Balance training

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
Allison & Dennett, 2007 PEDro score: 8	8	Standing practice + conventional physiotherapy (n=7) vs. conventional physiotherapy alone (n=10) **Treatment details**: 45 minutes/day, 5 days/week for duration of stay; conventional PT was provided for the same frequency and duration	At 1 week, 2 weeks and 12 weeks: (-) Berg Balance Scale* (-) Rivermead Motor Assessment – Gross Functional Tool Section (-) Trunk Control Test * a significant difference in change scores from week 1 to week 12 was seen in favour of the standing practice group compared to the control group
An & Shaugnessy, 2011 PEDro score: N/A (systematic review)	n/a (systematic review)	Aerobic exercise programs such as tai chi, body weight supported treadmill training and aquatic therapy (n=4); Comprehensive exercise programs (n=3); or Multisensory training programs (n=3)	Early initiation of exercise after stroke is effective in improving balance Aerobic exercise positively affects balance in subacute and chronic stroke. Improved balance can be attained with exercise performed at least 20 – 60 minutes, 3 – 4 times a week for 6 – 12 weeks. Multisensory programs do not seem to be effective in improving balance following stroke.
Au-Yeung et al., 2009 PEDro score: 6/10	6	Tai chi (n=74) vs. General exercises (n=62) **Treatment details**: 1 hour group exercises and 3 hours self-directed exercises/week for 12 weeks	At 6 weeks (mid-treatment): (-) Limit of Stability test – reaction time (+) Limit of Stability test – end-point excursion (forward, backward and toward nonaffected side only) (-) Sensory Organization test somatosensory ratio Sensory Organization test – visual ratio (-) Sensory Organization test – vestibular ratio (-) Timed Up and Go test

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
			At 12 weeks (post-treatment): (+) Limit of Stability test – reaction time (nonaffected side only) (+) Limit of Stability test – end-point excursion (all directions) (-) Sensory Organization test somatosensory ratio (-) Sensory Organization test – visual ratio (+) Sensory Organization test – vestibular ratio (-) Timed Up and Go test At 18 weeks (follow-up): (+) Limit of Stability test – reaction time (nonaffected side only) (+) Limit of Stability test – end-point excursion (all directions) (-) Sensory Organization test somatosensory ratio (-) Sensory Organization test – visual ratio (-) Sensory Organization test – vestibular ratio (-) Timed Up and Go test
Badke et al. 1987 PEDro score: 6	6	Platform induced sway with or without prior knowledge of platformoes movement	(+) Muscle burst onset latencies (paretic limb) (+) Voluntary responses (nonparetic extremities) (+) With prior knowledge, AP-response latencies in the paretic limb
Bayouk et al., 2006 PEDro score: 4/10	4	Task-oriented exercise program with manipulation of sensory input (n=8) Vs.	At 8 weeks (post-treatment): COP displacement during: (+) Double-leg stance – eyes open, normal

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
		Task-oriented program under normal conditions (n=8) **Treatment details**: 1 hour, 2 times per week for 8 weeks. Sensory conditions included visual (eyes open/closed) and surface (soft/firm) manipulation.	surface* (+) Double-leg stance – eyes open, soft surface* (-) Double-leg stance – eyes closed, normal surface (-) Double-leg stance – eyes closed, soft surface (-) Sit-to-stand – eyes open, normal surface (+) Sit-to-stand – eyes open, soft surface** (-) Sit-to-stand – eyes closed, normal surface (-) Sit-to-stand – eyes closed, soft surface (+) 10m walking test** * significant difference between pre- and post-test results in intervention group but not control group. ** significant difference between pre- and post-test results in both groups.
Bonan et al. 2004 PEDro score: 6	6	Vision-deprived training vs.Free vision training	(+) Sensory Organization Test (SOT) (Balance)(perceived health status) (-) Gait velocity (-) Timed stair climbing (-) VAS- Ease of gait (-) Nottingham Health Profile (NHP)
Byun et al., 2011 PEDro score: n/a (non-randomised crossover design study)	n/a (non-randomised crossover design study)	Sliding rehabilitation machine (n=15) vs. Conventional rehabilitation (n=15) **Treatment details**: Sliding rehabilitation machine training 30 minutes/day, 5 days/week for 2 weeks plus 40 minutes of conventional	At post-treatment (2 weeks): (+) Functional Ambulation Category (+) Berg Balance Scale (+) Six-Minute Walk Test (+) Timed Up and Go Test (+) Korean Modified Barthel Index

