Table S3: Summary of findings of included studies.

First Author	Pub Year	Intervention	Intervention Length	Intervention Frequency	Session Duration	VR Hardware	VR Software	Relevant Measures	Finding	Provided Cited Rational of Intervention
Afridi [23]	2018	VR	6 weeks	4 days/week	30 min	Nintendo Wii & Balance Board	Wii Fit Plus	BBS, TUG, FRT	Overall mean improvements on BBS, TUG and FRT	No
Aharoni [24]	2021	VR	Single session	Not applicable	15 min	HTC Vive head-mounted display	Custom-developed VR software for the FSST-VR test	Head kinematics (movement range, smoothness)	No significant differences in head kinematics between PPPD and control groups	PPPD can affect dynamic balance due to visual sensitivity and altered postural control
Alahmari [25]	2014	VR vs. CR	6 weeks	1 day/week	60 min	multi-projection screens integrated with treadmill	Custom VR grocery store	DGI, FGA, gait speed, TUG, SOT	Significant improvement in DGI, FGA, gait speed and SOT for VR group. No significant between group differences for functional measures.	Yes
Alhirsan [26]	2021	VR	Single session	Not applicable	Not specified	Microsoft HoloLens AR headset (for Groups 2 and 3)	Custom-developed VR software with virtual environments	Berg Balance Scale, Timed Up and Go test, knee extensor and flexor muscle strength	Not yet available, this is a planned study	Traditional stroke rehabilitation

An [27]	2018	VR	6 weeks	3 days/week	30 min	IREX	IREX-available programs	LOS, BBS, TUG, WISCI-II	Significant improvement in OLOS, TUG score	Yes
Anson [28]	2018	VRTT vs. TT	4 weeks	3 days/week	30 min	TV screen integrated with treadmill	Custom Target and cursor integrated with sensors on participant's trunk	BBS, BESTest, mBESTest, 6MWT	Significant improvement on BESTest and mBESTest for VR group	No
Anwar [29]	2021	VR vs. CR	6 weeks	3 days/week	60 min	Custom-designed VR headset and motion capture system	Custom-developed VR software with balance and gait training exercises	Berg Balance Scale (BBS), Fugl-Meyer Assessment-Lower Extremity (FMA-LE)	VR training was more effective than conventional physical therapy in improving balance and lower extremity function. VR training group had significantly higher scores on BBS and FMA-LE compared to the conventional therapy group.	Limitations of conventional physical therapy
Bang [30]	2016	VR vs. TT	8 weeks	3 days/week	40 min	Nintendo Wii & Balance Board	Wii Fit	Pedoscan, Smart Step	Significant improvement in balance for both groups, significant difference between groups for balance in favor of VR group, significant improvement in gait for VR group.	No
Bellomo [31]	2020	VR	4 weeks	3 days/week	≥ 15 min	WeReha (tablet and bluetooth inertial sensors)	WeReha software with interactive games	BBS, FM	Significant improvement in BBS and FM at post-test and remained stable at f/u	No

Brachman [32]	2021	VR vs. CR	4 weeks	3 days/week	30 min	Kinect sensors integrated with force platform and projected on a screen	Custom created games	Quiet standing, LOS, FBT	Significant improvements in static balance in both groups. Significant improvement in LOS and FBT in the VR group only.	Yes
Brachman [33]	2021	VR	4 weeks	3 days/week	30 min	WeReha (tablet and bluetooth inertial sensors)	WeReha software with interactive games	Quiet standing, LOS, FBT	Significant improvement in LOS and FBT	No
Pazzaglia [34]	2020	VR vs. CR	6 weeks	3 days/week	40 min	NIRVANA & motion analysis equipment	NIRVANA exercises	BBS, DGI	Significant improvement in BBS and DGI in VR group, greater improvement than CR group.	No
Cacau [35]	2013	VR+CR vs. CR	Not applicable	Not applicable	Not specified	Not specified	Not specified	6MWT	Greater improvement in 6MWT in VR group compared to CR	Yes
Calabrò [36]	2020	VR vs. CR within subjects	5 weeks	4 days/week	40 min	CAREN	CAREN	BBS, TUG, 10MWT	Significant improvement in clinical masures following both CR and VR, however greater magnitude and retention at 3-month f/u only after VR	No

Campo-Prieto [37]	2022	VR vs. No VR	10 weeks	3 days/week	Not specified	Oculus Rift VR headset and treadmill with force plates	Custom-developed VR software with different virtual environments and exergames.	Tinetti Performance Oriented Mobility Assessement (POMA).	The VR exergame program was feasible and well-tolerated with high adherence (92.3% of sessions completed) and no adverse events.	Traditional exercise in elderly care can be repetitive and lack motivation.
Cannell [38]	2018	VR+CR vs. CR	8 weeks	2 days/week	60 min	JRS	JRS Wave	Functional Reach, Step Test, Gait Velocity, TUG	Improvement functional outcomes, although not significant. No difference between groups	No
Cano Porras [39]	2019	VR vs. CR vs. CG w/ no tx	Not applicable	Not specified	Not specified	Multiple VR systems used (not specified in the abstract)	Multiple VR software applications used (not specified in the abstract)	10-Meter Walk Test, Timed-Up-and-Go, Berg Balance Scale, Mini BESTest	Significant improvements in balance and gait function observed across all outcome measures.	Limitations of traditional rehabilitation methods.
Chen [40]	2020	AR Tai-Chi vs. Traditional Tai-Chi	6 weeks	3 days/week	60 min	Custom-designed VR headset and motion capture system	Custom-developed VR software with balance and gait training exercises	Berg Balance Scale (BBS), Fugl-Meyer Assessment-Lower Extremity (FMA-LE)	VR training was more effective than conventional physical therapy in improving balance and lower extremity function. VR training group had significantly higher scores on BBS and FMA-LE compared to the conventional therapy group.	Limitations of conventional physical therapy.
Cho [41]	2014	VR vs. no tx	8 weeks	3 days/week	30 min	Nintendo Wii & Balance Board	Wii Fit	Rhomberg measured on Bio-rescue	Improvement in COP excursions measured during Rhomberg eyes open and eyes closed in VR group only	No

