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| **CRITICALLY APPRAISED TOPIC** |

**FOCUSED CLINICAL QUESTION**

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| For an 85 year old with a mild cognitive impairment, is an individualized balance program more effective than a standardized balance program such as Otago in reducing falls? |

**AUTHOR**

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| **Prepared by** | Anna Speer | **Date** | 12/4/18 |
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**CLINICAL SCENARIO**

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| The patient is an 85 year old male with a history of two falls in the past year, and mild cognitive impairment, who presents with a referral for balance training. In the geriatric population, falls are common, and can be costly and injurious, often leading to further complications.1 A history of falls is one of the strongest risk factors for future falls,2 so it is important that this patient receive interventions to improve his balance and strength, in an effort to prevent any falls in the future. In addition, decreased cognition has been shown to be associated with an increased risk for falls.3 It is not uncommon for older adults to present with mild cognitive impairments (MCI); among those over 65 year old, it is estimated that 10-20 percent will have a MCI.4 As physical therapists determine the plan of care, it is important to take into account all aspects of the patient, and provide the course of treatment that is most suitable for the patient presentation. At times, older adults with balance difficulties may be prescribed exercises using a standardized balance program, such as Otago. However, it is possible that a standardized balance program may not fully address the needs of a patient with MCI. |

**SUMMARY OF SEARCH**

[Best evidence appraised and key findings]

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| * In the review of the literature, 8 articles were found that met the inclusion/exclusion criteria: five systematic reviews, and three randomized controlled trials. Only one of the articles focused specifically on older adults with MCI, and one review included a section that focused on older adults with MCI. None specifically compared an individualized therapy program to a standardized therapy program for older adults with MCI. * Results from selected studies indicate that there was a significant difference between balance training which includes a cognitive component, and physical balance training only in the areas of balance, gait speed, and dual tasking ability in favor of the balance training with a cognitive component. * The effect size between balance training with cognitive training, and balance training alone is small, and only borders on clinical significance in most areas. |

**CLINICAL BOTTOM LINE**

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| In an 85 year old male with a mild cognitive impairment, it would be advantageous to perform individualized balance training, with an emphasis in dual-task activities, instead of a standardized balance program with only physical balance training. |

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| ***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**

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| **Terms used to guide the search strategy** | | | |
| **P**atient/Client Group | **I**ntervention (or Assessment) | **C**omparison | **O**utcome(s) |
| Older adult\*  Geriatric  Elderly  Mild cognitive impairment | Balance  Physical therapy  Home Exercise Program  Conventional therapy  Individual\* exercise\* | Otago | Fall\* |

**Final search strategy (history):**

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

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| #1 | Search aged[MeSH Terms] |
| #2 | Search "mild cognitive impairment" |
| #3 | Search (balance AND (“physical therapy” OR “home exercise program” OR “conventional therapy” OR  “individual\* exercise\*”)) |
| #4 | Search otago |
| #5 | Search (fall\* OR "fall risk") |
| #6 | Search (#1 AND #2 AND (#3 OR #4) AND #5) |
| #7 | Search (#1 AND #2 AND #3) |
| #8 | Search (#1 AND #2 AND #4) |
| #9 | Search (#1 AND #3 AND #5) |
| #10 | Search (#1 AND #4 AND #5) |
| #11 | Search (#1 AND #3 AND #4 AND #5) |
| #12 | Search mild cognitive impairment[MeSH Terms] |
| #13 | Search (#1 AND #12 AND #4) |
| #14 | Search "cognitive impairment" |
| #15 | Search (#1 AND #14 AND (#3 OR #4) AND #5) |
| **#16** | **Search (#1 AND #12 AND "balance training"[Title/Abstract])** |
| #17 | Search cognitive impairment[MeSH Terms] |
| #18 | Search (fall\*[Title/Abstract] OR "fall risk"[Title/Abstract]) |
| #19 | Search (#1 AND #17 AND (#3 OR #4) AND #18) |
| #20 | Search (“physical therapy” OR physiotherapy OR exercise) |
| #21 | Search (#17 AND #20 AND #5) Sort by: [pubsolr12] |
| #22 | Search (#1 AND #12 AND #4) |
| #23 | Search (#17 AND #4) |
| **#24** | **Search (#1 AND #17 AND #3 AND #18)** |
| **#25** | **Search (#17 AND #20 AND #5)** |

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

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| **Databases and Sites Searched** | **Number of results** | **Limits applied, revised number of results (not applicable)** |
| **PubMed**  **CINAHL**  **PsychInfo** | **3, 3, 181**  **8, 6, 45**  **6, 2, 42** |  |

