 6 sessions, 6-8weeks in EXPG	M-ABC PSPCSA	(p<0,001) in posttest for EXPG in M-ABC and PSPCSA	Feasible intervention for children with DCD and may be effective in improving their GMF skills.

Table 2

Study	Study design	Sample	Sample Groups	Treatment time	Outcome measures	Results	Conclusion
Lee et al. ³⁶	RCT	26 children	13 children Hippotherapy Group 13 children Hippotherapy Simulator Group	1h, 3days/wk, 12weeks	PBS BPM	Sig. improvements in Hippotherapy Group & Hippotherapy Simulator Group (p>0,05) between groups	Hippotherapy Simulator is a useful alternative to hippotherapy for static & dynamic balance.
Benda et al. ³⁴	RCT	15 children	7 children Experimental Group 8 children in Control Group	8` in EXP.G. 8` in C.G.	EMG	(p<0,001) in EXP.G. contrary to CG in symmetry of muscle activity	Improved symmetry in muscle activity in CP after an 8` of hippotherapy.
Ionatamishvili et al. ⁶⁹	Clinical Trial	100 children	50 children in Hippotherapy Group 50 children in Control Group	90`-120`, 2-3days/wk,	Five-point scale	(p<0,001) in Hippotherapy Group in involuntary movements, hyperkinesis, spasticity & motor activity	Hippotherapy is advisable since it maximally mobilizes the reserve possibilities of children for integrating perceptive and behavioral skills.
El-Meniawy & Thabet ³⁷	RCT	30 children	15 children in Experimental Group 15 children in Control Group	40`, 1 day/wk, 13weeks	Formetric Instrument System	(p<0,001) post-treatment between groups (p<0,001) pre/post treatment in EXPG & CG	Hippotherapy may be used in conjunction with therapeutic exercise for the improvement of back geometry in CP.
Davis et al. ³⁵	RCT	99 children	50 children Experimental Group 49 children Control Group	40`, 1 day/wk, 10weeks	GMFM-66	(p>0,05) in GMFM-66 between the EXPG & CG	Hippotherapy does not have a clinically significant impact in CP.
Herrero et al. ³²	RCT (stratified single-blinded)	38 children	Experimental Group 19 children Control Group 19 children	15`, 1 day/wk, 10weeks	GMFM-66 SAS	SB and effect size sig. improved in EXPG (p>0,05) in GMFM-6 & SAS	Treatment with HS primarily improves posture and balance in Level V in GMFM.

Hamill et al. ⁵⁵	Single-subject report	3 children	-	50`, 1 day/wk, 10weeks	GMFM-88 SAS	(p>0,05) in GMFM-88 & SAS in the subject	Hippotherapy is less effective in improving GMFM in Level V on the GMFCS
Giagazoglou et al. ⁴⁹	Clinical Trial	19 children	10 children in Experimental Group 9 children in Control Group	30`, 2days/wk, 10weeks	DLS OLS vGRF RFD	(p<0,001) in EXPG in vGRF & RFD (p>0,05) in DLS & OLS in both groups	Hippotherapy can be used as an effective intervention for improving balance and strength in CP.
Shurtleff et al. ⁵²	Clinical Trial	11 children	-	45`, 1 day/wk, 12weeks	VMC	(p<0,001) with large effect size in head/trunk stability	Hippotherapy improves trunk/head stability.
Drnach et al. ⁴⁸	Case Study	1 child (10 y.o. boy)	-	1h, 1 day/wk, 5weeks	GMFM	(p<0,001) in 2/5 dimensions in GMFM. Positive change in trunk balance and strength	5weeks of hippotherapy are sufficient to produce positive changes in the GMF in children with CP.
Park et al. ⁷⁰	Clinical Trial	34 children	23 children Experimental Group 21 children Control Group	45`, 2days/wk, 8weeks	GMFM-66 GMFM-88 PEDI-FSS	(p<0,001) in GMFM-66 and GMFM-88 in both groups (p<0,001) in dimension E and GMFM-66 and in PEDI-FSS in EXPG	Maximize functional performance and amelioration of GMF was found my hippotherapy.
Shurtleff et al. ⁵³	Pilot Study	12 children	6 children Cerebral Palsy Group 6 children Non-Disabled Group	45`, 1 day/wk, 12weeks	Video Motion Capture	(p<0,001) in movement variability (p<0,001) in trunk/head control as a result of gaining motor learning	Possible improvement in head and trunk stability in CP children by hippotherapy.
Winchester et al. ⁵⁴	Clinical Trial	7 children	-	1h, 1 day/wk, 7weeks	GMFM	(p<0,001) in GMFM (p<0,001) between pre-test and post-test 1 & 2 (p>0,05) between post-test 1 & 2	Developmentally delayed children may improve the GMF by hippotherapy.
McGibbon et al. ³³	RCT	47 children	25 children Hippotherapy Group 22 children Barrel Group	10` both groups (phase 1), 30`, 1 day/wk, 12weeks (phase 2)	sEMG GMFM-66	Phase 1: (p>0, 05) in BG in AMS, (p<0,001) in HG in AMS Phase 2: (p<0,001) in GMFM-88	Some functional motor skills and adductor muscle symmetry during walking can have a progress with hippotherapy.
Streba et al. ⁵¹	Clinical Trial	17 children	-	1h, 1 day/wk, 18weeks	GMFM-88	(p<0,001) in GMFM total score (Dimension A-E) after 18weeks	Reduced degree of motor disability in CP children after hippotherapy was due to improvement of GMF.

