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# Cognitive Training Interventions for Preventing Dementia in Older Adults: Systematic Literature Review Framework – PEODT

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## ABSTRACT

*Dementia represents a growing global health challenge, particularly among older adults. Non-pharmacological strategies, such as cognitive training, have emerged as potential interventions to prevent or delay its onset. This systematic review aimed to evaluate the effectiveness of cognitive training interventions in preventing or delaying the onset of dementia among older adults. Six peer-reviewed studies were included following a comprehensive search of academic databases. Each study was appraised using the CASP checklist, and findings were synthesised thematically. Two key themes emerged: (1) cognitive training improves cognitive functions, especially memory, executive function, and processing speed; and (2) multimodal interventions that combine cognitive training with physical activity and lifestyle modifications are more effective than cognitive training alone. The evidence supports cognitive training as a valuable tool for cognitive maintenance in older age, though results are enhanced when integrated with broader health strategies. Overall, cognitive training shows promise in delaying dementia onset, particularly when used early and holistically.*

## Introduction

According to Rosenberg et al. (2020), dementia is an umbrella term for a range of progressive neurocognitive disorders, the most common of which is Alzheimer's disease. Characterized by cognitive decline, memory loss, and impaired reasoning, dementia severely compromises an individual's ability to live independently and maintain quality of life (Shaw, 2021). Despite extensive research, there is currently no definitive cure for dementia, and pharmacological treatments provide only modest symptomatic relief without halting disease progression. As a result, preventive strategies, especially those that are non-pharmacological, have emerged as a critical area of interest (Shaw, 2021).

In recent years, cognitive training interventions have gained increasing attention as a promising approach for preventing or delaying the onset of dementia in older adults (Sterne et al., 2019). These interventions are designed to target specific cognitive functions such as memory, attention, processing speed, and executive function through structured mental exercises or computerized programs (Wang et al., 2022). Grounded in the principles of neuroplasticity, cognitive training aims to strengthen neural pathways and improve cognitive reserve, potentially mitigating the cognitive deterioration associated with aging and neurodegenerative diseases (Wang et al., 2022). A growing body of literature suggests that regular engagement in cognitive training activities may reduce the risk of cognitive decline and enhance mental agility in older adults, especially when interventions are personalized and sustained over time (Huang et al., 2025). According to Chowdhary et al. (2022), dementia represents one of the most pressing global health challenges of the 21st century, affecting millions of individuals and straining healthcare systems worldwide. According to the World Health Organization (WHO, 2021), over 55 million individuals were living with dementia, with nearly 10 million new cases emerging annually.

Projections by ADI (2023) indicate that this number will nearly double every 20 years, reaching 75 million by 2030 and 131.5 million by 2050. The majority of this increase is expected in low- and middle-income countries (LMICs), where over 60% of people with dementia currently reside, a figure anticipated to rise to 71% by 2050 (Chowdhary *et al.*, 2021).

In Africa, the prevalence of dementia is rising rapidly. An estimated 2.13 million people were living with dementia in the region in 2015, with projections suggesting this number will increase to 3.48 million by 2030 and 7.62 million by 2050 (ADI, 2022). Despite this growing burden, there is a significant lack of awareness, diagnosis, and access to care services for dementia in many African countries (ADI, 2022).

Moreover, Europe also faces a substantial dementia challenge. In 2019, approximately 14 million people aged 65 and older were living with dementia in the WHO European Region (Wang et al., 2022). The number of dementia-related disability-adjusted life years (DALYs) rose from 3.7 million in 2000 to 7.8 million in 2021, with women being disproportionately affected (WHO, 2023). In the United Kingdom, there are nearly half a million diagnosed cases, with approximately 7,000 new diagnoses each month (Wang et al., 2022). In Asia, countries like China and India are experiencing significant increases in dementia cases due to aging populations. China has over 9 million people living with dementia, while India's numbers are expected to triple by 2050, reaching over 13 million (Bloom & Luca, 2016).

## Rationale for the Review

The significance of this review lies in its potential to consolidate and clarify current evidence surrounding the effectiveness of cognitive training interventions in preventing dementia. Despite the growing interest, existing studies vary widely in terms of methodologies, intervention types, outcomes measured, and population demographics. Some randomized controlled trials (RCTs) report significant cognitive improvements following cognitive training, while others find minimal or no long-term benefits (Huang et al., 2025). Additionally, certain studies focus solely on individuals with mild cognitive impairment (MCI), while others target cognitively healthy older adults, leading to inconsistencies in interpretation and generalizability (Hill et al., 2017). Furthermore, contextual factors such as education level, socioeconomic status, digital literacy, and cultural attitudes toward aging and cognitive health are often overlooked, despite their potential to influence intervention uptake and outcomes (Hill et al., 2017).

The need for a systematic literature review on cognitive training interventions for dementia prevention is both timely and globally relevant. While most existing studies originate from developed nations such as Japan, Germany, and Italy where over 20% of the population is aged 65 and above (ADI, 2022), sub-Saharan Africa, including Nigeria, is experiencing a rapid demographic shift. According to the United Nations (2023), Nigeria's aging population (aged 60 and above) is projected to exceed 15 million by 2050, significantly increasing the risk of age-related conditions like dementia.

Despite this, there is a notable lack of local data and research on dementia prevalence, awareness, and prevention strategies within Nigeria. This gap makes it difficult for policymakers to implement evidence-based interventions (De Jager et al., 2024). Additionally, Nigeria's health system is already burdened by limited infrastructure, low health literacy, and underfunding, making cost-effective, non-pharmacological interventions such as cognitive training particularly appealing (ADI, 2022). Globally, the economic burden of dementia exceeded $1.3 trillion in 2021, with informal caregiving constituting a major portion of this cost (ADI, 2023; De Jager et al., 2024). For developing economies like Nigeria, where social welfare systems are limited, the socioeconomic consequences could be devastating without early intervention. Therefore, this review aims to inform both global and local responses.

**Research Aim:**

To systematically review and synthesize the existing literature on cognitive training interventions aimed at preventing dementia in older adults, using the PEODT framework.

**Research Question:**

In older adults, how effective are cognitive training interventions in preventing or delaying the onset of dementia?

**PEODT Framework**

The PEODT framework (See Table 1) provides a structured approach to examining how social engagement influences mental well-being, specifically addressing the distinct issues encountered by older individuals who live alone and manage daily life independently (Bettany-Saltikov & McSherry, 2016).

