CRITICALLY APPRAISED TOPIC

FOCUSED CLINICAL QUESTION

For a community-dwelling, 72-year-old female without a neurological disorder who presents with an increased risk for falls (P), do interactive exergames used for balance training (I) reduce the risk for falls (O) compared to usual physical therapy care (C)?

AUTHOR

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CLINICAL SCENARIO

The patient is a 74-year-old female who lives with her husband in an older adult community. She has no diagnosed neurological conditions, however has experienced 2 falls in the past year that did not result in serious injury. She is largely sedentary, retired, lives with her supportive husband who drives her, and ambulates with a RW for community distances. Her largest limitations are balance and strength deficits which were reflected in lower scores on the MCSTIB, TUG, and 5xSTS tests. Her scores placed her in the "fall risk" category for her age. The patient would like to be able to walk around her home and the community independently and ultimately reduce her fall risk. I would like to investigate whether interactive exergames performed at home and/or the clinic would reduce her risk for falls compared to the usual physical therapy care (LE strengthening, static/dynamic balance exercises) I performed with her in the outpatient setting. There is not enough research on whether exergames would increase HEP compliance, but that would be another relevant area of interest to investigate.

SUMMARY OF SEARCH

[Best evidence appraised and key findings]

Eights studies were selected that met the inclusion and exclusion criteria including 4 systematic reviews, 3 RCTs, and 1 qualitative study.

- Exergames have the potential to increase patient compliance with home exercises although some older adults may experience challenges with the technnology[1]
- Exergames such as Nintendo Wii can improve balance outcomes compared to inactive control groups[2,3,4]
- Games that involve stepping can improve dynamic postural control, sensory functions, and cognitive demand sustainably[5]
- An exergame intervention may improve balance but there is not enough evidence to conclude a reduction in the number of falls[6]
- Xbox Kinect demonstrated improvements in overall balance in older adults[7]
- The use of exergames in older adult populations is generally safe, accepted, and feasible when used as a fall prevention intervention[8]

CLINICAL BOTTOM LINE

Falls can be detrimental and possibly deadly in older adult populations. Fall prevention is an important focus of physical therapy in order to reduce this risk, even in healthy, community-dwelling older adults. Exergames have the potential to improve balance outcomes and consequently reduce fall risk. These interventions also have the bonus of interactivity and engagement which may result in increased compliance compared to traditional physical therapy exercises. Exergames are no replacement from standard physical therapy interventions, however, they can be a useful supplementary intervention to improve balance performance in this population.

This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor

The above information should fit onto the first page of your CAT

SEARCH STRATEGY

Terms used to guide the search strategy			
Patient/Client Group	**I**ntervention (or Assessment)	**C**omparison	**O**utcome(s)
Older adults, community dwelling, geriatric	Exergames, exergaming, video games, active video games, interactive games, Nintendo Wii, Wii Fit, Xbox Kinect, virtual reality	Physical therapy, physiotherapy, exercise, balance	Falls, fall reduction, fall risk, fall diary, balance, Berg Balance Score, Timed Up and Go

Final search strategy (history):

Show your final search strategy (full history) from PubMed. Indicate which "line" you chose as the final search strategy.

PubMed:

(falls OR fall reduction OR fall risk) AND virtual reality

(physical therapy OR physiotherapy) AND (falls OR fall reduction OR fall risk) AND exergam*

falls exergam*

falls exergam* community-dwelling

Final strategy:

falls exergam* community-dwelling Filters: Aged: 65+ years, from 2014-2021

In the table below, show how many results you got from your search from each database you searched.

