

Cognitive Skills Model for Predicting Alzheimer's Disease

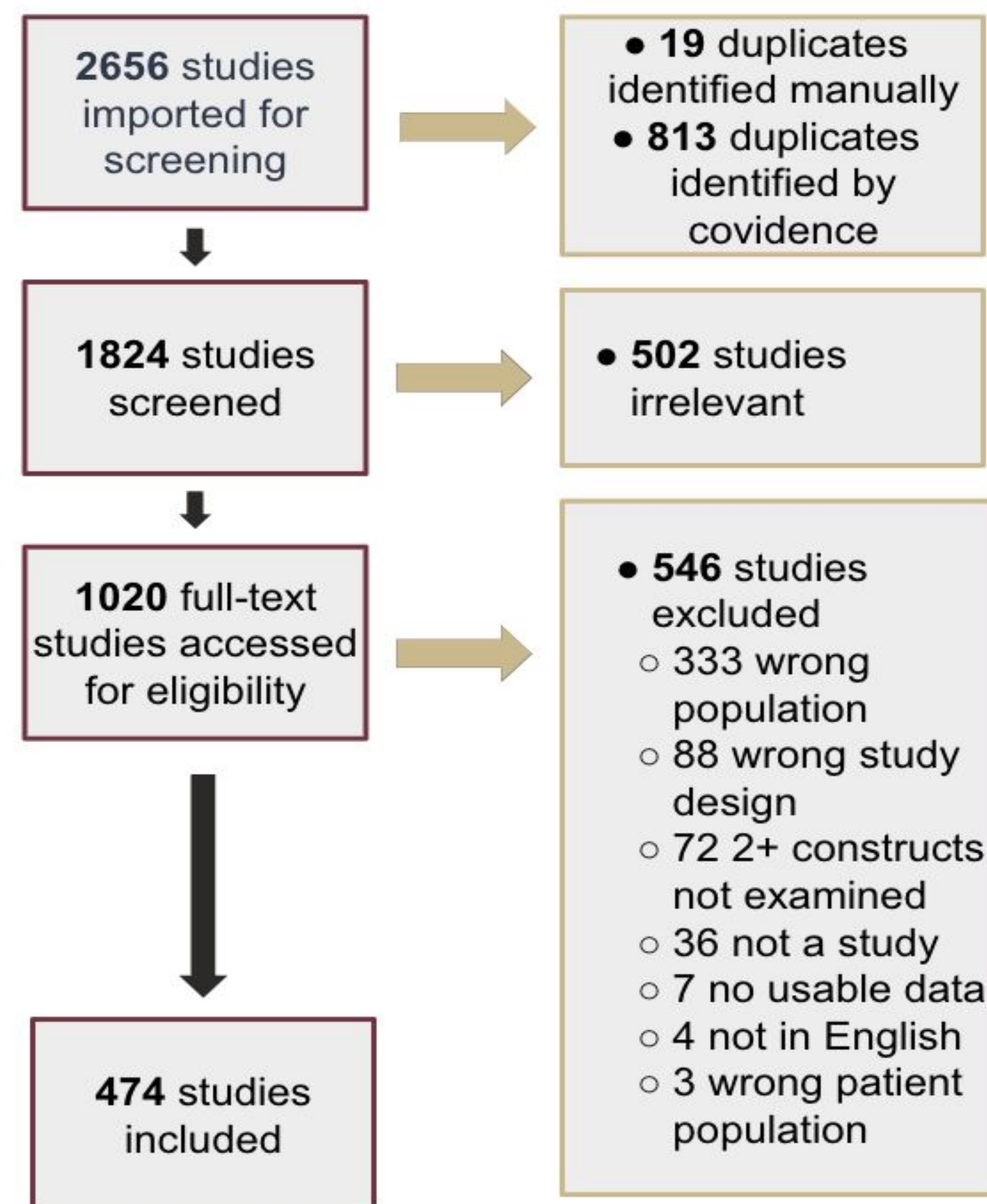
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Abstract

- Dementia is a growing global health concern, and Mild Cognitive Impairment (MCI) represents an early stage of cognitive decline with impairment present while daily independence is largely preserved
- Spatial navigation has emerged as a sensitive indicator of early cognitive change and may detect deficits beyond traditional episodic memory measures used in screening
- This meta-analysis examined differences in spatial navigation performance between cognitively healthy older adults and individuals with MCI while evaluating study- and sample-level moderators influencing outcomes
- Moderators included publication year, mean age, sex distribution, education level, MCI diagnostic criteria, task administration method, outcome measure, and spatial navigation task type
- Analysis of 138 effect sizes across 52 studies showed significantly poorer navigation performance in individuals with MCI, with a large overall effect size (Hedges' $g = 0.81$, $p < .001$) stable across sensitivity analyses despite heterogeneity
- Findings support spatial navigation measures as promising tools for early detection of cognitive decline and emphasize the need for greater standardization in cognitive assessment approaches

Introduction

- Dementia is a major global public health concern and was the seventh leading cause of death worldwide in 2021
- U.S. dementia-related care costs are projected to reach \$384 billion by 2025
- Alzheimer's disease (AD) accounts for 60–80% of dementia cases and affects ~7.2 million Americans, with prevalence expected to rise
- Mild Cognitive Impairment (MCI) represents a transitional stage between typical aging and dementia
- MCI involves cognitive decline beyond age expectations while largely preserving functional independence
- MCI may be amnesic or non-amnesic and affect single or multiple cognitive domains
- Approximately 22% of adults aged 65+ meet criteria for MCI, with 10–15% progressing to dementia annually
- Early identification supports care planning, intervention development, and understanding of disease mechanisms
- Spatial navigation is particularly vulnerable in MCI and sensitive to early AD pathology
- Navigation measures remain underused diagnostically compared to episodic memory tests
- Prior meta-analyses show navigation deficits in amnesic MCI, but comparisons with healthy aging are limited
- This study presents a meta-analysis examining relationships among spatial navigation and multiple cognitive domains in individuals with MCI to evaluate potential predictors



Methods

- Meta-analysis comparing cognitive test performance in individuals with Mild Cognitive Impairment (MCI) and healthy controls to identify associations that may improve MCI prediction
- Screening and data management conducted using Covidence following PRISMA 2020 guidelines
- Initial search imported 2,656 articles
- Title and abstract screening excluded 502 studies for irrelevance, non-empirical design, or non-human subjects
- Full-text review of 1,028 articles required assessment of ≥ 2 cognitive domains (episodic memory, working memory, executive function, attention, language) and use of correlational or group-comparison designs
- Screening resulted in 482 eligible studies for data extraction
- Standardized Covidence template used to extract study characteristics, sample sizes, MCI subtype, and means/standard deviations for individual cognitive tests
- Composite and global cognitive scores were excluded
- Articles independently coded by two reviewers with consensus review and final verification by the project mentor

Results

- Data extraction is ongoing; quantitative outcomes are not yet finalized, and analyses will use meta-analytic structural equation modeling (MASEM) to examine relationships among cognitive measures in individuals with Mild Cognitive Impairment (MCI)
- MASEM integrates findings across studies to construct a pooled correlational matrix across cognitive domains (episodic memory, working memory, executive function, attention, language, and spatial navigation), allowing evaluation of cognition as an interconnected system rather than isolated deficits
- Structural modeling will identify shared variance patterns and domain clustering to improve understanding of cognitive organization in MCI and support development of future diagnostic and predictive frameworks

Acknowledgments

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References