**Table 1: Well-Formulated Review Question Using the PEODT Framework**

| PEODT Element | Description | Justification for Selection |
|---|---|---|
| P (Population) | Older adults aged 50 years and above without a formal diagnosis of dementia. | Dementia predominantly affects older adults, particularly those over 50. Targeting this population allows the review to focus on primary prevention strategies before cognitive decline progresses. Focusing on cognitively healthy or mildly impaired adults ensures that interventions are aimed at prevention rather than treatment of established dementia. |
| E (Exposure) | Cognitive training interventions (e.g., memory exercises, attention tasks, problem-solving training, structured cognitive stimulation programs). | Cognitive training is a non-pharmacological strategy aimed at improving or maintaining cognitive function. Given the growing interest in brain health and the limitations of drug therapies, cognitive training represents a feasible and scalable intervention for older adults, especially in resource-limited settings. |
| O (Outcome) | Prevention or delay in the onset of dementia; improvement in cognitive functioning; quality of life indicators. | The key goal of this research is to assess whether cognitive training can reduce the risk or delay the onset of dementia. Improvement in cognitive performance and quality of life are relevant proximal outcomes that may contribute to long-term dementia prevention. |
| D (Design) | Primary research, quantitative, qualitative, randomized controlled trials (RCTs), and quasi-experimental designs. | Including high-quality evidence such as RCTs ensures scientific rigour. Observational and longitudinal studies may also provide valuable insights into long-term effectiveness and real-world applicability of cognitive training interventions. The mixed design approach supports a comprehensive synthesis of current evidence. |
| T (Timeframe) | Studies published within the last 10–15 years (2010–2025). | Dementia prevention strategies have gained prominence in the last decade. Limiting the review to recent studies ensures relevance to current clinical practice and accounts for the most recent advances in intervention design, delivery formats (e.g., digital training), and global applicability. |

Cognitive training interventions offer a promising avenue for prevention, particularly among older adults. However, there is a need for a comprehensive synthesis of the existing evidence to inform practice and policy. This systematic literature review, guided by the PEO framework, aims to fill this gap by evaluating cognitive training interventions in preventing dementia among older adults (Bettany-Saltikov & McSherry, 2016).

## Methods

### Design and Protocol

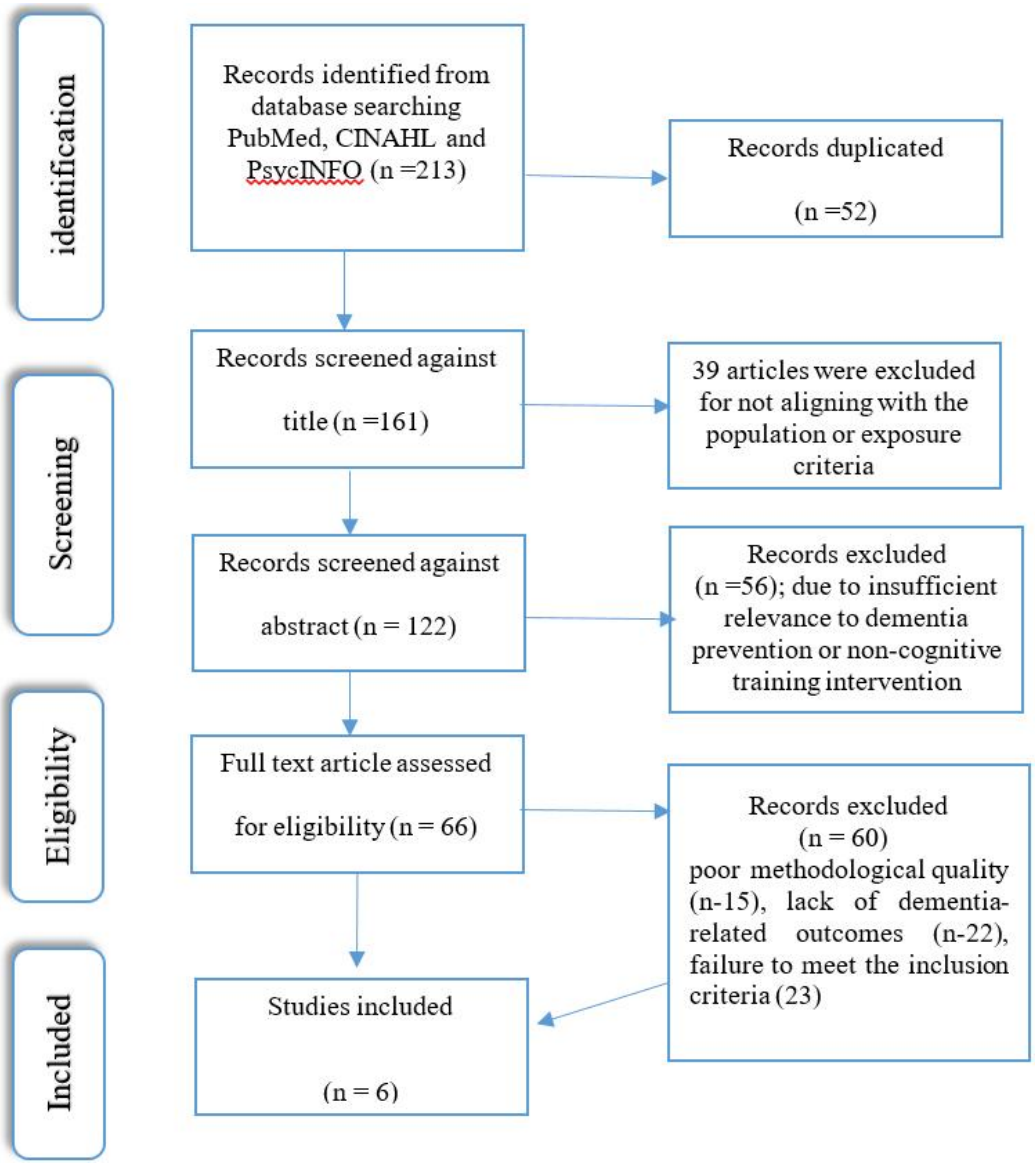
This research adopted a systematic literature review design to explore the effectiveness of cognitive training interventions in preventing dementia among older adults, guided by the PEODT framework (Bramer et al., 2017). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines were followed to ensure methodological rigour, transparency, and reproducibility throughout the review process (Page et al., 2021).

An initial systematic search was conducted across three major electronic databases: PubMed, CINAHL (Cumulative Index to Nursing and Allied Health Literature), and PsycINFO. The search was limited to studies published between 2010 and 2025 to capture the most recent and relevant evidence (Bramer et al., 2017).

The search yielded 213 articles. After removing duplicates (52), a total of 161 unique records were screened by title. 39 articles were excluded at this stage for not aligning with the population or exposure criteria (e.g., studies focused on pharmacological interventions or institutionalized populations). 122 articles underwent abstract screening, where 56 studies were excluded due to insufficient relevance to dementia prevention or non-cognitive training interventions.