Databases and Sites Searched	Number of results	Limits applied, revised number of results (if applicable)
PubMed	26	Results since 2014, ages 65+
CINAHL	8	Included only results since 2014, ages 65+, results only in English, excluded PD, CVA, MS
PEDro	18	n/a

INCLUSION and EXCLUSION CRITERIA

Inclusion Criteria
• Patient population of community dwelling older adults (age ≥65 years) • Patient may or may not have a previous history of falls • Intervention may include Nintendo Wii, Wii Fit, X-Box Kinect, or any exercise-based game • Comparison must be to usual, standard, or traditional physical therapy care • Must use an objective measure for falls risk (ex: BBS, TUG, Tinetti)
Exclusion Criteria
• Diagnosed neurological disorders (ex: PD, MS, CVA) • Studies published before 2014 • Studies published in English

RESULTS OF SEARCH

Summary of articles retrieved that met inclusion and exclusion criteria

For each article being considered for inclusion in the CAT, score for methodological quality on an appropriate scale, categorize the level of evidence, indicate whether the relevance of the study PICO to your PICO is high/mod/low, and note the study design (e.g., RCT, systematic review, case study).

Author (Year)	Risk of bias (quality score)*	Level of Evidence** (Portney 2020)	Relevance	Study design
Ambrens et al. (2021)[1]	**CASP (Critical Appraisal Skills Programme)** 9/9	Level 2 Downgraded due to qualitative nature of study that was based off an RCT	Moderate	Qualitative Study
Donath et al. (2016)[2]	**AMSTAR-2** **Yes**: 11 **Partial yes**: 2 **No**: 3	Level 1	High	Systematic Review
Fang et al. (2019)[3]	**AMSTAR-2** **Yes**: 12 **Partial yes**: 2 **No**: 2	Level 1	High	Systematic Review
Fu et al. (2015)[4]	**PEDro** 7/10	Level 2	Moderate-High	RCT
Hauer et al. (2020)[5]	**PEDro** 7/10	Level 2	High	RCT
Pietrzak et al. (2014)[6]	**AMSTAR-2** **Yes**: 3 **Partial yes**: 2 **No**: 8 *no meta-analysis performed for questions 11, 12, 15	Level 3 Downgraded: utilized weaker studies including quasiexperimental studies, higher RoB from high number of "No's" from AMSTAR-2; provided a "scoping review of preliminary evidence" rather than meta-analysis	Moderate	Systematic Review
Yang et al. (2020)[7]	**PEDro** 6/10	Level 2	High	RCT
Zheng et al. (2020)[8]	**AMSTAR-2** **Yes**: 7 **Partial yes**: 3 **No**: 3 *no meta-analysis	Level 2 Downgraded: no meta-analysis performed, utilized Cochrane collaboration's tool for assessing risk of bias but	Moderate	Systematic Review

	performed for questions 11, 12, 15	still included low quality studies in results		

*Indicate tool name and score

**Use Portney Table 36-1: Summary of Levels of Evidence (2020). If downgraded, indicate reason why.

BEST EVIDENCE

The following 2 studies were identified as the 'best' evidence and selected for critical appraisal. Rationale for selecting these studies were:

- **Fang et al. (2019)**
- This study was strong, relevant to my clinical question, and contained lots of in-depth meta-analysis. It also focused more on including information relevant to risk of bias and contained more recent studies ranging from 2012-2017.
- **Donath et al. (2016)**
- This systematic review was also strong according to the AMSTAR-2 and was written in a way that appeared to have the AMSTAR-2 criteria in mind. It was organized well for easy readability and also included somewhat more recent studies from 2012-2015.
- Both of these systematic reviews utilized PEDro scoring for the articles: Fang et al. broke down theirs into Low (≤3), Medium (4-6), and High (7+) while Donath et al. categorized evidence as weak (≤5) and strong (6+). They both had quality meta-analysis which the other systematic reviews did not include. Each systematic review included at least 15 RCTs with quality analysis which I why I selected them over a single strong RCT such as the one by Hauer et al.

SUMMARY OF BEST EVIDENCE

- **(1) Description and appraisal of (Effects of Exergaming on Balance of Healthy Older Adults: A Systematic Review and Meta-analysis of Randomized Controlled Trials) by (Fang et al., 2019)**

Aim/Objective of the Study/Systematic Review:

The authors of this systematic review note previous studies prior to 2014 have concluded insufficient evidence on whether exergames can be used as an effective intervention to reduce fall risk in older adults. They explored newer studies in order to gain more information to see if exergames can be an effective fall risk intervention in this population.