Cho [42]	2012	VR+CR vs. CR	6 weeks	1 days/week	30 min	Nintendo Wii & Balance Board	Wii Fit	COP, BBS, TUG	Significant improvement in BBS and TUG in both groups with significant greater improvement in VR group vs. control	No
Cikajlo [43]	2020	VR+CR vs. CR	1 week	5 days/week	15 min	REWIRE System; Kinect camera, Nintendo Wii balance board, LCD screen	REWIRE games	FSST, TUG, 10mWT, ROM, STOLL, STORL, sROM, CTSIB	Significant improvement in favor of VR group on FSST and 10mWT. Significant difference between groups in sROM and STORL wih eyes closed	Yes
Collado-Mateo [44]	2017	VR vs. no tx	8 weeks	2 days/week	60 min	Microsoft Kinect, computer screen	VirtualEx-FM	TUG, Functional Reach Test, CTSIB	Significant improvement in TUG, CTSIB condition eyes closed on unstable surfaces, and functional reach test. Significant difference between groups in favor of VR group.	No
de Melo [45]	2018	CR vs. TT vs. VR Gait Training	4 weeks	3 days/week	20 min	Xbox Kinect, projector screen	Your Shape - Fitness Evolved 2012 - Run the World game	6MWT, gait speed, symmetry index	Improvement in 6MWT and gait speed in both VR and TT groups compared to CR.	Yes
de Rooij [46]	2021	VRT vs nonVRT	6 weeks	2 days/week	30 min	GRAIL; Motekforce Link,	GRAIL; Motekforce Link,	time up n go, Mini-BESTest	secondary outcome measures, including subjective physical functioning, balance and walking ability, walking activity, and falls efficacy, did also not show significant greater	yes

									improvements in the VRT group compared to the non-VRT group	
de Vries [47]	2018	VR	Single session	Single session	Not specified	Wii Balance Board (Wiiski) and Kinect sensor (Kinski)	Custom-developed VR software with virtual skiing environments for both games	Center of mass (COM) displacement during gameplay relative to Functional Limits of Stability (FLOS), maximal COM speed	Participants showed significantly larger COM displacements in all directions (except posterior) during Kinski compared to WiiSki, indicating greater balance challenge.	Falls are a major concern in older adults, and balance training is crucial for prevention.
Feng [48]	2019	VR vs. CR	12 weeks	5 days/week	45 min	Not stated	Not stated	BBS, TUG, FGA	Significant improvement in functional outcomes in both groups with significant difference between groups in favor of VR group.	No
Ferraz [49]	2018	CR vs. Cycle vs. VR	8 weeks	3 days/week	50 min	Xbox Kinect	Kinect Adventures	6MWT, 10mWT, SRT	Significant improvement in 6MWT, 10mWT, and SRT in all groups with no significant difference between groups	Yes
Finley [50]	2020	VR	Not specified	Not specified	Not specified	VR headset (Oculus Rift), treadmill with force plates	Unity game engine with custom-developed VR game software	Not applicable (feasibility study, no participants involved)	The VR game prototype was deemed feasible and enjoyable by Parkinson's disease experts and potential users.	Traditional PD rehabilitation exercises can be repetitive and lack motivation.

Fransson [51]	2019	Immersive VR with Repetition	5 sessions	Single session	15-20 min	Oculus Rift DK2 VR headset	Custom-developed VR software with a rollercoaster simulation	Center of pressure (COP) sway (measure of postural stability) in anteroposterior and lateral directions	Initial exposure to the VR motion caused significant postural instability, with increased COP sway in both directions.	Understanding individual differences in adaptation can inform VR applications.
Gagliardi [52]	2018	VR	4 weeks	5 days/week	30 min	GRAIL	D-flow	GMFM88, 6MWT, gait analysis on GRAIL	Significant improvement in GMFM-88, gait speed, stride length and 6MWT.	No
Gandolfi [53]	2017	CR vs. VR telerehab	7 weeks	3 days/week	50 min	Nintendo Wii & Balance Board	Wii Fit	BBS, 10MWT, DGI	Improvement in functional outcomes following training in both groups. Significant between-group difference in improvement on BBS in favor of VR group	No
Garcia [54]	2013	VR vs. no rehab tx	6 weeks	2 days/week	45 min	BRU System	BRU Modules	Posturography	Significant improvement in limits of stability seen in VR group	No