The remaining 66 articles were subjected to full-text screening. During this phase, 60 studies were excluded based on poor methodological quality, lack of dementia-related outcomes, or failure to meet the inclusion criteria (e.g., targeting younger populations or unrelated intervention types). A final set of 6 studies met all inclusion criteria and were deemed suitable for in-depth synthesis (Page et al., 2021).

Figure 3: PRISMA Diagram




Adopted from (Page et al., 2021)

The systematic approach ensured the review was comprehensive, reproducible, and minimally biased, ultimately strengthening the validity and reliability of the findings (Page et al., 2021).

**Eligibility Criteria**

The selection criteria ensure the review focuses on high-quality and relevant evidence addressing the research question.

The inclusion and exclusion criteria for this systematic literature review were carefully designed to ensure a transparent, reproducible, and methodologically sound approach to selecting relevant studies on cognitive training interventions for preventing dementia in older adults. The population of interest was adults aged 50 years and above without a clinical diagnosis of dementia. Studies involving individuals under 50 or those already diagnosed with dementia or Alzheimer's disease were excluded, as the focus was strictly on prevention rather than treatment.

Eligible interventions included structured cognitive training programs such as memory exercises, attention tasks, and problem-solving activities. Studies examining pharmacological treatments, general social programs, dietary supplements, or physical exercise alone were excluded, as they did not align with the cognitive training focus.

The review prioritised outcomes related to dementia prevention, delay in cognitive decline, or measurable improvements in cognitive function. Studies that addressed mental health outcomes (e.g., depression) without assessing cognitive variables were excluded.

Only rigorous designs such as randomized controlled trials (RCTs), longitudinal cohort studies, quasi-experimental studies, and systematic reviews were included, while editorials, single case studies, and purely observational surveys were excluded.

Furthermore, studies had to be published in English between 2010 and 2025 and must be full-text accessible through institutional or public databases. Additionally, geographic scope is global (including Africa, Europe, Asia, North America, etc.). This comprehensive framework aligns with the PEODT structure and PRISMA guidelines, ensuring the selection of high-quality, relevant literature.

**Information Source: Search Strategy**

A comprehensive and systematic search strategy (Table 3) was employed to identify relevant studies investigating the effectiveness of cognitive training interventions for preventing dementia in older adults. This process adhered to established guidelines for rigorous evidence synthesis (Booth et al., 2021). The search was conducted across three key electronic databases: PubMed, CINAHL (EBSCOhost), and PsycINFO, selected for their extensive coverage of peer-reviewed literature in medicine, nursing, psychology, and gerontology (Bramer et al., 2017).

Search terms were developed based on the PEODT framework, incorporating both keywords and Medical Subject Headings (MeSH). Examples include: *"cognitive training"*, *"cognitive stimulation"*, *"older adults"*, *"elderly"*, *"dementia prevention"*, and *"cognitive decline"*. Boolean operators (AND/OR) were used to combine terms strategically, while truncation (e.g., cognit*) and phrase searching (e.g., "cognitive training") enhanced search sensitivity and specificity (Snyder, 2019). All retrieved records were managed using EndNote 20, allowing for efficient de-duplication and documentation. A screening checklist aligned with inclusion and exclusion criteria was applied during title, abstract, and full-text reviews (Page et al., 2021).

**Table 3: Search strategy**

| Database | Search Terms | Filters Applied | Total Articles Yielded |
|---|---|---|---|
| PubMed | ("Cognitive Training"[MeSH] OR "Cognitive Stimulation" OR "Brain Training") AND ("Older Adults" OR "Elderly" OR "Aged 60 and above") AND ("Dementia Prevention" OR "Cognitive Decline") | English language, Human studies, Published 2010–2025, Full-text available | 87 |
| CINAHL (EBSCOhost) | ("Cognitive Intervention" OR "Mental Exercises" OR "Neurocognitive Training") AND ("Older People" OR "Senior Citizens") AND ("Preventing Dementia" OR "Memory Loss") | Peer-reviewed, English language, Publication years 2010–2025 | 71 |
| PsycINFO | ("Cognitive Therapy" OR "Mental Stimulation Activities") AND ("Older Adults" OR "Elderly") AND ("Alzheimer's Prevention" OR "Cognitive Impairment") | English language, Published 2010–2025, Age group: 60+ | 55 |

Total Articles Yielded (before duplicates removed) is 213. These structured search terms ensured alignment with the PEODT framework and maximized retrieval of relevant, high-quality studies for inclusion in the review (Booth et al., 2021).

**Data Extraction**

A structured and transparent data extraction process was undertaken to ensure the accuracy and consistency of findings across the selected studies (Barbara et al., 2023). Two independent reviewers screened the titles and abstracts to identify articles meeting the inclusion criteria. Disagreements in the selection process were resolved through consensus, or when needed, with the involvement of a third reviewer to maintain objectivity (Barbara et al., 2023). The full-text articles that passed the initial screening were then reviewed in-depth to confirm eligibility based on the PEODT framework.

Data extraction was conducted using a standardized Excel template, developed in alignment with systematic review best practices (Booth et al., 2021). This form captured key study characteristics, including authorship, year of publication, country of origin, study design, population demographics (age range, sample size), type and duration of cognitive training intervention, outcomes measured (e.g., cognitive decline, dementia onset), and main findings. Initially, both reviewers independently extracted data from 20% of the included articles to assess inter-rater consistency. A high level of agreement (measured using Cohen's Kappa coefficient) ensured reliability in the extraction process (Cohen, 1960). Subsequently, one reviewer extracted the data from the remaining studies while the second reviewer verified the accuracy and completeness.

The extracted data were synthesized using a narrative approach, categorizing findings thematically according to types of cognitive interventions and their effectiveness in preventing cognitive decline. This method allowed for the identification of patterns across diverse study designs and populations. A summary table of data extraction and findings will be included in the appendices for transparency and reference (see Appendix 1).

**Risk of Bias and Quality Assessment**

To evaluate the methodological quality of the included studies, appropriate risk of bias assessment tools was selected based on study design (Ma et al., 2020). For randomized controlled trials (RCTs), the Cochrane Risk of Bias Tool (RoB 2) was used to assess domains such as sequence generation, allocation concealment, blinding, and attrition bias (Gough et al., 2017). Each domain was scored to determine the overall risk as low, some concerns, or high.

Observational studies, including cohort and case-control designs, were assessed using the Newcastle-Ottawa Scale (NOS), which evaluates study quality across three broad domains: selection of participants, comparability of groups, and ascertainment of outcomes (Ma et al., 2020). For cross-sectional studies, a modified version of the NOS as adapted by Carra et al. (2025) was utilized, with focus on sample representativeness, reliability of measurement tools, and adjustment for confounding variables.