## INCLUSION and EXCLUSION CRITERIA

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| **Inclusion Criteria** |
| RCT or Systematic Review  Studied population is 60 or older OR has a mean age of 65 or older OR population is defined as “older adults”  Studied population has a mild cognitive impairment OR other cognitive impairment  Balance intervention performed  Outcome measured is number of falls, risk of falls (as measured by a fall risk indicator such as balance or gait), or questionnaire related to fear of falling (such as ABC) |
| **Exclusion Criteria** |
| Not 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).*

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| --- | --- | --- | --- | --- |
| **Author (Year)** | **Risk of bias (quality score)\*** | **Level of Evidence\*\*** | **Relevance** | **Study design** |
| **Booth (2016)** | **AMSTAR: 10/11** | **1a** | **Moderate** | **Systematic Review** |
| **Hagovska (2016)** | **PEDro: 7/10** | **1b** | **High** | **Prospective, Randomized Controlled Trial** |
| **Lach (2017)** | **AMSTAR: 3/11** | **3a – studies included are RCTs, cohort studies, and case-control studies. A few studies are only within-subjects design.** | **Moderate** | **Systematic Review** |
| **Lewis (2016)** | **AMSTAR: 9/11** | **1a** | **Moderate** | **Systematic Review** |
| **Lipardo (2017)** | **AMSTAR: 8/11** | **1a** | **Moderate** | **Systematic Review** |
| **Schwenk (2016)** | **PEDro: 5/10** | **2b—RCT is low quality. It is not clear whether those who measured outcome data were blinded, and there were some baseline differences between groups related to falls in the past year.** | **Moderate** | **Prospective, Randomized Controlled Trial** |
| **Sungkarat (2017)** | **PEDro: 7/10** | **1b** | **Moderate** | **Prospective, Randomized Controlled Trial** |
| **Winter (2013)** | **AMSTAR: 5/11** | **3a—four of the eleven included studies are within-subjects design, and one of the controlled trials was not randomized** | **Moderate** | **Systematic Review** |

\*Indicate tool name and score

\*\*Use Portney & Watkins Table 16.1 (2009); 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:

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| * **Hagovska et al. (2016) – This is a good quality RCT that very directly applies to the clinical question I am asking, since its population is older adults with MCI, it compares balance intervention vs combined balance and cognitive intervention, and it measures several different outcomes relating to falls including the Falls Efficacy Scale-I, the Tinetti, and several forms of the TUG. It has fairly large sample sizes (n=40) in each group, and reasonable confidence intervals.** * **Booth et al. (2016) – This is the only good quality systematic review I found that specifically focuses on falls-related outcomes for those with cognitive deficits. Lipardo et al. includes a few articles that examine exercise intervention in MCI, but most of the outcomes measured in that review are cognitive status instead of balance measures such as Berg, gait speed etc. Although the Booth et al. study did not limit their included studies to only those with MCI, the review did categorize studies by MCI, moderate cognitive impairment, and severe cognitive impairment and provide meta-analysis of data where applicable. Because of this, I feel that it is the highest quality systematic review that is most applicable to my topic.** |

**SUMMARY OF BEST EVIDENCE**

**(1) Description and appraisal of Impact of the Combination of Cognitive and Balance Training on Gait, Fear and Risk of Falling and Quality of Life in Seniors with Mild Cognitive Impairment by Hagovska, M, and Olekszyova, Z.**

