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REVIEW PAPER

A systemic review and meta-analysis of the effect of virtual reality training on balance in the elderly to prevent falls

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ABSTRACT

Introduction and aim. Virtual reality (VR) is used in various healthcare treatments. This review evaluates virtual reality therapy (VRT) for balance rehabilitation to prevent falls in older adults.

Material and methods. Randomised control trials from January 2013 to May 2024 were searched in databases like PubMed and Web of Science. Data were extracted and analysed using RevMan 5.4 software.

Analysis of the literature. The review included 12 studies with an average of 56 participants aged 50-80 years. Treatments lasted 4–10 weeks with 2-5 sessions per week, each 30-60 minutes. Meta-analyses of five studies using the berg balance scale (BBS) showed a weak impact on balance (Z=2.07, p=0.04; SMD=1.05, 95% CI [0.06, 2.05], p<0.0001). Conversely, the Timed Up and Go (TUG) test showed a more positive impact (Z=2.25, p=0.02; SMD=-0.74, 95% CI [-1.39, -0.09], p<0.001), with a difference of 4.4 higher in the experimental group than the control group.

Conclusion. VRT shows promising effects in balance and gait training for older adults, but further clinical trials are needed to compare its impact with other therapies.

Keywords. virtual reality, balance, ageing, BBS, TUG

Introduction

Ageing is a natural, progressive, and irreversible process that affects the visual, somatosensory, and vestibular systems. Globally, more than 35% of individuals over 65 experience gait imbalance.[1–3] A combination of intrinsic factors such as reduced balance, mobility, and functional skills and extrinsic or environmental factors are predictors of falls in older adults.[4] Falls, prevalent in 30% of the population, are considered one of the main reasons for hospitalisations, morbidity, and mortality.[5–8] Furthermore, the psychological fear of falls limits activities and lowers the overall quality of life.[9] Therefore, correcting or reducing the intrinsic and extrinsic risk factors associated with ageing can help prevent falls in these individuals.[4]

Though balance can be assessed with sophisticated technologies using force platforms to study the kinetics and kinematics of movement, researchers recommend more functional methods that challenge a person's postural control for this purpose.[10] Hence, scales, such as the Berg Balance Scale (BBS), the Timed-Up and Go test (TUG), the Performance Oriented Mobility Assessment

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scale (POMA), the Functional Reach test, the Clinical Test of Sensory Integration for Balance (CTSIB), Dynamic Gait Index (GTI),[10] and the Balance Evaluation Systems Test (BESTest)[11] are used to assess an individual's balance and gait. BBS and TUG are common methods for balance and gait assessment due to their reliability, validity, and ease of implementation. However, the intrinsic complexity of fall risk calls for a comprehensive evaluation approach.. Researchers have recommended concurrently using multiple assessment tools to assess risk and tailor strategies to improve gait imbalances.[12]

Multiple approaches and interventions, such as strength training,[13,14] mobility training,[15] *Tai Chi,*[16] task-specific activities training,[17] Otago exercises,[18] aerobic training,[19] Pilates,[20] and audio-visual feedback training[21] have significantly improved balance in older adults. Recently, newer strategies, such as computer games and virtual workouts, have shown a favourable impact on the balance training of this population.[22,23]

Virtual reality (VR) is a sophisticated end-user immersive interactive simulation system that motivates users through real-time simulations to perform complex tasks in real-life scenarios.[24,25] VR systems are widely used in gaming, and modified versions have been extensively utilised in medical education and healthcare. VR systems are advantageous as the VR therapeutic tools sense the patient's movements and provide audio-visual feedback that engages their sensorimotor systems to move and control items as if they were real.[26–31] The augmented and interactive experiences within the virtual environments allow learners to apply therapeutic learning in their daily lives and help enhance the quality of movements and self-confidence.[26,27] This strategy encourages patients to complete the rehabilitation tasks with interest and enjoyment.[30,31] Virtual reality therapy (VRT) has proven to be a cost-effective therapeutic approach, providing exceptional benefits for individuals, especially those in rural areas.[32–34] Its compatibility with telehealth services further amplifies its reach to the masses, making it an effective and powerful tool in healthcare.[34]