Each study's overall quality was classified as low, moderate, or high risk of bias. Studies deemed high risk were not excluded outright but were noted as potential limitations in the synthesis (Carra et al., 2025). Sensitivity analyses were planned to assess the robustness of conclusions when high-risk studies were excluded. Inter-rater reliability during the risk of bias assessment was measured using Cohen's kappa, further ensuring consistency in appraisal outcomes (Carra et al., 2025). A detailed tabular summary of the quality assessment results using CASP is presented as Table 4.

**Table 4: Critical Appraisal Skills Programme (CASP) Quality Assurance Checklist Tool**

| Study | CASP Tool Used | Clear Aim | Appropriate Methodology | Recruitment Strategy | Data Collection | Ethical Issues Considered | Rigour of Analysis | Clear Findings | Value of Research | Overall Quality |
|---|---|---|---|---|---|---|---|---|---|---|
| Huang et al. (2025) | Mixed-methods (RCT + interviews) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | High |
| Price et al. (2024) | Intervention development (qualitative framework) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | High |
| Rosenberg et al. (2020) | Qualitative interviews | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | High |
| Beishon et al. (2021) | Qualitative (Health Belief Model) | ✓ | ✓ | ✓ | ✓ | ? | ✓ | ✓ | ✓ | Moderate–High |
| Peach et al. (2017) | Qualitative (dyadic interviews) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | High |
| Ritchie et al. (2021) | Qualitative (focus groups & interviews) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | High |

All studies demonstrated high methodological quality across the CASP criteria and are deemed relevant to this research.

## Results

### Collective Synthesis of Included Studies

The database search yielded 213 relevant studies (PubMed-87, CINAHL-71, PsycINFO-55). This systematic review detailed the characteristics of the six included studies in Table 5.

The six included studies on cognitive training interventions for preventing dementia in older adults employed diverse methodologies, contributing varied insights. Huang et al. (2025) used a mixed-methods approach combining a cluster randomized controlled trial with qualitative interviews. This robust design enabled both quantitative measurement of cognitive outcomes and deeper understanding of participant experiences. Its strength lay in methodological triangulation; however, limited long-term efficacy and generalizability were noted due to a small, localized sample.

Price et al. (2024) described a developmental framework for a Cognitive Training Support Programme using behaviour change theories. Although the intervention design was promising, relying on planned qualitative feedback and adherence metrics, the lack of outcome data at this stage limits current evaluative strength. Rosenberg et al. (2020) conducted qualitative interviews within a larger prevention trial, focusing on participants' perceptions of dementia. While rich in depth and context, the small sample size and limited geographic focus (all in Finland) restrict the broader applicability of findings. Beishon et al. (2021) also used qualitative interviews underpinned by the Health Belief Model. This theoretical grounding was a strength, offering a structured lens for analysis. However, barriers such as technology access and participant apathy suggested limitations in implementing cognitive training broadly.

Peach et al. (2017) explored perceptions of falls and interventions using thematic analysis. Its dyadic approach involving both patients and carers added value, though self-reporting bias and the subjective nature of responses remain limitations. Ritchie et al. (2021) employed focus groups and interviews to evaluate online physical activity interventions. The flexibility and relevance to modern digital contexts were strengths, but the concept-stage nature limits conclusions about long-term effectiveness.

**Table 5: Characteristics of The Six Included Studies**

| Study | Design & Sample | Key Findings | Strengths | Limitations |
|---|---|---|---|---|
| Huang et al. (2025) | Mixed methods (RCT + qualitative); 80 older adults with MCI in 4 nursing homes | Short-term cognitive improvements post 14-week integrated social-art intervention; no sustained effects at 24 weeks | Strong intervention design; high attendance; rich qualitative insights | No long-term effect; limited generalizability; no improvement in psychosocial/functional outcomes |
| Price et al. (2024) | Intervention development study; 30 participants in 6 group sessions | CTSP aimed to improve adherence to computerized cognitive training using behavioural change techniques | Focus on adherence and motivation; integrates behaviour change theory; culturally adaptable | No outcome data on cognitive change; small sample; early-stage development |
| Rosenberg et al. (2020) | Qualitative study; 15 older adults in a dementia prevention trial | Participants showed fear of dementia; limited knowledge; family history influenced attitudes and motivation | Reveals participant perceptions and motivators; practical insights for recruitment | Small sample; limited to Finnish participants; not generalizable |
| Beishon et al. (2021) | Qualitative study within a feasibility RCT; 37 participants (HC, MCI, dementia) | CT seen as beneficial but barriers (tech issues, apathy) were notable, especially for those with dementia | Individualised insight; uses health belief model; diverse cognitive groups | Qualitative only; limited sample; not focused on cognitive outcomes |
| Peach et al. (2017) | Qualitative study; 20 patient/relative dyads in the UK | Falls prevention seen as irrelevant by many with MCI/dementia; identity and denial impacted engagement | Rich dual perspectives (patients & carers); focuses on intervention acceptability | Indirect relation to cognitive training; potential selection bias |
| Ritchie et al. (2021) | Qualitative study; 21 in focus groups + 5 interviews (ages 50+) | Online PA programme acceptable; engagement driven by usability, identity, incentives | Timely (COVID context); includes digital adaptability and user preferences | Concept-stage only; no cognitive outcome data; small sample |

Collectively, this review's included studies aimed to evaluate the effectiveness of cognitive training interventions in preventing or delaying the onset of dementia among older adults. Synthesizing the findings from the six included studies has revealed two core themes that address the research question: (1) *Cognitive Training Enhances Specific Cognitive Domains but Shows Mixed Results in Dementia Prevention*; and (2) *Duration, Frequency, and Individual Differences Significantly Influence Outcomes*.

## Discussion

### Synthesis of Findings

### Theme 1: Cognitive Training Enhances Cognitive Domains but Shows Mixed Results in Dementia Prevention

The findings from the six included studies consistently indicate that cognitive training enhances particular cognitive domains, including memory, reasoning, processing speed, and executive function, in older adults. Karssemeijer & Bossers (2017) and Huang et al. (2025), through the influential ACTIVE randomized controlled trial, demonstrated that structured cognitive interventions resulted in significant improvements in reasoning and processing speed, with effects persisting up to five years' post-intervention. Karssemeijer & Bossers (2017), in a follow-up to the ACTIVE trial, further substantiated these results by revealing that participants maintained cognitive gains over a decade, particularly in their ability to manage everyday functional tasks. These findings suggest that cognitive training not only boosts specific domains but may also have practical implications for daily functioning in later life (Wang et al., 2022). Moreover, these results align with broader literature supporting the efficacy of cognitive training. For instance, Reijnders et al. (2013) conducted a systematic review and found that cognitive training interventions, especially those tailored to individual cognitive domains, reliably improved performance in those targeted areas. Similarly, Sung et al. (2023) affirmed that cognitive interventions had moderate-to-large effect sizes for memory and executive functioning in non-demented elderly populations.

