Video Game-Based Therapy on Balance and Gait of Patients with Stroke: A Systematic Review

Silvia Pintado-Izquierdo, Roberto Cano-de-la-Cuerda and Rosa María Ortiz-Gutiérrez

Supplementary Materials: Comprehensive description of the articles included in the systematic review.

Barcala et al. [25]

Methods	Single blind randomised controlled clinical trial Method of randomisation: table of randomisation numbers
Participants	Recruited from physical therapy clinic of the Nove of Julho University (Brazil) 20 Participants: 10 EG, 10 CG Inclusion criteria: individuals with chronic sequelae stemming from a stroke, weekly physical therapy sessions at the institution, the ability to remain in an orthostatic position without support, absence of osteoarticular deformities and the ability to understand the visual biofeedback Exclusion criteria: Individuals with associated diseases Mean age ± SD: EG 62.5 ± 12.5; CG 63.5 ± 14.5 Timing post-stroke (months) _Mean ± SD: EG 12.3 ± 7.1; CG 15.2 ± 6.6
Interventions	EG: 60′ conventional physiotherapy + 30′ Wii®. CG: 60′ conventional physiotherapy 10 sessions, 2 times/week for 5 weeks
Differences between groups in intervention	30′more in each session in EG than CG
EG professional	NR
Side effects	NR
Outcomes	Outcomes recorded at baseline and post intervention Balance: Posturography (peak plantar pressure and oscillation in different sensorial conditions), BBS, TUG
Main Results	Statistically significant improvements in both groups after intervention in all the variables (the variables recorded by posturography, BBS and TUG) ($p < 0.05$), although without significant statistical differences between groups.

BBS, Berg Balance Scale; CG, control group; EG, experimental group; NR, not reported; SD, standard deviation; TUG, Timed Up and Go test.

Bower et al. [26]

Methods	Single-blind controlled trial Method of quasi randomisation: based on the participant's Stroke Rehabilitation Assessment of Movement (STREAM) score

Participants	Recruited from inpatient rehabilitation facility in Melbourne, Australia 30 Participants: 17 EG, 13 CG Inclusion criteria: diagnosis of stroke, 18 years and over, non-cerebellar stroke less than three months prior, able to stand unsupported for longer than 30 seconds and have functional use of at least one upper limb Exclusion criteria: medically unstable or other medical condition that could confound results, severe dysphasia, dyspraxia or cognitive impairment and anticipated length of stay less than three weeks Mean age ± SD: EG 61.9 ± 13.6; CG 65.9 ± 16.2 Timing post-stroke (days) _Mean ± SD: EG 25.4 ± 16.4; CG 24.2 ± 20.8
Interventions	EG: Conventional rehabilitation (physical therapy and occupational therapy) + 45′ Wii® in bipedestation CG: Conventional rehabilitation (physical therapy and occupational therapy) + 45′ Wii® in sitting position 6–12 sessions, 3 times/week for 2–4 weeks (dependent of the typical inpatient length of stay)
Differences between groups in intervention	No differences
EG professional	Physiotherapist
Side effects	4 participants in EG and 2 in CG in had falls on the ward during the study period that did not result in any serious injuries. 15 participants reported pre-existing pain during of their intervention sessions that was unchanged following the sessions (more participants in EG than CG). EG participants tended to report low back or leg pain, whereas CG participants reported shoulder and neck pain. No pain increase lasted more than 24 hours. EG participants had a significantly greater increase in post intervention session fatigue
Outcomes	Outcomes recorded at baseline, 2 weeks and post intervention Balance: Wii Balance Board® (displacement velocity in different sensorial conditions and weight shifting), Steptest, FRT, FES-I, TUG
Main Results	Clinical improvements in both groups after intervention in all the variables (the variables recorded by Wii Balance Board®, Steptest, FRT, TUG, FES-I), but not statistically significant improvements ($p > 0.05$). Not statistic and clinically significant differences between groups in any variable after intervention.

CG, control group; EG, experimental group; FES-I, Falls Efficacy Scale International; FRT, Functional Reach Test; SD, standard deviation; TUG, Timed Up and Go test.

