

Statistical challenges in investigating prognostic factors for memory training success in healthy older adults: A systematic review

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BACKGROUND

Even in the absence of disease, the aging process is associated with a decline in cognitive functioning, a process that may lead to a loss of autonomy and quality of life¹. Recent meta-analyses and reviews show that **cognitive training (CT) targeting memory functions** can be effective in improving quality of life, cognitive functions and especially memory in healthy older adults².

However, one question that remains underinvestigated until now is: **who benefits from memory training?** Identifying prognostic factors is highly important for providing new treatment options for stabilizing cognition and in terms of dementia prevention³.

Prognostic factors for CT intervention success that are under debate are sociodemographic variables, brain imaging parameters, genetic parameters, and blood factors, as well as personality traits, cognitive abilities at the entry of the training, and different training characteristics, e.g. intensity of the trainings⁴.

Yet, **inconsistent results** regarding prognostic factors of CT can be seen throughout the prognostic factor literature for CT benefits so far and until now, no systematic review exists. Therefore, the goal was **to investigate prognostic factors for memory training success in healthy older adults** and to report and discuss the different statistical procedures used for investigating this topic in the literature.

METHODS

PICOTS

P	Healthy older adults aged ≥ 55 years with absence of any neurological or psychiatric disease.
I	All prognostic factors assessed for memory training success .
C	No comparator factor is being considered.
O	Improvements after memory training in the domains verbal short-term memory, verbal long-term memory , as well as non-verbal short- and long-term memory operationalized with objective and standardized measurement instruments.
T	The measurement of the prognostic factor had to be done before the memory training started and all follow-up information on the outcomes (all time periods) was extracted from the studies.
S	Non-clinical settings to provide prognostic information for possibilities of prevention of cognitive decline in cognitively intact individuals.

Table 1: PICOTS system to define the systematic review research question.

Search and Study Selection

A search filter was used to search up to October 2018 in:

- MEDLINE Ovid
- Web of Science Core Collection
- CENTRAL
- PsycINFO

Reference lists of all identified trials and relevant review articles were hand searched for further literature.

Titles and abstracts were screened according to predefined eligibility criteria by two authors. Full-text articles of the studies meeting the inclusion criteria were further reviewed for inclusion.