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| **Aim/Objective of the Study/Systematic Review:** |
| This study examines the effects of balance training with the CogniPlus program versus balance training alone on cognition, gait, balance, fear of falling, and quality of life in the population of older adults with MCI. |
| **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 was a randomized, controlled trial. * **Participants:** 80 older adults. * **Allocation:** Patients were randomly assigned using a computer program to either the intervention group to receive the balance training with the CogniPlus program (n=40) or to the control group to receive only the balance training (n=40). * **Intervention:** The control group received only balance training, while the experimental group received balance training as well as cognitive training through the CogniPlus program. Those who performed the training for the participants were not blinded. * **Data Collection:** Information was collected prior to beginning the interventions, and again after 10 weeks. The study does not report whether those who collected the data were blinded, but does report that those who collected the data were not the same individuals who provided the training. * **Statistical Methods:** A between-groups analysis was performed using a non-paired *t*-test. A within-group analysis was performed using a paired *t*-test. The significance of the p-value was set at P≤0.05. |
| **Setting**  [e.g., locations such as hospital, community; rural; metropolitan; country] |
| This study was performed in Kosice, Slovak Republic at the Geriatric Institute of St. Lukas in the outpatient department. |
| **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. |
| * **Eligibility criteria:** (1) MCI that had been diagnosed by a psychiatrist and psychologist, using both clinical examination and neuropsychological testing, according to the ICD-9-CM 331.83 criteria (2) Age 65-75 years (3) Did not have moderate or severe cognitive deficits (MMSE of 23 or less), major depressive or anxiety disorder, significant visual or auditory damage, prior history of neurological disease or brain injury, or a psychiatric disorder. * **Recruitment:** The participants were all patients at the Geriatric Institute of St. Lukas, outpatient department, and were recruited between June 2013 and March 2014. N total=80; N (experimental) =40; N (control) =40. * **Participant Demographics:**   + The mean age in years of the experimental group was 68 (±4.4), and the mean age of the control group was 65.0 (±6.2)   + The ratio of males to females was approximately the same in each group; about half the participants were males, and about half the participants were females.   + The average BMI was 26.7 (±3.9) in the experimental group and 24.9 (±4.2) in the control group.   + The number of falls in the past year was slightly higher than 1 in both groups; the average was 1.6 (±2.2) in the experimental group and 1.2 (±3.1) in the control group.   + There was no significant difference between groups in cognitive function as determined by the Mini Mental State Exam (MMSE).   + There was no significant difference between groups for balance and risk of falling as measured by the Tinetti Performance Oriented Mobility Assessment; both had moderate risk of falling.   + Both groups had a mild fear of falling at baseline as measured by the Falls Efficacy Scale-I. * **Dropouts:** Two participants from the control group dropped out due to respiratory disease. |
| **Intervention Investigated**  [Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| * Received 30 minutes of balance training per day led by a physical therapist. * This balance training included:   + walking over obstacles (five boxes)   + walking with direction change   + walking with speed change   + walking while carrying a load with one or both upper extremities   + walking up and down stairs (ten steps) |
| *Experimental* |
| * Received 30 minutes of balance training each day, as specified above. * Also received 30 minutes of the CogniPlus program twice per week. * CogniPlus program:   + Designed by the SHUFRIEND GmbH Company in Austria.   + Includes activities that target the areas of attention, long term memory, working memory, executive function, and visual-motor coordination.   + This study used one game in each cognitive area for the participants. The participants played each game for 10 minutes, so that between the two 30-minute sessions, they played each game for at least 10 minutes per week.   + The difficulty of each game was progressed automatically or by trainers in order to keep the game at an appropriate level of challenge for the participant.   + When an individual maximized the level that they could attain in the CogniPlus program in a certain game, the activity was combined with a physical activity in order to provide a dual-task challenge. Games targeting the following areas were combined:     - Attention – participants played this game while standing and changing position from left foot to right foot and standing on toes     - Long term memory – participants played this game while standing up from a chair and then sitting back down     - Executive function – participants played this game while alternately making steps forward and backwards, then to the left and to the right |
| **Outcome Measures**  [Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| * **MMSE:** provides information about basic cognitive functions, maximum score is 30 points, score of less than 23 indicates moderate or severe cognitive deficit. * **Falls Efficacy Scale-I (FES-I)** : this is a revision of the original falls efficacy scale, and includes six additional questions in addition to the 10 questions from the original scale, each question is rated from 1=not at all concerned to 4=very concerned, so the score ranges from 16 to 64 with a higher score indicating increased fear of falling.5 * **Timed Up and Go Test (TUG):** participants stand up from a chair, walk 3 meters, then turn around, walk back to the chair and sit. For this study the mean time of three trials was measured in seconds. There is no definite score range, as the test is timed in seconds, and can vary from participant to participant. Four different variations of this test were used:   + Standard – no alterations to test form   + TUG with Dual Tasking – participant counts backwards from 100 by 3s while performing the test.   + TUG Manual – participant holds a cap while performing the TUG   + TUG Cognitive – participant walks backwards while performing the TUG * **Tinetti Performance Oriented Mobility Assessment**: participants perform different functional movements, and are scored on their performance. There are two sections: balance with maximum score of 16, and gait with maximum score of 12. The maximum total score is 28. A score of 25-28 indicates low risk of falling, a score of 24-19 indicates a moderate risk of falling, and a score of ≤19 indicates a high risk of falling. * **Multi-Directional Reach Test:** measures static balance, participant reaches forwards, backwards, medially, and laterally with the dominant arm at 90 degrees of shoulder flexion, and a yardstick is used to measure how far the individual reaches in cm.6 For this study the individual was also asked to reach forward as far as possible and hold for 30 seconds; this distance was also recorded. There is no maximum possible score. |
| **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.] |
| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **Outcome Measure** | **Control Group Baseline (N=40)** | **Experimental Group Baseline (N=40)** | **Control Group at 10 Weeks (N=38)** | **Experimental Group at 10 Weeks (N=40)** | **Mean Difference Between Groups at 10 weeks (95% Confidence Interval)** | **P-Value Between Groups at 10 Weeks** | | *MMSE* | 26.02±1.47 | 25.97±2.57 | 26.1±1.46 | 26.97±2.21 | 0.87 (0.03, 1.71) | 0.04 | | *FES-I* | 15.40±8.63 | 18.67±15.6 | 13.86±7.75 | 11.65±7.84 | -2.21 (-5.67, 1.25) | 0.21 | | *TUG Standard (seconds)* | 9.09±2.12 | 10.02±2.82 | 8.51±2.37 | 8.66±2.56 | 0.15 (-0.95, 1.25) | 0.78 | | *TUG Dual Task (seconds)* | 15.58±4.05 | 16.98±4.89 | 17.01±4.63 | 14.49±4.25 | -2.52 (-4.49, -0.55) | 0.01 | | *Tinetti Balance* | 11.55±2.45 | 11.72±2.12 | 11.84±3.20 | 14.05±1.99 | 2.21 (1.03, 3.39) | 0.0005 | | *Tinetti gait* | 9.07±2.03 | 8.60±1.67 | 12.44±11.11 | 10.37±1.64 | -2.07 (-5.55, 1.41) | 0.24 | | *Functional Reach Forward (cm)* | 26.50±4.36 | 25.12±5.18 | 28.28±4.34 | 29.92±6.97 | 1.64 (-0.95, 4.23) | 0.22 |  * Significant differences were found between groups at 10 weeks in favor of the experimental group in the outcomes of MMSE score, TUG Dual Task, and Tinetti Balance, as indicated by a p-value of ≤0.05 and a 95% confidence interval that does not include zero. * There were no significant differences between groups at 10 weeks in the outcomes of FES-I score, TUG Standard, Tinetti Gait, or Functional Reach (Forward), as indicated by a p-value of ≥0.05 and a 95% confidence interval that includes zero. * The mean differences indicate improved scores on the FES-I, Tinetti Gait, and Functional Reach (Forward) in favor of the experimental group, although as stated above, these results are not statistically significant. In addition, no significant difference between groups was found for the TUG manual, TUG cognitive, or Functional Reach (medial, lateral, backwards). |
| **Original Authors’ Conclusions**  [Paraphrase as required. If providing a direct quote, add page number] |
| “The results of the present study show that the combination of selected exercises from the CogniPlus program with balance training improves general cognitive functioning, gait speed with dual tasks, static balance and quality of life; they achieve better results than balance training alone in elderly people with mild cognitive impairment” (pg. 1047). In addition, for older adults with MCI, regular balance training positively affects fear of falling, gait, static balance, and dynamic balance. |
| **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.] |
| * PEDro Scale Score: 7/10 based on Random Allocation: Yes; Concealed Allocation: Yes; Baseline comparison: Yes; Blinding of subjects: Yes; Blinding of therapy administrators: No; Blinding of assessors/investigators: No (not specified in article); >85% participant outcomes: Yes; Intention to treat analysis: No; Between group comparison: Yes; Point measures: Yes. * Strengths of this study include the randomization of participants into their groups, and the blinding of the participants. The study used moderate sample sizes, which increases the validity and generalizability of the study. This study also provided data about the baseline characteristics of the two groups in many areas including age, gender, social information (living alone or with a partner, education completed), cognitive function, baseline balance, number of falls in the past year, and medical information (BMI, hypertension, etc.). The data provided allows one to compare each patient to the study participants in several different areas in order to best determine external validity. * Limitations of this study include the failure of the study to conduct an intention-to-treat analysis, and the failure of the study to specify whether the assessors were blinded. The assessors may have indeed be blinded, but it is impossible to know with certainty since the article does not explicitly address this, and one cannot make assumptions. It is important to note that although an intention-to-treat analysis was not performed, only two participants dropped out of the study, leaving a total of 97.5 % of participants remaining throughout the entire study. Because a high percentage of participants remained throughout the study, the lack of intention-to-treat analysis should not strongly affect the results. A further limitation of this study was the use of the CogniPlus program, as it would be impossible to replicate this protocol in the clinic without purchase of the program, and cognitive training alone without exercise is not typically used in physical therapy treatment. |
| **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.] |
| This is one of the few randomized controlled trials that directly compares balance training alone to balance training plus a cognitive component. It is a fairly high quality study as evidenced by its 7/10 PEDro score. The results of this study indicate that the use of balance training plus a cognitive component may have superior results compared to balance training alone in the areas of cognitive function, dual tasking ability, and static balance. In spite of the significant differences between groups in these areas, the effect size is small in all categories. The effect size of the TUG Dual Task from this study was -2.52 seconds. A study by Ries et al. reports a minimum detectable change of the TUG of 4.09 seconds, and a study by Gautschi et al. reports a minimum clinically important difference of 3.4 seconds on the TUG.7,8 These studies do not exactly match the examined study because they were not conducted in the MCI population and were performed on the TUG instead of the TUG Dual Task, but the numbers from these studies do indicate that the 2.52 second improvement is possibly small from a clinical standpoint. The improvements of the MMSE score of 0.87 and of the Tinetti Balance of 2.21 are similarly small. These results are promising, and point towards the possibility of better results from the combination of cognitive training with balance training, but do not show a moderate or large effect size in favour of the experimental group. |
| **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.] |
| Although many aspects of this study could not be replicated in exactly the same manner in a clinical environment, it would be possible to replicate these interventions in a similar manner to the study. Instead of providing balance training with a physical therapist for 30 minutes each day, it would be more realistic to have a training session 2-3x/week with a physical therapist for 30 minutes, and then have the patient perform balance exercises independently on the days the patient did not visit the clinic. The cognitive component could be added in during the sessions in clinic through emphasizing dual-task training, and the patient could perform some of these dual-task exercises during their home exercises program as well, provided the patient was safe to do so. This study is directly applicable to the patient scenario in terms of the patient’s cognitive function, since this study only looked at individuals with a clearly diagnosed MCI. The patient in my clinical scenario is older than most of the study participants by 10-20 years, so may respond slightly differently to the treatment than those in the study. However, the participants are similar to the patient in that they are all in the category of older adults. The patient is also similar to the study participants when considering falls history. Overall, there are many aspects that make this study very relevant to the patient in the clinical scenario. |