Although numerous studies have demonstrated the effectiveness of VRT in enhancing balance and preventing falls among the elderly, there is considerable heterogeneity in the intervention protocols and types of VR tools employed.[35–38] Most previous reviews have not thoroughly analysed the assessment tools used across various studies or conducted a meta-analysis.[39] Additionally, the inclusion criteria of these studies have varied significantly. For instance, Bleakley et al. included both healthy elderly individuals and those with cognitive deficits, whereas de Amorim et al. focused on individuals with balance impairments.[37,38] Rodríguez-Almagro et al. included healthy individuals in VR combined with occupational therapy (OT) and rehabilitation but did not conduct a meta-analysis.[36] Consequently, the inconsistent outcomes raise questions about the effectiveness of this unique balance therapy method in older adults.[40,41]

Given the need for in-depth research with consistent methodologies, types of interventions, and scales used to compare the effects of VRT to traditional exercises on the balance of older adults, there is a significant gap in the knowledge of this emerging technology and treatment. Studies examining the positive and negative effects of VRT in rehabilitation will broaden the scope of geriatric rehabilitative care.

Aim

Therefore, our study aims to systematically review the existing literature on physical therapy interventions involving VR and conduct a meta-analysis of the BBS and TUG scales frequently used in these studies. This article is the first to conduct a meta-analysis on VR in older adults. This study will help determine the effectiveness of VRT in improving balance in older adults and thereby preventing falls.

Material and methods

Search strategy

We used the (PICOTS) framework, i.e., population, intervention, comparison, outcomes, timeframe, and study type, to develop the inclusion criteria. We searched the Scopus, PubMed, Web of Science, EMBASE, CINAHL, ICTRP databases, CT.gov, and grey literature electronically using controlled vocabulary and the following keywords: virtual reality or "VR," augmented reality or "AR," "Wii Fit," video games, "Nintendo," older adults or elderly, balance measures or outcome measures, postural reactions, and postural stability. The search strategy was discussed with the institutional librarian. We also conducted an additional grey literature and manual search of dissertations and unpublished literature to include all the relevant articles for further review.

Selection criteria

We included peer-reviewed randomised control trials (RCT) and experimental studies with full-text articles published in English between January 2013 and May 2024 for final inclusion. We excluded editorials, commentaries, conference abstracts, observational studies reviews, grey literature, and non-English studies. The data screening and selection of articles is mentioned in the PRISMA flow diagram below (Fig. 1).

Two reviewers independently screened the titles and abstracts of articles based on the keywords and search strategy. The reviewers resolved the discrepancy in scoring through discussions to reach a consensus. All trials classified as relevant by either of the two reviewers were retrieved. A third reviewer resolved disagreements through discussions, and the third and fourth reviewers helped compile the data into a final set. Figure 1 above provides the summary of the search articles and study analysed.