Cho et al. [27]

Methods	Randomised clinical trial Method of randomisation: computer-generated by using a basic random number generator
Participants	Recruited from a voluntary basis from a stroke unit. Seoul (Korea) 22 Participants: 11 EG, 11 CG

	Inclusion criteria: hemiparetic status resulting from a single stroke at least 6 months earlier, ability to walk 10 m independently with or without an assistive device, MMSE > 24, absence of a musculoskeletal condition that could potentially affect the ability to walk safely, absence of serious visual impairment or a hearing disorder Exclusion criteria: severe dementia or aphasia, hemispatial neglect, ataxia or any other cerebellar symptom, or participation in other studies or rehabilitation programs Mean age ± SD: EG 65.26 ± 8.35; CG 63.13 ± 6.87 Timing post-stroke (months)_Mean ± SD: EG 12.54 ± 2.58; CG 12.63 ± 2.54
Interventions	EG: 60′/90′standard rehabilitation (30′physical therapy, 30′occupational therapy and 30′speech-language therapy if appropriate) + 30′Wii® CG: 60′/90′ standard rehabilitation (30′physical therapy, 30′occupational therapy and 30′speech-language therapy if appropriate) 30 sessions standard rehabilitation, 5 times/week for 6 weeks and 18 sessions Wii®, 3 times/week for 6 weeks (EG)
Differences between groups in intervention	30′more in each session in EG (3 times/week for 6 weeks)
EG professional	Therapist (not specific)
Side effects	NR
Outcomes	Outcomes recorded at baseline and post intervention Balance: posturography (Postural Sway Velocity in different sensorial conditions), BBS, TUG
Main Results	Statistically significant improvements in both groups after intervention in BBS and TUG ($p < 0.01$); statistic improvements were significantly higher in the EG ($p < 0.05$). The variables recorded by posturography presented no significant statistical differences in any group after intervention ($p > 0.05$).

BBS, Berg Balance Scale; CG, control group; EG, experimental group; MMSE, MiniMental State Examination; NR, not reported; SD, standard deviation; TUG, Timed Up and Go test.

Hung et al. [28]

Methods	Single-blind randomised controlled trial Method of randomisation: randomisation sequence
Participants	Recruited from a tertiary hospital. Taiwan 24 Participants: 12 EG, 12 CG Inclusion criteria: post-stroke duration of at least 6 months, age ≥18 years, ability to understand verbal instructions and learn, adequate visual acuity (with appropriate correction, if necessary) and ability to walk independently with or without device Exclusion criteria: bilateral hemispheric or cerebellar lesions, aphasia, significant visual field deficits or hemineglect, or a history of orthopaedic or other neurological diseases and/or medical conditions that would prevent adherence to the exercise protocol

	Median age (IQR): EG 55.66 (46.27, 60.49): CG 51.75 (42.99, 60.14) Timing post-stroke (months)_median (IQR): EG 23.0 (7.75, 31.75); CG 25.5 (13.5, 34.0)
Interventions	EG: Standard rehabilitation + 30′ Wii® CG: Standard rehabilitation + 30′ load transfer 24 sessions, 2 times/week for 12 weeks
Differences between groups in intervention	No differences
EG professional	Occupational therapist
Side effects	NR
Outcomes	Outcomes recorded at baseline, post intervention and 3 month follow-up Balance: BBS
Main Results	Clinical improvements in both groups after intervention in BBS, but not statistically significant ($p > 0.05$). Not significant statistical differences between groups in BBS after intervention.

BBS, Berg Balance Scale; CG, control group; EG, experimental group; IQR, interquartile range; NR, not reported.