Study Design

[e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]

Note: For systematic review, use headings 'search strategy', 'selection criteria', 'methods' etc. For qualitative studies, identify data collection/analyses methods.

Search Strategy:

The authors searched PubMed, SPORTDiscus, ScienceDirecte, COCHRANE, EMBASE, and EBSCO for relevant articles from the years January 2000-2019. The final search strategy utilized Boolean phrases "AND" as well as "OR" with variations of search terms including "exergame*," "older adult," "balance," and "RCT."

Selection Criteria:

The following inclusion criteria were used: studies published in English, the primary intervention involved exergames, RCTS only, an outcome measure with a balance assessment, and subjects >60 years old without cognitive, neurological, or visual impairments who were able to walk independently. Studies of poor design such as editorials or nonrandomized studies were excluded in order to provide high quality evidence on the clinical question.

Methods:

RCTs found were scored using the PEDro scale in order to assess the quality of the study and reduce the risk of bias. Out of a possible 10, the authors deemed studies with a score 9 or 10 to be "excellent," 6 to 8 as "good," 4 to 6 as "fair," and <4 to be "poor." Ultimately, a cut-off score of 6 was established as there is difficulty with double-blinding the studies due to nature of the intervention. However, studies with PEDro scores as low as 5 were included. Data summaries of the studies including participants, interventions, outcomes, and results were extracted and synthesized by the authors. A statistical analysis was completed using Comprehensive Meta-Analysis 2.2 and included Hedges' g, heterogeneity, Egger's regression, and p-values.

The two authors searched articles, screened for eligibility, and completed the quality assessment independently; conflicts were resolved with discussion between the two authors. The initial search resulted in 774 articles and after 3 rounds of screening, 16 studies were selected for this systematic review.

Setting

[e.g., locations such as hospital, community; rural; metropolitan; country]

The authors failed to mention specific settings of the RCTs. Upon further investigation of each of the 16 studies, the interventions all to appear to have been completed in a supervised clinical setting with some studies supplementing the intervention with a home program. Some of the countries represented include the USA, Czech Republic, Denmark, and Malaysia.

Participants

[N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]

Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article.

Participants of the systematic review were selected from RCTs and consisted of older adults (>60 years old) who were generally healthy. Participants were excluded if they had vision impairments, required more than minimal assistance with ADLs, neurological or cognitive impairments (MMSE score needed to be >24), cardiovascular/respiratory problems, and needed to be able to stand/walk without assistance. The ultimate age range of all the participants was between 60-86 years old. 322 subjects performed the exergame intervention and 324 were in the control group. A total of 22 participants dropped out due to health issues, issues with travel, other time commitments, or lack of interest.

Intervention Investigated

[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided]

Control

Each of the 16 RCTs included in this systematic review compared the exergame intervention to a control group. Unfortunately, not much information is provided about the specifics of the control groups. Nine studies had the control group perform "normal activities." One study had a placebo treatment for the control and another study had a cognitive exercise as the control group. The remaining five studies had an active control group participating in a standard balance or other physical exercise program. Three of these five studies specifically had a combination of balance, aerobic and ball practice exercises.

Experimental

Exergames such as Wii Fit, Xbox 360 Kinect, Wii games, Wii Balance Board, and Dance Dance Revolution (DDR) were used in the experimental groups. Wii Fit was used the most with 9 out of the 16 RCTs using it as the primary intervention. Each session averaged 40 minutes and were performed two to three times per week (ranged from 30 to 180 total minutes per week). The trials averaged 8 weeks in duration with a range of 3 to 15 weeks.

