

Systematic Review

Artificial Intelligence Interventions for Resilience and Mental Health in Older Adults: A Systematic Review

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Abstract

Background: As global population ages, the supply-demand imbalance in geriatric mental health services has become increasingly pronounced. In this emerging field, artificial intelligence (AI)-driven interventions for geriatric mental health remain fragmented. This systematic review synthesizes the application process of AI interventions and dissects the disciplinary knowledge structure of existing studies to unlock AI potential and facilitate evidence-based interventions. **Methods:** Guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, a systematic search of seven databases was performed from January 1, 2005 to November 5, 2025. This review includes a total of 95 studies in English and Chinese on AI-based interventions for geriatric mental health. These studies were categorized by basic characteristics, intervention processes, and thematic clustering. **Results:** The field has evolved from an initial exploratory phase to a period of rapid growth. These AI interventions encompass four core dimensions, involving seven AI technology types, nine intervention pathways, and seven key acceptance-influencing factors. Research topics focused on clinical efficacy and risk management of AI interventions, as well as psychological assessment and human-computer interaction. This study summarized interdisciplinary, comprehensive research on AI-based geriatric mental health interventions. Furthermore, it establishes an explanatory model emphasizing multidisciplinary synergy, which provides a framework for future theoretical and practical development. **Conclusions:** There remains a notable gap between technology design and the psychological characteristics of older adults in AI mental health interventions, and interdisciplinary research is still insufficient. Future efforts should strengthen collaboration across clinical medicine, psychology, sociology, and computer science, embed elderly psychological traits into closed-loop technology design, increase policy support, enhance AI accessibility in community and family settings, and improve caregivers' technical literacy. Only through these steps can human-centered AI technology sustainably and equitably address the unmet mental health needs of older adults in the context of global aging. **Registration:** The study has been registered on <https://www.crd.york.ac.uk/PROSPERO/> (registration number: CRD420261287044; registration link: <https://www.crd.york.ac.uk/PROSPERO/view/CRD420261287044>).

Keywords: AI; geriatric mental health; intervention; systematic review

1. Introduction

The global aging process is expanding; improving the mental health and psychological resilience of older adults has become an urgent public health issue. As people age, the connection between mind and body strengthens (Peters, 2023). A positive mental state is crucial in order for older adults to resist physical diseases and improve their quality of life. Also, psychological resilience—defined as an individual's ability to adapt and recover from adversity—is a core need for older adults in order to resist psychological distress and achieve successful aging. However, data from the Global Burden of Disease have shown that about 14% of people aged 70 and above, worldwide suffer from mental disorders (GBD, 2024), and the utilization rate of mental health services among this group is only 25% to 50% that of middle-aged and younger populations. The shortage of geriatric medical professionals and insufficient par-

ticipation of psychologists have exacerbated the difference between supply and demand for services. Moreover, traditional single-domain intervention methods such as clinical medical treatment, psychological counseling, and community services have not only been unable to meet the mental health needs of older adults but also lack systematic attention to the cultivation of psychological resilience.

Artificial intelligence (AI), as an interdisciplinary technology system, integrates machine learning, natural language processing, and other technologies (Chen and Decary, 2020). AI can simulate human cognitive functions and demonstrate unique advantages in precise assessment and personalized intervention (Cheng, 2017), and become an innovative path to improve the mental health and psychological resilience of older adults (Eysenbach, 2023). The crisis caused by social events, exemplified by the COVID-19 pandemic, has further exacerbated the psychological risks faced by older adults. As a result, social connections and



communication are essential (Romero-Moreno et al., 2025). However, social relationships centered around the family may not always provide long-term, stable support. Artificial intelligence has effectively mitigated this issue.

Research has shown that AI technology can assist in improving the mental health of older adults through precise assessment and personalized intervention. Machine-learning-based models can optimize mental health assessment by identifying risk factors for depression in older adults and provide early warnings for resilience protection. This, combined with comprehensive intervention models, can significantly increase depression-detection rates through early intervention (Li, 2023). The SUNSHINE framework has further aimed to enhance the resilience of older adults at both the individual and system levels through AI technology and cross-departmental collaboration (Chen et al., 2025).

