# Enhancing Functional Autonomy and Quality of Life in Dementia Afflicted Elderly: The Role of AI Interventions in the Home Setting - A Systematic Review

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## Introduction

Dementia, including Alzheimer's disease, significantly affects the elderly, leading to cognitive decline, loss of independence, and reduced quality of life. Artificial intelligence (AI) technologies have emerged as promising tools for enhancing dementia care by improving diagnostic accuracy, monitoring disease progression, and supporting daily living activities. The objective of this systematic review is to evaluate the effectiveness of artificial intelligence (AI) interventions in enhancing the quality of life, autonomy, and health outcomes for elderly individuals with dementia. Additionally, it aims to explore the specific mechanisms and features of AI technologies that contribute to these improvements, providing insights for future development and implementation.

## Methods

**Search and Screening:** A systematic review was conducted to evaluate AI-based interventions designed for dementia care in elderly populations. Comprehensive searches of PubMed, Scopus, and Web of Science were performed through January 2025, using keywords such as "artificial intelligence," "dementia," "elderly," and "quality of life." Studies were included if they involved elderly participants with a clinical diagnosis of dementia, utilized AI-based tools or technologies, and reported measurable outcomes related to quality of life, cognitive function, emotional well-being, or daily living. Exclusion criteria included studies focusing on non-AI interventions or non-dementia populations.

**Quality Assessment:** Quality appraisal was conducted using tools like the Cochrane Risk of Bias Tool for randomized controlled trials and the Newcastle-Ottawa Scale for observational studies.

**Data Extraction and Synthesis:** Data extraction captured study design, sample characteristics, intervention type, duration, and outcomes. Due to methodological and outcome heterogeneity, findings were synthesized narratively rather than quantitatively. Subgroup analyses explored specific intervention types, such as robotic companions and cognitive training tools, and their distinct impacts on dementia care outcomes.
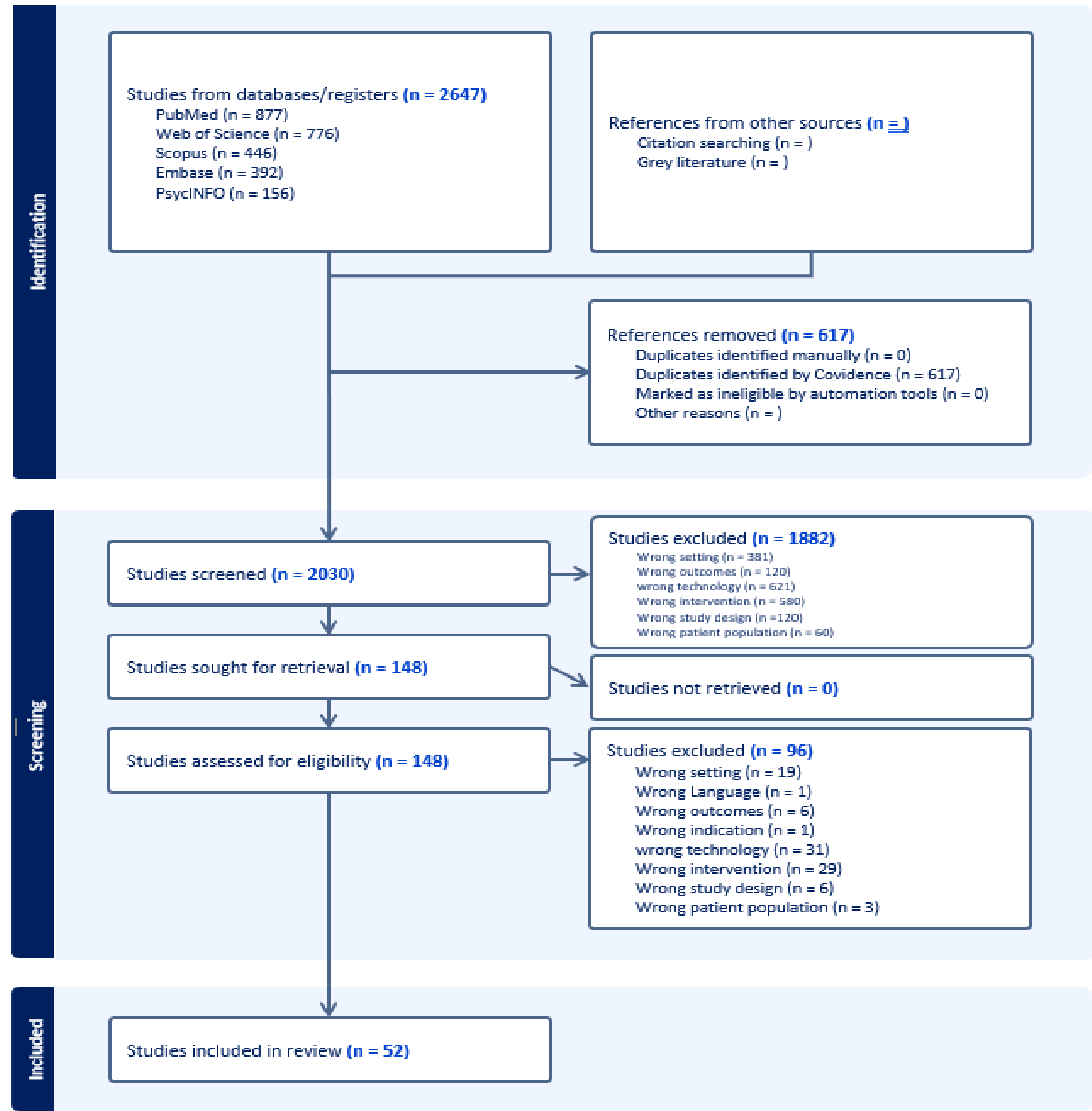