Gatica-Rojas [55]	2017	Wii Fit Plus video games	6 week	18 session	Not specified	Nintendo Wii Balance Board	Wii Fit Plus video games	Berg Balance Scale (BBS), Timed Up and Go (TUG) test	Not yet reported	Wii balance board exercise programs are effective in improving standing balance in children with CP.
Gianola [56]	2020	VR vs. CR	~10 days	7 days/week	60 min	VRRS	VRRS-based exercises	Strenght of quadriceps and hamstrings, active ROM, proprioception via VRRS	Significant improvement in proprioception in favor of VR group.	No
Goffredo [57]	2019	VRR vs. CT	3 weeks	1 days/week	45 min	no stated	computerised posturography	TUG, CoP	Results suggested that VRR improves clinical outcomes, similarly to conventional therapy. The performance of the Timed Up and Go test is different between groups, in favour of VRG.	Yes
Gómez Álvarez [58]	2018	VR	5 weeks	2 days/week	20 min	Wii Fit software with games.	Wii console and Balance Board	Significant improvement in TGMD-2 and its subtest of manipulation, COP OA	Wii console and Balance Board are accessible, motivating and enjoyable for children with Down Syndrome. Video games can be used to improve motor development and postural control.	No

Gonçalves [59]	2014	Wii Fit + Sensorimotor Training	14 sessions	2 days/week	40 min	Nintendo Wii Fit Plus platform	Built-in Wii Fit Plus software providing various virtual environments and tasks.	Unified Parkinson's Disease Rating Scale (UPDRS).	The training improved sensorimotor performance in PD gait, with increases in stride length and gait speed, along with reductions in motor impairment (rigidity and flexibility) and improvements in functional independence.	Traditional PD rehabilitation exercises can be repetitive and lack motivation.
Gulcan [60]	2022	AR vs. VR	6 weeks	3 days/week	30 min	Samsung Gear VR headset (for VR group)	Custom-developed VR software.	Motor symptoms with the Unified Parkinson Disease Rating Scale-Motor Examination (UPDRS-III).	Both groups improved in motor symptoms, balance, and gait.	Conventional physiotherapy for PD may lack engaging and motivating training environments.
Gutiérrez [61]	2013	CR vs. VR telerehab	10 weeks	4 days/week	20 min	Xbox 360 w/ Xbox Kinect via Videoconference	Kinect Sports, Joy Ride, Adventures	SOT, MCT, BBS, Tinetti	Significant betwee-group post-intervention improvement on composite equilibrium score of SOT, BBS and Tinetti in favor of VR group	Yes
Hadamus [62]	2021	CR vs. CR+VR	4 weeks	3 days/week	Not specified	Balance plate integrated with Kinect 2 camera	Virtual Balance Clinic	COP displacement, COP path length, COP velocity, sample entropy	Improvement in COP linear measures in VR group, although not at leave of significance.	No

Hadamus [63]	2022	VR vs. CR+PT	10 days	5 days/week	Not specified	Nintendo Wii console and balance board	Wii Sports Resort game with various virtual activities.	10-meter walk test, Timed Up and Go test, Berg Balance Scale, Functional Ambulation Performance (FAP) score	Both groups showed improvements in gait function after 10 days of rehabilitation. However, VR group had significantly greater improvements in walking speed (10-meter walk test) and balance (Berg Balance Scale) compared to the conventional therapy group.	Conventional therapy may not be immediately achievable after surgery due to pain and limitations.
Holmes [64]	2013	VR	12 weeks	3 days/week	30 min	Nintendo Wii & Balance Board	Balance domain of Wii Fit Plus	COP length	Improvement in COPL from pre-testing to midtraining and decreased back toward baseline at post-testing, however this was a nonsignificant change	No
Ibrahim [65]	2016	Biodex Balance Group vs. VR	4 weeks	3 days/week	15 min	Nintendo Wii & Balance Board	Wii Fit Plus	Overall balance on Biodex Balance System	Signinficant improvement in overall balance in both groups without significant difference between groups.	No

Imaizumi [66]	2020	Effect of VR Head-Mounted	3 session	Single session	60 min	Oculus Rift VR headset	Static image displayed within the VR headset	Center of pressure (COP) sway (measure of postural stability) in anteroposterior and lateral directions	Wearing VR goggles with eyes open significantly increased COP sway in both anteroposterior and lateral directions compared to the non-VR condition. - The effect was similar regardless of the VR content (static image in this case).	VR environments can disrupt sensory integration and challenge postural control.
Janeh [67]	2019	VR	Approximately 45 minutes (estimated based on experiment duration)	Single session	45 min	CAVE virtual reality system with treadmill	Custom-developed VR software for manipulating visual and proprioceptive feedback during walking tasks.	Step length, step time variability, swing time variability, gait asymmetry index (GiAsym)	Compared to natural gait, all VR manipulations increased variability in step length and swing time for both legs.	Gait asymmetry is a major challenge in Parkinson's disease and contributes to freezing of gait.
Jelsma [68]	2013	VR	3 weeks	4 days/week	25 min	Nintendo Wii & Balance Board	Wii Fit	TUDS, RSA, Subtests 5 and 6 of BOT-2	Singificant improvement in Balance subtest of BOT-2, and non-significant changes in RSA and TUDS	Yes
Junior [69]	2019	PNF vs. PNF/VR vs. VR	8 weeks	2 days/week	50 min	Nintendo Wii	Wii Fit	FMA	Improvement on FMA in all groups without significant between-group differences. Significant improvement in lower limb motor performance on FMA only in VR group.	No

Kafri [70]	2021	VR vs. CR	Single session	Not applicable (single session study)	2 hours	Head-mounted display with motion tracking	Custom-developed VR software simulating a virtual supermarket environment	Task completion time, accuracy, errors, attention score, cognitive function tests, walking speed	Older adults performed slower and with more errors compared to younger adults in both environments.	Daily tasks in real-world environments can be challenging for older adults.
Kalron [71]	2016	VR vs. CR	6 weeks	2 days/week	30 min	CAREN	D-flow	Instrumented Posturography, FRT, BBS, FSST	Both groups improved COPL and sway with eyes open, FST, and FSST. Significant between group difference on FST in favor of VR group.	Yes
Kamińska [72]	2018	VR	30 days	3 days/week	30 min	Xbox 360 & Kinect	Kinect Sports	6MWT, DGI, TST TWT	Significant improvement in 6MWT, DGI, TST and TWT.	No
Kantha [73]	2023	VR	not specified	Not specified	Not specified	VR headset, motion capture system, treadmill	Custom-developed VR skateboarding simulation software	Joint kinematics and muscle activity of trunk and legs, ground reaction force	VR skateboarding increased trunk flexion angles and muscle activity compared to walking. - Increased hip flexion and ankle dorsiflexion in the supporting leg, as well as knee extensor muscle activity. - Higher weight distribution on the supporting leg.	Growing interest in VR for training and rehabilitation.