Table 3

Study	Study design	Sample	Sample groups	Treatment time	Outcome Measures	Results	Conclusion
Lazzari et al. ²⁸	RCT (double-blinded)	12 children	6 children in EXPG 6 children in CG	1 session	Force plate under four conditions static balance)	An increase in sway velocity was the only significant difference observed	A single session of anodal transcranial direct current stimulation combined with mobility training elicited to lead to an increase in the body sway velocity of CP children.
Deepak et al. ²⁹	RCT	16 children	8 children in EXPG 8 children in CG	No time, 3days/wk, 3weeks	MACS PBS	(p<0,001) in PBS and MACS in both groups	Possible improvement in CP through VR-based therapy in balance.
Deutsch et al. ⁵⁷	Case Report	1 child (13 y.o.)	-	60`-90`, 11 training sessions	Posture Scale Analyzer functional mobility	(p<0,001) for postural scale analyzer and functional mobility	Improvement for all studied parameters in this study.
Barton et al. ⁶⁰	Clinical Trial (pilot)	2 children	1 healthy 1 CP	1 session	ROM of spine and hip joint	Differences were found between healthy and control in spine and hip joints (p<0,001)	Motion pattern can be analyzed & improved during SG session.
Barton et al. ⁵⁸	Single – subject report	1 child	-	30`, 2days/wk, 6weeks (13 sessions)	Motion of pelvis & trunk (Vicon 612 optoelectronic system)	(p<0,001) in coupling (from angle-angle plots of trunk & pelvis rotations)	With VR increasing coupling appears to be an initial compensation mechanism using the better controlled trunk to drive rotation of the pelvis.
Bonnechere et al. ⁶¹	Clinical Trial	10 children	-	30`, 1 day/wk, 4weeks	TCMS	(p<0,001) in TCMS for all children after treatment	SG could be an interesting option to integrate in the conventional treatment of CP children.
Reid & Campbell ³⁰	RCT (pilot)	31 children	19 children in EXPG 12 children in CG	90`, 1 day/wk, 8weeks	COPM	(p>0,05) in COPM in both groups	VR provides results for social engagement between non-disabled and disabled but no effects in motor function.
Akhutina et al. ⁶²	Clinical Trial	21 children (Part 1) 45 children (Part 2)	-	30`-60`, 6-8 sessions, 1 month (Part 1) 30`-60`, 6-8 sessions	2 computer based tests and 2 non computer tasks (Part 1), Benton Judgment of Line Orientation test, arrows subtest of the Nepsy, Roads	No difference was observed between groups (Part 1) Treatment group improved more than control group (Part 2)	VE-based spatial training is effective for children with complex disabilities, particularly when combined with training that remediates cognitive weaknesses.

