

Health economic assessment of technologies for preventing cognitive impairment in elderly people living at home: The case of the digital tablet combined with human support

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Abstract

Background: The study addresses the challenges of cognitive impairment in an aging population, focusing on the health economic assessment of technologies used by community-dwelling older adults to support cognitive function.

Objective: To conduct a systematic review of economic evaluations of digital tablets combined with human support in preventing cognitive impairment in elderly people living at home.

Methods: The following databases were used: PubMed, Scopus, Science Direct, Cochrane library. A total of 45 articles from 2000 to 2024 were identified and screened following the PRISMA guidelines.

Results: One protocol study and one randomized control trial were included.

Conclusions: The economic evaluation of tablet-based digital intervention for older adults with cognitive impairments is underexplored, necessitating broader research on technology use in this area.

Keywords

aged, Alzheimer's disease, cost-effectiveness, dementia, digital tablet, human support, mild cognitive impairment

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Introduction

The main challenge in primary health care is the aging population, which faces increasing multimorbidity, long-term care demands, and associated costs. Among these concerns, cognitive impairment, particularly mild cognitive impairment (MCI), is significant due to its potential progression to dementia and its impact on quality of life.¹ The overall prevalence of MCI was estimated at 15.56% (95% CI: 13.24–18.03%). The prevalence in community-dwelling of amnesic MCI was 10.03% (95% CI: 7.98–12.27%), while non-amnesic MCI was reported at 8.72% (95% CI: 6.78–10.89%).² As the aging population faces difficulties in maintaining cognitive function and neuroplasticity, these processes are crucial for healthy brain aging. Neuroplasticity, the brain's ability to reorganize and form new neural pathways, is essential for cognitive rehabilitation, enabling adaptation and recovery from cognitive challenges, but cognitive impairment hinders this process by limiting the brain's capacity to create new connections.^{3–5}

Mental exercises and cognitive training can enhance neuroplasticity, strengthening cognitive reserve and supporting brain health in older adults.⁶ Computerized cognitive training programs are effective interventions for older adults with MCI, as they have been shown to improve cognitive function and support healthy brain aging by fostering neuroplasticity.⁷

Additionally, cognitive training programs focus on preserving or enhancing specific cognitive functions through

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structured and guided exercises, conducted either individually or in group settings.⁸ Individuals with MCI have demonstrated improvements in overall cognitive functioning through such training. Many of these programs have also been adapted for use on modern devices like computers, tablets, and smartphones, providing more cost-effective alternatives to traditional cognitive therapies.⁹

Computerized cognitive therapies offer several advantages over traditional methods, improving not only cognitive, memory, and attention abilities but also enhancing the psychosocial functioning of older adults with MCI.⁷ Since cognitive damage cannot be cured, it is imperative to look at ways to slow down memory issues. An important strategy for promoting healthy aging is cognitive training programs, which can help older people live independently for longer if dementia can be delayed. Older adults can stay in their homes for longer due to home telemonitoring systems, which can significantly decrease readmission rates and avoid medical emergencies.¹⁰

They demonstrated how sophisticated interventions can support older adults in staying in their homes. The purpose of this study is to perform a thorough analysis of informal human support roles in preserving cognitive function in older people living at home, as well as technology interventions. We want to evaluate the cost-effectiveness and efficacy of different therapies intended to decelerate cognitive decline in this study by concentrating on health economic evaluations. A more comprehensive understanding of the tactics required to support aging in place will be provided by this more comprehensive approach, which will also help make better decisions on the implementation of these interventions.

Our research question is formulated using the PICO method. Specifically, we investigate: in community-dwelling older adults, does the use of digital tablets combined with human support, compared to no intervention or the use of digital tablets without human support, effectively prevent cognitive impairment and provide a cost-effective solution in terms of healthcare outcomes?

Firstly, the population (P) under study consists of elderly individuals living at home. Secondly, the intervention (I) involves the use of digital tablets in conjunction with human support. In comparison (C), we evaluate outcomes against either no intervention or the use of digital tablets without human support. Lastly, the focus is on the outcome (O), which is the prevention or reduction of cognitive impairment and the associated cost-effectiveness.

Methods

The methodology outlined in the PRISMA (Preferred Reporting Items for systematic Reviews and Meta-Analyses) statement was used as a guide for this systematic review. A literature search in PubMed, Scopus, Science Direct, and Cochrane Library carried out in August 2024. The search was limited to French and English studies. A

combination of indexing (MeSH) terms and free-text keywords concerning health-economic assessment was used to find relevant articles. The multiple database search provided a total of 47 titles. After removing book titles, 45 were stored in a Zotero database.¹¹

The selection procedure is presented in a flow diagram in Figure 1.

The economic evaluation was conducted following the consolidated Health Economic Evaluation Reporting Standards (CHEERS) guideline.¹² This evaluation is composed of 28 items and identifies four levels of quality, excellent quality level (score 100%), good quality level (score from 76–99%), moderate quality level (score from 51–75%) and low quality level (score $\leq 50\%$).