Kanyılmaz [74]	2022	CR vs. VR	4 weeks	3 days/week	Not specified	Custom-designed VR system with head-mounted display, platform with force plates, and safety bars	Custom-developed VR software with 3 virtual environments.	Dizziness Handicap Inventory (DHI), Berg Balance Scale (BBS), Timed Up and Go test (TUG), Functional Gait Assessment (FGA)	Both groups showed improvements in dizziness symptoms, balance, and functional mobility.	Conventional vestibular rehabilitation is effective but can be repetitive and monotonous.
Karasu [75]	2018	CR vs. VR+CR	4 weeks	5 days/week	20 min	Nintendo Wii & Balance Board	Wii Fit	BBS, FRT, TUG, SBI on KAT	Significant improvement on BBS, FRT, A/P M/L COP with eyes open and closed, and weight shifting in favor of the VR group	No
Khalil [76]	2018	home-basedCR vs. VR	6 weeks	2 days/week	Not specified	Kinect sensors & Wii Balance Board	6 VR scenarios developed in pre-study focus group	BBS, TUG, 10mWT, 3MWT	Improvements in funcitonal outcomes in both groups. Significant between-group difference on BBS in favor of VR group.	Yes
Kim [77]	2013	VR vs. no tx	8 weesk	3 days/week	60 min	Xbox 360 & Kinect	Your Shape Fitness Evolved - Zen	Hip muscle strength testing via dynamometer, backward step and crossover step test on force plate	Significant improvement in hip extensor, flexor, abductor and adductor strength and increased GRF in backward step and crossover step test in VR group.	Yes

Kim [78]	2019	VR vs. CR	4 weeks	3 days/week	20 min	Nintendo Wii & Balance Board	Wii Fit Plus	Static and Dynamic balance measured by Biodex Balance System	Significant improvement in static and dynamic balance betweeng groups in favor of VR group.	No
Kim [79]	2015	VR1 Strength vs. VR2 balance	4 weeks	3 days/week	20 min	Nintendo Wii & Balance Board	Wii Fit Plus	Static and Dynamic balance measured by Biodex Balance System	Significant improvement in M/L static balance and overall dynamic balance in VR1 Strength group. Significant improvement in A/P, M/L, and overall static balance and M/L and overall dynamic balance in VR2 Balance group. Significant between group differences on Overall static and dynamic balance in favor of VR2 balance group.	No
Kim [80]	2015	CR vs. CR+VRTT	4 weeks	3 days/week	30 min	Video projector integrated with treadmill	Custom video scene with optic flow adjusted based on treadmill speed	COP on force plate	Significant improvement in COPL in A/P direction and total COPL in VRTT group	No
Kiper [81]	2020	Subacute VR vs.. Chronic VR	3 weeks	5 days/week	60 min	VRRS	VRRS-based exercises	FMLE, BBS, 10mWT, kinematic assessment in main axes of LE joints	Significant improvement in clinical and kinematic variables in subacute group, in clinical variables in chronic group, and no significant differences between groups.	Yes

Kumar [82]	2019	VR	Single session	Not specified	Not specified	Two Wii Balance Boards	Custom-developed VR software with a virtual environment	Center of pressure (COP).	The VR-based training with operant conditioning improved weight distribution and reduced imbalance in the paretic leg.	Traditional stroke rehabilitation often neglects functional activities.
Kwon [83]	2022	VR Hemiplegic Patients	8 weeks	2 days/week	16 min	Customized Wii Fit system with pressure plate and balance board	Custom-developed software for Wii Fit with virtual balance training challenges	Berg Balance Scale (BBS).	VR group demonstrated significantly greater improvements in Berg Balance Scale score and Functional Reach test performance compared to the conventional therapy group.	Conventional balance training can be repetitive and lack motivation in chronic hemiplegia.
Lee [84]	2015	VR+CR vs. TO+CR	6 weeks	3 days/week	30 min	Nintendo Wii & Balance Board	Wii Fit Plus	COP on force plate, FRT	Static balance FRT improved significantly more in VR group than task-oriented (TO) group	No
Lee [85]	2019	VR cycling +CR vs. Cycling +CR	6 weeks	5 days/week	40 min	Speed-interactive stationary bike, TV screen	Smartphone app - Virtual Active	FMA, gait assessment via Optogait	FMA and gait assessment significantly better in VR group than control	No
Lee [86]	2020	TT vs. VRTT	4 weeks	5 days/week	50 min	Speed-interactive non-motorized treadmill, TV screen	Smartphone app - Virtual Active	One-leg standing test, BBS, FRT, TUG, gait assessment via Optogait	Significant improvement in TUG, and spatiotemporal gait parameters of velocity, step width, stride length and step length in VRTT group.	No