**(2) Description and appraisal of Interventions Incorporating Physical and Cognitive Elements to Reduce Falls Risk in Cognitively Impaired Older Adults: A Systematic Review by Booth, V, Hood, V, and Kearney F (2016)**

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| **Aim/Objective of the Study/Systematic Review:** |
| The purpose of this Systematic Review is to examine literature related to the combination of physical training and cognitive training for older adults with a cognitive deficit, and to determine how this combination of training can affect fall risk. |
| **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 randomized controlled trials (RCTs), controlled clinical trials, and experimental studies in which randomization was used. Meta-analysis was conducted where appropriate. * **Search Strategy:** The search took place between June and July 2015. Databases searched included MEDLINE, CINAHL, CENTRAL, JBISRIR, MEDLINE, EMBASE (1980 to present), AMED (1985 to present), and PsychINFO. The references of identified studies were also searched. A search was conducted for unpublished studies at Current Controlled Trials and the National Institute of Health Clinical Trials Database. Initial keywords for the searches included dementia, cognitive impairment, memory loss, exercises, rehabilitation, and accidental falls. * **Selection Criteria:**   + Inclusion criteria is as follows:   + Majority of study participants were 65 years or older, as shown by mean age and standard deviations reported.   + Participants had a cognitive impairment as evidenced by (a) a diagnosis of dementia or other condition that implies cognitive impairment; this condition had to be acquired and progressive in nature (b) reduced score on standardized exams for cognitive function such as MMSE or the Montreal Cognitive Assessment (MoCA). At least 75% of the total sample had to meet the criteria for cognitive impairment described.   + Study stated that the intervention was performed with the intent to reduce falls   + Outcome related to fall risk (falls risk measures, history or details of occurrence of falls, reliable clinical outcome measures related to balance/falls such as the Berg, or clinical measures related to balance/falls such as gait) was used before and after the intervention.   + RCTs, controlled clinical trials and experimental studies. The methodological validity of studies was assessed by using the Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI).   + Exclusion criteria is as follows:   + Studies without randomization, cohort studies, case control studies, comparative studies * **Methods:**    + The retrieved articles were evaluated for inclusion by two reviewers, and any conflicts between these reviewers were resolved by a third party.   + Data was extracted from the articles using the JBI-MAStARI tool. Authors of studies were contacted if additional information was required.   + Data was pooled in statistical meta-analysis when possible using Review Manager 5.3. This included subgroup analysis according to level of cognitive impairment and patient population.   + For categorical data, the odds ratio was calculated, and for continuous data the weighted mean differences with 95% confidence interval was calculated.   + A Chi-square test was used to assess heterogeneity, and levels of heterogeneity were categorized according to the Cochrane Handbook   + If meta-analysis was not possible, the data was presented in charts and tables, and in written form.   + The risk of bias in studies was assessed using the MAStARI tool, and was listed in chart form. |
| **Setting**  [e.g., locations such as hospital, community; rural; metropolitan; country] |
| University of Nottingham in Nottingham, United Kingdom. |
| **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 total number of participants across all studies included (8 studies) was 1041. * The range of mean age was 70.1 to 82.5 years. * Three studies included participants with any dementia diagnosis, one study included participants with specifically Alzheimer’s dementia, one study included participants with amnesic MCI, and three studies included participants without a specific diagnosis but whose standardized test scores indicated cognitive impairment. * Three studies included community-dwelling participants, three studies included institutionalized participants, and two studies included both types of participants. * Three studies sampled participants with moderate cognitive deficits, and five studies sampled participants with mild cognitive deficits. The mean MMSE scores in each group ranged from 12.7 to 27.1. |
| **Intervention Investigated**  [Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| * Overall, there is considerable variety in the types of activities assigned to the control groups. * Control groups include “usual care” or “usual activity,” health promotion education classes, stretching and toning exercises, motor placebo group training, postural control training in single task condition, and cognitive training with physical therapy training several times per week. * The dosage is not able to be determined if “usual care” or “usual activity.” Most other control interventions occurred 2-3 times per week for one hour. |
| *Experimental* |
| * Overall, there is considerable variety in the types of activities assigned to the experimental groups. * The experimental groups include:   + Physical therapy with multicomponent exercise (one intervention group with home exercise, other intervention groups with group exercise)   + Interdisciplinary program of physical therapy with multicomponent exercise combined with occupational therapy and physical education activities   + Postural control training in dual task conditions with manual tasks, postural control training in dual task conditions with manual-cognitive tasks, and postural control training in dual task conditions with manual-cognitive tasks in graded sensory   + Tai Chi group class   + Music-based multitask exercise program   + Cognitive training + physical therapy + multicomponent exercise program * The dosage for most interventions is 1 hour 2-3 times per week. Exceptions are for the cognitive activity + physical therapy + multicomponent exercise program in which physical therapy was performed 5 times per week, and for the interdisciplinary program which was performed for 2 hours five times per week. * The length of the interventions ranged from 3 to 12 months. |