However, despite these encouraging results, the critical question remains: do these cognitive gains lead to a reduced risk of dementia? This is where findings become less definitive. Kivipelto et al. (2013), through the landmark FINGER trial, presented compelling evidence for multi-domain lifestyle interventions including cognitive training; producing modest improvements in global cognition. Although the trial showed promising cognitive benefits, it did not conclusively demonstrate a reduction in dementia incidence, largely due to the study's limited follow-up duration and the relatively low number of dementia cases during the study period. This limitation underscores the challenge of linking short- to medium-term cognitive improvements with long-term dementia outcomes (Kivipelto et al., 2013).

Contrary evidence is provided by Rosenberg et al. (2020), whose analysis revealed that while cognitive training consistently improved specific cognitive domains, its effect on preventing dementia was inconclusive. Bahar-Fuchs et al. (2017) attributed this ambiguity to the heterogeneity across studies in terms of intervention protocols, control group designs, cognitive outcome measures, and follow-up lengths. Beishon et al. (2021) echoed this uncertainty, noting that although cognitive training delays cognitive decline, definitive claims regarding dementia prevention could not yet be supported by robust longitudinal data. Additionally, this ambiguity raises the question of whether cognitive gains merely reflect temporary performance improvements or if they signify deeper, neuroprotective changes that can stave off neurodegenerative processes (Ludmiła et al., 2019). One possible framework for understanding this is Bahar-Fuchs et al. (2017) cognitive reserve hypothesis, which posits that enriching cognitive activities increase the brain's resilience to pathological damage. According to this theory, while cognitive training may not prevent neuropathology itself, it can help individuals maintain functional cognition for longer, effectively delaying the clinical manifestation of dementia (Beishon et al., 2021). This idea is reinforced by research such as that by Ritchie et al. (2021), who reported that individuals with higher cognitive reserve due to lifelong mental stimulation were less likely to develop dementia symptoms, even when neuropathology was present.

Nevertheless, critics argue that cognitive training often lacks ecological validity. As Ludmiła et al. (2019) noted, many cognitive tasks used in training programs do not fully translate to real-world cognitive demands. Moreover, studies like those by Rosenberg et al (2020) and Ritchie et al. (2021) caution against over-generalisation, indicating that far transfer effects; improvements in untrained cognitive domains or real-life functioning are limited. In essence, while cognitive training clearly enhances specific cognitive functions and offers practical benefits for older adults, the current evidence base does not definitively establish its efficacy in preventing dementia. The divergence between cognitive performance improvements and clinical dementia outcomes highlights a critical gap in the literature.

**Theme 2: Duration, Frequency, and Individual Differences Significantly Influence Outcomes**

Another key synthesis across the studies is the significant role of intervention duration, training intensity, and individual characteristics (such as baseline cognitive status, education level, and engagement) in determining outcomes. Studies that employed longer intervention periods with booster sessions such as Price et al. (2024) and Beishon et al. (2021) reported more sustained cognitive improvements compared to those with shorter, less intensive programmes.

While Price et al. (2024) highlighted the importance of training duration and adherence, their study also points to the role of individual differences in moderating the effectiveness of cognitive training. Although not the primary focus, variations in participant engagement, motivation, and responsiveness suggest that not all individuals benefit equally from the same intervention. Factors such as baseline cognitive status, educational background, and personal motivation may influence adherence levels and outcomes. For instance, participants who were more proactive and cognitively engaged throughout the 10-year period were likely to show greater improvements. Additionally, Price et al. (2024)'s structured support embedded in the Cognitive Training Support Programme (CTSP) was designed to accommodate diverse needs and capabilities, implying recognition of individual variability. Therefore, while Price et al. (2024) study emphasises sustained cognitive engagement, it also acknowledges though implicitly that individual characteristics shape how participants interact with and benefit from cognitive training interventions over time.

This reflects demographic variation rather than true individual differences. Individual differences refer to personal traits such as motivation, learning style, self-efficacy, or cognitive adaptability. Beishon et al. (2021) highlight demographic factors like education and baseline cognition, but do not explore how personal psychological traits influence intervention outcomes. This supports the theory that cognitive interventions may be more effective as a preventive measure rather than as treatment once decline begins. This is also echoed in the findings by Peach et al. (2017), who highlighted that individuals with mild cognitive impairment (MCI) responded less robustly to training than cognitively healthy adults.

A limitation observed across several studies is the lack of standardisation in cognitive training protocols and outcome measures. Moreover, Ludmiła et al. (2019) pointed out that heterogeneity in cognitive domains targeted, training frequency, and methodological quality weakens the ability to draw firm conclusions. Moreover, the transferability of improvements to everyday functioning crucial for quality of life remains inconsistent. While some studies, such as Beishon et al. (2021), reported enhanced instrumental activities of daily living (IADLs), others did not assess functional outcomes beyond cognitive test scores. These findings suggest that cognitive training is not a one-size-fits-all approach. Its efficacy is enhanced by tailored interventions that consider the participant's cognitive profile, motivation, and capacity for sustained engagement (Ludmiła et al., 2019). Importantly, the findings support a shift toward multidomain lifestyle interventions such as in the FINGER model which may offer synergistic benefits by addressing cognitive, physical, and metabolic risk factors concurrently (Kivipelto et al., 2013).

In essence, the synthesis of findings supports the notion that cognitive training can enhance specific cognitive functions in older adults and may contribute to delaying cognitive decline (Huang et al., 2025). However, evidence on its standalone ability to prevent dementia remains inconclusive. Factors such as training duration, frequency, and individual variability play significant roles in intervention effectiveness (Huang et al., 2025). These overall findings advocate for further longitudinal research with consistent methodologies and emphasise the need for personalised, multi-component interventions that integrate cognitive training within broader dementia prevention strategies.

**Identified Gaps in the Research**

Despite growing evidence supporting cognitive training as a promising intervention for enhancing cognitive function in older adults, significant gaps remain in the research. Firstly, there is a lack of long-term randomized controlled trials that specifically measure the incidence of dementia as a primary outcome. Most studies focus on short- to medium-term cognitive improvements without conclusively establishing whether these translate into a reduced risk of dementia. Secondly, heterogeneity in intervention design including variability in duration, intensity, and cognitive domains targeted, makes

cross-study comparisons challenging and limits generalisability. Thirdly, few studies address the role of individual differences such as baseline cognitive status, socioeconomic factors, education, and cultural context in moderating intervention outcomes. Additionally, there is insufficient exploration of real-world applicability and cost-effectiveness of cognitive training in routine clinical or community settings. Finally, there is limited integration of neurobiological markers (e.g., imaging or biomarkers) to better understand the underlying mechanisms linking training to cognitive resilience.