Lee [87]	2016	CR vs. VR+CR	4 weeks	2 days/week	30 min	No stated	not stated	TIS,FRT, TUG, BBS, FMA	Improvements in trunk postural stability, balance, and upper limb motor function were observed in the EG and CG, but were greater in the EG. The mean SUS scores in the EG and TG were 71 ± 5.2 and 74.2 ± 4.8, respectively.	Yes
Lee [88]	2015	CR vs. VR+CR	6 weeks	5 days/week	30 min	Nintendo Wii	K-Pop Dance Festival	BBS	Significant improvement in balance in VR group after training and in comparison to CG.	No
Lee [89]	2013	no tx vs. VR	10 weeks	2 days/week	50 min	PlayStation 2 & EyeToy	EyeToy Play 1, 2,3	One-leg standing test, BBS, FRT, TUG, STS, gait assessment via GAITRite	Significant improvement in balance, improved STS and gait speed in VR group.	Yes
Lheureux [90]	2020	VR	Not specified	Single session	25 min	HTC Vive VR headset	Custom-developed VR software depicting a forest path with trees, grass, and birdsong	Gait speed, stride length, cadence	iVRTW increased step length and decreased cadence compared to both OW and TW.	Treadmill walking may disrupt natural gait patterns and LRAs in PD patients.

Liao [91]	2015	no tx vs. TE. Vs. VR	6 weeks	2 days/week	45 min	Nintendo Wii & Balance Board	Wii Fit Plus	Obstacle crossing performance, LOS test, SOT, TUG	Great improvement in obstacle crossing velocity, stride length, dynamic balance, SOT and TUG in VR than CG. Greater improvement in LOS movement velocity than TE group.	No
Lima Rebêlo [92]	2021	VR vs. CR	8 weeks	2 days/week	8 games	Oculus Rift	Balance games in Oculus Rift library	DGI, CTSIB, TUG, FRT	Significant improvement in DGI and FRT in both CR and VR groups. Significant improvement in TUG in VR group. No significant between group differences.	Yes
Lloréns [93]	2013	VR vs. CR	20 sessions	3 to 5 days/week	20 min	PC, panoramicc screen, tracking system, BioTrak	Balance games in BioTrak	BBS, Tinetti, posturography	Significant improvement in BBS, Tinetti, and A/P weight shifting control, and gains remained at 1-month f/u	No
Lloréns [94]	2015	CR vs. CR+VR	4 weeks	5 days/week	60 min	Computer, video display, motion tracking, 3D audio	Custom VE with participant's feet mapped into the VE and were used to reach for targets.	BBS, gait & balance sub-scales of Tinetti, Brunel Balance Assessment, 10mWT	Significant improvement in BBS and 10mWT in both groups. Significant between group difference on these measures in favor of VR group.	No
Malik [95]	2017	VR vs. CR	6 weeks	3 days/week	15 min	Xbox 360 & Kinect	Kinect Adventures: 20,000 water leaks, river rush, reflex ridge	FMA-LE, TUG	Improvement in FMA-LE and TUG from pre- to post-training	No

Martelli [96]	2019	VR + Visual Field Oscillations	Approximately 45 minutes (estimated based on experiment duration)	Single session	45 min	Oculus Rift VR headset	Custom-developed VR software for manipulating the visual field	Spatiotemporal gait parameters (stride length, stride time, cadence, swing phase duration, etc.)	Compared to the control condition, all visual field perturbations led to reductions in stride length and increases in stride variability.	Visual information plays a crucial role in balance and gait control.
McEwen [97]	2014	TT vs. VRTT	4 weeks	5 days/week	50 min	Speed-interactive non-motorized treadmill, TV screen	Smartphone app - Virtual Active	One-leg standing test, BBS, FRT, TUG, gait assessment via Optogait	Significant improvement in TUG, and spatiotemporal gait parameters of velocity, step width, stride length and step length in VRTT group.	No
Meldrum [98]	2012	VR vs. CR	6 weeks	5 days/week	15 min	Wii Fit & Balance Board + Frii Board	Wii Fit Plus	Self-preferred gait speed, gait parameters and SOT	Improvements in both groups following training with no significant difference between groups in gait speed or SOT score. No significant difference between groups on functional outcomes at 6-month f/u.	Yes

Micarelli [99]	2019	VR vs. CR	4 weeks	7 days/week	30-45 min	5.2'' phone display in Revelation HMD	Track Speed Racing 3D game	DGI	Significant improvement in DGI in both CR and VR groups. VR older adults significantly higher improvement in DGI than CR Older Adults, CR MCI and VR MCI. VR MCI group had significant greater improvement in DGI than VR Older Adults	Yes
Miclaus [100]	2021	VR + T	Single session	Not specified	Not specified	Microsoft HoloLens AR headset (for Groups 2 and 3)	Custom-developed VR software with virtual environments and tasks for Groups 2 and 3	Berg Balance Scale, Timed Up and Go test.	Not yet available, this is a planned study	Traditional stroke rehabilitation often focuses on isolated movements, neglecting real-world functional activities.
Mirelman [101]	2011	VR-Induced Motor Learning	8 weeks	3 days/week	Not specified	Not specified in the abstract.	Custom-developed VR software.	Fugl-Meyer Assessment-Lower Extremity (FMA-LE).	Both groups showed improvements in motor function, mobility, balance, and walking speed.	Conventional physiotherapy for PD can be repetitive and lack motivation.
Mohammadi [102]	2023	Traditional Training vs. VR	3 months	3 days/week	Not specified	Wii console with balance board (not explicitly mentioned in the abstract)	Various Wii games that provide virtual balance training challenges	Cumberland Ankle Instability Tool (CAIT) score for subjective-sense of instability.	Both training groups showed improvements in subjective-sense of instability (higher CAIT scores) and balance (improved SEBT performance) compared to baseline.	Traditional balance training is effective for FAI but can be repetitive and lack motivation.