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
		training using the Bobath approach, preceded or followed by conventional training only for two weeks.	(-) Modified Ashworth Scale (+) Manual Muscle Test
Chen et al. 2002 PEDro score: 4	4	Visual feedback balance training with "Smart Balance Master" device plus conventional physical and occupational therapy vs. Conventional physical and occupational therapy only	(+) Self-care domain of FIM scale Static balance function: (-) Maximum stability (Indicator of center of gravity stability) (+) Ankle strategy (The absence of sway) (-) COG alignment Dynamic balance function:c (+) Axis velocity (Average speed of COG movement in specified direction) (+) Directional control (Ratio of the actual distance traveled by the COG from the center to endpoint excursion) (+) End-point excursion (Distance traveled by the COG on the first attempt to reach a moving target)
Chen et al., 2011 PEDro score: 7/10	7	Thermal stimulation + conventional rehabilitation (n=17) vs. Conventional rehabilitation alone (n=16) **Treatment details**: Alternating use of hot and cold packs with active or passive movement for 30-40 minutes/day, 5 days/week for 6 weeks.	At post-treatment (6 weeks): (+) Fugl-Meyer Assessment for Lower Extremity (+) Medical Research Council scale for the lower extremity (-) Modified Motor Assessment Scale (-) Postural Assessment Scale for Stroke Trunk Control (-) Berg Balance Scale (+) Functional Ambulation Classification (-) Modified Ashworth Scale

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
Cheng et al. 2001 PEDro score: 6	6	Symmetrical standing training and repetitive sit-to-stand training with a standing biofeedback trainer Vs. Conventional physical therapy (control)	Following treatment: (-) Sit-to-stand performance (-) Stand-to-sit performance (+) Mediolateral sway (+) Rate of rise in force while rising from a chair (+) Frequency of falls (significant decrease in falls) At 6-months: (+) Sit-to-stand performance
de Seze et al. 2001 PEDro score: 6	6	Trunk control training using the Bon Saint Come device vs. Conventional neurorehabilitation	At day 30 and day 90*: (-) Motricity Index (-) Ashworth Scale (-) Visual perimetry (-) Language function (-) Mini-mental status (-) Sitting Equilibrium Index (+) Upright Equilibrium Index (+) Trunk Control test (TCT) (+) Bells Neglect test (+) Functional Ambulation Categories (FAC) (-) Functional Independence Measure (FIM) *These outcomes changed at 90: (-) Trunk Control Test (-) Functional Ambulation Categories (FAC)
Dean et al., 2000 PEDro score: 5/10	5	Task-oriented mobility training program (n=5) Vs.	At 4 weeks (post-treatment): (-) 10-m Walking Test – with assistive device (+) 10-m Walking Test – without assistive device