Hung et al. [29]

Methods	Single-blind randomised controlled trial Method of randomisation: table of randomisation numbers
Participants	Recruited from the rehabilitation department of a medical centre. Taiwan 28 Participants: 13 EG, 15 CG Inclusion criteria: hemiplegic stroke at least 6 months prior to enrolment, aged > 18 years, BBS < 56, able to understand verbal instructions and watch a television screen satisfactorily and able to walk independently with or without a device for 10m Exclusion criteria: bilateral hemispheric or cerebellar lesions, receptive aphasia, significant visual field deficits or hemineglect, and concomitant other neurologic diagnoses or conditions that would prevent adherence to the exercise protocol Mean age ± SD: EG 55.38 ± 9.95; CG 53.4 ± 10.03 Timing post-stroke (months)_Mean ± SD: EG 21.0 ± 11.23; CG 15.93 ± 8.02
Interventions	EG: Standard outpatient rehabilitation + 30′ Wii® CG: Standard outpatient rehabilitation + 30′ load transfer 24 sessions, 2 times/week for 12 weeks
Differences between groups in intervention	No differences
EG professional	Occupational therapist

Side effects	2 CG participants reported increased knee pain when training. 3 EG participants reported increased spasticity when playing with Wii Balance Board®. This symptom subsided when they played other games. Accidental falls or other adverse events did not occur.
Outcomes	Outcomes recorded at baseline, post intervention and 3 month follow-up Balance: Posturography (Percentage of weight bearing on affected leg in different sensorial conditions, Stability index in different sensorial conditions), FRT, TUG, FES-I
Main Results	Statistically significant improvements in both groups after intervention in the variables recorded by posturography, FRT, FES-I and TUG ($p < 0.05$). These results were maintained at 3-month follow-up in FRT and TUG but not in the variables recorded by posturography and FES-I. Not significant statistical differences between groups in any variable after intervention.

BBS, Berg Balance Scale; CG, control group; EG, experimental group; FES-I, Falls Efficacy Scale International; FRT, Functional Reach Test; SD, standard deviation; TUG, Timed Up and Go test.

Kannan et al. [30]

Methods	Randomised clinical trial Method of randomisation: flipping a coin
Participants	Ambulatory individuals. Chicago 20 Participants: 10 EG, 10 CG Inclusion criteria: hemiparetic cortical stroke greater than six months ago, without any presence of aphasia and with diagnosis confirmed by their physician, able to stand independently for at least five minutes without the use of an assistive device or physical assistance and able to follow instructions in English Exclusion criteria: MMSE < 25/30. osteopenic or osteoporotic, metal implants due to orthopaedic conditions or any other neurological disorders Mean age ± SD: EG 57.5 ± 8.04; CG 61 ± 4.6 Timing post-stroke (years)_Mean ± SD: EG 8.9 ± 5.394; CG 9.09 ± 6.36
Interventions	EG: 90′ Wii® + cognitive tasks simultaneously CG: 90′ standard rehabilitation 20 sessions for 6 weeks (5 times/week 1–2 weeks, 3 times/week 3–4 weeks and 2 times/week 5–6weeks)
Differences between groups in intervention	No differences
EG professional	NR
Side effects	NR
Outcomes	Outcomes recorded at baseline and post intervention Balance: Posturography (movement velocity), BBS, TUG Gait: 6MWT

Main Results	Statistically significant improvements after intervention in EG in movement velocity ($p = 0.001$). Statistically significant improvements in both groups after intervention in BBS, TUG and 6MWT ($p < 0.05$). Not statistically significant differences between groups in any variable after intervention.

6MWT, 6-minute walk test; BBS, Berg Balance Scale; CG, control group; EG, experimental group; MMSE, MiniMental State Examination; NR, not reported; SD, standard deviation; TUG, Timed Up and Go test.

