

# Systematic Reviews

## Computer-based cognitive interventions for dementia and mild cognitive impairment in older adults: protocol for a systematic review and meta-analysis

--Manuscript Draft--

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<b>Full Title:</b>	Computer-based cognitive interventions for dementia and mild cognitive impairment in older adults: protocol for a systematic review and meta-analysis
<b>Article Type:</b>	Protocol
<b>Abstract:</b>	<p>Background: A growing number of older adults experience neurocognitive disorders such as dementia and mild cognitive impairment (MCI). Recent technological advances allow for traditional cognitive interventions to be administered via computers and other devices. We aim to explore the effect of computer-based cognitive interventions on cognition for older adults with dementia or MCI.</p> <p>Methods: We will systematically search chosen electronic databases to identify randomised and quasi-randomised controlled trials, cluster-randomised trials, and cross-over trials that meet our inclusion criteria. We will screen for studies that examine the use of computer-based cognitive interventions for adults aged over 60 with MCI or dementia at any level of severity and type. Primarily, we will examine the effects of such interventions on cognitive function (e.g., memory, executive function). Secondly, we will examine outcomes such as mood and quality of life. Risk of bias will be assessed using Downs and Black's checklist for the assessment of the methodological quality of randomised and non-randomised studies. After data extraction we will pool the data and conduct a meta-analysis, with subgroup analysis where possible in order to explore differences for disorder type (dementia vs. MCI) and intervention type (cognitive stimulation, cognitive training, cognitive rehabilitation, cognitive recreation). Finally, we will assess the quality of the evidence using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system.</p> <p>Discussion: This systematic review will be the first to explore the effect of computer-based cognitive interventions for older adults with dementia and MCI. Results from this review will provide the basis for future research in developing computer-based interventions for this population.</p> <p>Systematic review registration: PROSPERO CRD42016050236</p> <p>Keywords: dementia, cognition, impairment, mild cognitive impairment (MCI), computer-based intervention, technology, stimulation, therapy</p>

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14 adults: protocol for a systematic review and meta-analysis  
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## Abstract

22

23 **Background:** A growing number of older adults experience neurocognitive disorders such as  
24 dementia and mild cognitive impairment (MCI). Recent technological advances allow for  
25 traditional cognitive interventions to be administered via computers and other devices. We  
26 aim to explore the effect of computer-based cognitive interventions on cognition for older  
27 adults with dementia or MCI.

28 **Methods:** We will systematically search chosen electronic databases to identify randomised  
29 and quasi-randomised controlled trials, cluster-randomised trials, and cross-over trials that  
30 meet our inclusion criteria. We will screen for studies that examine the use of computer-  
31 based cognitive interventions for adults aged over 60 with MCI or dementia at any level of  
32 severity and type. Primarily, we will examine the effects of such interventions on cognitive  
33 function (e.g., memory, executive function). Secondly, we will examine outcomes such as  
34 mood and quality of life. Risk of bias will be assessed using Downs and Black's checklist for  
35 the assessment of the methodological quality of randomised and non-randomised studies.  
36 After data extraction we will pool the data and conduct a meta-analysis, with subgroup  
37 analysis where possible in order to explore differences for disorder type (dementia vs. MCI)  
38 and intervention type (cognitive stimulation, cognitive training, cognitive rehabilitation,  
39 cognitive recreation). Finally, we will assess the quality of the evidence using the Grading of  
40 Recommendations Assessment, Development and Evaluation (GRADE) system.

41 **Discussion:** This systematic review will be the first to explore the effect of computer-based  
42 cognitive interventions for older adults with dementia and MCI. Results from this review will  
43 provide the basis for future research in developing computer-based interventions for this  
44 population.

45 **Systematic review registration:** PROSPERO CRD42016050236

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46 **Keywords:** dementia, cognition, impairment, mild cognitive impairment (MCI), computer-  
47 based intervention, technology, stimulation, therapy

## 48 **Background**

49 Globally, the number of older persons—aged 60 and over—is growing faster than any  
50 other age group [1]. In line with population aging, the prevalence of later-life cognitive  
51 disorders can be expected to increase. Dementia, which is referred to as Major  
52 Neurocognitive Disorder in the *Diagnostic and Statistical Manual of Mental Disorders* (5<sup>th</sup>  
53 ed.; *DSM-5*), is the significant impairment of cognitive performance in one or more cognitive  
54 domains (e.g., complex attention, learning and memory, executive function, language),  
55 ultimately resulting in functional incapacity and death [2]. Whilst many forms of dementia  
56 exist, the most common form is seen in Alzheimer’s disease, where it affects 6-9% of adults  
57 aged over 60 worldwide [3]. Similarly, Mild Cognitive Impairment (MCI) involves cognitive  
58 decline that is greater than that which occurs in normal aging, but does not significantly  
59 interfere with daily functioning [4]. It is estimated that MCI affects 3-42% of older adults,  
60 and precedes the onset of dementia in a number of cases [5].