The application research of AI in the field of mental health has provided empirical support and a foundational framework for the mental health and resilience of older adults. However, most studies have focused on the single effect of specific technologies, without a systematic review of the entire intervention chain. In many studies, a disconnect between technical design and clinical needs, coupled with insufficient interdisciplinary collaboration, has fragmented the research landscape and delayed the formation of replicable intervention models.

2. Research Theory

AI intervention in the mental health of older adults, as an emerging interdisciplinary field that integrates digital technology with older adults' health services, has its theoretical construction rooted in multiple disciplines. This paper reviewed the theoretical foundation and academic evolution of this field and constructed a framework for AI intervention in older adults' mental health using four dimensions: academic field evolution; core theoretical support; concept definition; and research question formulation, thereby providing theoretical support and logical guidance for subsequent systematic reviews.

2.1 Analysis of Related Academic Fields

As a valuable and emerging research field, AI intervention in the mental health of older adults relies on the integration of digital technology and the specification of the objects and fields of health issues. Dividing the process into three levels can clarify the research context and focus the research field.

First, digital technology intervention in mental health. The essence of digitalization is the transformation of information into measurable numbers and data and the construction of models to enable recognition and processing by computers. Therefore, digital technology refers to the combination of "information, computing, communication, and connection technologies" (Piccinini et al., 2015). The

use of digital technology in mental health intervention typically includes vehicles such as websites, computers, mobile applications, text messages, emails, video conferences, and wearable devices to provide information, support, and treatment for mental health (Hollis et al., 2017). Leveraging the characteristics of high efficiency, convenience, and low cost of this technology, digital technology intervention in mental health has great potential in narrowing the supply-demand gap, reducing stigma and discrimination, and expanding coverage (Arias et al., 2022; Li et al., 2023).

Second, AI intervention in mental health. As an extension and upgrade of digital technology, the significance of AI lies in processing and analyzing large datasets through intelligent algorithms to achieve more efficient decision support and more accurate predictions (Babic et al., 2021). McCarthy (1989) defined AI as "the science and engineering of creating intelligent machines", highlighting the concept that distinguishes AI from ordinary digital machines. In terms of classification, AI technology includes machine learning, deep learning, expert knowledge systems, neural networks, and predictive analytics based on these (Ray et al., 2022). Compared to intervention in physical diseases, AI intervention in mental health is limited by the subjectivity of psychology (Miller and Brown, 2018), but it still has strong applicability, including promoting earlier detection, more accurate diagnosis, personalized intervention, and simplifying service delivery through automation (Sun et al., 2025).

Third, AI intervention in the mental health of older adults. The mental health of older adults requires efficiency, accessibility, acceptability, and applicability. This makes AI technology significant in providing personalized and efficient care, meeting the changing needs of older adults, and addressing the growing demand for care services (Czaja and Ceruso, 2022). There is great potential for improving early detection, achieving more precise diagnosis, and formulating personalized treatment strategies. Furthermore, AI intervention can help to address common psychological problems among older adults, such as loneliness, depression, anxiety, and cognitive decline, by improving the efficiency of psychological assessment and diagnostic accuracy (Şenol Durak, 2024).

2.2 Theoretical Research-Based Definition Framework

The onset of the digital age and the increasing emphasis on mental health have provided rich theoretical perspectives for AI intervention in the mental health and resilience of older adults. We selected six major theoretical models (Fig. 1) and integrated them around the research theme, laying a theoretical foundation for the systematic review of AI intervention in the mental health of older adults, including concept definition, literature search and inclusion, systematic analysis, and the construction of an interdisciplinary integration model.