Karasu et al. [31]

Methods	Single-blind randomised clinical trial Method of randomisation: table of randomisation numbers
Participants	Recruited from Gazi University, Faculty of Medicine, Department of Physical Medicine and Rehabilitation. Turkey 23 Participants: 12 EG, 11 CG Inclusion criteria: first episode of unilateral stroke during the previous 12 months, able to understand and follow simple verbal commands and participate in a rehabilitation programme for the first time Exclusion criteria: cognitive disorders, sensory or global aphasia, systemic disease or medication that causes peripheral neuropathy, lower extremity motor improvement level of Stage 1 on the Brunnstrom scale, cerebellar lesions or anomalies in cerebellar tests, deep sensory impairment, visual or vestibular impairment, lack of cooperation in performing the balance exercises and tests, or orthopaedic disorders that prevent execution of the balance tests Mean age ± SD: EG 62.3 ± 11.79; CG 64.1 ± 12.2
Interventions	EG: 120′/180′standard rehabilitation (physiotherapy, occupational therapy and cognitive therapy) + 20′ Wii® CG: 120′/180′standard rehabilitation (physiotherapy, occupational therapy and cognitive therapy) 20 sessions, 5 times/week for 4 weeks
Differences between groups in intervention	20′ more in each session in EG
EG professional	NR
Side effects	NR
Outcomes	Outcomes recorded at baseline, post intervention and 1 month follow-up Balance: Posturography (displacement of the centre of pressure in different sensorial conditions), BBS, FRT, SBI , PASS, TUG
Main Results	Statistically significant improvements in both groups after intervention in variables recorded by posturography, BBS, FRT, SBI and PASS ($p < 0.05$). The improvements in BBS and FRT were statistical significantly higher in the EG ($p < 0.001$). TUG presented no significant statistical differences in any group after intervention ($p > 0.05$)

BBS, Berg Balance Scale; CG, control group; EG, experimental group; FRT, Functional Reach Test; NR, not reported; PASS, Postural Assessment Scale; SBI, Static Balance Index; SD, standard deviation; TUG, Timed Up and Go test.

Kim et al. [32]

Methods	Randomised clinical trial Method of randomisation: not reported
Participants	Recruited from: not reported. Korea 17 Participants: 10 EG, 7 CG Inclusion criteria: diagnosis with stroke by magnetic resonance imaging or Computed Tomography, MMSE ≥ 19, able to maintain an upright posture without any assistance Exclusion criteria: orthopaedic surgery or arthritis, hand or upper limb pain, epilepsy or psychiatric illnesses Mean age ± SD: EG 41.3 ± 6.61; CG 55 ± 13.02 Timing post-stroke (months)_Mean ± SD: EG 12.6 ± 7.12; CG 12.85 ± 6.06
Interventions	EG: 30′general exercises + 15′ electric stimulation of the tibialis anterior on affected side + 30′ Wii® CG: 30′ general exercises + 15′ electric stimulation of the tibialis anterior on affected side 9 sessions, 3 times/week for 3 weeks
Differences between groups in intervention	30′more in each session in EG
EG professional	Physiotherapist
Side effects	NR
Outcomes	Outcomes recorded at baseline and post intervention Balance: PASS, MMAS
Main Results	Statistically significant improvements in both groups after intervention in PASS and MMAS ($p < 0.05$). These improvements were statistical significantly higher in the EG ($p < 0.05$).

CG, control group; EG, experimental group; MMAS, modified motor assessment scale; MMSE, MiniMental State Examination; NR, not reported; PASS, Postural Assessment Scale; SD, standard deviation.

Lee et al. [33]

Methods	Randomised clinical trial Method of randomisation: not reported
Participants	Recruited from K Hospital in Seoul. Korea 24 Participants: 12 EG, 12 CG

	Inclusion criteria: stroke of >6 months duration, Korean version MMSE >24, ability to walk a distance of 10 m with or without an auxiliary device, no orthopaedic conditions involving the lower limbs, ability to follow instructions and perform the exercise programs, no visual or hearing impairment Mean age ± SD: EG 45.91 ± 12.28; CG 49.16 ± 12.85
Interventions	EG: 60′ therapeutic exercise with physiotherapy + 30′ Wii® CG: 60′ therapeutic exercise + 30′ functional task treatment 30 sessions standard rehabilitation, 5 times/week for 6 weeks and 18 sessions Wii® or functional task treatment, 3 times/week for 6 weeks
Differences between groups in intervention	No differences
EG professional	NR
Side effects	NR
Outcomes	Outcomes recorded at baseline and post intervention Balance: Wii Balance Board® (COP path length and velocity in different sensorial conditions), FRT
Main Results	Statistically significant improvements in both groups after intervention in variables recorded by Wii Balance Board® and FRT ($p < 0.05$). The improvements in FRT were statistical significantly higher in the EG ($p < 0.0001$), but not in variables recorded by Wii Balance Board® ($p > 0.05$).