Outcome Measures

[Give details of each measure, maximum possible score and range for each measure, administered by whom, where]

Outcome measures were specifically aimed at balance performance to evaluate risk of falls. The following tests were used in all of the studies:

Test	**Number of Studies**	**Scoring Range**	**Type of Balance**
BBS (Berg Balance Scale)	6	0-56 (higher score = decreased fall risk)	Balance test battery
TUG (Timed Up and Go)	10	Time in seconds (higher score = increased fall risk)	Dynamic balance
ABC (Activities-specific Balance Confidence Scale)	4	0-100% (higher score = greater balance confidence)	Perceived balance
Functional Reach	3	Distance in inches/cm (higher score = decreased fall risk)	Proactive balance
Chair Stand	6	Number of times subject stands (higher score = increased lower extremity functional strength/endurance)	According to authors this test is more focused on lower extremity strength/endurance with balance as a secondary component
PPA (Physiological Profile Assessment)	2	-2 to 3 (higher score = increased fall risk)	Balance test battery
Tinetti Balance	2	0-28 (higher score = decreased fall risk)	Balance test battery
FES (Falls Efficacy Scale)	3	0-64 (higher score = increased fall risk)	Perceived balance
Static Standing	4	Measured postural sway in A/P and M/L directions. (Increased postural sway = increased fall risk)	Static balance

Main Findings

[Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. You may summarize results in a table but you must explain the results with some narrative.]

This systematic review performed a meta-analysis of the data and utilized Hedges' g for effect sizes, heterogeneity (I^2), Egger's regression with P-values for significance. The authors defined an effect size as small (Hedge's g <0.2), moderate (0.2< Hedge's g <0.8), or large (Hedge's g >0.8). In regards to heterogeneity of the studies, it was deemed likely (I^2 >25%), moderate (25% <I^2 <50%), or considerate (I^2 >50%). P-values were determined to be significant with values <0.05.

Type of Balance	Hedge's g	95% CI	I^2	P-value	Risk of Bias (Egger's regression)	Significance of Results
Static balance	0.20	-0.09 to 0.48	0%	0.18	Nonsignificant	Not significant improvement
Dynamic balance	0.36	-0.26 to 1.30	0%	<0.001	No publication bias	Significant improvement
Proactive balance	0.53	-0.12 to 1.20	44.68%	0.11	No publication bias	Not significant improvement
Balance test batteries	0.72	0.42 to 1.02	25.27%	<0.001	No publication bias	Significant improvement
Perceived balance	0.31	0.04 to 0.58	0%	0.02	No publication bias	Significant improvement
Chair Stand Test	0.78	45.24	0.26 to 1.30	0.003	No publication bias	Significant improvement

Original Authors' Conclusions

[Paraphrase as required. If providing a direct quote, add page number]

The authors conclude that exergames when used as a supplemental intervention in physical therapy can reduce the risk of falls in community-dwelling, healthy older adults compared to a control. In particular, balance performance significantly improved in regards to dynamic and perceived balance as well as balance test batteries and Chair Stand Test. These improvements in balance performance have been directly shown to result in a decrease in overall fall risk. In regards to static and proactive balance, exergame interventions do not significantly improve balance performance which may be due to the ceiling effect of these tests in this particular population. However, when comparing exergame interventions to an active control group that performed aerobic and balance program, exergames are no more effective than these interventions. The authors suggest the interactive and engaging nature of exergames should be considered when implementing their use in order to encourage increased participation and compliance. Further studies should be performed considering reactive balance due to the lack of studies on this balance outcome, gait perturbation, changes in center of pressure, and cost effectiveness of the interventions.

Critical Appraisal

Validity

[Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.]