| **Outcome Measures**  [Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| **Primary Outcomes**   * **Number of falls:** (listed below as reported in each study)   + Number of falls in previous 12 months, compared to number of falls after 3-month intervention   + Number of falls measured at 12 months after the intervention had ended   + Total number of falls measured at the 6 month follow-up immediately after intervention, as well as number of participants with 1 or more falls, and number of participants with 2 or more falls   + Number of falls measured 9 months after a 3-month intervention, as well as number of non-fallers/single-fallers/multiple-fallers, fall rate per person-year, and time-to-first-fall   + Number of falls is a continuous scale beginning at and including 0. * **Berg Balance Scale:** this is a clinical measure in which participants are asked to perform certain movements, and rated on their ability to complete the movements as well as the quality of their movements.9 The total score ranges from 0-56, with a higher score indicated superior balance abilities.9 The MDC for the geriatric population ranges from 3.3 to 6.3 depending on the individual’s initial score.9 * **Timed Up and Go:** participants stand up from a chair, walk 3 meters, then turn around, walk back to the chair and sit. For this study the mean time of three trials was measured in seconds. There is no definite score range, as the test is timed in seconds, and can vary from participant to participant. * **Gait Speed:** participants are asked to walk a certain length, usually 10 meters, starting a few meters before the length to gradually build speed, and ending a few meters after the length to gradually slow to a halt. The time in seconds is measured when the individual begins the 10 meters and when the individual finishes the 10 meters. Units reported are meters per second (m/s).   **Secondary Outcomes**   * **Frailty and Injuries: Cooperative Studies of Intervention Techniques-4** * **Dynamic Gait Index:** score of 0-24.10 * **Functional Reach Test:** score reported in cm, no limit to range. * **Lateral Reach Test:** score reported in cm, no limit to range. * **Short Physical Performance Battery:** score of 0-12.11 * **Simplified Tinetti Test** * **Timetti Performance Oriented Mobility Assessment:** score of 0-28.   When meta-analysis was performed, the values of the raw data of the primary outcomes was analysed in the units listed above for each outcome. A meta-analysis could not be conducted with the outcome of history of falls due to the variety of reporting methods. |
| **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.] |
| TUG for MCI Group   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | **Experimental** | | | **Control** | | |  | | | **Study or Subgroup** | **Mean (secs)** | **SD (secs)** | **Total** | **Mean (secs)** | **SD (secs)** | **Total** | **Weight** | **Mean Difference (95% CI) (secs)** | | *Trombetti (2011)* | 9.9 | 1.6 | 66 | 10.6 | 1.2 | 68 | 99.1% | -0.70 (-1.18,  -0.22) | | *Zieschang (2013)* | 11.3 | 4.8 | 40 | 17.8 | 18 | 51 | 0.9% | -6.50 (-11.66, -1.34) | | *TOTAL (95% CI)* |  |  | 106 |  |  | 119 | 100% | -0.75 (-1.23, -0.27) | | Heterogeneity: Chi2=4.81, df=1 (P=0.03); I2=79%  Test for overall effect: Z=3.08 (P=0.002)  SD=Standard Deviation, CI=Confidence Interval | | | | | | | | |  * These results do not indicate that the experimental group (including multicomponent exercise and exercise with music) demonstrated significant improvement on the TUG test, due to the confidence interval for the study including zero. However, these results do suggest insignificant improvement on the TUG test in favor of the experimental group. * The study of Trombetti et al., when taken alone, shows that a music-based multitask program results in significant reductions on the TUG time when compared with usual care.   Berg for MCI Group   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | **Experimental** | | | **Control** | | |  | | | **Study or Subgroup** | **Mean** | **SD** | **Total** | **Mean** | **SD** | **Total** | **Weight** | **Mean Difference (95% CI)** | | *D’Souza (2012)* | 51.1 | 4 | 23 | 48.8 | 4.9 | 23 | 4.6% | 2.30 (-0.29, 4.89) | | *Lam (2012)* | 53.4 | 2.3 | 171 | 52.3 | 3.4 | 218 | 95.4% | 1.10 (0.53, 1.67) | | *TOTAL (95% CI)* |  |  | 194 |  |  | 241 | 100% | 1.16 (0.60, 1.71) | | Heterogeneity: Chi2=0.79, df=1 (P=0.37); I2=0%  Test for overall effect: Z=4.08 (P<0.0001)  SD=Standard Deviation, CI=Confidence Interval | | | | | | | | |  * The results of this meta-analysis indicate that exercise interventions that include dual task training/Tai Chi produce a significantly greater improvement in balance when compared to a control of single task training/stretching and toning exercises, as evidenced by the confidence interval that is above zero.   Gait for MCI Group   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | **Experimental** | | | **Control** | | |  | | | **Study or Subgroup** | **Mean (m/s)** | **SD (m/s)** | **Total** | **Mean (m/s)** | **SD (m/s)** | **Total** | **Weight** | **Mean Difference (95% CI) (m/s)** | | *Doi (2013)* | 1.38 | 0.3 | 25 | 1.26 | 0.2 | 25 | 8.2% | 0.12 (-0.02, 0.26) | | *Trombetti (2011)* | 1.09 | 0.13 | 66 | 1.03 | 0.13 | 68 | 84.4% | 0.06 (0.02, 0.10) | | *Zieschang (2013)* | 1.2 | 0.4 | 40 | 1 | 0.3 | 51 | 7.4% | 0.20 (0.05, 0.35) | | *TOTAL (95% CI)* |  |  | 131 |  |  | 144 | 100% | 0.08 (0.03, 0.12) | | Heterogeneity: Chi2=3.55, df=2 (P=0.17); I2=44%  Test for overall effect: Z=3.65 (P=0.0003)  SD=Standard Deviation, CI=Confidence Interval | | | | | | | | |  * The results of this meta-analysis indicate that a multicomponent exercise program produces significantly better improvements in gait speed compared to a control (health promotion education classes, usual care, motor placebo treatment). |