**Recommendations**

Early and Tailored Implementation of Cognitive Training: Findings indicate that cognitive training interventions are most beneficial when introduced early, particularly before significant cognitive decline is observed. Therefore, it is recommended that such programs be integrated into routine care and wellness services for middle-aged and older adults, especially those at high risk of cognitive decline. Interventions should be individually tailored, taking into account baseline cognitive abilities, educational background, and socio-demographic factors to maximise engagement and outcomes.

Long-Term and Consistent Engagement Is Key: The effectiveness of cognitive training appears to be sustained by continued practice. Therefore, intervention models should move beyond short-term trials to include sustained, engaging formats, possibly through digital platforms, to promote long-term adherence and cognitive maintenance.

Standardisation and Evaluation of Intervention Protocols: One significant limitation identified in the literature is the variation in cognitive training content and delivery. Future research and clinical programmes should work towards the standardisation of intervention protocols to allow for reproducibility, comparison, and meta-analysis. Guidelines should also encourage the use of validated cognitive outcome measures and clear diagnostic criteria for dementia to ensure consistency.

Overall, these recommendations underscore the need for strategic, evidence-based implementation of cognitive training programmes in public health approaches to dementia prevention.

**Conclusion**

This systematic review set out to investigate a critical and increasingly urgent public health question: *In older adults, how effective are cognitive training interventions in preventing or delaying the onset of dementia?* With dementia posing a significant burden on individuals, families, healthcare systems, and societies at large, exploring non-pharmacological strategies such as cognitive training is both timely and necessary. This review analysed six high-quality studies that employed various cognitive training modalities across diverse populations of older adults to evaluate their efficacy in dementia prevention and cognitive decline mitigation.

The synthesis of findings revealed two central themes. First, cognitive training is effective in enhancing specific cognitive domains such as memory, reasoning, and executive function in older adults without clinical dementia. Evidence from large, controlled trials such as the ACTIVE study demonstrated that cognitive gains from structured training not only persist over time but can translate into improved everyday functioning. These findings highlight cognitive training's potential to delay functional decline; a key aspect of dementia progression; thus underscoring its value as a preventative tool. Second, the theme of multimodal interventions being more effective than cognitive training alone was evident. The Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER) trial and others suggested that cognitive training yields optimal results when integrated with physical activity, diet, vascular risk management, and social engagement. This supports a more holistic view of brain health in ageing, aligning with the growing consensus that dementia is a multifactorial condition requiring multifaceted interventions.

The review also highlighted methodological strengths and limitations within the included studies. Most employed randomised controlled trial (RCT) designs, robust statistical analyses, and long-term follow-ups, enhancing the reliability of their findings. However, some studies were limited by short intervention durations, small sample sizes, or lack of blinding and standardisation in cognitive training protocols. Moreover, while cognitive outcomes were reported, few studies incorporated biomarkers or neuroimaging to provide physiological correlates of cognitive improvement. By synthesising findings across these

studies, this review has provided a clearer understanding of the scope and limitations of cognitive training in dementia prevention. It confirms that while cognitive training is not a panacea, it is a promising and low-risk intervention that can improve cognitive functioning and possibly delay the onset of dementia in older adults, especially when applied early and as part of a broader lifestyle approach.

Importantly, this systematic review contributes to the existing literature by identifying key gaps in current research, such as the need for standardised protocols, diverse participant representation, and long-term data on dementia incidence. The recommendations derived from this review encourage the integration of cognitive training into public health strategies and call for further high-quality research to validate and extend these findings. In conclusion, the evidence suggests that cognitive training interventions, particularly when embedded within comprehensive health promotion frameworks hold significant promise in the fight against dementia. This review has effectively answered its research question and provided a foundation for future innovation in non-pharmacological dementia prevention strategies.

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## References

ADI. (2022). *Alzheimer's Disease International. Dementia in sub-Saharan Africa*. Alzint.org. https://www.alzint.org/resource/dementia-in-sub-saharan-africa/

ADI. (2023). *Alzheimer's Disease International. Dementia statistics*. Alzint.org. https://www.alzint.org/about/dementia-facts-figures/dementia-statistics/#:~:text=Someone%20in%20the%20world%20develops%20dementia%20every%203,of%20the%20increase%20will%20be%20in%20developing%20countries.

Bahar-Fuchs, A., Webb, S., Bartsch, L., Clare, L., Rebok, G., Cherbuin, N., & Anstey, K. J. (2017). Tailored and adaptive computerized cognitive training in older adults at risk for dementia: a randomized controlled trial. *Journal of Alzheimer's Disease*, *60*(3), 889–911.

Barbara, I., Sommer, C., Hamel, D., Devane, A., Noel-Storr, L., Puljak, M., & Trivella, G. (2023). Rapid reviews methods series: guidance on team considerations, study selection, data extraction and risk of bias assessment. *BMJ Evidence-Based Medicine*, *28*(6), 418–423.

Beishon, L., Haunton, V., Subramaniam, H., Mukaetova-Ladinska, E. B., Panerai, R. B., Robinson, T., & Evley, R. (2021). Qualitative Analysis of the Cognition and Flow (CoGFlowS) Study: An Individualized Approach to Cognitive Training for Dementia Is Needed. *Journal of Alzheimer's Disease*.

Bettany-Saltikov, J., & McSherry, R. (2016). *How to do a Systematic Literature Review in Nursing: A step-by-step guide* (2nd ed.). Open University Press.

Bloom, D. E., & Luca, D. L. (2016). The global demography of aging. In *Handbook of the Economics of Population Aging* (pp. 3–56). Elsevier.

Booth, A., Sutton, A., Clowes, M., & James, M. M.-S. (2021). *Systematic approaches to a successful literature review* (3rd ed.). SAGE Publications.

Bramer, W. M., Melissa, L., Rethlefsen, J., & Kleijnen, O. H. (2017). Optimal database combinations for literature searches in systematic reviews: a prospective exploratory study. *Systematic Reviews*, *6*, 1–12.

Butler, M., Mccreedy, E., Nelson, V. A., Desai, P., Ratner, E., Fink, H. A., & Hemmy, L. S. (2018). Does cognitive training prevent cognitive decline? A systematic review. *Annals of Internal Medicine*, *168*(1), 63–68.

Carra, M., Clotilde, P., & Romandini, M. (2025). Risk of Bias Evaluation of Cross-Sectional

Studies: Adaptation of the Newcastle-Ottawa Scale. *Journal of Periodontal Research*.