61 Cognitive interventions for conditions such as dementia and MCI aim to maximise  
62 current function and reduce the risk of further cognitive decline [6]. In recent years, advances  
63 in computer technology have allowed such interventions to be administered using personal  
64 computers, laptops, tablets and other mobile devices, in an increasingly accessible,  
65 individualised and cost-effective manner. Studies suggest that such computer-based  
66 interventions may be beneficial for improving cognitive abilities such as memory, attentional  
67 control, executive function, for both those with dementia and MCI [7-11].

68 A recently published systematic review and meta-analysis of computer-based  
69 cognitive interventions for dementia reported significant improvements in the areas of

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70 cognition, depression and anxiety, and found that computer-based interventions may improve  
71 cognition superior to non-computer-based interventions [12]. We plan to build upon the work  
72 of García-Casal and colleagues [12] by producing an updated review. As this is a fast-  
73 developing field of research, we anticipate that further studies relevant to this review will  
74 have been published since 2014. Notably, this review will also include studies of older adults  
75 with MCI.

## 76 **Method**

### 77 **Objectives**

78 The purpose of the systematic review and meta-analysis is to review the current  
79 evidence regarding computer-based cognitive interventions for older adults with dementia  
80 and MCI. It aims to explore whether computer-based cognitive interventions improve  
81 cognitive ability for older adults with dementia and MCI, compared to non-computer-based  
82 interventions. The aim of this systematic review protocol is to transparently present the  
83 method we will undertake in order to conduct the systematic review, such that it could be  
84 adequately replicated. This method includes information regarding eligibility criteria,  
85 information sources and search strategy to be used, and the process of data extraction,  
86 synthesis, and analysis.

### 87 **Protocol and registration**

88 This protocol was developed in adherence with the Preferred Reporting Items for  
89 Systematic Review and Meta-Analysis Protocols (PRISMA-P) guidelines (see additional file  
90 1) [13]. The review will also adhere to the guidelines specified by the Preferred Reporting  
91 Items for Systematic Reviews and Meta-Analyses (PRISMA) [14]. This review has been  
92 registered with the International Prospective Register of Systematic Reviews (PROSPERO;  
93 CRD42016050236).

94 **Eligibility criteria**

95 **Types of studies.** We will include randomised and quasi-randomised controlled trials,  
96 cluster-randomised trials, and cross-over trials. We will exclude single-subject case studies.

97 **Population.** We will include studies of individuals identified as having MCI and/or  
98 any form of dementia at any level of severity and type, such as dementia in Alzheimer's  
99 disease, and vascular dementia. Participants of included studies will be at least 60 years of  
100 age. Studies that include participants below the age of 60 will be included if the mean age of  
101 participants is 60 or over.

102 **Intervention.** The target intervention is computer-based, that is, utilising screen-  
103 based technology such as personal computers, laptops, and other devices such as tablets and  
104 mobile phones. The intervention must be designed to address cognition and improve aspects  
105 of cognitive function, such as memory, attention and executive function. We will use the  
106 classification method specified by García-Casal et al. [12], where interventions were  
107 categorised as either cognitive stimulation, cognitive recreation, cognitive rehabilitation, or  
108 cognitive training [12]. We will exclude any studies where participants were provided with  
109 the target intervention alongside another intervention if results are only given for the  
110 interventions combined, due to potential difficulty clarifying whether the outcomes are a  
111 result of the target intervention or the other intervention.

112 **Comparator groups.** The comparator groups are likely to comprise participants  
113 receiving care-as-usual, participants receiving a cognitive intervention that is non-  
114 computerised, and participants receiving pharmacological interventions.

115 **Outcomes.** The primary outcome measures of interest will be those that measure the  
116 participants' cognitive ability (e.g., memory, attention, and executive function) using  
117 standardised measures such as the Mini Mental State Examination (MMSE) [15]. Secondary

118 outcome measures which may be included are those such as participant mood, quality of life,  
119 and mental illness such as depression and anxiety, also using standardised measures. Other  
120 outcomes may include changes in specific activity-related function. Included studies will  
121 report pre- and post-treatment scores.