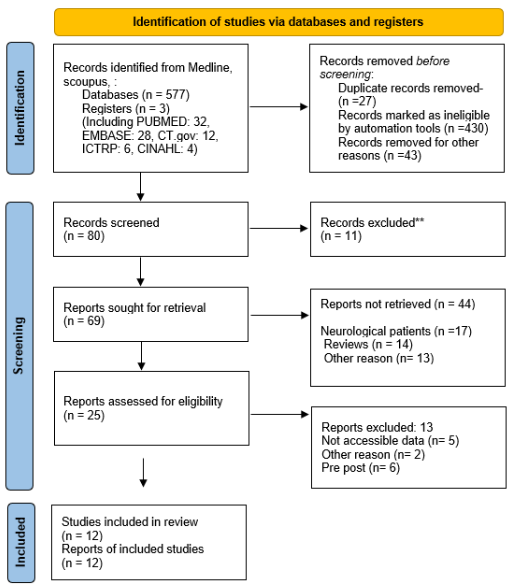

Fig. 1. PRISMA flow diagram

After full data extraction, the reviewers independently assessed the risk of bias using the RoB 2 tool.[40] We assessed the studies' bias based on random sequence generation, allocation concealment, blinding of outcome assessment, incomplete outcome data, intention-to-treat analysis, and follow-up. Items were classified as 'low risk' when clearly described, 'adequate or high risk' when not adopted, and 'inadequate and unclear' when not clearly defined or missing in the text.[41] The "incomplete outcome data" was also classified as 'high risk' if the drop-out rate was higher than 20%.[41]

Data extraction and analysis

Data from relevant articles were extracted on Excel sheet and further synthesised using the RevMan 5.4® software to calculate the mean differences at 95% confidence intervals (95% CIs) for continuous data and (95% CI) for the dichotomous discrete data. Table 1 summarises different studies, durations, sample sizes, ages, and protocols.

Results

Study characteristics

Out of 580 records identified from databases, 69 articles were retrieved for full-text review, and 12 RCTs met the selection criteria and were included in the final analysis, as summarised in Table 1. The combined analysis of the reviewed studies spanned healthy individuals between ages 45 and 75 years with a demographic focus on older adults with a mean age ranging from 60.6 to 69.1 years. The sample sizes ranged between 10 and 90, with 10 studies having less than 30 participants, two having sample sizes near 80, and only one having a sample size of 281 participants. The reviewed studies compared the virtual training protocols to tailored conventional training protocols for balance, coordination, strength, and mobility commonly employed in clinical practice. The studies exhibited variations in weeks and session lengths. Notably, 14.29% of studies[42–44] considered session lengths of 12 weeks (about three months) appropriate for better outcomes with VRT, 3.57% of studies showed that 3-week VRT sessions[15] and 4.76% of studies showed that 4-week VRT sessions[45] proved impactful.

The included studies' experimental and control group intervention sessions ranged between 4 and 10 weeks, with a weekly frequency of two to three times and an average duration of 30 minutes to an hour per session. Two studies demonstrated results intending to treat, eight had a post-intervention follow-up, and two did not mention either intention to treat or post-intervention follow-up.

Types of interventions

Participants in the studies were administered strengthening and balance exercises, treadmill walking, static and dynamic balance training, lower leg strengthening, and balance and coordination training with or without VR equipment. Some studies conducted VR training using the Xbox 360 platform and the Wii Fit Nintendo system for their motion detection and activity tracking features. In contrast, others used the Kinect Xbox 360 for a three-dimensional augmented reality experience.[5,19,46–51]

As shown in Table 1, the studies showed variability in the type of intervention and the analysed outcomes. Of the selected 12 RCTs, two were parallel trials where the control group received no intervention. The experimental groups in these trials received either brain exercises (BE), physical exercises (PE), lumbar stabilisation exercises (LSE), or virtual reality exercises (VRE).[46,52] Overall, 46% of studies (n=6) did not provide any intervention for the control group participants, and 62% (n=8) provided different exercise protocols such as ball exercises, treadmill walking, cognitive training, Otago exercises, leg strengthening with balance training, balance training alone, and balance with coordination exercises. Of the different VR gadgets used in these studies, six (46%) used the Wiifit Nintendo, and five (38%) used Xbox and Kinect.

One study demonstrated enhanced postural control with VRT versus traditional exercises.[50] Likewise, another study showed VRT's role in improving balance and coordination in elderly patients.[51] In yet another study, researchers used a smartphone-running application that mirrored the video from the smartphone on a curved 65-inch screen TV for VR training.[53] The results