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
		Task-oriented upper limb training program (n=4) **Treatment details**: 1hour/day, 3x/week for 4 weeks.	(+) 6-Minute Walking Test (+) Sit-to-stand ground reaction force (+) Step Test (-) Timed Up and Go test At 2 months (follow-up): (-) 10-m Walking Test – with assistive device (+) 10-m Walking Test – without assistive device (+) 6-Minute Walking Test (-) Sit-to-stand ground reaction force (+) Step Test (-) Timed Up and Go test
Geiger et al. 2001 PEDro score: 3	3	Biofeedback training using NeuroCom Balance Master vs. regular balance training	(-) Berg Balance Scale (-) Timed Up and Go (TUG)
Gok et al., 2008 PEDro score: 7/10	7	Balance training with a kinaesthetic ability training (KAT) device + conventional rehabilitation (n=15) vs. conventional rehabilitation alone (n=15) **Treatment details**: KAT balance training for 20 mins during 2-3 hours rehabilitation, 5 days/week for 4 weeks.	At 4 weeks (post-treatment): (+) KAT static balance index (+) KAT dynamic balance index (+) FMA balance subscore (-) FMA lower extremity subscore (-) FIM locomotor subscore (-) FMI total motor score
Goljar et al., 2010 PEDro score: 6/10	6	Balance trainer (n=22) Vs. Standard balance training (n=22) **Treatment details**: 20 mins/day, 5 days/week for 4 weeks.	At 4 weeks (post-treatment): (-) FIM (-) Berg Balance Scale (-) One-leg standing (-) Timed Up and Go test

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
		Both groups received conventional physiotherapy for a further 25 mins.	(-) 10m walk
Grant et al. 1997 PEDro score: 5	5	Standard physiotherapy with biofeedback balance training vs.Standard physiotherapy including balance training	(-) Postural sway (-) Standing symmetry (-) Berg Balance Scale (-) Timed Up and Go (TUG) (-) Gait velocity
Heller et al. 2005 PEDro score: 4	4	Standing balance training by biofeedback coupled with standard physical therapy vs. standard physical therapy (control)	(-) Time from onset of stroke to walking (-) Gait velocity (-) Walking pattern
Howe et al., 2005 PEDro score: 7/10	7	Lateral weight transference training + usual care (n=17) Vs. Usual care alone (n=18) **Treatment details**: 12 x 30-minute sessions over 4 weeks	At 4 weeks (post-treatment) and 8 weeks (follow-up): (-) Weight displacement during lateral reaching in sitting (-) Weight displacement during lateral reaching in standing (-) Sit-to-stand time (-) Stand-to-sit time
Karthikbabu et al., 2011 PEDro score: 8/10	8	Trunk exercises on an unstable surface (n=15) vs. Trunk exercises on a stable surface (n=15) **Treatment details**: Trunk exercises for 1hr/day, 4 days/week for 3 weeks. Both groups also received conventional physiotherapy	At 3 weeks (post-treatment): (+) Trunk Impairment Scale (TIS) – total score (-) TIS – static sitting balance (+) TIS – dynamic sitting balance (+) TIS – coordination (+) Brunel Balance Assessment (BBA) – total score (-) BBA – standing

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
			(+) BBA – stepping Note: results depict mean change scores at post-treatment
Katz-Leurer et al., 2006 PEDro score: 6/10	6	Cycling training + conventional rehabilitation (n=10) Vs. Conventional rehablitation alone (n=14) **Treatment details**: Cycling training 10-30 minutes/day, 5 days/week for 3 weeks; conventional rehabilitation 5 days/week for 6 weeks	At 6 weeks (post-treatment): (+) Postural Assessment Scale for Stroke Patients (PASS) - total, static and dynamic scores (-) Standing Balance test (+) Fugl-Meyer Assessment – lower extremity (FMA-LE) (-) FIM total score (+) FIM motor score (-) Modified Ashworth Scale
Lau et al., 2011 PEDro score: 6/10	6	Speed-dependent treadmill training group (n=15) Vs. Steady-speed treadmill training group (n=15) **Treatment details**: 10 x 30-minute treadmill training sessions and 90 minutes of conventional physiotherapy	After 10 sessions (post-treatment): (-) Berg Balance Scale (-) 10m Walk Test - cadence (+) 10m Walk Test - gait speed (+) 10m Walk Test - stride length
Marigold et al., 2005 PEDro score: 6/10	6	Task-oriented mobility training program (n=30) Vs. Control program emphasizing slow stretching and weight-shifting (n=31) **Treatment details**: 3x 1-hour sessions/week for 10 weeks	At 10 weeks (post-treatment): (-) Berg Balance Scale (-) Activities-specific Balance Confidence (-) Timed Up and Go (+) Step Reaction Time (-) Nottingham Health Profile (-) Forced falls due to platform translation (-) Unforced falls