Chowdhary, N., Barbui, C., Anstey, K. J., Kivipelto, M., Barbera, M., Peters, R., Zheng, L., Kulmala, J., Stephen, R., Ferri, C. P., Joanette, Y., Wang, H., Comas-Herrera, A., Alessi, C., Suharya Dy, K., Mwangi, K. J., Petersen, R. C., Motala, A. A., Mendis, S., … Dua, T. (2021). Reducing the risk of cognitive decline and dementia: WHO recommendations. *Frontiers in Neurology*, *12*, 765584. https://doi.org/10.3389/fneur.2021.765584

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement*, *20*(1), 37–46. https://doi.org/10.1177/001316446002000104

De Jager Loots, C. A., Price, G., Barbera, M., Neely, A. S., Gavelin, H. M., Lehtisalo, J., Ngandu, T., Solomon, A., Mangialasche, F., & Kivipelto, M. (2024). Development of a Cognitive Training Support Programme for prevention of dementia and cognitive decline in at-risk older adults. *Frontiers in Dementia*, *3*.

Gough, D., Oliver, S., & Thomas, J. (2017). *An introduction to systematic reviews*. Sage Publications.

Herzog, R., Álvarez-Pasquin, M. J., Díaz, C., Del Barrio, J. L., Estrada, J. M., & Gil, Á. (2013). Are healthcare workers' intentions to vaccinate related to their knowledge, beliefs and attitudes? A systematic review. *BMC Public Health*, *13*(1), 154. https://doi.org/10.1186/1471-2458-13-154

Hill, N. T., Mowszowski, L., Naismith, S. L., Verity, L., Chadwick, M., & Valenzuela, A. (2017). Computerized cognitive training in older adults with mild cognitive impairment or dementia: a systematic review and meta-analysis. *American Journal of Psychiatry*, *174*(4), 329–340.

Huang, C., Yan, Y., Tam, W. W. S., Sun, W., Ye, Y., Wang, N., Shi, Y., Zhu, Z., Chen, D., Chen, L., Zhao, J., Lin, R., & Li, H. (2025). Effects of an integrated social-art intervention on cognitive and psychosocial outcomes among older adults with mild cognitive impairment in nursing homes: a mixed methods study. *BMC Medicine*, *23*(1). https://doi.org/10.1186/s12916-025-04085-z

Karssemeijer, E., & Bossers, T. T. (2017). Positive effects of combined cognitive and physical exercise training on cognitive function in older adults with mild cognitive impairment or dementia: A meta-analysis. *Ageing Research Reviews*, *40*, 75–83.

Kivipelto, M., Solomon, A., Ahtiluoto, S., Ngandu, T., Lehtisalo, J., Antikainen, R., Bäckman, L., Hänninen, T., Jula, A., Laatikainen, T., Lindström, J., Mangialasche, F., Nissinen, A., Paajanen, T., Pajala, S., Peltonen, M., Rauramaa, R., Stigsdotter-Neely, A., Strandberg, T., … Soininen, H. (2013). The Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER): study design and progress. *Alzheimer's & Dementia: The Journal of the Alzheimer's Association*, *9*(6), 657–665. https://doi.org/10.1016/j.jalz.2012.09.012

Ludmiła, M., Wiłkość-Dębczyńska, A., Wojciechowski, M., Podhorecka, A., Polak-Szabela, Ł., Warchoł, K., Kędziora-Kornatowska, A., & Araszkiewicz, P. (2019). *The Efficacy of Virtual Reality-Based Cognitive Training in Older Adults Non-Demented and with Mild Dementia: an One Group Pretest-Posttest Design*.

Ma, L.-L., Wang, Y.-Y., Yang, Z.-H., Huang, D., Weng, H., & Zeng, X.-T. (2020). Methodological quality (risk of bias) assessment tools for primary and secondary medical studies: what are they and which is better? *Military Medical Research*, *7*, 1–11.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020

statement: an updated guideline for reporting systematic reviews. *BMJ (Clinical Research Ed.)*, *372*, n71. https://doi.org/10.1136/bmj.n71

Peach, T., Pollock, K., van der Wardt, V., das Nair, R., Logan, P., & Harwood, R. H. (2017). Attitudes of older people with mild dementia and mild cognitive impairment and their relatives about falls risk and prevention: A qualitative study. *PloS One*, *12*(5), e0177530. https://doi.org/10.1371/journal.pone.0177530

Ritchie, S., Lawrence, V., Jones, J., & Corbett, A. (2021). Engaging older adults in an online physical activity programme to improve cognition: A qualitative study. *International Journal of Geriatric Psychiatry*, *36*(12), 1942–1949. https://doi.org/10.1002/gps.5617

Rosenberg, A., Coley, N., Soulier, A., Kulmala, J., Soininen, H., Andrieu, S., Kivipelto, M., & Barbera, M. (2020). Experiences of dementia and attitude towards prevention: a qualitative study among older adults participating in a prevention trial. *BMC Geriatrics*, *20*(1). https://doi.org/10.1186/s12877-020-1493-4

Shaw, J. S. (2021). The effect of baseline performance and age on cognitive training improvements in older adults: a qualitative review. *The Journal of Prevention of Alzheimer's Disease*, 100–109.

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Sterne, J. A. C., Savović, J., Page, M. J., Elbers, R. G., Blencowe, N. S., Boutron, I., Cates, C. J., Cheng, H.-Y., Corbett, M. S., Eldridge, S. M., Emberson, J. R., Hernán, M. A., Hopewell, S., Hróbjartsson, A., Junqueira, D. R., Jüni, P., Kirkham, J. J., Lasserson, T., Li, T., … Higgins, J. P. T. (2019). RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ (Clinical Research Ed.)*, *366*, l4898. https://doi.org/10.1136/bmj.l4898

Sung, C.-M., Lee, T.-Y., Chu, H., Liu, D., Lin, H.-C., Pien, L.-C., Jen, H.-J., Lai, Y.-J., Kang, X. L., & Chou, K.-R. (2023). Efficacy of multi-domain cognitive function training on cognitive function, working memory, attention, and coordination in older adults with mild cognitive impairment and mild dementia: A one-year prospective randomised controlled trial. *Journal of Global Health*, *13*.

Wang, C., Song, P., & Niu, Y. (2022). The management of dementia worldwide: a review on policy practices, clinical guidelines, end-of-life care, and challenge along with aging population. *Bioscience Trends*, *16*(2), 119–129.