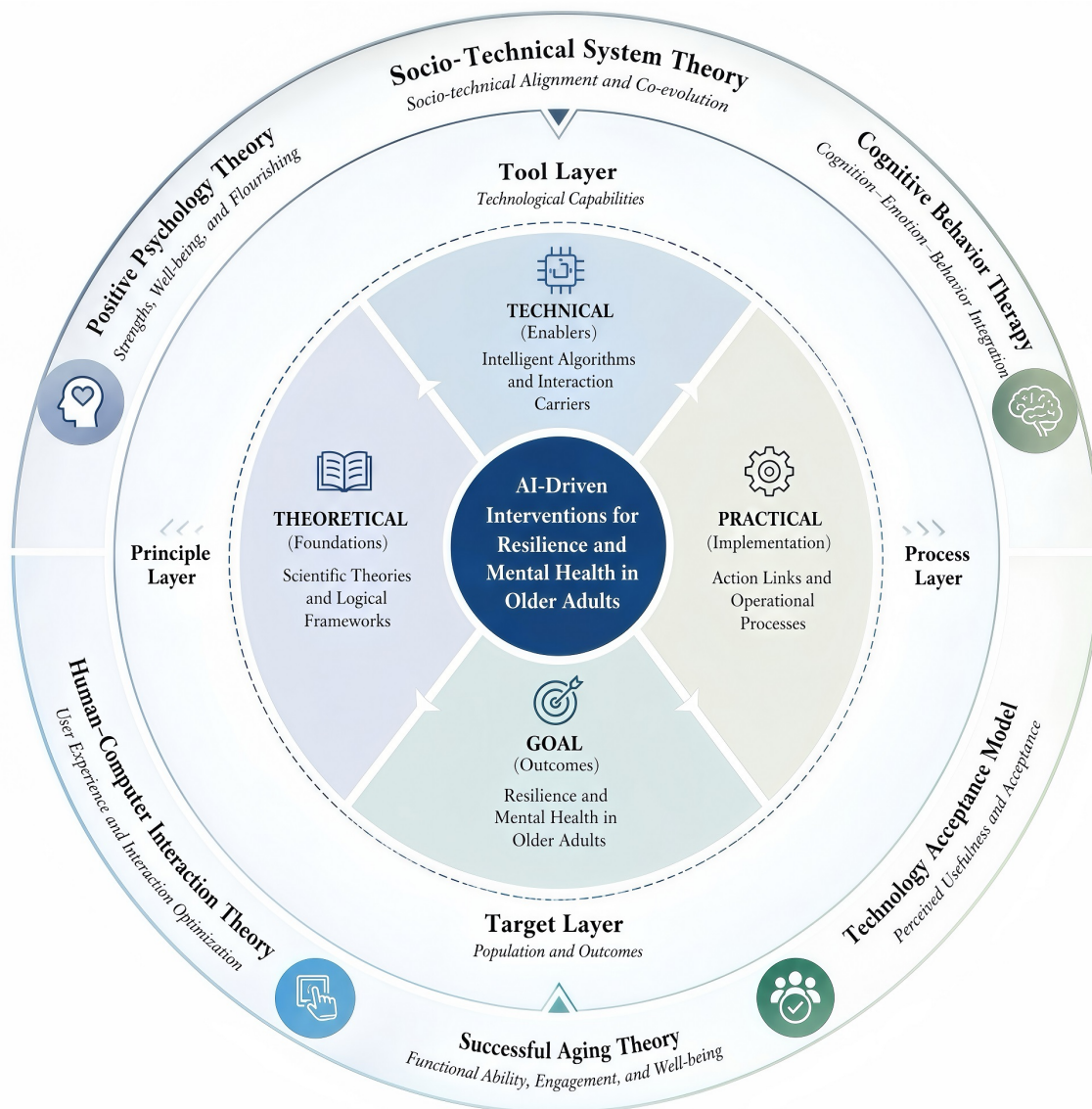


Fig. 1. Diagram of the model for concept definition and theoretical structure. AI, artificial intelligence.

Cognitive Behavior Therapy. Developed by Beck in the 1960s, it is a structured, short-term, and cognitive-oriented psychotherapy method that targets psychological disorders such as depression and anxiety, as well as psychological problems caused by irrational cognition. Based on cognitive learning theory, it links people's emotions and behaviors with cognition, linking cognitive therapy and behavioral therapy. It is currently the most commonly researched form of psychotherapy and the most widely applied treatment technique, based on psychotherapy research evidence (Norcross et al., 2005). Therefore, it serves as an important theoretical support in the field of AI intervention in the mental health of older adults and is one of the core intervention paths.

Positive Psychology Theory. The rise of humanism laid the foundation for the development of positive psychology theory. In 1998, promoted by Seligman, it was estab-

lished as a new branch of psychology. Sheldon and King (2001) defined it as "a science dedicated to studying the positive qualities of human potential and virtues". This theory emphasizes focusing on people's strengths, happiness, and meaning construction rather than merely on pathology. It is significant for broadening the scope of AI intervention in the mental health of older adults, intervention approaches, and intervention concepts.