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
			At 14 weeks (1-month follow-up): (-) Berg Balance Scale (-) Activities-specific Balance Confidence (-) Timed Up and Go (-) Step Reaction Time (-) Nottingham Health Profile (-) Forced falls due to platform translation (-) Unforced falls
McClellan & Ada, 2004 PEDro score: 7/10	7	Home-based task-oriented mobility training (n= 13) Vs. Home-based program to improve upper-limb function (n=10) **Treatment details**: 6 weeks of home-based exercises; participants met with a therapist at week 0, 2 & 4.	At 6 weeks (post-treatment) and 14 weeks (follow-up): (+) Functional Reach Test (-) Motor Assessment Scale – walking (-) Stroke Adapted Sickness Impact Profile
Merkert et al., 2011 PEDro score: 4/10	4	Vibration therapy and balance training using the Vibrosphere® platform + conventional rehabilitation (n=33) vs. Conventional rehabilitation alone (n=33) **Treatment details**: 2 repetitions of 3 exercises (15-90 second training intervals) for 15 days	At 15 days (post-treatment): (-) Berg Balance Scale (-) Barthel Index (-) Tinetti Gait Test (-) Timed Up and Go test (-) Functional test of lower back
Morioka et al. 2003 PEDro score: 6	6	A rehabilitation program including perceptual learning exercises (discriminate the hardness of a sponge rubber placed under the sole of the foot) vs.control	(+) Length, enveloped area and rectangular area of the parameter of postural sway measured by a stabilometer

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
Mudie et al. 2002 PEDro score: 4	4	Task specific reaching vs. Bobath Methods vs. Balance Performance Monitor (BPM) biofeedback training vs. Conventional physiotherapy and occupational therapy (control)	At 2 weeks (post-treatment): (-) Seated weight distribution* (-) Barthel Index (-) Standing symmetry * significant within-group improvement noted in Bobath, BPM and control groups
Noh et al., 2008 PEDro score: 4/10	4	Aquatic therapy (n=13) vs. Conventional gym exercise program (n=12) **Treatment details**: 1 hour, 3 times per week for 8 weeks	At 12 weeks (1 month post-treatment): (+) Berg Balance Scale (-) Vertical Ground Reaction Force (VGRF) – rising from a chair (+) VGRF – forward weightshift (affected side only) (+) VGRF – backward weightshift (affected side only) (-) VGRF – lateral weightshift (-) modified Motor Assessment Scale (+) Muscle strength – knee flexor (-) Muscle strength – knee extensor (-) Muscle strength – trunk flexor (-) Muscle strength – trunk extensor
Onigbinde et al., 2009 PEDro score: 3/10	3	Wobble board exercises with visual feedback + conventional physiotherapy (n=10) Vs. Conventional physiotherapy alone (n=7) **Treatment details**:	At post-treatment (6 weeks): (-) Static balance (eyes open) (+) Static balance (eyes closed) (+) Four Square Step Test time