Morone [103]	2016	VR vs. CR	8 weeks	2 days/week	60 min	Wii Fit & Balance Board	Wii Fit	BBS	Significant improvement in BBS in both groups with higher scores in VR group	No
Nuic [104]	2018	CR + VR	6 weeks	18 sessions	15-40 min	TV screen and computer integrated with Kinect sensors	Custom "Toap Run" game	Gait kinematics via foce plate, Motor scale of UPDRS, GABS	Significant improvement in gait parameters following training including increased step length and gait velocity and decreased double-stance time. Increase in step length and velcoity persisted after 3 months.	No
Oh [105]	2018	VR-based Turning Exercise on Treadmill	Not specified	Not specified	Not specified	Not specified in the abstract.	VR headset (not specified in the abstract)	Custom-developed VR software with virtual environments and tuKinematic and kinetic data.	VR turning resulted in similar overall turning speeds and trunk rotation angles compared to real-world turning.	Interest in VR for rehabilitation and training, particularly for balance and gait.
Ortiz-Gutiérrez [106]	2013	VR vs. CR	10 weeks	2 days/week	40 min	Xbox 360 & Kinect	Kinect Sports, Joy Ride, Adventures	SOT	Improvement in overall balance in both groups. Significant difference in improvement in visual preference and vestibular contribution in favor of VR group	No

Park [107]	2015	VR vs. CR	8 weeks	3 days/week	30 min	Nintendo Wii & Balance Board	Wii Fit balance games: Soccer Heading, Snowboard Slalom, Table Tilt	30s sway length and average sway speed, TUG	Significant improvement in static balance and TUG in both groups. Significant difference between groups in sway length in favor of VR group.	No
Park [108]	2013	VR Postural Control Training vs. CR	4 weeks	5 days/week	30 min	Oculus Rift VR headset	Custom-developed VR software with different virtual environments.	10-meter walk test, Timed Up and Go test.	VR group showed significant improvements in gait speed (10-meter walk test), balance (Berg Balance Scale), and some gait parameters (stride length) compared to the control group.	Traditional stroke rehabilitation often focuses on isolated movements.
Pedreira Da Fonseca [109]	2017	VR vs. CR	3 months	20 sessions	60 min	Nintendo Wii	Wii Fit: tennis, soccer, boxing	DGI	Improvement in DGI in VR group, significant improvement in DGI in CR group. No significant between group differences.	No
Peri [110]	2019	CR+VR	1 month	20 sessions	45 min	GRAIL	GRAIL games tailored to each patient	SARA, GMFM-88, 6MWT, BBS, gait analysis via GRAIL	Significant improvement on SARA motor domains, walking and balance abilities post-training	No

Phu [111]	2019	CR vs. VR vs. CG w/ no tx	6 weeks	2 days/week	30 min	BRU System	BRU Modules	5STS, TUG, gait speed, posturography via BRU	Both CR and VR groups improved on gait and balance assessments, and LOS posturography significantly over CG. Only VR group improved static balance posturography.	Yes
Punt [112]	2017	CR vs. VR vs. CG w/ no tx	6 weeks	2 days/week	30 min	Nintendo Wii & Balance Board	Wii Fit	Gait speed, temporal-spatial gait parameters, ankle kinematics	Improvement in all groups for gait speed, cadence and step length from pre- to post-training. Single-limb support time only improved in VR group, however no between-group differences seen for temporal-spatial gait parameters.	No
Raffegeau [113]	2023	VR	Not specified	Single session	15 min	Virtual reality system with treadmill	Custom-developed VR software with different height simulations	Gait speed, step length, turning speed, self-reported cognitive and somatic anxiety, mental effort	High VR height increased self-reported anxiety, mental effort, and decreased confidence in walking for all participants.	Fear of heights is a common anxiety disorder that can affect mobility and fall risk.
Rajaratnam [114]	2013	VR vs. CR+VR	Not specified	15 sessions	20 min	Nintendo Wii & Xbox Kinect	Games associated with each console	FRT, TUG, BBS, COP, MBI	Significant improvement in TUG, FRT and MBI in VR group. Significant improvement in TUG and MBI in CR group. Significant improvement between groups on FRT in favor of VR group.	No

Rendon [115]	2012	VR vs. no tx	6 weeks	3 days/week	35-45 min	Nintendo Wii	Wii Fit	8-ft up & go	Significant improvement in 8-ft up & go test compared to CG	No
Rodrigues [116]	2018	VR fall/non vs. No tx fall/non	12 weeks	3 days/week	40 min	Xbox 360 & Kinect	Dance Central Game	Concentric and eccentric isokinetic peak torque of quadriceps and hamstrings and muscle bulk, TUG, gait speed, 5STS	VR non-fallers significantly increased hamstring peak torque over other groups. No other significant differences between groups.	Yes
Rosiak [117]	2018	Biodex Balance Group vs. VR	4 weeks	3 days/week	15 min	Nintendo Wii & Balance Board	Wii Fit Plus	Overall balance on Biodex Balance System	Signinficant improvement in overall balance in both groups without significant difference between groups.	No
Shema [118]	2014	VR+TT	5 weeks	3 days/week	60 min	Projector screen and LED diodes on participants' shoes	Outdoor scene with obstacles	Gait speed, TUG, 2MWT, FSST	Significant improvement in gait speed, TUG and FSST after treatment.	No