Successful Aging Theory. First proposed by Havighurst (1961), it focuses on "the most satisfactory and happy state that an individual can achieve". Rowe and Kahn (1987) conducted large-scale, systematic, and multidisciplinary research on successful aging from an empirical perspective and proposed a three-dimensional conceptual model from a biomedical perspective, which emphasized that minimizing the decline in physical and mental functions and disability is the key to successful aging. In con-

trast, German psychologist Baltes (1990) proposed the Selection, Optimization, and Compensation (SOC) model of successful aging, choosing the optimization meta-model of compensation from a psychosocial perspective, which emphasized that aging is also a process of development, and viewed it as a strategic balance between gains and losses. Some studies have integrated the two, proposing a biological, psychological, and social model of successful aging (Kanning and Schlicht, 2008), which provided guidance for the interdisciplinary nature and value orientation of AI intervention in the mental health of older adults.

Technology Acceptance Model. Based on the Theory of Reasoned Action, the Technology Acceptance Model was proposed by Davis (1989), and emphasized that an individual's acceptance of technology mainly depends on perceived usefulness and ease of use, which directly affect the willingness and behavior to use technology. This theory provided a framework for AI intervention in mental health from the perspective of older adults and offered a new perspective for establishing a comprehensive framework for the intervention process.

Human-Computer Interaction Theory. This is a discipline that studies how people effectively communicate and interact with computer systems. Its core lies in building human-centered interactive relationships, enhancing user experience and intervention effects by optimizing interaction logic and emotional feedback. As a digital technology, AI represents a high-intensity form of human-computer interaction in the context of intervening in the mental health of older adults. Therefore, this theory, from a dynamic perspective of interaction, elevates the technical positioning of AI in the review.

Sociotechnical Systems Theory. As an important theoretical framework for understanding the complex interaction between technology and social factors, the Sociotechnical Systems Theory was proposed by Trist and his team in the 1950s (Trist and Bamforth, 1951). It emphasized that technical systems and social systems are not isolated but are interdependent and dynamically interactive as a whole. The comprehensive theory provided support for the multidisciplinary perspective of AI in intervening in the mental health of older adults.

2.3 Research Concept Definition and Problem Formulation

Based on the comprehensive analysis of the relevant academic fields and theoretical support mentioned above, and on the basis of the development of the existing older adults' mental health field, the present review defined and constructed the concept of AI intervention in the mental health of older adults and its theoretical structure model. Specifically, it included four core concept elements:

First, the technical dimension. The technical dimension is the "tool" layer of the intervention, referring to intelligent algorithms and interaction carriers. The research,

based on the theory of human-computer interaction and the technology acceptance model, emphasized the application of specific AI technologies and their carrier forms to achieve the effectiveness and usability of the technology.

Second, the goal dimension. The goal dimension is the "target" layer of the intervention, referring to the issues of older adults' mental health. Based on cognitive behavioral therapy, positive psychology theory, and successful aging theory, the intervention targets both pathological mental health problems and the promotion of positive psychological states.

Third, the theoretical dimension. The theoretical dimension is the "principle" layer of the intervention, referring to the underlying scientific theories and logic that drive and explain the effectiveness of the intervention. It is not a simple application of a single theory, but rather a complex interaction and synergy among multiple disciplines based on an integrated theoretical framework.

Fourth, the practical dimension. The practical dimension is the "process" layer of the intervention, referring to the specific action links and processes of AI technology intervention in older adults' mental health. This process was also constructed under the guidance of multiple theories and disciplines. The practical dimension emphasizes that AI technology intervention in older adults' mental health is not a static single step, but a comprehensive intervention system formed through interaction and feedback between both parties.

Therefore, as shown in Fig. 1, we have defined AI intervention in older adults' psychological resilience and mental health as a full-chain, personalized framework for individuals aged 60 and above, designed to address and improve pathological issues such as depression and anxiety, and to cultivate the individual's ability to adapt and recover from adversity. The framework incorporated technological acceptability, contextual adaptability, and ethical safety. Furthermore, it is grounded in cognitive behavioral therapy, positive psychology, and successful aging theory, and is implemented through seven core AI technologies and nine practical intervention pathways. The aim of this is to achieve the dual goals of mental health protection and psychological resilience enhancement through human-machine collaborative intelligent services, thereby helping older adults resist psychological risks, maintain a positive state, and promote the healthy development of their psychology.