This systematic review consists of many strengths and few weaknesses. The authors performed quality assessment and risk of bias using the PEDro scale for the RCTs selected in this systematic review. The PEDro scale includes 10 questions regarding internal validity and one unscored question for external validity. The authors included studies with PEDro scores ≥5/10 with an average score of 6.4/10. It is important to note that almost all of the studies did not receive points for blinding the subjects and/or therapists due to the interactive and obvious nature of the exergame interventions. Regardless, the studies included in this systematic review were moderate to high in quality with low risk of bias. Additionally, this systematic review was partly selected due to its high AMSTAR-2 quality assessment rating and thorough meta-analysis. The authors acknowledge an increase in heterogeneity for the results regarding proactive balance, Chair Stand Test, and balance test battery; they advise the viewer to take caution with these findings. The overall strength of this paper increase the confidence in the results, evidence quality, and conclusions of the systematic review.

Interpretation of Results

[This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.]

Exergames have the potential to be used as an effective intervention to improve balance performance and therefore decrease the risk of falls in healthy older adults. The systematic review was overall strong with its meta-analysis and made a concerted effort to reduce the risk of bias, heterogeneity, and measure effect size. All of the balance outcomes had at least a moderate effect size using Hedge's g with the exception of static balance. A larger effect size correlates to increased level of practical significance. Static balance outcomes were already found to be weak in this systematic review which may warrant further research. There are few weaknesses of the study; notably, the authors failed to investigate the application of exergames in regards to cost, availability, ease of use, technological issues, and patient preferences. The data for the effectiveness of exergames when used as a supplemental intervention for balance performance is strong, however, the weaknesses listed above are additional valid considerations for its applicability in the real world.

Applicability of Study Results

[Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.]

The overall results should only be applied when considering the specific patient population of older adults without any significant health problems or comorbidities. A majority of patients who present to PT with balance deficits and are at risk for falls have one or more comorbidities such as neurological issues or use of a walking aid. These patients were excluded from this study and are arguable the ones who would benefit most from balance interventions. Additionally, as mentioned above, aspects of exergames such as cost and ease of use for older adults should be considered for clinical application. It would be feasible for an outpatient clinic to have a Nintendo Wii Fit which was the most commonly used exergame used in this systematic review. However, in order to get the most benefit of the intervention, the patient would need to use the exergame at home in addition to the clinic. Safety of the patient when performing the exergame at home would also need to be considered in its use outside of a supervised setting. Also, exergames have the potential for increased compliance due to the interactive nature of the programs instead of "boring" standard exercises.

- **(2) Description and appraisal of (Effects of Virtual Reality Training (Exergaming) Compared to Alternative Exercise Training and Passive Control on Standing Balance and Functional Mobility in Healthy Community-Dwelling Seniors: A Meta-Analytical Review) by (Donath et al., 2016)**

Aim/Objective of the Study/Systematic Review:

The authors of this study conducted a systematic review consisting of RCTs in order to determine the effectiveness of exergames to reduce fall risk in older adults. The aim of this paper is to evaluate the differences using meta-analysis between exergame interventions (called "Virtual Reality Training" or VRT) compared to an active control ("alternative exercise-based training regime" or AT) and an inactive control (CON). The authors note previous systematic reviews on exergames used to reduce fall risk have been completed, but this paper is specifically analyzing the differences between AT and CON whereas previous publications did not differentiate between the two controls.

Study Design

[e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]

Note: For systematic review, use headings 'search strategy', 'selection criteria', 'methods' etc. For qualitative studies, identify data collection/analyses methods.

This study is a systematic review of 18 RCTs.

Search Strategy

Three authors searched databases including CINAHL, EMBASE, ISI Web of Knowledge, PubMed, and SPORTDiscus. Relevant search terms such as "exergam*," "fall*," and "old*," were included and utilized Boolean phrases OR/AND to narrow results for better sensitivity.

Selection Criteria

4,063 were initially found and after screening for duplicates (2,796), reading through titles/abstracts for relevancy, and applying inclusion/exclusion criteria resulting in 18 RCTs used for the systematic review. Studies were excluded if they were not peer-reviewed, published in English, and only RCTs were included in order for higher quality evidence. All of the RCTs required to have an intervention (VRT) and a control (AT and/or CON) comparison to be relevant to the clinical question.