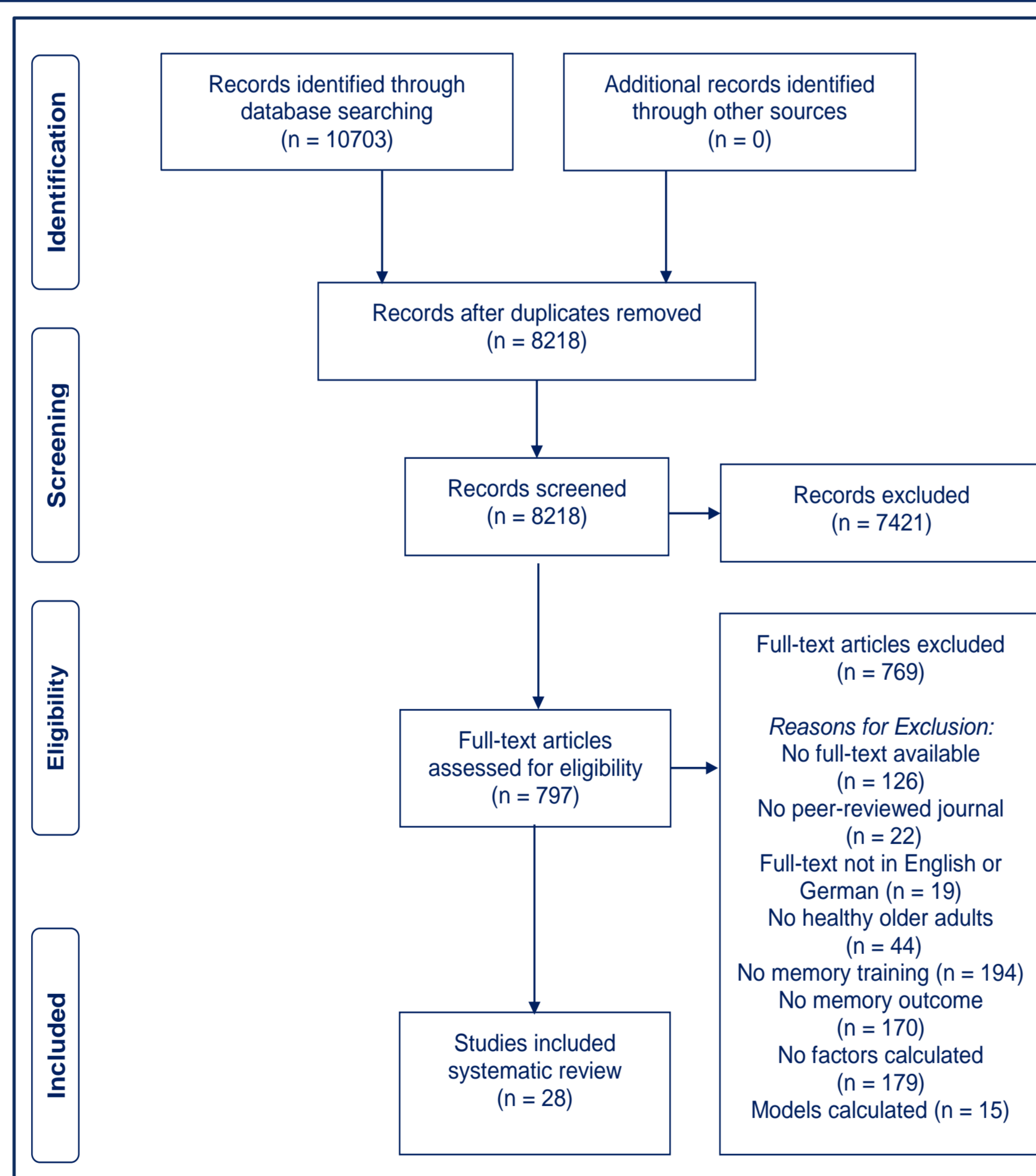


Figure 1: PRISMA flow chart.

Data Extraction and Quality Assessment

Two review authors independently extracted the data according to the **CHARMS_PF checklist**⁵. Risk of Bias was assessed using the **QUIPS checklist**⁶ to examine the Risk of Bias in six domains: Study participation, study attrition, prognostic factor measurement, outcome measurement, adjustment for other prognostic factors, statistical analyses and reporting.

DISCUSSION

This present systematic review on prognostic factors of memory improvement after memory training emphasizes the **need of elaborated prognostic factor studies** with large sample sizes, clear descriptions of prognostic factor and confounder measurement, and clear reporting standards.

Furthermore, a special focus should clearly be on the **use of the dependent**

RESULTS

Study characteristics

The sample sizes of the memory training intervention groups varied greatly between the studies, ranging from n = 10 participants to n = 531 participants. The mean age of the samples ranged from 67.8 years to 78.3 years, and education ranged from 11.9 to 18.77 years.



QR Code 1: References of included studies in the systematic review.



QR Code 2: Overview of main characteristics of the included studies.



QR Code 3: Overview of outcomes, prognostic factors and results.

Predictors and Statistical Methods

Investigated predictors include sociodemographic variables (i.e. age, sex, education, and ethnicity), brain imaging measures, genetic variables (i.e. apolipoprotein E4), personality traits, neuropsychological test status at study entry in different domains, and training characteristics.

There is a similar **pattern** that can be detected over all four outcome domains: the **tendency of the prognostic factor** (the more of x/ the less of x) is dependent on the used dependent outcome measure. This finding is substantial for the interpretation of the current literature on prognostic factors of memory training success in healthy older adults.

The **predictor age** was the predictor that was investigated in most studies. Studies that used the post-test scores as the dependent outcome measure showed that participants with lower age benefited most from the training. In contrast, studies using the change score as the dependent variable found that participants with higher age benefit most from the training.

Study	Dependent Variable	Prognostic Factor: Age More benefit caused by
Outcome: verbal short-term memory		
McDougall et al., 2010b	Relative gains	Higher Age
Neely & Bäckman, 1995	Post-test scores	Lower Age
Rosi et al., 2018	Post-test scores	Lower Age
Sandberg et al., 2016	Post-test scores	Lower Age

Table 2: Excerpt of the results of the prognostic factor "age" for success in verbal short-term memory after memory training.

Regarding the risk of bias, there is important information lacking, especially regarding the domains study attrition, prognostic factor measurement, study confounding and statistical analysis and reporting.

variables used for prognostic factor calculations. Prognostic factor research should not be an "add-on" to already existing studies, but should be a **separate focus following clear reporting** and conduction guidelines.

As a preliminary conclusion, regarding prognostic factors for memory training success, **older adults** seem to benefit more from training than younger adults.