122 **Report characteristics.** We will include full-text articles in the English language, and  
123 there will be no geographical or date limitation on the included studies.

#### 124 **Search methods for identification of studies**

125 We will conduct a systematic search of the following databases: The Cochrane  
126 Library, PubMed, EMBASE, MEDLINE, PsycINFO, ScienceDirect, the Specialised Register  
127 of the Cochrane Dementia and Cognitive Improvement Group, CINAHL, ACM Digital  
128 Library, IEEE Xplore Digital Library, Web of Science, and Springer Link. We will also  
129 search the following databases for additional grey literature: Open Grey. Reference lists of  
130 relevant literature will be examined in order to find any relevant publications that may have  
131 been missed in the initial source. No date restriction will apply. In instances where more  
132 information is required, we will correspond with the authors of the publication to obtain such  
133 information, where feasible.

134 A search strategy will be modified from that used by García-Casal et al. We will use  
135 key terms relevant to the topic, as identified by García-Casal et al., such as “dementia”,  
136 “cognition”, “computer”, and “stimulation”. We will add the term “mild cognitive  
137 impairment”. An example of a database search is shown below:

- 138 • (((dementia OR alzheimer\* OR "mild cognitive impairment")) AND (cognit\* OR  
139 memory OR "reality orientation" OR stimul\* OR rehabilit\* OR train\*)) AND  
140 (comput\* OR technolog\* OR telerehab\*)

#### 141 **Data collection and analysis**

142           **Selection of studies.** We will independently screen titles and abstracts to identify  
143 studies that may be relevant to the review, and full-text copies of the studies identified will be  
144 retrieved. We will then screen the full-text publications for their eligibility. We will use  
145 online screening and extraction software Covidence to conduct both stages of screening [16].  
146 One reviewer will conduct all screening, and a second reviewer will conduct 20% of the  
147 screening at both stages, for the purposes of quality assessment. Discrepancies between the  
148 reviewers' decisions will be resolved by reaching consensus, or by obtaining the opinion of a  
149 third reviewer. Reasons for excluding any studies from the review at this stage will be noted  
150 and reported in the review. A flow chart illustrating the search and selection process of the  
151 review will be included.

152           **Data extraction and management.** We extract pre-defined data from studies chosen  
153 for inclusion in the review using the Covidence software. The following information will be  
154 extracted:

- 155           1. Publication details: authors, title, journal, year, publication type (e.g., peer-reviewed  
156           article, conference proceedings), geographical location in which the was conducted,  
157           and funding source.
- 158           2. Study design: type of study (e.g., RCT, quasi-RCT)
- 159           3. Participant details: sample size, demographic information (e.g., age and gender of  
160           participants), condition (e.g., form of dementia and/or MCI).
- 161           4. Intervention details: technology and software used, aim of the intervention, dosage  
162           and timing of the intervention, information regarding the comparator group(s).
- 163           5. Outcome details: data for primary (cognitive ability) and secondary (e.g., mood,  
164           quality of life) outcomes including pre- and post-treatment scores.



165 The first reviewer will independently extract data from all chosen studies. The second  
166 reviewer will extract data from 20% of the studies for quality assessment purposes.  
167 Discrepancies between the reviewers' extracted data will be discussed, and resolved by  
168 consensus or with the assistance of a third reviewer if necessary. We will contact study  
169 authors to obtain further information where necessary. The data will then be exported into the  
170 Review Manager (RevMan) program for further analysis [17].

171 **Assessment of risk of bias in included studies.** To assess the risk of bias of  
172 individual studies, we will use Downs and Black's checklist for the assessment of  
173 methodological quality of the included studies [18]. The checklist assesses study quality in  
174 respect to five domains—reporting biases, external validity, internal validity regarding  
175 selection bias and potential bias in measurement and outcomes, and statistical power. The  
176 checklist has demonstrated high internal consistency (K-R 20: 0.89), test-retest reliability ( $r =$   
177 0.88) and inter-rater reliability ( $r = 0.75$ ) [18]. We will report on the assessed quality of the  
178 included studies overall, and provide summaries for the five quality domains. The second  
179 reviewer will assess 20% of included studies for the purposes of quality assessment, and both  
180 reviewers will reach consensus regarding the assessment of those studies by discussion or the  
181 opinion of a third reviewer.