Methods

The three authors searched the databases listed above from the "inception of the journal to 10 June 2015" (page 1294). Inclusion and exclusion criteria were agreed upon by the three reviewers and the searches were performed independently. The PEDro scale was used to evaluate the quality of evidence and risk of bias; "weak" studies were classified if the PEDro score was ≤5 and "strong" studies had a PEDro score was ≥6 out of a possible 10 points. Data was extracted for balance outcomes by two of the three reviewers as well as other data such as type of exergame, the type of control, and exercise parameters. Statistica 10.0 and Cochrane Review Manager Software (RevMan 5.3) were used for statistical analysis. There is no mention of how agreement was achieved between the reviewers when selecting articles for this systematic review.

Setting

[e.g., locations such as hospital, community; rural; metropolitan; country]

Multiple settings and locations were used in the 18 studies included in this systematic review. No specific mention of a setting is written, however, clinical settings appear to be the most common after investigation of some of the individual RCTs included in the paper. The authors do note they would have liked to see application of the exergame interventions in home settings.

Participants

[N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]

Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article.

The participants in this systematic review were healthy, community-dwelling older adults. A total of 619 individuals with a mean age of 76 were included in this paper. The final overall retention rate was 89% with dropout rates listed for illness, travel conflicts, or no reason provided as some examples. The RCTs included a variety of interventions with 272 subjects participating in the VRT intervention and the rest completing an active or passive control. Participants had to be at least 60 years of age and be absent of cognitive, cardiac, neurological, or orthopedic conditions.

Intervention Investigated

[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided]

Control

Each of the 18 RCTs included in this study required a control group to compare results to the intervention group as part of the inclusion criteria. 11 of the RCTs had a control group that received no treatment or were told to continue with their daily activities. 8 of the RCTs included a control group that perform balance training and/or resistance exercises commonly seen in an outpatient physical therapy clinic. Some of the exercises mentioned included side stepping, SLS, forwards/backwards walking, balance activities with eyes open/closed, and bridges. One RCT included a control group labeled "shoes with copolymer insoles," but no further information is provided (page 1296).

Experimental

All of the RCTs in this systematic review included an experimental group that utilized exergames. 13 studies used Nintendo Wii activities as their intervention group. 4 studies used a nonspecific VRT games that included weight shifting, stepping, and reaching activities. 1 RCT utilized Dance Dance Revolution (DDR) which includes different stepping patterns. The trials ranged from 5 to 20 weeks in duration with 1 to 3 sessions per week. Each session lasted anywhere from 10 to 60 minutes with a majority of the studies including 30-45 minute sessions. 16 of the RCTs were supervised while 2 were unsupervised.

Outcome Measures

[Give details of each measure, maximum possible score and range for each measure, administered by whom, where]

Minimal information is provided for the outcome measures in this systematic review. The data from forest plots is primarily focused on "functional mobility" and "standing balance" outcomes. Postural sway activities were performed in variations of single/double limb stance with eyes open/closed.

Test	Number of Studies	Scoring Range	Type of Balance
BBS (Berg Balance Scale)	7	0-56 (higher score = decreased fall risk)	Functional Mobility
FR (Functional Reach)	4	Distance in inches/cm (higher score = decreased fall risk)	Standing balance
TUG (Timed Up and Go)	13	Time in seconds (higher score = increased fall risk)	Functional Mobility
Postural Sway (path, velocity, area, or accuracy)	8	Various; amount of movement from COP. (Increased postural sway = increased fall risk)	Standing balance
Tinetti	2	0-28 (higher score = decreased fall risk)	Functional Mobility
SLEO (Single Leg Eyes Open)	2	Seconds (higher score = decreased fall risk)	Standing balance
Postural Sway Index (OPI- Overall Postural Performance)	1	Distance deviated from center in regards to A/P and M/L sway	Standing balance

Main Findings

[Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. Use a table to summarize results if possible.]

