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 **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. 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.	**At 8 weeks (post-treatment):** COP displacement during: (+) Double-leg stance – eyes open, normal 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 training using the Bobath approach, preceded or followed by conventional training only for two weeks.	**At post-treatment (2 weeks):** (+) Functional Ambulation Category (+) Berg Balance Scale (+) Six-Minute Walk Test (+) Timed Up and Go Test (+) Korean Modified Barthel Index (-) 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**:	**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

		Alternating use of hot and cold packs with active or passive movement for 30-40 minutes/day, 5 days/week for 6 weeks.	(+) Functional Ambulation Classification (-) Modified Ashworth Scale
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)	**At 4 weeks (post-treatment):** (-) 10-m Walking Test – with assistive device

		Vs. Task-oriented upper limb training program (n=4) **Treatment details**: 1hour/day, 3x/week for 4 weeks.	(+) 10-m Walking Test – without assistive device (+) 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 (-) 10m walk

		Both groups received conventional physiotherapy for a further 25 mins.	
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 (+) 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 **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
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**: Wobble board exercises for 6 weeks; frequency and intensity not specified	**At post-treatment (6 weeks):** (-) Static balance (eyes open) (+) Static balance (eyes closed) (+) Four Square Step Test time
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) 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	**At 6 weeks (post-intervention) and 3 months (follow-up):** (-) Berg Balance Scale (-) 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 (-) 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*) *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**: Individualized trunk exercises in supine and sitting for 30 mins, 4 times/week for 5 weeks (total of 10 hours)	**At 5 weeks (post-treatment):** (-) Trunk Impairment Scale (TIS) – total score (-) TIS – static sitting balance (+) TIS – dynamic sitting balance (-) TIS – coordination
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 (-) 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