We have used all the terms associated with the PICO elements:

(“cognitive decline” OR “cognitive impairment” OR “cognition”) AND (“aged” OR “older adults” OR “elderly”) AND (“community dwelling” OR “independent living”) AND (“digital devices” OR “tablet computers” OR “technology”) AND (“cost benefit analysis” OR “cost effectiveness analysis” OR “cost utility analysis” OR “health economic assessment” OR “incremental cost effectiveness ratio” OR “quality adjusted life years” OR “QALY” OR “ICER” OR “economic analysis” OR “economic impact” OR “cost minimization analysis”).

The inclusion criteria are as follows: studies published between 2000 and August 2024, involving community-dwelling individuals aged 60 and older with any form of dementia or cognitive decline, utilizing any type of technology aimed at cognitive prevention. A particular focus is on articles that include a medico-economic evaluation of the interventions. The exclusion criteria include studies not published in French or English, those involving elderly individuals living in nursing homes, long-term care units, or interventions unrelated to cognitive technologies.

Results

This literature review will present an overview of the relevant studies on the medico-economic assessment of technologies with human support aimed at preventing cognitive impairment. It includes findings from one study protocol and one randomized controlled trial (RCT).

The protocol for the FindMyApps evaluation,¹³ was identified through a systematic search using a specific search equation. However, the RCT and its economic evaluation were found in a systematic review discussing the cost-effectiveness of non-pharmacological interventions for mild cognitive impairment and dementia. Since the economic evaluation was not part of the initial search results, it was manually added.

Of the two studies identified, we begin with the economic evaluation of the digital platform SMART4MD.¹⁴

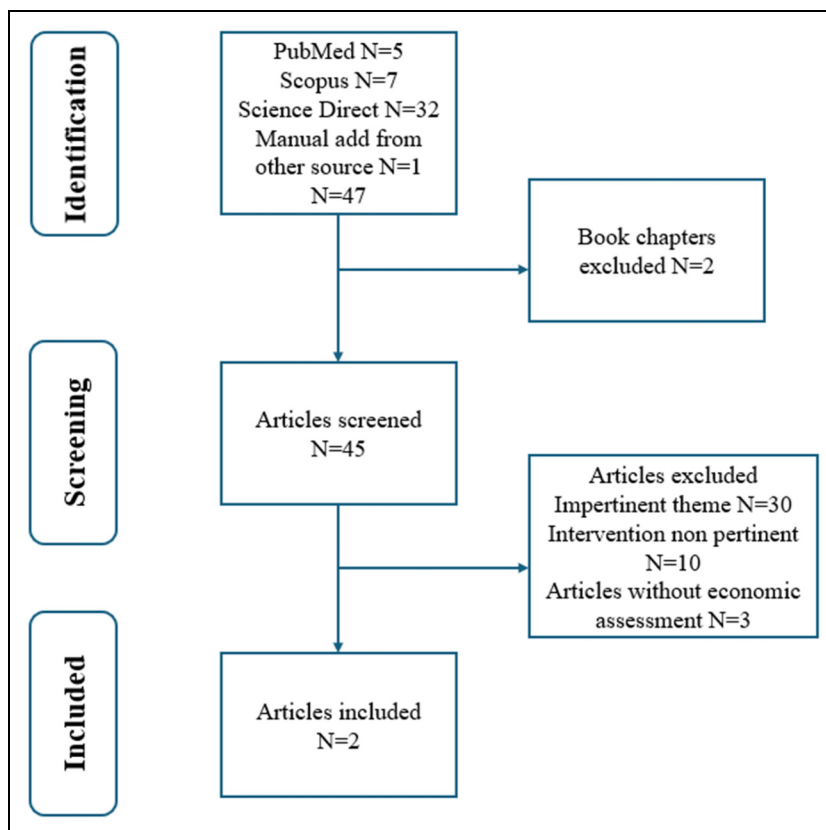


Figure 1. Flow chart PRISMA.

This intervention is a digital health application developed for tablets, specifically designed for individuals with MCI and their informal caregivers. Its aim is to help maintain routines, establish habits for disease management, and reduce stress. The app includes features such as cognitively stimulating games and cognitive support tools. The intervention was conducted in Sweden over a period of six months, involving 173 dyads in the intervention group and 172 in the standard care group. This study did not meet all 28 items of the CHEERS checklist; however, it is of good quality as the quality score is 78%.

Quality-adjusted life years (QALY) were measured using the EQ-5D-3L questionnaire, and cost-effectiveness was assessed through the incremental cost-effectiveness ratio (ICER). The ICER represents the ratio of the difference in average costs per participant to the difference in average health benefits between the intervention and control groups. The study found that SMART4MD was more expensive and less effective for individuals with cognitive impairment, less expensive but more effective for informal caregivers, and both less expensive and less effective when considering both groups combined. However, these differences were generally insignificant.