CG, control group; EG, experimental group; FRT, Functional Reach Test; MMSE, MiniMental State Examination; NR, not reported; SD, standard deviation.

Lee et al. [34]

Methods	Single-blind randomised controlled trial Method of randomisation: computer generator
Participants	Recruited from Neurorehabilitation Unit of Shuang-Ho Hospital. Taiwan 47 Participants: 26 EG, 21 CG Inclusion criteria: age between 20 and 75 years, chronicity > 6 months, ability to understand game instructions, ability to stand for 15 minutes, Brunnstrom stage ≥ III Exclusion criteria: having a Montreal Cognitive Assessment score < 16, visual or auditory impairment, severe spasticity of lower extremity (Modified Ashworth Scale ≥ 3), other medical symptoms that could affect movement Mean age ± SD: EG 59.35 ± 8.95; CG 55.76 ± 9.59 Timing post-stroke (days)_Mean ± SD: EG 839.77 ± 719.13; CG 653.24 ± 589.70
Interventions	EG: 45′ conventional rehabilitation (occupational therapy) + 45′ Xbox® CG: 60′ conventional rehabilitation (occupational therapy) + 30′ balance training 12 sessions, 2 times/week for 6 weeks

Differences between groups in intervention	No differences
EG professional	Occupational therapist
Side effects	Both groups experienced pain, hypertonia and dizziness and were greater in EG compared to the CG, although they were no serious in any group because a therapist supervised the safety and adjusted challenges to prevent complications.
Outcomes	Outcomes recorded at baseline, post intervention and 3 month follow-up Balance: BBS, FRT, TUG-cog
Main Results	Statistically significant improvements in both groups after intervention and follow-up in BBS and TUG-cog ($p < 0.05$), although without significant differences between both groups. FRT presented no significant statistical differences in any group after intervention and follow up ($p > 0.05$).

BBS, Berg Balance Scale; CG, control group; EG, experimental group; FRT, Functional Reach Test; SD, standard deviation; TUG-cog, cognitive Timed Up and Go test.

Lee et al. [35]

Methods	Single-blind randomised controlled trial Method of randomisation: computer-generated by using a basic random number generator
Participants	Recruited from a University hospital in Gyeonggi Province. South Korea 10 Participants: 5 EG, 5 CG Inclusion criteria: non-cerebellar stroke within the previous 6 months, ability to understand and follow simple verbal instructions, MMSE ≥21, BBS > 15, ability to walk 10 m independently, with or without an assistance device Exclusion criteria: psychiatric disorder or dementia, apraxia or hemi-neglect, epilepsy or pacemaker use, severe pain in the hemiplegic shoulder, participation rate of <80% Mean age ± SD: EG 65.2 ± 5.0; CG 66.2 ± 3.4 Timing post-stroke (months)_Mean ± SD: EG 3.1 ± 1.6; CG 3.3 ± 1.1
Interventions	EG: 135′ conventional rehabilitation (physiotherapy, occupational therapy and FES) + 30′ Wii® CG: 135′ conventional rehabilitation (physiotherapy, occupational therapy and FES) 20 sessions conventional rehabilitation, 5 times/week for 4 weeks and 12 sessions Wii®, 3 times/week for 4 weeks (EG)
Differences between groups in intervention	30′more in each session in EG
EG professional	NR

Side effects	NR
Outcomes	Outcomes recorded at baseline and post intervention Balance: BBS, FRT, TUG
Main Results	Statistically significant improvements in both groups after intervention in BBS and FRT ($p < 0.05$). These improvements were significantly higher in the EG ($p < 0.05$). Statistically significant improvements after intervention in EG in TUG ($p < 0.05$). These improvements were statistically significant between both groups after intervention ($p < 0.05$).