The authors of this systematic review primarily compared the effects of VRT to standing balance performance and functional mobility. These two outcomes were additionally compared to VRT versus a control (i.e. no treatment) and VRT versus an alternative treatment (i.e. Tai Chi). P-values, standard mean differences with confidence intervals, and heterogeneity were calculated to compare the data of the interventions.

Outcome	Comparison	p-value	SMD (Standardized Mean Difference)	95% CI (Confidence Interval)	I^2 (Heterogeneity)

Standing balance	VRT vs Control	< 0.001	0.70	0.42 to 0.99	53%
Functional mobility	VRT vs Control	< 0.001	0.54	0.24 to 0.84	55%
Standing balance	VRT vs Alternative treatment	0.31	-0.35	-1.03 to 0.32	76%
Functional mobility	VRT vs Alternative treatment	0.05	-0.44	-0.87 to 0.00	63%

Training volume and effect sizes were compared by multiplying the time duration of the sessions by the total number of sessions.

Outcome	**Comparison**	**Effect size (r)**	**p-value**
Standing balance	VRT vs Control	0.23	> 0.05
Functional mobility	VRT vs Control	0.73	< 0.05
Standing balance	VRT vs Alternative treatment	-0.71	< 0.05
Functional mobility	VRT vs Alternative treatment	-0.23	> 0.05

Original Authors' Conclusions

[Paraphrase as required. If providing a direct quote, add page number]

The authors of this systematic review compiled relevant evidence to compare the effectiveness of VRT to both control and alternative treatment groups. They concluded through meta-analysis of the data from the 18 RCTs that VRT can be an effective form of treatment to improve balance outcomes and therefore reduce fall risk in healthy, community-dwelling older adults. In regards to specifically comparing standing balance versus functional mobility, the authors concluded stronger effects with alternative treatments rather than VRT for improvements in functional mobility. Conversely, only small effects of alternative treatments over VRT were found for improvements in standing balance. The authors note these findings may be due to weaker studies (PEDro score ≤ 5) as the results were not as favorable for alternative treatments when these studies were removed. In comparison to an inactive control, VRT demonstrated moderate effects on improvements in standing balance and functional mobility.

Critical Appraisal

Validity

[Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.]

This systematic review was overall strong although contained some weak points. The authors utilized the PEDro scale in order to perform quality assessment and risk of bias of the 18 RCTs included. Similar to the previous systematic review in this CAT, the PEDro score is limited because it focuses on internal validity versus external validity. The mean PEDro score of the publications reviewed was a 6/10 which would place it in the "stronger" category of evidence (PEDro scores ≥ 6) according to the authors. Note that half of the studies included in this systematic review had PEDro scores ≥ 6 and the other half had PEDro scores ≤ 5 which would categorize them in "weaker" evidence according to the authors. The authors acknowledge the limitations of the study including "notable" heterogeneity (pages 1306-1307) as well as the inclusion of weaker studies. This systematic review was included in this CAT due to its high AMSTAR-2 quality assessment and inclusion of meta-analysis. The

evidence in this paper was overall moderate to strong which increases the confidence in the results, evidence quality, and conclusions. However, the results should be viewed with some caution due to the overall validity.

Interpretation of Results

[This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.]

VRT has been demonstrated to improve balance outcomes and consequent reduce fall risk in otherwise healthy older adults. The majority of the VRT interventions included utilized commercially available Nintendo Wii which could be a valuable and relatively low-cost addition to an outpatient setting. The authors made an effort to reduce bias and provide quality evidence through a quality assessment although they still included "weaker" studies which is a major limitation in my opinion. The authors at least acknowledge the inclusion of these weaker studies and mention how the result may be different with these studies taken out. The meta-analysis which included forest plots, effect size, and heterogeneity was also a strong point of this systematic review. The inclusion of alternative treatments compared to VRT was a welcomed addition and fills in some of the gaps in the research. Furthermore, this systematic review used evidence from 2011 and onwards which strengthens the data as it is more current.

Applicability of Study Results

[Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.]