test (Part 2)							
Chen et al. ³¹	RCT	28 children	13 children in Hvctg 15 children in CG	40', 3days/wk, 12weeks	GMFM BOTMP Muscle strength (Cybex)	(p<0,001) in hVCTG higher Cybex measurements BOTMP scores did not differ	The proposed 12-week hVCT protocol enhances knee muscle strength rather than motor functions in children with CP.
Ritterband-Rosenbaum et al. ⁶³	Clinical Trial	40 children	20 children in EXPG 20 children in CG	30', 7days/wk, 20weeks	Normal habits in relation to their physical activity level and computer habits	(p<0,001) in EXPG with a larger increase in the number of correct subjective reporting	That training of sense of agency may help to increase the outcome of training programmes in children with CP.
Gordon et al. ⁵⁹	Pilot Study	6 children	-	45', 2days/wk, 6weeks	GMFM-88	The mean change in the total GMFM score was 7%. It was noted that the mean post-test scores for all sections were higher.	The Nintendo Wii has the potential for use as a rehabilitation tool in the management of children with CP.

Table 4

Study	Study design	Sample	Sample groups	Treatment time	Outcome Measures	Results	Conclusion
Alagesan & Shetty ²³	RCT (single-blinded)	30 children	15 C.G 15 EX.G	2h daily, 3weeks (20` short break)	GMFM-88	Mean dif. In EX.G & C.Gà (p<0,001) Between groupsà Pre-test (p>0,5) Post-test (p<0,001)	Modified Suit Treatment along with conv. therapy is effective in GMF.
Ko et al. ⁶⁴	Single subject research report	8 y.o girl	-	50` once a week, 18weeks	GMFM-88 PBS	(p<0,001) in GMFM and PBS between the baseline and the intervention phase.	Improvement in GMF & postural balance.
Bar-Haim et al. ⁷¹	Clinical Trial	24 Children	12 children AST Group 12 children NDT Group	2h daily, 5times/wk, 4weeks (20 sessions)	GMFM-66 EIHB	(p<0,001) in GMFM-66 in AST group after 1month can be attributed to the improved EIHB	AST optimizes these skills in children with a higher level of gross motor functions.
Kim et al. ⁴³	RCT (single-blinded)	20 children	8 children NDT/AST Group 9 children NDT Group	NDT/ASTàNDT 30`, 2times/d, 5times/wk AST 30`, 5times/wk NDTà30`, 2times/d, 5times/wk	GMFM-88 PBS	The GMFM, PBS, and (in both groups) showed stat. significant increase (p < 0.05)	AST/NDT was effective in improving the patients' performance in GMFM and PBS.
Datorre ⁶⁷	Case Report	12 y.o. boy	-	4h, 5days/wk, 3weeks	GMFM-88	Demonstrated improvements at the end of the 3weeks in all categories of the GMFM	Thera Suit with ITP, aqua therapy and hippotherapy, improves the GMF
Bailes et al. ⁶⁶	Case Report	2 children	-	4h, 5days/wk, 3weeks	GMFM-66 GMFM-88 PEDI	Slight progress in function in dimension D of GMFM & PEDI Self-care domain. Symmetry, joint motion and posture showed progress	Minimal gains in some areas and decline in others of functional performance
Bailes et al.	RCT (single-blinded)	20 children	10 children EX.G. 10 children C.G.	4h, 5days/wk, 3weeks	PEDI GMFM-66	(p>0, 05) between groups. (p<0,001) within-group for the C.G on the GMFM-66 and for the EXP.G on the GMFM-66 and PEDI different skills	Children wearing Thera Suit did not demonstrate improved motor function compared with those wearing a control suit
Khayatza deh Mahani et al. ¹⁹	RCT	36 children	MAST 12 children AST 12 children NDT12 children	2h, 5days/wk, 4weeks	GMFM-66	All groups in the GMFM after treatment (p < 0,001) and among groups (p < 0,001). In the follow-up study, the GMFM within groups (p >0, 05), but among groups (p <0,001)	The MAST was more effective than using either the AST or the NDT treatment after treatment and at follow-up
Kunz et al. ⁶⁵	Clinical Trial	100 children	-	41/2/6h, 6days/wk, 3weeks	GMFM-88	There was overall improvement in all 5 test categories (p<0,001)	The GMFM-88 showed a high percentage of positive effect in 100 patients after treatment