Regarding the FindMyApps protocol, this RCT evaluates the effectiveness and cost-effectiveness of a tablet-based intervention to improve self-management and

social participation among community-dwelling individuals with mild dementia, compared to standard tablet use. The cost-effectiveness and cost-utility analyses will be performed in 2023, with a 12-week follow-up involving 75 dyads in the control group (receiving standard care) and 75 dyads in the experimental group (receiving standard care plus the FindMyApps intervention) (See Table 1).

Discussion

In this systematic review of the literature, two studies were included: one protocol study and one RCT were identified. The goal of this review is to assess the health economics of using tablet-based digital interventions, supported by human assistance, for older adults with cognitive impairments living at home. This field remains insufficiently explored. To address this limitation, instead of focusing solely on digital tablets, we used the term “technology” in the search strategy to broaden the scope and increase the number of health economic articles on the topic.

Notably, the trial SMART4MD was underpowered for cost-effectiveness analysis, as the sample size was calculated based on clinical outcomes rather than economic ones, complicating the detection of significant cost differences between the groups. A 6-month duration may be too short to observe health effects. The study revealed no

Table 1. Characteristic of included articles (N = 2).

| Interventions | Reference | Study design | Features of the app | Population/sample | Horizon | outcomes | Results |
|---------------|----------------|--|--|---|----------|-------------------------------|--|
| SMART4D | Ghani et al.14 | Economic evaluation using data from the SMART4MD trial | cognitive support (e.g., cognitive-stimulating games and photographs) | 345 dyads consisting of PwMCI and their main informal caregiver participated in the trial, randomized to intervention (n = 173) and control group (n = 172) | 6 months | QALYs: EQ-5D-3L, QoL-AD, MMSE | MMSE score improved in both groups, with statistically significantly greater improvement in the intervention group compared to the control group. For EQ-5D-3L scores, the intervention group showed a change of -0.03 group showed a change of -0.01, with no statistically significant difference between the two groups. ICER was dominated. Results published in May 2023, there is no statistically significant differences between experimental and control arm participants regarding quantity analysis of tablet use |
| FindMyApps | Neal et al.13 | Randomized controlled trial (STUDY PROTOCOL) | Help people with early stage dementia or MCI, find apps to self-management and meaningful activities | 150 dyads consisting of community-dwelling PwMCI or dementia with their informal caregiver, control arm (n = 75) and intervention (n = 75) | 3 months | EQ-5D-5L, DQoL | |

DQoL: Dementia Quality of Life Instrument; ICER: incremental cost-effectiveness ratio; MCI: mild cognitive impairment; MMSE: Mini-Mental State Examination; PwMCI: persons with mild cognitive impairment; QALYs: Quality-adjusted life years; QoL-AD: Quality of Life-Alzheimer's Disease.

significant differences in terms of effects or costs between the two groups, suggesting the absence of notable short-term benefits from the intervention. For persons with mild cognitive impairment, the ICER was dominated by standard care, as the intervention group incurred higher costs and had lower QALYs compared to the control group. The cost-effectiveness of SMART4MD remains inconclusive and should be interpreted with caution.¹⁴

The protocol did not include a health economic analysis; however, upon reviewing the article published in 2023 on this RCT,¹⁵ it appears that the researchers did not incorporate such an analysis due to the lack of statistically significant results. Specifically, the sample size and the duration of the intervention were deemed insufficient to draw robust conclusions that could support a meaningful economic evaluation.

These studies used a time horizon of 3/6 months failed to assess long-term costs and QALYs.


There are limitations associated with this systematic review: first, this study is limited because it does not utilize all search engines, which may reduce the likelihood of identifying additional relevant papers. Therefore, studies published in other languages were excluded by our search strategy. Although the PRISMA guideline is used in this review, there are few medico-economic studies on the use of digital technologies among older adults,¹⁶ and even fewer specifically addressing those with neurocognitive disorders, which significantly limits the scope of the research.

At present, there is no comprehensive health economic evaluation available on this subject. Moreover, comprehensive economic evaluation of mobile health interventions designed for older adults are needed to better assess these interventions.¹⁷ The evaluations conducted so far have either failed to produce conclusive results, highlighting the need for a dedicated trial focusing on the medico-economic assessment of technologies aimed at preventing cognitive impairment in elderly living at home. As previously demonstrated, digital inclusion and video games can enhance cognitive function in older adults.¹⁸ Similarly, electronic health technologies can support older adults in maintaining their independence and living at home for extended periods.¹⁹ Therefore, this underscores the importance of conducting thorough evaluations to inform decision-making regarding the implementation of these technologies in preventive strategies, particularly for elderly individuals who are aging in place.

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Ethical considerations

Ethical approval and informed consent were not sought for this study because it did not deal with human beings directly but with public data, already published.

Author contributions

Clément Rimlawi: Conceptualization; Investigation; Methodology; Writing - original draft.

Abdoul Razak Sawadogo: Writing - review & editing.

Gilles Kehoua: Writing - review & editing.

Caroline Gayot: Writing - review & editing.

Achille Tchalla: Supervision; Writing - review & editing.

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Data availability statement

The data supporting the findings of this study are available within the article.

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