Sadeghi [119]	2021	CR vs. VR vs. Mix vs. CG	8 weeks	3 days/week	40 min	Xbox 360 & Kinect	Xbox Sports games: The Light Race, Target Kick, Goalkeeper	Isokinetic muscle strength, SLS on firm and foam surfaces, tandem stance, TUG, 10mWT	Mix group (VR+CR) had greater improvement in strength, balance and functional measures compared to CR, VR and CG. VR group improved more than CR and CG on balance and functional mobility. CR demonstrated better balance and functional mobility than CG.	No
Salem [120]	2012	VR vs. CR	10 weeks	2 days/week	30 min	Nintendo Wii	Wii Sports and Wii Fit	Gait speed, TUG, SLS test, 5STS, time up & down stairs, 2MWT, grip strength, GMFM	Both groups demonstrated improvements in functional outcomes. Significant improvement in SLS in VR group over CR group.	No
Sana [121]	2023	VR vs. VR	8 weeks	3 sessions	Not specified	Custom-designed VR system with head-mounted display, platform with force plates, and safety bars	Custom-developed VR software with 3 virtual environments.	Dizziness Handicap Inventory (DHI), Berg Balance Scale (BBS), Timed Up and Go test (TUG), Dynamic Gait Index (DGI)	Both groups showed significant improvements in balance, dizziness, and gait after 8 weeks of therapy.	VRT is effective for stroke rehabilitation but can be repetitive and lack motivation.
Santos [122]	2019	CR vs. VR vs. CR + VR	2 months	2 days/week	Not specified	Nintendo Wii & Balance Board	Wii Fit and Wii Sports	BBS, TUG, DGI	Significant improvement in funcitonal outcomes in all groups without significant differences between groups. Greater effect sizes demonstrated by CR+VR group.	No

Sengupta [123]	2020	CR vs. CR+VR	3 weeks	5 days/week	30 min	Rhetoric VR	Rhetoric Games	BBS, balance section of Tinetti, and FRT	Significant improvements in functional outcomes in both groups post-training, however no significant betwee-group differences	No
Severiano [124]	2018	VR	10 weeks	2 days/week	50 min	Nintendo Wii & Balance Board	Wii Fit: Soccer Heading, Table Tilt, Tightrope Walk and Ski Slalom	BBS, SRT	Significant improvement in SRT after treatment. Improvement in BBS after treatment. Significant changes in functional capacity related to Tightrope Walk and Ski Slalom game.	No
Sheehy [125]	2016	VR vs. SR	2–3 weeks	10–12 sessions	30-45 min	Kinect v2	Jintronix Rehabilitation software	Function in Sitting Test (FIST), Ottawa Sitting Scale (OSS), quantitative measures of static sitting balance	Not yet reported	VRT is enjoyable and may motivate patients to do more repetitions of their exercises.
Shema [126]	2017	VR+TT	5 weeks	3 days/week	60 min	Projector screen and LED diodes on participants' shoes	Outdoor scene with obstacles	Gait speed, FSST, TUG	Significant improvement in gait speed, TUG and FSST after treatment.	No

Shideler [127]	2021	VR	Single session	Single session	23 min	Oculus Rift VR headset	Custom-developed VR software with a virtual path and foot placement targets	Spatiotemporal gait parameters (stride length, stride time, cadence, swing phase duration, etc.)	Participants who received biofeedback in the VR environment temporarily adapted their gait patterns to match the asymmetrical target step lengths.	Gait asymmetry is a common symptom in various neurological and musculoskeletal conditions.
Singh [128]	2013	CR vs. VR+CR	6 weeks	2 days/week	30 min	Nintendo Wii & Balance Board, Xbox 360 & Kinect	Balance Bubble on Wii Fit Plus, Rally Ball on Kinect	TUG, 30sSTS, 10mWT, 6MWT, Static Balance Ability via Probalance Board, Barthel Index	Significant improvement in TUG and 30sSTS. No significant difference between groups.	No
Singh [129]	2013	VR vs. CR	6 weeks	2 days/week	40 min	Nintendo Wii & Balance Board	Wii Fit: Ski Slalom, Table Tilt, Penguin Slide, Soccer Heading, Tight Rope Walk, Perfect 10 and Tilt City	Ten Step Test, Posture Sway, TUG	Both groups improved postural sway, TST, and TUG with significant difference between groups on TUG.	No
Song [130]	2015	Ergometer vs. VR	8 weeks	5 days/week	30 min	Xbox Kinect	Kinect Sport, Kinect Season 2, Kinect Adventure, Kinect Gunstringer	Posturography, TUG, 10mWT	Both groups demonstrated significant improvement in posturography and balance ability.	No

Takami [131]	2021	VR + Walking Illusion	Single session	Not specified	10 min	Head-mounted display with treadmill	Custom-developed VR software with a virtual hallway and moving floor	Gait speed on treadmill	Participants who watched the VR video at the faster speed showed a significant increase in their actual walking speed compared to those who watched the video at their own speed. This effect was short-lived and only lasted for a few minutes after watching the video.	Slow gait is a common problem after stroke and can affect daily life.
Tarakci [132]	2016	VR+CR vs. CR	12 weeks	2 days/week	50 min	Nintendo Wii & Balance Board	Wii Fit	FFRT, FSRT, TUG, STST, 10mWT, 10 SCT	Significant improvement in balance scores in both groups. Significant improvement in all balance tests in VR group compared to CR group.	No
Tefertiller [133]	2019	CR HEP vs. VR HEP	12 weeks	3 to 4 days/week	30 min	Xbox Kinect	Kinect Games	Community Balance & Mobility Scale, BESTest	No significant between group differences on CB&M or BESTest, however both groups improved significantly on these tests from baseline to post-intervention to 12-week f/u.	No
Tsang [134]	2016	VR vs. CR	12 weeks	5 days/week	45 min	Not stated	Not stated	BBS, TUG, FGA	Significant improvement in functional outcomes in both groups with significant difference between groups in favor of VR group.	No