Table 1. Data extraction sheet

No	Author	Study design	Sample Size	Age group	Control Group	Parallel group	VR tools used for the experimental group	Method protocol	Duration	Variables assessed	Results	Conclusion
1	Kyeongjin Lee (2021)[53]	RCT	56	VRGT 81.01±6.89 Control group 79.47±6.15	Gait training without virtual reality	NA	Gait training with virtual reality. A smartphone running application - The video from the smartphone was mirrored on a curved 65-inch screen TV placed in front of the treadmill.	5 times a week for 4 weeks	50 min	Balance	OLS ($p = 0.000$), BBS ($p = 0.634$), FRT ($p = 0.448$), and TUG ($p = 0.002$)	In the VRGT group, the balance ability variable showed a significant decrease in the one-leg-standing test and a significant improvement in the Timed Up and Go test. With respect to spatiotemporal gait parameters, velocity and step width decreased significantly in the VRGT group ($p<0.05$), and stride length and step length were significantly improved in the VRGT group ($p<0.05$).
2	Prasertsakul et al. (2018)[50]	RCT	10	40–60 years, age = 51.5±6.61 years, age = 55.0±5.72 years	Balance training	NA	Kinect sensor Dual Task Virtual Reality Balance Training	thrice weekly for four weeks	45 min	Balance	Five standing tasks were assessed: 1. Standing unsupported with eyes open (EO); $p<0.05$. 2. Standing unsupported with eyes closed (EC); $p<0.05$. 3. Standing with both feet together; $p<0.05$. 4. Tandem stance; $p<0.05$. 5. One-leg stance; $p<0.05$	VRT facilitates better postural control and contributes to fall prevention in the elderly
3	Žukienė et al. (2018)[51]	RCT	20	mean age 82.8 and 80.4 years	Balance - coordination training	NA	Microsoft Xbox 360 gaming device with Kinect	ten sessions (three months)	30-45 min per session	Balance and coordination	Tinetti Performance Oriented Mobility Assessment; $p<0.05$, Berg Balance Scale; $p<0.05$, The Activities-Specific Balance Confidence (ABC) Scale; has no statistical significance, unbalanced coordination samples (Schmitz); $p<0.05$	The use of virtual reality has a positive effect on the development of balance and coordination
4	Htut et al. (2018)[46]	Randomised Parallel Trial	84 (47 M &37 F)	65-85 years	No intervention	Two parallel groups BE- Brain exercises, and PE-strength and balance exercises	Ten games from X-box 360	thrice weekly for eight weeks	30 min	Balance, muscle strength, cognition, and fall prevention	BBS; $p<0.001$, TUG; $p<0.001$, TUGC, MoCA; $p<0.001$, FES-I; $p<0.001$, 5TSTS; $p<0.001$, HGS; $p<0.005$, TUG-cog; $p<0.001$	VRE produced measurable improvements in physical and cognition scores
5	Dockx et al. (2017)[56]	RCT	281	above 65 years	Treadmill walking	NA	X Box one Kinect-treadmill augmented training	thrice weekly for six weeks	45 min	Attitudes towards fall prevention	USQ questionnaire $p<0.001$	Older people's attitudes towards fall prevention exercise with VR were positively influenced by their experience
6	Tsang and Fu (2016)[55]	RCT	79 (31 M & 48 F)	mean age 82.3±3.8 and 82.0±4.3 years	Leg strengthening and balance training	NA	Wii Fit balance training games included Soccer Heading, Table Tilt, and Balance Bubble.	thrice weekly for six weeks	1 hour	Balance	BBS; $p<0.001$, timed-up-and-go test; $p= 0.434$, and limits of stability test; $p<0.01$.	WiiFiT balance training group achieved better balance performance
7	Park et al. (2015)[23]	RCT	30 (19 M & 5 F)	Above 65 years	Ball exercise	NA	Wii Fit	thrice weekly for eight weeks	30 min	Balance	TUG; $p<0.05$, step length; $p<0.05$, sway speed; $p<0.05$	Step length increased significantly, and the average sway speed and Timed-Up and Go time significantly decreased.
8	Jung et al. (2015)[52]	Randomised Parallel Trial	24 (24 F)	mean age 73.6±2.4; 74.3±3.5 and 74.3±2.1 years	No intervention	LSE - lumbar stabilisation	The Nintendo Wii Sports	twice weekly for eight weeks	30 min	Balance and risk of falls	BBS; $p<0.001$, FRT; $p<0.001$, TUG; $p<0.001$, CV; $p<0.001$, MVHC; $p<0.001$	Significant clinical improvements in lower extremity balance and mobility