## Results

**Study Selection and Characteristics:**
A total of **2,647 studies** were identified, with **2,030 screened** after removing duplicates. After full-text assessment, **52 studies** were included, published between **2010 and 2023**. These studies were conducted in **United States (n=15), China (n=10), United Kingdom (n=7), Canada (n=5), Australia (n=5), and various European nations (n=10).** Study designs consisted of **RCTs (n=32, 6-24 months), non-RCTs (n=10, 6-18 months), cohort studies (n=6, 12-36 months), and case-control studies (n=4, 9-24 months).**

**Types of AI Interventions:** AI applications in dementia care included **machine learning (n=20)** for **predictive analytics, early detection, and personalized care**, leading to improved **fall prediction and cognitive decline monitoring**. **Generative AI (n=12)** provided **virtual companions and customized cognitive exercises**, which enhanced **memory recall, problem-solving, and reduced loneliness**. **Deep learning (n=10)** was primarily used for **speech and image recognition**, aiding in **biomarker-based dementia detection and disease progression monitoring**. **Robotics and IoT (n=10)** supported **mobility, daily activities, and real-time health monitoring**, with IoT-enabled smart home systems providing **timely medication reminders and emergency alerts**.

**Impact of AI on Dementia Care: Physical and Health Outcomes:** AI-assisted rehabilitation **enhanced mobility (n=15)** and **reduced hospitalizations by 20-35% (n=18)** through continuous health monitoring and timely medical interventions.

**Mental and Cognitive Outcomes:** AI-driven cognitive training **improved memory and problem-solving by 15-40% (n=14)**. AI companions and virtual assistants **reduced loneliness and depression (n=12)**, enhancing emotional well-being.

**Social and Caregiver Support:** AI-facilitated communication **increased social engagement (n=10)**, and AI-based caregiver tools **reduced burden by improving care planning and decision-making (n=8).**

**Challenges** While AI shows promise, challenges remain. **Data privacy concerns (n=18)** arise from handling sensitive patient data. **Algorithm bias (n=12)** affects AI accuracy across different populations. **Acceptance issues (n=15)** persist due to caregiver and patient hesitancy in adopting AI tools. **High costs and accessibility barriers (n=10)** limit widespread AI implementation.

**Risk of Bias & Evidence Quality:** **80% of RCTs** had **low risk of bias**, but **20% showed concerns in allocation concealment and reporting**. According to **GRADE assessment**, AI's impact on **cognition and mobility** had **high certainty**, while **long-term benefits had moderate certainty** due to limited longitudinal studies.

## Conclusion

AI interventions hold transformative potential in addressing the multifaceted needs of elderly individuals with dementia, offering improvements in cognitive, emotional, and functional domains. However, there is a pressing need for standardized methodologies and longitudinal research to evaluate long-term outcomes and ensure equitable access to AI technologies. This review underscores the importance of further research to optimize these interventions and inform evidence-based dementia care.

## Acknowledgements

## References

1. **Alzheimer's Association.**. *What is Dementia?*. Alzheimer's Association. https://www.alz.org/alzheimers-dementia/what-is-dementia