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
		Wobble board exercises for 6 weeks; frequency and intensity not specified	
Outermans et al., 2010 PEDro score: 6/10	6	High-intensity task-oriented training for mobility (hiTOT, n=23) Vs. Low-intensity standard therapy (LiST, n=21) **Treatment details**: 3 x 45-minute sessions per week for 4 weeks	At 4 weeks (post-treatment): (+) 6-Minute Walk Test (+) 10-metres walking test (-) Berg Balance Scale (-) Functional Reach Test
Perennou et al. 2001 PEDro score: No score	N/A	Postural platform task coupled with TENS treatment (effective stimulation) vs. postural platform task coupled with BASE (placebo) stimulation	Compared to healthy controls. Postural performance: (+) Number of aborted trials (+) Angular dispersions of support oscillations Individuals with neglect vs. those without neglect: (+) Muscle strength (+) Ashworth Scale (+) Pressure sensitivity
Pollock et al. 2002 PEDro score: 5	5	Independent Practice with balance-focused exercise vs. Control* *Both groups received conventional therapy based on the Bobath approach	Mean symmetry of weight distribution: (-) Sitting (-) Standing (-) Rising to stand (-) Sitting down
Richards et al., 1993 PEDro score: 6/10	6	Early intensive gait-focused task-oriented training (n=10) Vs. Conventional physical therapy at the same intensity as the intervention group (n=8)	At 6 weeks (post-intervention) and 3 months (follow-up): (-) Berg Balance Scale

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
		Vs. Physical therapy later in admission and at reduced intensity (n=9) **Treatment details**: 2 x 105 minute sessions per day, approximately 8 days after stroke and continuing for 5 weeks	(-) Fugl-Meyer Assessment (FMA) upper extremity (-) FMA lower extremity (-) FMA balance (-) Barthel Index (-) 6-meter walk test (-) Gait parameters
Rose et al., 2011 PEDro score: N/A (quasi-experimental study)	n/a (quasi-experimental study)	Task-oriented training for mobility (n=78) Vs. Conventional rehabilitation (n=102) **Treatment details**: 1.5 hours per day (1 x 60-minute session and 1x30-minute session), 5 days per week until discharge	At discharge: (+) 5-meter Walk Test (-) Berg Balance Scale (-) Fugl-Meyer Assessment – lower extremity motor subscale (-) Fugl-Meyer Assessment – lower extremity sensory subscale At 90 days post-stroke: (-) Stroke Impact Scale (-) Phone-FIM
Sackley & Lincoln, 1997 PEDro score: 6/10	6	Visual feedback treatment group (n=13) Vs. Placebo group (n=13) **Treatment details**: 1-hour training sessions 3 times/week for 4 weeks	At 4 weeks (post-treatment): (+) stance symmetry (-) sway (+) Rivermead Motor Assessment (RMA) – total motor function (+) RMA - gross function (-) RMA – leg and trunk (+) Nottingham 10 Point ADL Scale (NADL) At 12 weeks (follow-up): (-) stance symmetry (-) sway

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
			(-) Rivermead Motor Assessment (RMA) – total motor function (-) RMA - gross function (-) RMA – leg and trunk (-) Nottingham 10 Point ADL Scale (NADL)
Saeys et al., 2011 PEDro score: 7/10	7	Trunk exercises (n=18) vs. Sham exercises (n=15) **Treatment details**: 30mins/day, 4 times/week for a total of 16 hours. Both groups received conventional rehabilitation	At 8 weeks (post-treatment): (+) Trunk Impairment Scale (TIS) – total score (-) TIS – static sitting balance (+) TIS – dynamic sitting balance (+) TIS – coordination (+) Tinetti Test – total score (+) Tinetti Test – balance (+) Tinetti Test – gait (-) Romberg test – eyes open (-) Romberg test – eyes closed (+) Four Test Balance Scale (+) Berg Balance Scale (+) Dynamic Gait Index (-) Functional Ambulation Categories (+) Rivermead Motor Assessment Battery (RMAB) – total score (+) RMAB – gross function (+) RMAB – leg and trunk (-) RMAB – arm
Salbach et al. 2005 PEDro score: 8	8	Task-oriented interventions targeting walking vs.Interventions targeting upper extremity (UE) function	(+) Activities-specific Balance Confidence scale (balance self-efficacy*)