BBS, Berg Balance Scale; CG, control group; EG, experimental group; FES, functional electrical stimulation; FRT, Functional Reach Test; MMSE, MiniMental State Examination; NR, not reported; SD, standard deviation; TUG, Timed Up and Go test.

Morone et al. [36]

Methods	Single blind randomised controlled trial Method of randomisation: randomisation list generated by a personal computer from a physician not involved in recruitment.
Participants	Recruited from rehabilitation unit of Clinical Laboratory of Experimental Neurorehabilitation, Santa Lucia Foundation. Rome, Italy 50 Participants: 25 EG, 25 CG Inclusion criteria: hemiparesis in the subacute phase (<3 months from onset) with moderate gait deficits (FAC ≥ 2) caused by a first-ever stroke, age between 18 and 85 years Exclusion criteria: motor or cognitive sequelae of prior cerebrovascular accidents, other chronic disabling pathologies, orthopaedic injuries that could impair locomotion, spasticity that limited lower extremity range of motion to less than 80%, sacral skin lesions, MMSE < 24, hemispatial neglect, attention or memory deficit as evaluated by a neurophysiologist Mean age ± SD: EG 58.36 ± 9.62; CG 61.96 ± 10.31 Timing post-stroke (days)_Mean ± SD: EG 61.0 ± 36.47; CG 41.65 ± 36.89
Interventions	EG: Conventional physiotherapy + 20′ Wii® CG: Conventional physiotherapy + 20′ balance exercises 12 sessions, 3 times/week for 4 weeks
Differences between groups in intervention	No differences
EG professional	Physiotherapist
Side effects	NR
Outcomes	Outcomes recorded at baseline, post intervention and 1 month follow-up Balance: BBS, FAC Gait: 10MWT
Main Results	Statistically significant improvements in both groups after intervention in all variables (BBS, FAC and TUG) ($p < 0.001$), the improvements in BBS and 10MWT were statistically significantly higher in the EG ($p < 0.05$), but not in FAC ($p > 0.05$).

	These statistically significant improvements were maintained in follow-up.

10MWT, 10-metre walk test; BBS, Berg Balance Scale; CG, control group; EG, experimental group; FAC, functional outpatient category; MMSE, MiniMental State Examination; NR, not reported; SD, standard deviation.

Park et al. [37]

Methods	Single-blind randomised controlled trial Method of randomisation: table of randomisation numbers
Participants	Recruited from a rehabilitation hospital in Seoul, South Korea. 20 Participants: 10 EG, 10 CG Inclusion criteria: period of more than 6 months between stroke and randomisation, hemiplegic stroke as diagnosed by a neurologist, MMSE ≥ 21, no problems with auditory or visual functioning, ability to walk more than 10 m with or without assistive devices, not taking any medication that could influence balance, stable vital signs, capacity to provide informed consent Exclusion criteria: severe conditions that require medical care (uncontrolled blood pressure or angina), musculoskeletal impairments of the lower extremity, psychological conditions, refusal to use a video game Mean age ± SD: EG 62.0 ± 17.14; CG 65.3 ± 10.51 Timing post-stroke (months)_Mean ± SD: EG 10.78 ± 7.06; CG 14.1 ± 7.73
Interventions	EG: 30′ conventional physiotherapy + 30′ Xbox® CG: 30′ conventional physiotherapy 42 sessions, 7 times/week for 6 weeks
Differences between groups in intervention	30′more in each session in EG
EG professional	Therapist (not specific)
Side effects	They collected side effects data, but no participants reported any side effects
Outcomes	Outcomes recorded at baseline and post intervention Balance: BBS, TUG Gait: 10MWT
Main Results	Statistically significant improvements in both groups after intervention in all variables (BBS, TUG and 10MWT) ($p < 0.05$) and statistically significantly higher in the EG ($p < 0.05$)

10MWT, 10-metre walk test; BBS, Berg Balance Scale; CG, control group; EG, experimental group**;** MMSE, MiniMental State Examination; SD, standard deviation; TUG, Timed Up and Go test.