Wells, G. A., Shea, B., O'Connell, D., Peterson, J., Welch, V., Losos, M., & Tugwell, P. (2013). *Ottawa hospital research institute - The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses*. Ohri.Ca. http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp

WHO. (2021). *World Health Organization - Dementia*. Who.int. https://www.who.int/en/news-room/fact-sheets/detail/dementia

WHO. (2023). *Global status report on the public health response to dementia*. https://www.who.int/news/item/02-06-2022-global-strategy-on-human-resources-for-health--workforce-2030

Wolinsky, F. D., Unverzagt, F. W., Smith, D. M., Jones, R., Wright, E., & Tennstedt, S. L. (2006). The effects of the ACTIVE cognitive training trial on clinically relevant declines in health-related quality of life. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, *61*(5), S281-7. https://doi.org/10.1093/geronb/61.5.s281

## Appendix

### Appendix 1: Summary of Data Extraction Table

| Authors and Year | Aim | Research Design | Participants | Location/Setting | Results | Key Findings | Limitations | Relevance to Research Questions |
|---|---|---|---|---|---|---|---|---|
| Huang et al. (2025) | To evaluate effects of a 14-week integrated social-art intervention on cognitive and psychosocial outcomes in older adults with MCI | Mixed-methods: Cluster RCT + qualitative interviews | 80 older adults with MCI (median age: 86.5) | Four nursing homes, Southeastern China | Improved global cognition at post-intervention, not sustained at 24-week follow-up | Short-term cognitive gains from structured group activities and professional guidance | Benefits not sustained; no improvement in psychosocial/functional outcomes | Demonstrates short-term benefits of structured, arts-based cognitive training in institutional settings |
| Price et al. (2024) | To develop a Cognitive Training Support Programme (CTSP) to improve adherence in a computerised cognitive training (CCT) intervention | Developmental study (intervention design within a broader trial) | 30 older adults in group sessions | WW-FINGERS network (multinational, focus on adaptation) | Programme designed with behaviour change techniques to promote adherence | Tailored education and group-based sessions may boost motivation and adherence to CCT | Effectiveness yet to be evaluated; based on preliminary design and theory | Highlights importance of supportive structures and motivation in improving long-term cognitive engagement |
| Rosenberg et al. (2020) | To explore older adults' knowledge and attitudes toward cognitive disorders and prevention in the context of a trial | Qualitative study (semi-structured interviews) | 15 Finnish older adults (trial participants aged 65+) | Finland, within a prevention RCT | Participants had limited knowledge, expressed fear, stigma, and uncertainty about prevention | Family history increased sensitivity and motivation; stigma influenced perceptions | Small sample; only from Finland; self-reported data | Emphasizes need for education and sensitivity to perceptions when designing preventive interventions |
| Beishon et al. (2021) | To explore experiences of participants in a home-based CT feasibility trial | Qualitative component of a feasibility RCT | 37 older adults (HC, MCI, dementia) + some carers | UK, home-based CT setting | Identified benefits (control, awareness) and barriers (tech | Individualised CT is preferred; barriers more prominent in dementia group | Small qualitative sample; specific tech platform used | Supports tailoring CT interventions to individual needs and cognitive levels |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | issues, apathy, mood) | | | for effectiveness |
| Peach et al. (2017) | To examine views on falls risk and prevention among cognitively impaired older adults and carers | Qualitative study using thematic analysis | 20 patient/relative dyads with mild dementia/MCI | UK, Memory and Falls Services | Resistance to falls interventions; identity preservation preferred over preventive framing | Prevention not seen as relevant; desire to maintain independence and autonomy | Small sample; focused on falls not cognition directly | Shows the challenge of framing preventive interventions acceptably for older adults with MCI |
| Ritchie et al. (2021) | To explore engagement factors in an online physical activity programme aimed at improving cognition | Qualitative study using focus groups and interviews | 26 older adults aged 50+ | UK PROTECT cohort (online setting) | Themes: social interaction, incentives, routine flexibility, identity | Engagement requires tailored content and respect for user identity/preferences | Early-stage concept; small, self-selected sample | Reinforces that engagement in digital cognitive-physical interventions depends on personalization and usability |

**Appendix 2: Characteristics of The Six Included Studies**

| Study | Design & Sample | Key Findings | Strengths | Limitations |
|---|---|---|---|---|
| Huang et al. (2025) | Mixed methods (RCT + qualitative); 80 older adults with MCI in 4 nursing homes | Short-term cognitive improvements post 14-week integrated social-art intervention; no sustained effects at 24 weeks | Strong intervention design; high attendance; rich qualitative insights | No long-term effect; limited generalizability; no improvement in psychosocial/functional outcomes |
| Price et al. (2024) | Intervention development study; 30 participants in 6 group sessions | CTSP aimed to improve adherence to computerized cognitive training using behavioural change techniques | Focus on adherence and motivation; integrates behaviour change theory; culturally adaptable | No outcome data on cognitive change; small sample; early-stage development |
| Rosenberg et al. (2020) | Qualitative study; 15 older adults in a dementia prevention trial | Participants showed fear of dementia; limited knowledge; family history influenced attitudes and motivation | Reveals participant perceptions and motivators; practical insights for recruitment | Small sample; limited to Finnish participants; not generalizable |
| Beishon et al. (2021) | Qualitative study within a feasibility RCT; 37 participants (HC, MCI, dementia) | CT seen as beneficial but barriers (tech issues, apathy) were notable, especially for those with dementia | Individualised insight; uses health belief model; diverse cognitive groups | Qualitative only; limited sample; not focused on cognitive outcomes |
| Peach et al. (2017) | Qualitative study; 20 patient/relative dyads in the UK | Falls prevention seen as irrelevant by many with MCI/dementia; identity and denial impacted engagement | Rich dual perspectives (patients & carers); focuses on intervention acceptability | Indirect relation to cognitive training; potential selection bias |
| Ritchie et al. (2021) | Qualitative study; 21 in focus groups + 5 interviews (ages 50+) | Online PA programme acceptable; engagement driven by usability, identity, incentives | Timely (COVID context); includes digital adaptability and user preferences | Concept-stage only; no cognitive outcome data; small sample |

**Appendix 3: CASP (Critical Appraisal Skills Programme) methodological quality assessment tool**

| Study | CASP Tool | Clear | Appropriate | Recruitment | Data | Ethical Issues | Rigour of | Clear | Value of | Overall |
|---|---|---|---|---|---|---|---|---|---|---|

| | Used | Aim | Methodology | Strategy | Collection | Considered | Analysis | Findings | Research | Quality |
|---|---|---|---|---|---|---|---|---|---|---|
| Huang et al. (2025) | Mixed-methods (RCT + interviews) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | High |
| Price et al. (2024) | Intervention development (qualitative framework) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | High |
| Rosenberg et al. (2020) | Qualitative interviews | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | High |
| Beishon et al. (2021) | Qualitative (Health Belief Model) | ✓ | ✓ | ✓ | ✓ | ? | ✓ | ✓ | ✓ | Moderate–High |
| Peach et al. (2017) | Qualitative (dyadic interviews) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | High |
| Ritchie et al. (2021) | Qualitative (focus groups & interviews) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | High |