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
			*self-efficacy is defined as "a judgment of oneoes ability to organize and execute given types of performances."
Salbach et al., 2004 PEDro score: 8/10	8	Task-oriented mobility training (n=44) Vs. Upper extremity task-oriented training (n=47) **Treatment details**: Training sessions 3x/week for 6 weeks (length of each session unspecified)	At 6 weeks (post-treatment): (+) 6-Minute Walk Test (+) 5-m Walk Test – comfortable speed (+) 5-m Walk Test – maximum speed (-) Berg Balance Scale (-) Timed Up and Go test
Shumway-Cook et al. 1988 PEDro score: 4	4	Standing balance retraining using a static force platform biofeedback vs.Standing balance training without biofeedback	(+) Lateral sway displacement (-) Total sway area
van Nes, et al., 2006 PEDro score: 9/10	9	Whole-body vibration (n=27) Vs. Sham stimulation (n=26) **Treatment details**: 4 x 45-second stimulations, 5 days/week for 6 weeks. Both groups also received conventional rehabilitation	At 6 weeks (post-treatment) and 12 weeks (follow-up): (-) Berg Balance Scale (-) Trunk Control Test (-) Rivermead Mobility Index (-) Barthel Index (-) Functional Ambulation Categories (-) Motricity Index (-) somatosensory threshold of the affected leg
Verheyden et al., 2009 PEDro score: 6/10	6	Trunk exercises + conventional rehabilitation (n=17) Vs. Conventional rehabilitation (n=16) **Treatment details**:	At 5 weeks (post-treatment): (-) Trunk Impairment Scale (TIS) – total score (-) TIS – static sitting balance (+) TIS – dynamic sitting balance (-) TIS – coordination

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
		Individualized trunk exercises in supine and sitting for 30 mins, 4 times/week for 5 weeks (total of 10 hours)	
Walker et al. 2000 PEDro score: 5	5	Visual feedback training and additional balance training* vs.Additional balance training vs. Control** *all three groups received conventional physical and occupational therapy **balance training consisted of weight shifting exercises and modification of these	For both intervention groups compared to control: (-) Postural sway (-) Berg Balance Scale (BBS) (-) Gait speed (-) Timed "Up and Go" (TUG) test
Wong et al., 1997 PEDro score: 5/10	5	Standing Biofeedback Training (SBT) device (n=30) Vs. Standing Training Table (STT) worktable (n=30) **Treatment details**: 60-minute training sessions 5 days a week for 3 to 4 weeks	At week 1, 2, 4: (+) Postural symmetry Note: there was no significant difference between groups in postural symmetry at day 1 or week 3.
Yang et al., 2011 PEDro score: 5/10	5	Treadmill training with virtual reality (n=7) Vs. Traditional treadmill training (n=7) **Treatment details**: 20-minute treadmill training sessions 3 times per week for 3 weeks, as well as routine physiotherapy and occupational therapy	At 3 weeks (post-treatment): Quiet stance (+) Center of pressure displacement (COP) medial-lateral direction (-) COP anterior-posterior direction (-) COP total path excursion (-) COP sway area (-) Symmetry index Sit-to-stand transfer (-) COP medial-lateral direction (-) COP anterior-posterior direction

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
			(-) COP total path excursion (-) COP sway area (-) Symmetry index (-) COP path excursion under the paretic limb Level walking (-) Stance time of the paretic limb (-) Contact area of the paretic foot (-) Number of steps of the paretic limb
Yelnik et al. 2008 PEDro score: 8	8	Multisensorial therapy which included vision-deprived balance tasks and exercises vs neurodevelopmental therapy (NDT). 20 sessions, 5 days/week x 4 weeks.	Day 30 (-) Berg Balance Scale (-) 10m gait speed, (-) Percentage of double-limb stance time, (-) Self-report on perception of security (+) Fucntional Independence Measure (FIM) (-) Nottingham Health Profile Day 90 (-) Berg Balance Scale (-) 10m gait speed (+) Percentage of double-limb stance time (-) Self- report on perception of security (+) Functional Independence Measure (FIM) (+) Nottingham Health Profile