Valiani [135]	2017	VR	4 weeks	2 days/week	30 min	Jinxtronix, TV screen, Kinect camera	Jintronix Wave	Short Physical Performance Battery	Significant improvement in SPPB post-training and at 3-month f/u	Yes
Van Dijsseldonk [136]	2018	VR	6 weeks	12 sessions	60 min	GRAIL	D-flow	2MWT, spatiotemporal gait parameters, gait stability measures	Improvement in gait speed, stride length and postural stability measures in A/P direction following training. These improvements persisted at 6-month f/u.	No
Villiger [137]	2017	VR	4 weeks	16-20 sessions	30-45 min	YouKicker, computer	Footbag, Hamster Splash, Get to the Game, Star Kick, Planet Drive	LEMS, TUG, BBS, 10mWT, WISCI II, SCIM	Singificant improvements in BBS, TUG and LEMS following training. Improvement in TUG persistent at 2-3month f/u.	No
Villiger [138]	2013	VR	4 weeks	16-20 sessions	45 min	Shoe sensor system adapted from YouGrabber	Custom developed games including Footbag, Hamster Splash, Star Kick, and Planet Drive	10mWT, BBS, Muscle Strength, SCIM, gait parameters	Improvements noted in walking capacity, balance and lower extremity strength following training which persisted at f/u	No

Wiskerke [139]	2022	VR Exergame	3 weeks for MS; 4 weeks for stroke	7 days/week	7 min	MindMotion GO	MindMotion GO software	Berg Balance Scale, VR exercise scores	VR exercises sufficiently fit the Rasch model and resulted in a hierarchical order of VR balance exercises for persons with stroke and MS with low to moderate balance ability.	To increase motivation and treatment dose.
Wüest [140]	2014	VR	12 weeks	3 days/week	20 min	Force platform and display	Five games integrated with force platform: Scarecrow, Tractor driver, Fruit cather, Worm Hurdler, Mix soup	BBS, TUG, SPPB, Posturography, gait analysis on GAITRite	Significant improvement in functional outcomes of BBS, TUG and SPPB. No changes in COP area in quiet stance or in walking parameters.	No
Yaman [141]	2022	VR vs. CT	3 sessions per week	8 days/week	Not specified	Not specified in the abstract.	Custom-developed VR software with various virtual environments.	Fugl-Meyer Assessment-Lower Extremity (FMA-LE).	Both groups showed improvements in motor function, mobility, balance, and walking speed. However, the VR group showed significantly greater improvements in motor function (FMA-LE) and balance (BBS) compared to the control group.	Conventional physiotherapy can be repetitive and lack motivation.
Yang [142]	2016	VR vs. CR	6 weeks	2 days/week	50 min	Computer, balance board	Developed by Cycling and Health Center of Taichun, Taiwan. Used COP to control virtual objects and perform tasks.	BBS, DGI, TUG, motor score of UPDRS	Improvements seen in both group son BBS, DGI, and TUG after training and at post-test f/u. No significant difference found between group.	No

Xu [143]	2021	Two-group, pre- post-	2 weeks		5 min	N/A	Monitor, PrimeSense 3D Awareness Sensor	Custom-created StompJoy	FMA-LE, MBI, BBS, SLS	Yes
Yeh [144]	2014	VR	4 weeks	6 sessions	Not specified	3D Glasses, Kinect, Wii Balance Board	Wii Fit	COP and balance indices including mean M/L & A/P excursion	Significant improvement in COP displacement and maximal mediolateral balance following training.	No
Yin [145]	2016	VR Cycling Training System for Lower Limb Balance	4 weeks	3 days/week	12 sessions	VR headset (not specified in the abstract)	Custom-developed VR software simulating cycling in different environments	Bilateral pedal force, force plate stand balance, asymmetry ratio index (ARI)	VRCTS training improved both cycling force and stand balance in stroke patients. Significant increases observed in bilateral pedal force and force plate stand balance compared to pre-training values.	Conventional cycling training can lead to compensation by the unaffected limb in stroke patients.
Yom [146]	2015	VR vs. no tx	6 weeks	5 days/week	30 min	Projector screen, computer, projector	Virtual-reality Ankle Exercise Program	TUG and gait analysis on GAITRite	Significant improvement in TUG and gait parameters in VR group following training and when compared to CG	No

Yousefi [147]	2021	VR vs. CR vs. no tx	9 weeks	3 days/week	60 min	Xbox Kinect	Kinect Sports 1and 2: Boxing, table tennis, soccer, golf, skiing, american football	SLS, FRT, TUG, FABS	Significant improvement in SLS, FRT, TUG and FABS in both CR and VR groups, but no significant difference between these groups	Yes
Zahedian-Nasab [148]	2021	VR vs. CT	6 weeks	2 days/week	30-45 min	Xbox Kinect	Video games	Berg Balance Scale (BBS), Timed Up and Go (TUG) test, Falling Efficacy Scale (FES)	Improved balance and reduced fear of falling in the intervention group	Yes