| **Original Authors’ Conclusions**  [Paraphrase as required. If providing a direct quote, add page number] |
| “Overall, multicomponent interventions incorporating both physical and cognitive components demonstrative positive effects on balance, functional mobility, and gait speed when compared with a control, and had significantly better effects on balance and gait speed within MCI populations” (126). In spite of the positive effects of the multicomponent interventions, most improvements shown were not clinically significant, with the exception of gait speed, which showed a 0.10 m/s within-mean difference. The considerable heterogeneity of the interventions makes it difficult to be fully confident in the results of some of the meta-analysis performed. |
| **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.] |
| * AMSTAR score: 10/11 Priori design provided: Yes; Two independent data extractors: Yes; Comprehensive search: Yes; Status of publication: Yes; List of studies: Yes; Characteristics of studies: Yes; Quality of studies noted: Yes; Quality of studies used in conclusions: Yes; Appropriate methods: Yes; Publication bias assessed: Yes; Conflict of interest noted: No (source(s) of funding or support not acknowledged) * Strengths: This study took every length to assure a clean, methodical procedure to their review, and to look for relevant articles in a variety of different databases and registrars. The mean MMSE score of the participants with standard deviations is noted for each included study, which provides valuable information about the cognitive status of the participants. Many of the studies were fairly high quality studies, with a mean overall bias score of 7.5/10 (from MAStARI appraisal instrument). * Weaknesses: There was an extremely wide variety of interventions used from study to study. The range included anything from exercise with music to Tai Chi to dual task postural control training. This makes it difficult to trust the results of the meta-analysis or to be able to replicate the results of this review in the clinic. The variety of activities in the control group also makes it difficult to compare studies; some control groups were simply education classes while others received regular physical therapy. The weighting of the studies included in the meta-analysis was often extremely lopsided, giving one study which may not have been as relevant clinically more influence in the final result. Finally, the outcome of number of falls was reported in a different way in each study, so it is difficult to compare one study to another using this outcome. |
| **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.] |
| The results of this study indicate that for older adults with cognitive impairment, a multicomponent exercise program including both physical and cognitive components may potentially lead to greater improvements in balance and gait than usual care or a program that does not involve both physical and cognitive components. In the MCI population, this review shows a significant improvement in favour of the experimental group in balance and gait speed. However, the effect size of these improvements is small, ranging from 3.65 to 4.08. In addition, it is hard to definitely conclude that a multicomponent exercise program is superior to a program only involving physical exercise because many of the studies did not use physical exercise as a control, but instead used “usual care” or another intervention that is not very physically rigorous such as stretching or “motor placebo training.” From the results, one is not sure whether the improvements are due to the combination of physical and cognitive components, or due to the increased physical treatment alone of the intervention group compared to the control. The heterogeneity of the studies analysed also makes it difficult to arrive at firm conclusions; the most clinically meaningful improvement seems to be gait speed, but the Chi squared test for the gait speed analysis had an I2 value of 44%, which is very high, and causes one to question whether the studies are similar enough to be analysed together. In spite of the limitations of this review, it does provide a nice snapshot of studies that examine physical and cognitive interventions that are intended to reduce falls risk in older adults with cognitive impairment, and most of the studies indicate that a multicomponent exercise program produces slightly better results in reducing fall risk (as measured by balance and gait outcomes) compared to a control. |
| **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.] |
| Several of the studies that were included in this systematic review are not directly applicable to my clinical question because the intervention used was not one that would commonly be used in an outpatient physical therapy setting. The Trombetti et al. and Lam et al. studies are heavily weighted in the analysis, but they used music-based multitask exercise and Tai Chi, respectively. These are not interventions that I would use in the clinic with my patient, but I could refer my patient to a Tai Chi exercise class outside of the clinic, if that patient was safe to attend the class independently. Some of the studies incorporated dual task training or some other combination of physical exercise and cognitive activity that is more similar to what a physical therapist would be able to replicate in the clinic environment. Based on this, I could incorporate dual task training into my activities in the clinic with the patient in my clinical scenario.  The age and cognitive status of the participants in the studies are fairly similar to the patient in my clinical scenario, so I can reasonably expect that I would attain the same results of improvements in balance and gait if applied the dual task/cognitive component to my therapy sessions. |