9	Schwenk et al. (2014)[45]	RCT	33	mean age 84.3±7.3 and 84.9±6.6 years.	No intervention	NA	24-inch computer screen, V2.54, and five wearable inertial sensors	twice weekly for four weeks	45 min	Balance	30-second standing with feet close together (but not touching) with eyes open (EO); $p = .007$ and eyes closed (EC); $p = 0.010$. The CoM sway area (cm2) during EO stance. Physical performance was quantified by the Alternate-Step-Test (AST); $p = .037$, Timed-up-and-go (TUG); $p = .024$, and Gait assessment; $p = .902$.	Study findings guide future exercise interventions integrating wearable sensors for guided game-based training in home and community environments.
10	Cho et al. (2014)[22]	RCT	32	mean age 73.1±1.1 and 71.7±1.2 years	No intervention	NA	The Nintendo Wii Fit balance board and a CD	thrice weekly for eight weeks	30 min	Balance	Subjects' balance with their eye open; $p<0.001$ and closed; $p<0.001$ was measured using the Romberg test on a Bio-rescue (RM INGENERIE, France).	Virtual reality training is effective at improving the balance
11	Bieryla and Dold (2013b)[15]	RCT	9	mean age 82.5±1.6 and 80.5±7.8 years	No intervention	NA	Wii Balance Board with Wii Fit	thrice weekly for three weeks	30 min	Balance	BBS; $p = 0.037$, FAB scale; $p = 0.529$, FR; $p = 0.779$ and TUG; $p = 0.174$	Balance training with Nintendo's Wii Fit may improve balance.
12	Yoo et al. (2013)[42]	RCT	21	mean age 72.90 (3.41)	Otago exercises	NA	Augmented reality environment (graphic and vision-based web-camera)	thrice weekly for twelve weeks	40 min	Fall prevention	BBS; $p<0.001$, GAITRite system was used to measure spatiotemporal parameters including gait velocity; $p<0.001$, cadence; $p<0.001$, step length; $p<0.05$, and stride length; $p<0.05$, FES-I; $p<0.05$	Augmented reality-based Otago exercise is effective for improving balance, gait, and fall efficacy

significantly improved the TUG test and gait parameters.[53]

Similarly, balance training with Nintendo's Wii Fit [15] and augmented reality-based Otago exercises improved balance and gait and reduced falls in older women.[42]

Assessment parameters

Table 1 demonstrates that the studies used scales such as the BBS, TUG, POMA, and ABC tests to assess balance, gait, and fear of falls in older adults. Seven studies used BBS, and five used TUG as measuring tools to evaluate the post-intervention balance. Almost all studies showed significant improvement in the scale assessments after VR training compared to regular exercises.

Risk of bias

The risk of bias analysis of the studies using the RoB 2 tool demonstrated that nine studies had a low risk of bias. Three studies showed bias in blinding and performance, and three showed unclear bias in the randomisation and allocation. Please refer to Figure 2 and 3.

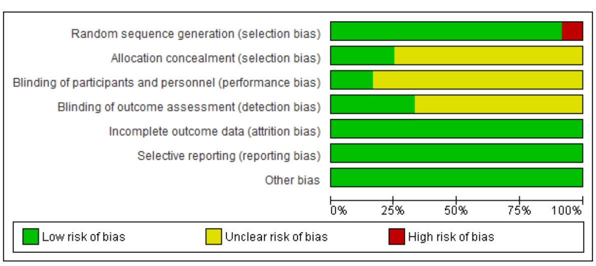

Fig. 2. Risk of bias graph: review authors' judgments about each risk of bias item presented as percentages across all included studies.