Similar to the previous systematic review in this CAT, the evidence in this article is relevant only to older adults who are otherwise healthy. Further research in specific population such as patients with Parkinson's disease or post cerebrovascular incident would need to be completed to evaluate the effectiveness of VRT to reduce fall risk. The evidence gathered in this study, however, is relevant to the clinical question presented in this CAT as the patient does not have any complications. The majority of the RCTs in this systematic review used Nintendo Wii which is commercially available except only in the used market as it is no longer in production. The availability of this product in particular would have to be investigated. The intervention itself is practical and feasible for the purposes of this CAT; the acceptability of the intervention may be patient dependent as some older adults are hesitant with technology. The authors also provided whether the interventions in the RCTs were supervised or unsupervised; however, they fail to mention safety considerations of unsupervised VRT performed in the home setting. The authors also did not go into great detail about user engagement in performing VRTs versus standing physical therapy exercises in regards to HEP compliance.

SYNTHESIS AND CLINICAL IMPLICATIONS

[Synthesize the results, quality/validity, and applicability of the two studies reviewed for the CAT. Future implications for research should be addressed briefly. Limit: 1 page.]

Both of the systematic reviews evaluated in this CAT compared the use of exergames to a control group to determine its effectiveness to improve balance outcomes. The two studies supported the use of exergames as a supplementary treatment intervention to improve static and dynamic balance, and therefore reduce the risk of falls in healthy, community-dwelling older adults. Both of these publications are highly relevant to the clinical question and patient population proposed in this CAT. The first systematic review by Fang et al. focused on comparing exergames to either an inactive or active control group. This study utilized high quality RCTs, performed a thorough meta-analysis, and made concerted efforts to reduce bias. The authors presented their results by grouping the different outcome measures from the RCTs into static, dynamic, proactive, perceived, and balance battery tests which was useful for clinical application as there are multiple domains of balance. Fang et al. concluded exergames have the potential to significantly improve dynamic and perceived balance in this population when used as a supplemental intervention. This systematic review was overall strong with few weaknesses. The authors acknowledged and attempted to explain limitations of their study such as external validity, reactive balance, and evaluating user engagement.

The second systematic review presented in this CAT by Donath et al. compared exergames, referred to as VRT, to a control group as well as an alternative treatment group in some studies. This study also performed a meta-analysis, made an effort to use high quality RCTs, and attempted to reduce bias. Donath et al. presented their findings by grouping their balance outcome measures as functional mobility and standing balance. This method was useful to divide the different types of balance but perhaps may be an oversimplification compared to Fang

et al.'s grouping method. The authors concluded VRT has the ability to moderately improve both functional mobility and standing balance when compared to a control group; however, alternative treatments were shown to have the edge over VRT in regards to improving functional mobility and standing balance. Although this systematic review was highly relevant to the clinical question and received a high AMSTAR-2 rating, the data is questionable in regards to validity. Half of the 18 RCTs included in this study were "weaker" in quality (PEDro score ≤ 5). The authors make an effort to explore the limitations of this systematic review such as increased heterogeneity and lack of blinding in the RCTs. This systematic review was unique in nature because it included alternative treatments to further evaluate the effectiveness of exergames to improve balance outcomes.

After thoroughly reviewing the systematic reviews by Fang et al. and Donath et al. in this CAT, I can conclude exergames have the potential to be clinically useful to improve balance outcomes in healthy, community-dwelling older adults. However, there are questions on which device to use although a majority of RCTs in both studies included Nintendo Wii as the primary intervention. This specific exergame console is no longer in production at this time, although there appears to be a large used market online. Exergames would best be utilized in the clinic as a supplementary intervention in addition to traditional strength and balance training exercises. The bonus of a device such as Nintendo Wii is the user interactivity which may increase enjoyment and compliance if used as an HEP. However, I cannot recommend its use without supervision outside the clinic as not enough information is provided on safety parameters and ease of use for the user. Future studies should be performed on creating a cost-effective, safe, and interactive exergame specifically made for physical therapy intervention.

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