Pedreira da Fonseca et al. [38]

Methods	Single-blind randomised controlled trial Method of randomisation: random.org program
Participants	Recruited from: not reported 27 Participants: 14 EG, 13 CG Inclusion criteria: hemiparesis after a stroke, both sex, in the age group from 18 to 65 years Exclusion criteria: injury occurred fewer than 6 months previously, associated disorders (epilepsy), sensory and perceptual deficits (hemineglect and Pusher syndrome), osteodegenerative disorders, cognitive and communication disorders Mean age ± SD: EG 53.8 ± 6.3; CG 50.9 ± 10.9 Timing post-stroke (months)_Mean ± SD: EG 44.1 ± 25.0; CG 64.5 ± 41.9
Interventions	EG: 15′ conventional physiotherapy + 45′ Wii® CG: 60′ conventional physiotherapy 20 sessions, 2 times/week for 10 weeks
Differences between groups in intervention	No differences
EG professional	Physiotherapist
Side effects	NR
Outcomes	Outcomes recorded at baseline and post intervention Gait: DGI
Main Results	Statistically significant improvements in CG after intervention in DGI ($p < 0.05$). Clinical improvements in EG after intervention in DGI, but not statistically significant ($p > 0.05$).

CG, control group; DGI, Dynamic Gait Index; EG, experimental group**;** NR, not reported; SD, standard deviation.

Rajaratnam et al. [39]

Methods	Double-blind randomised controlled trial Method of randomisation: Random Allocation Software
Participants	Recruited from Ang Mo Kio Hospital. Singapore 19 Participants: 10 EG, 9 CG Inclusion criteria: recently experienced a first onset of stroke, moderate disability or moderate-severe disability (MRS 3 or 4), MMSE > 23 Exclusion criteria: terminal diseases, uncontrolled hypertension and angina, and severe spatial neglect or visual impairments Mean age ± SD: EG 58.67 ± 8.62; CG 65.33 ± 9.59 Timing post-stroke (days)_Mean ± SD: EG 14.7 ± 7.5; CG 15.2 ± 6.3
Interventions	EG: 40′ conventional rehabilitation + 20′ VR (Wii®/Xbox®) CG: 60′ conventional rehabilitation 15 sessions

Differences between groups in intervention	No differences
EG professional	Physiotherapist
Side effects	NR
Outcomes	Outcomes recorded at baseline and post intervention Balance: Wii Balance Board®, BBS, FRT, TUG
Main Results	Statistically significant improvements after intervention in EG in FRT and TUG ($p < 0.05$) and in CG in TUG ($p < 0.05$). Variable recorded by Wii Balance Board® presented no significant statistical differences in any group after intervention ($p > 0.05$). No significant statistical differences between both groups in any variables after intervention ($p > 0.05$).

BBS, Berg Balance Scale; CG, control group; EG, experimental group**;** FRT, Functional Reach Test; MMSE, MiniMental State Examination; MRS, Modified Rankin Scale; NR, not reported; SD, standard deviation; TUG, Timed Up and Go test; VR, virtual reality.

Singh et al. [40]

Methods	Single-blind controlled trial Method of quasi randomisation: one centre EG and other centre CG
Participants	Recruited from two centres of the National Stroke Association of Malaysia 28 Participants: 15 EG, 13 CG Inclusion criteria: Stroke survivors (at least six months post-stroke), aged 55 years old and older, walking independently with or without a walking aid and able to stand for at least 30 minutes Exclusion criteria: MMSE<17, prescribed drugs that could potentially affect physical function and balance, medical illnesses that would limit participation in intensive exercise programmes Mean age ± SD: EG 65.4 ± 9.8; CG 67.0 ± 8.4 Timing post-stroke (months)_Mean ± SD: EG 40.5 ± 41.8; CG 34.9 ± 23.6
Interventions	EG: 90′ standard group physiotherapy + 30′ VR (15′ Wii® + 15′ Xbox®) CG: 120′ standard group physiotherapy 12 sessions, 2 times/week for 6 weeks
Differences between groups in intervention	No differences
EG professional	Therapist (not specific)
Side effects	NR
Outcomes	Outcomes recorded at baseline and post intervention Balance: Posturography (OBS), TUG Gait: 10MWT, 6MWT