Key findings

The selected studies demonstrated that of the individuals who underwent VRT, 92% showed improved static and dynamic balance (n=12) as measured using the BBS (39%, n=5) and the TUG (39%, n=5) as the main tools to measure the outcomes. Two studies had insufficient data for the BBS assessment. Hence, of the seven studies that evaluated balance using the BBS, only five had complete data.[42,46,52,54,55] The post-intervention results of the studies showed improved BBS scores of 4.29±1.27 and TUG test scores of 2.65±1.20 seconds in the VRT group compared to the control group. Our meta-analysis of five studies[42,46,52,54,55] using *RevMan®* 5.4 revealed the BBS's overall effect z= 2.07 (P=0.04) with a Standardized Mean Difference (SMD) of 1.05 at 95% confidence interval (CI) [0.06, 2.05], p<0.001 showing a weak effect of VR training in the experimental group as compared to the control group. The Chi-square test (Chi^2=39.73), df=4 (p<0.00001) and I^2 value (90%) indicated significant heterogeneity, suggesting considerable variability in the true effect of VR training on BBS across the included studies. Please refer to Figure 4 below and supplementary Figure S1.

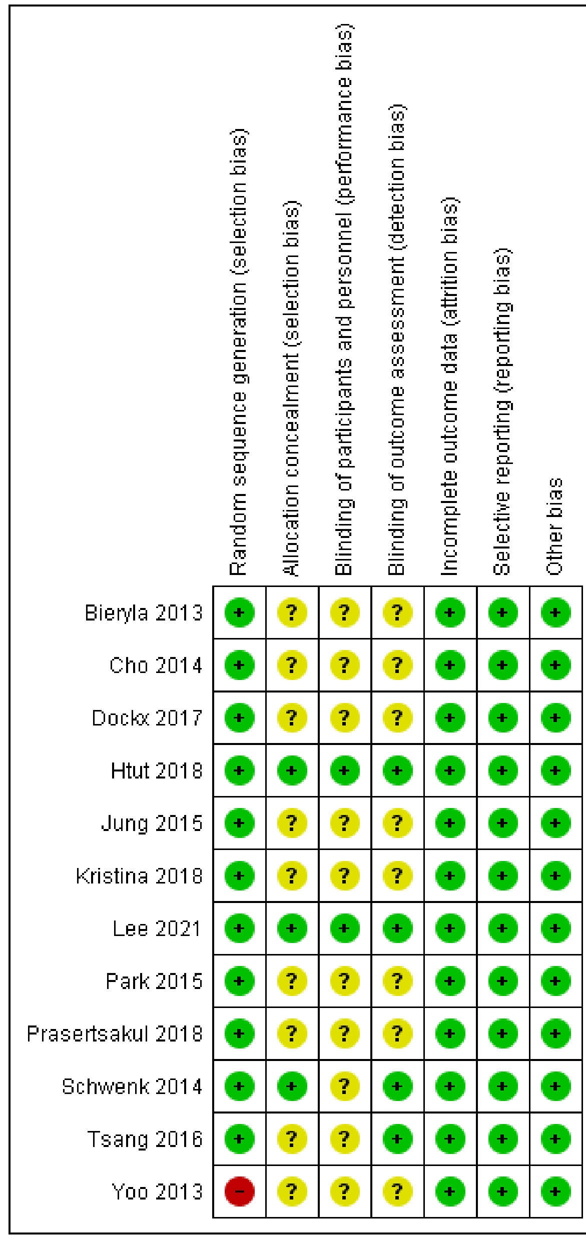

Fig. 3. Risk of bias summary: review authors' judgments about each risk of bias item for each included study

The TUG test meta-analysis for VRT (please refer to Figure 5), based on five different studies, revealed the effect size as z= 2.25 (p=0.02) with the SMD as -0.74, at 95% CI [-1.39, -0.09], P<0.001 indicating that the experimental group showed improved results on the TUG test.[23,45,46,52,55] However, statistically significant heterogeneity was found between studies (Tau^2 = 0.41, Chi^2 = 18.63, df=4 (p=0.0009); I^2=79%, suggesting that the actual effect sizes may vary considerably across studies. The mean TUG Scale score in the experimental group was 18.2 compared to the control group score of 13.8. (Figure 5 and supplementary Figure S2).