182 **Measures of treatment effect.** Standardised mean differences (SMDs) will be  
183 calculated for continuous data where studies report the same outcome using various  
184 measures. If studies use the same outcome measure, the mean differences (MDs) will be  
185 calculated and used as the measure of treatment effect. If necessary, scores will be modified  
186 to ensure the direction of the effect is consistent.

187 **Dealing with missing data.** If there is missing data, we will attempt to contact the  
188 authors of the studies via e-mail for further information. We will also contact study authors to

189 provide clarification if any key information regarding their studies are unclear. We will  
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3 190 indicate to any data that was provided after consultation with study authors.  
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5 191 **Data synthesis.** Studies will be meta-analysed using the RevMan software [17]. We  
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8 192 will meta-analyse studies that report our outcomes of interest, primarily cognitive ability, to  
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10 193 compare the effects of computer-based cognitive interventions with non-computer-based  
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12 194 interventions. The meta-analyses will be conducted using an inverse-variance, random-effects  
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14 195 model. We will calculate 95% confidence intervals and two-sided *p* values for each outcome.  
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16 196 We will include forest plots to display the results of the meta-analyses. Where it is not  
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18 197 appropriate to include studies in a meta-analysis, we will provide a narrative summary.  
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23 198 **Subgroup analysis.** If the data provided in the studies allows, we will also conduct  
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25 199 the following subgroup analyses:  
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- 28 200 • Pre-treatment and post-treatment scores for computer-based interventions.
- 29 201 • Type of cognitive impairment—dementia or MCI
- 30  
31 202 • Classification of computer-based cognitive intervention—i.e., cognitive  
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33 203 training, cognitive rehabilitation.  
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39 204 **Assessment of heterogeneity.** Statistical heterogeneity will be examined using the  
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41 205 chi-squared test and the I-squared statistic, and it will be examined for all studies included  
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43 206 and for all subgroups analysed. A fixed-effects model will be run for the purposes of  
44  
45 207 sensitivity analysis, and we will report relevant differences between the models.  
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49 208 **Assessment of reporting biases.** We will examine funnel plots of the included  
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51 209 studies to evaluate potential publication bias.  
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55 210 **Assessment of the quality of the evidence.** We will use the Grades of  
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57 211 Recommendation, Assessment, Development and Evaluation (GRADE) approach, as  
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212 described in the Cochrane Handbook for Systematic Reviews and Interventions to evaluate  
213 the quality of the body of evidence [19]. In accordance with GRADE guidelines, rating the  
214 quality of the body of evidence for each outcome involves consideration of limitations in  
215 study design and implementation, directness of evidence, heterogeneity/inconsistency of  
216 results, precision of results demonstrated by confidence intervals, and the probability of  
217 publication bias. A summary of evidence based on these guidelines will be provided for all  
218 meta-analysed outcomes in the review.

## 219 **Discussion**

220 The rapidly growing number of older adults worldwide is likely to result in an  
221 increase in the prevalence of neurocognitive disorders such as dementia and MCI. Computer-  
222 based cognitive interventions may be effective for improving the lives of older adults with  
223 dementia and MCI, and may be favoured over traditional interventions for their accessibility  
224 and cost-effectiveness.

225 To our knowledge, this will be the first systematic review and meta-analysis of  
226 computer-based interventions for older adults with both dementia and MCI. Observing the  
227 methods detailed in this protocol, the review will present up-to-date evidence regarding the  
228 effects of computer-based cognitive interventions for older adults with dementia and MCI.  
229 The systematic review will be reported according to the PRISMA guidelines [14] and  
230 submitted for publication to an appropriate peer-reviewed journal. The findings of the  
231 systematic review will serve as a basis for further research regarding the development of  
232 computer applications for dementia and MCI.

## 233 **Declarations**

### 234 **Ethics approval and consent to participate**

235 Not applicable.


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3 236 **Consent for publication**  
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6 237 Not applicable.  
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9 238 **Availability of data and materials**  
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12 239 Not applicable.  
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15 240 **Competing interests**  
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17 241 The authors have no competing interests.  
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25 244 **Authors' contributions**  
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28 245 All authors devised the protocol. JS wrote the manuscript with assistance from other authors.  
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31 246 All authors approved the final manuscript.  
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34 247 **Acknowledgements**  
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37 248 Not applicable.  
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