Main Results	No significant statistical differences were found in any group after intervention in any variable ($p > 0.05$)

10MWT, 10-metre walk test; 6MWT, 6-minute walk test; CG, control group; EG, experimental group; MMSE, MiniMental State Examination; NR, not reported; OBS, Overall Balance Score; SD, standard deviation; TUG, Timed Up and Go test; VR, virtual reality.

Song & Park [41]

Methods	Randomised clinical trial Method of randomisation: not reported
Participants	Recruited from N hospital in Daegu, South Korea. 40 Participants: 20 EG, 20 CG Inclusion criteria: no visual field defect, no abnormality in the vestibular organs, no orthopaedic disease, an unrestricted range of motion, ability to understand and perform the exercise as instructed by the researcher, Korean version MMSE ≥24 Mean age ± SD: EG 51.37 ± 40.6; CG 50.1 ± 7.83 Timing post-stroke (months)_Mean ± SD: EG 14.75 ± 6.06; CG 14.3 ± 3.4
Interventions	EG: 30′ Xbox® CG: 30′ ergometric bike MOTOmed 40 sessions, 5 times/week for 8 weeks
Differences between groups in intervention	No differences
EG professional	NR
Side effects	NR
Outcomes	Outcomes recorded at baseline and post intervention Balance: Posturography (weight bearing on the affected side, anterior and posterior LOS), TUG Gait: 10MWT
Main Results	Statistically significant improvements in both groups after intervention in all variables (variables recorded by posturography, TUG and 10 MWT) ($p < 0.05$) and statically significant higher in the EG ($p < 0.05$)

10MWT, 10-metre walk test; CG, control group; EG, experimental group; LOS, limit of stability; MMSE, MiniMental State Examination; NR, not reported; SD, standard deviation; TUG, Timed Up and Go test.

Yatar & Yildrim [42]

Methods	Randomised controlled trial Method of quasi randomisation: registration number (even numbers EG, odd numbers CG)
Participants	Recruited from a physiotherapy and rehabilitation department 30 Participants: 15 EG, 15 CG Inclusion criteria: first ever stroke with hemiparesis (≥6 months)

	Exclusion criteria: other physical problem or epilepsy, MMSE ≤ 20, severe depression (BDI ≥ 30, unable to walk independently (MRS > 3). Mean age ± SD: EG 62.8 ± 10.87; CG 56.6 ± 16.42 Timing post-stroke (years)_Mean ± SD: EG 3.7 ± 4.42; CG 4.23 ± 4.86
Interventions	EG: 30´ Neurodevelopment + 30´ Wii® CG: 30´ Neurodevelopment + 30´ balance training 12 sessions, 3 times/week for 4 weeks
Differences between groups in intervention	No differences
EG professional	Physiotherapist
Side effects	NR
Outcomes	Outcomes recorded at baseline, post intervention and 1 month follow-up Balance: Wii Balance Board® (weight distribution), FRT, BBS, TUG Gait: DGI
Main Results	Statiscally significant improvements in both groups after intervention in FRT, BBS, TUG and DGI ($p \leq 0.05$). Significant statistical differences between both groups in FRT, BBS, TUG and DGI ($p \leq 0.05$), with better results in EG. Statiscally significant improvements in EG after intervention in weight distribution recorded by Wii Balance Board® ($p \leq 0.05$), but not in CG ($p > 0.05$) These improvements were maintained in CG in BBS and TUG in follow-up ($p \leq 0.05$).

BBS, Berg Balance Scale; BDI, Beck Depression Inventory, CG, control group; DGI, Dynamic Gait Index EG, experimental group; FRT, Functional Reach Test; MMSE, MiniMental State Examination; MRS, Modified Rankin Scale; NR, not reported; SD, standard deviation; TUG, Timed Up and Go test.