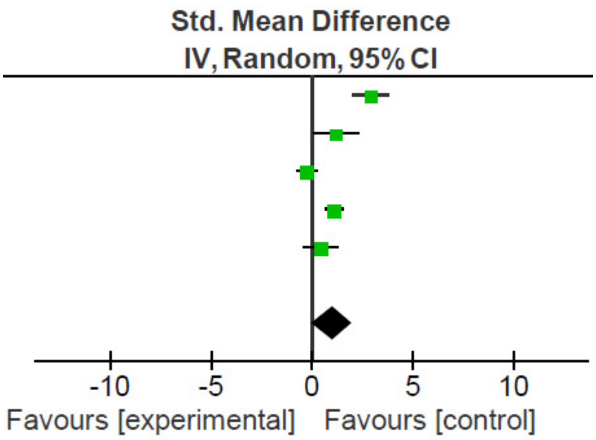

Fig. 4. Forest plot for meta-analysis of studies reporting BBS

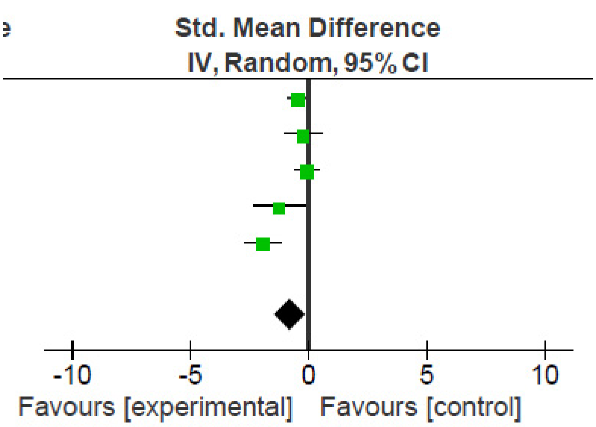

Fig. 5. Forest plot for TUG

Discussion

The analysis of the selected studies demonstrated that exposure to VR can improve physical and cognitive scores,[46,56] positively impacting the individual's physical and psychological well-being.[44] Additionally, high-functioning virtual reality games helped manage the individual's fear of falls.[43] The findings of our study are consistent with previous systematic reviews on VR training.[36–39] However, similar to earlier studies, we found it challenging to single out the most effective treatment method, assessment tool, and types of VR equipment to recommend. Individual study objectives and available technology influenced the selection of VR equipment in all studies. Researchers chose devices based on their motion detection capabilities, interaction, target population, user-friendliness, and the intended level of immersion and engagement – all studies aimed to construct appealing virtual worlds to enhance intervention effectiveness and collect relevant data.

The diverse assessment scales used across the studies reflected the multidimensional nature of balance, mobility, and related factors. The results from various studies demonstrate that selecting a singularly superior measurement scale proves challenging as some scales have distinct advantages over others.[15,22,23,42,45,46,50–53,55,56] Our meta-analysis found that balance training did not improve on the BBS scale assessment but showed significant improvement on the TUG test. Our meta-analysis findings differ from those of de Amorim et al., who reported improved balance training measurements with the BBS scale but similar TUG test results.[37] This difference suggests that the effectiveness of a measurement scale is context-dependent and conditional to the research objectives, the population under study, and the specific variables being measured.[42,55,56] Therefore, measurement scales should be selected based on the intervention or research objective. The BBS scale can assess an individual's ability to sustain balance during specific tasks.[15,23,42,52,53,55] The TUG test can capture functional mobility, which is particularly relevant in research settings.[23,46,47,52,55] The Falls Efficacy Scale (FES) and the ABC scale, both psychological scales, can give valuable insights into the individual's confidence in performing daily activities without the fear of falling.[44]