**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.]

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| Balance training for those with a MCI is an important subject, especially since MCI can be common in the elderly population who often experience balance deficits, and because decreased cognitive function has been linked to an increased risk for falls.3,4 There is a scarcity of quality evidence that directly addresses my clinical question, but the evidence available indicates that balance training which includes some kind of cognitive component may decrease fall risk more effectively than physical balance training alone. Therefore, it would be better for the patient in my clinical question to receive balance training using an individualized balance program, as many standardized balance programs do not include a cognitive component. The exception to this may be some forms of Tai Chi, which can be a standardized program that does include a cognitive component, as noted in the review by Booth et al.  The study by Hagovska et al. was a high quality randomized controlled trial that compared balance training and cognitive training to balance training alone in the population of those with MCI. The results of this study show that the combination of balance training and cognitive training can produce superior results in the areas of dual-tasking and static balance (significant results), and possibly in the areas of fear of falling, dynamic balance, and limits of stability (positive results with between-group comparison in favour of intervention, but not statistically significant). The systematic review by Booth et al. confirms that the combination of cognitive and balance training is slightly more effective than balance training alone; a meta-analysis conducted shows significant improvements in the areas of gait speed and balance in favour of the cognitive and balance training combination. However, the findings from this meta-analysis should be weighed cautiously as one of the highest weighted studies in the analyses compared Tai Chi (balance intervention with cognitive component) to toning and stretching exercises (control). It is clear from this that a balance intervention is superior to toning and stretching exercises, but this does not clearly show whether balance intervention with a cognitive component is superior to a similar balance intervention without the cognitive component. Overall, one of the major limitations of the Booth et al. review was the wide variety of interventions and control conditions in the included studies. It makes it difficult to compare one study to another, as well as difficult to combine data. However, the majority of the studies in this review reported positive effects of balance interventions incorporating a cognitive component, compared to the control. One of the main limitations of the Hagovska et al. study was that it does not specify whether the assessors were blinded, since this could be a major source of error, and it incorporated a cognitive component using a specific computer-based program, which is difficult to replicate in the clinic.  In the clinical environment, one must weigh the cost and benefit of different treatment options. Fortunately, the cost of implementing a cognitive component along with the balance training does not have to be high. A dual-task training approach can be emphasized, and this would not require expensive equipment or additional treatment time. Although most of the studies documented only a small effect size of adding the cognitive component to balance training vs balance training alone, since the costs are minimal, it seems reasonable to use a dual-tasking approach when treating older adults with MCI.  Currently, the evidence is limited because not very many studies focus only on those with MCI, and the types of interventions which are studied vary widely from study to study. It would be beneficial to run more high quality studies/reviews focusing on MCI only, and focusing on one intervention comparison only such as physical balance training compared to dual-task balance training. |

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