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 amnestic or non-amnestic and affect single or multiple cognitive domains

• Approximately 22% of adults aged 65+ meet criteria for MCI, with 10–15% progressing to dementia annually

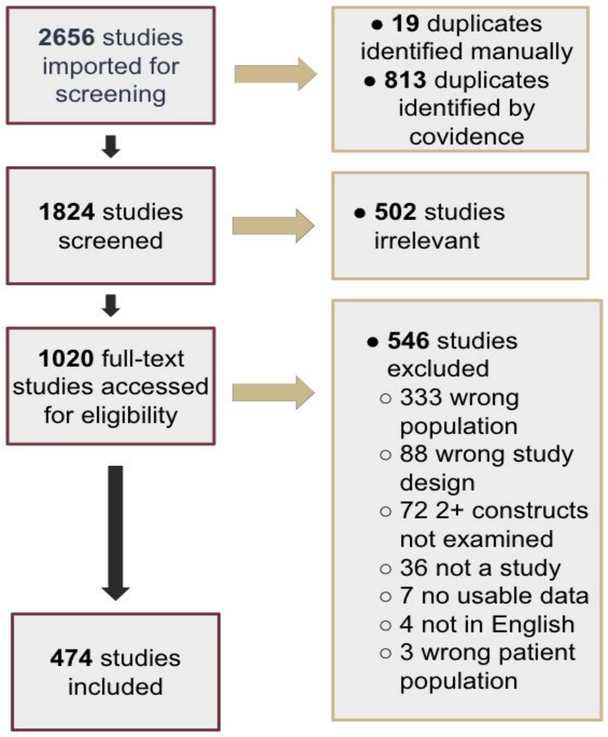
• Early identification supports care planning, intervention development, and understanding of disease mechanisms

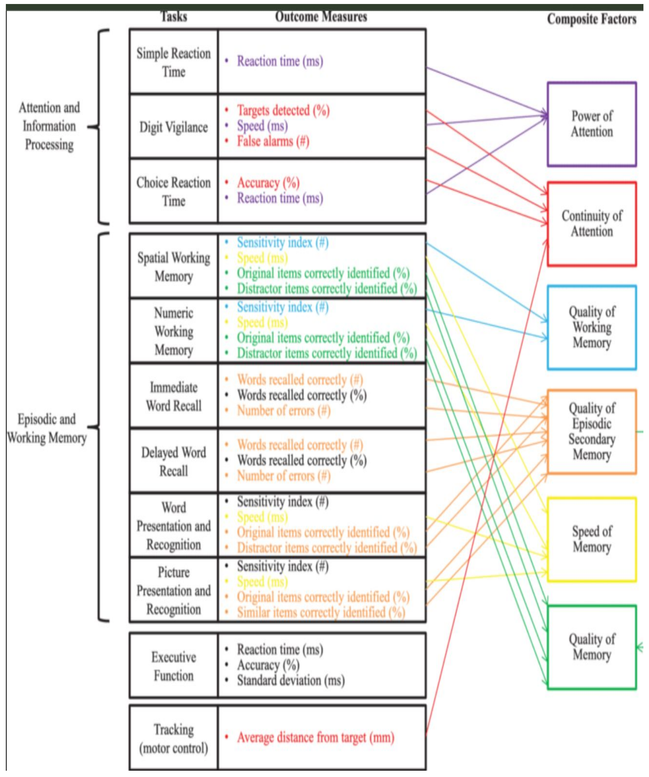
• Spatial navigation is particularly vulnerable in MCI and sensitive to early AD pathology

• Navigation measures remain underused diagnostically compared to episodic memory tests

• Prior meta-analyses show navigation deficits in amnestic 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