Enhanced balance and mobility, confirmed by improved step length, sway speed, and TUG scores,[23] underlined the positive impact of physical therapy using VR versus traditional ball exercises on physical performance and balance in older adults.[48,52] Better results with VR training can be attributed to its immersive, interactive, safe, and controlled environments that simulate real-life scenarios, enhancing participants' engagement and motivation.[22,23,53] VR allows precise control over the training environment and tasks, enabling tailored and progressive challenges that can adapt to the individual's performance.[22,23,47] This adaptability can lead to more effective and personalised training outcomes.[44,55] Furthermore, the technological advantage of VR allows for creating consistent and repeatable training scenarios, which can be challenging to achieve with traditional methods.[46,51] Such engaging experiences created by VR games lead to increased patient adherence and effort during training sessions.[51,53] Apart from the treatment acceptability, VR systems provide immediate feedback and collect detailed data on performance metrics, which can be used to adjust training protocols in real-time training.[22,23,45,52]

Studies have reported improved dynamic postural control and functional ability in institutionalised elderly individuals with VRT using video games.[47] These video games encourage the patients to adapt to the game challenges, integrating diverse movement patterns and moving in different directions. Hence, incorporating wearable sensors for guided game-based training in home and community environments may help improve the patient's cognitive and lower limb motor control.[22,42] The reviewed studies conclusively showed the growing acceptance of VR technology as a helpful tool for testing and improving the balance, mobility, and other characteristics of the older population.

Our study has several strengths, primarily due to our rigorous methodology and meta-analysis inclusion. We used strict selection criteria, and two reviewers independently assessed the articles and thoroughly assessed their quality and risk of bias, which is also a crucial strength of our study. Although we have reported the positive effects of VRT in improving balance in older adults for fall prevention, our study has some limitations. The meta-analysis included only the BBS and TUG scores that produced low effect sizes due to lower sample sizes and heterogenicity of the studies. Thus, variations in sample sizes, methods, interventions, and durations of the reviewed studies may have influenced the results.

Future studies focussing on the meta-analysis of other assessment scales used for the post-intervention balance and gait evaluation of older adults would help conclude the effectiveness of VRT over traditional rehabilitation. Comparing the various assessment scales in a single study is also warranted. There is limited research on comprehensive economic evaluations or cost-effectiveness analyses of VRTs compared to traditional balance training. Cost-effectiveness analysis is essential for informing future funding decisions in rehabilitative care. We recommend that future clinical trials thoroughly compare various VR technologies' initial equipment costs, setup, and operational expenses. This will provide policymakers with the detailed data needed to incorporate VR into standard rehabilitation protocols strategically.

Conclusion

Based on the findings of our systematic review, we can conclude that VRT is a feasible and effective treatment option for improving balance, as assessed by the TUG test in older adults, to prevent falls. While many studies suggest promising effects, based on our meta-analysis, we recommend additional research with rigorous study designs, larger sample sizes and meta-analysis of a more significant number of balance assessment scales to strengthen the evidence. One must also consider the feasibility of implementing VRT for balance rehabilitation programs for older adults.

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Declarations

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Author contributions

Conceptualization, M.R. and S.B.; Methodology, M.R., S.B. and R.D.; Software, R.D.; Validation, R.D., S.B. and M.R.; Formal Analysis, S.B. and R.D.; Investigation, S.B. and R.D.; Resources, S.B. and M.R.; Data Curation, S.B. and R.D.; Writing – Original Draft Preparation, S.B., M.S., M.R., R.D. and T.B.; Writing – Review & Editing, S.B., M.S. and T.B.; Visualization, R.D.; Supervision, M.R., S.B. and T.B.; Project Administration, S.B. and M.R.

Conflicts of interest

The authors declare no conflict of interest.

Data availability

The systematic review and meta-analysis data are available in the main manuscript and the supplementary material.

Ethics approval

Dr. D. Y. Patil Deemed University's ethics committee has approved the study under the reference DYPV/EC/448/2020.

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