Based on the preceding academic review, theoretical framework, and concept definition, we included a systematic review of empirical research in both Chinese and English from 2005 to 2025, comprehensively sorting the technical applications, implementation pathways, core effectiveness, and interdisciplinary collaboration characteristics of AI in mental health interventions for older adults. We integrated existing research results, clarified the internal logic and practical value of AI intervention, and provided theo-

retical references and practical guidance for promoting the scientific, standardized, and sustainable application of AI technology in this field. Accordingly, the following four fundamental research questions are formed:

RQ1: What is the current state of research on AI-based interventions for mental health in older adults?

RQ2: How is the process-oriented research on AI intervention in the mental health of older adults carried out?

RQ3: What are the four core themes and their key contents of AI intervention research in the mental health of older adults?

RQ4: What are the disciplinary characteristic differences of AI intervention in the mental health of older adults, and could an interdisciplinary integrated model for it be constructed?

3. Materials and Methods

The present systematic review was registered in PROSPERO (CRD420261287044) and followed the PRISMA guidelines as the methodological framework to systematically review on AI intervention in the mental health of older adults.

3.1 Research Identification and Screening

The period of the search was from January 1, 2005 to November 5, 2025. With the continuous advancement of perception skills and technologies, not only has it enhanced the machine's ability to process visual information (Kriegeskorte, 2015), but it has also laid a solid foundation for the transformation of the mental health intervention model of AI in the fields of human cognition and emotion. Therefore, the selected time range was designed to ensure that the identification of research results was relevant and applicable.

To ensure the professionalism, comprehensiveness, and authority of the literature sources, seven databases were selected for comprehensive literature retrieval based on three major criteria: the coverage of literature, the positioning of retrieval functions, and the adaptability to disciplines. Two international authoritative academic index databases were selected, Web of Science and Scopus, which can locate and retrieve core literature in multiple disciplines worldwide. In addition, three publisher databases, ScienceDirect, EBSCO, and PubMed, were included. Among them, ScienceDirect and EBSCO cover a large volume of full-text journal resources in the fields of the humanities, social sciences, and education, whereas PubMed can supplement relevant research results in interdisciplinary fields such as educational neuroscience. Although ScienceDirect and Scopus both belong to Elsevier, their functional positioning is different. Scopus focuses on literature indexing and citation analysis, and ScienceDirect emphasizes providing direct access to full-text journals; they complement each other in function. In addition, two Chinese databases, CNKI and Wanfang Data, were added to incorporate local

research results in the intersection of older adults' education and educational technology in the Chinese context. In response to the differences in indexing rules, field settings, and retrieval logics of the above seven databases, targeted retrieval strategies for each database were formulated and adjusted to ensure the rigor of the literature retrieval process.

For search-term settings, the research was divided into three parts based on keywords: AI technology (including "intelligent", "AI", etc.); older adults ("aged", "older adults", "senior", "older adults", "old", "people", "geriatric", etc.); and mental health ("Mental health", "Mental wellness", "Psychological resilience", "Psychological well-being", "Psychological intervention", etc.).

The inclusion criteria for the literature were: (a) The research subjects were 60 years and above; (b) the type of literature was interventional empirical research; (c) the intervention measures were mental health interventions based on AI technology, including executable speech recognition, deep learning, visual perception, mathematical calculation, and reasoning, that incorporated intervention studies dominated by AI technology; (d) the language of the literature was either English or Chinese; (e) full text or abstract was available.

The exclusion criteria were: (1) literature where the research subjects are not older adults aged 60 and above; (2) non-interventional empirical research literature such as conference abstracts, reviews, dissertations, research proposals, commentaries, and letters, as well as literature that only contains viewpoints and discussions without conducting empirical research; (3) literature where the intervention measures are not AI technology-driven mental health intervention programs, excluding literature where AI is a component of broad digital intervention means, and literature where "intelligent" refers to human intelligence rather than AI technology; (4) literature in languages other than English and Chinese; (5) literature where the full text or abstract cannot be obtained, and duplicate publications.

In summary, as shown in the PRISMA flowchart in Fig. 2, the literature screening process of this study was divided into four steps: (1) Identification: The search was conducted in seven databases, and all the literature was organized through EndNote software, resulting in 3781 structured documents initially. (2) Basic screening: After the initial screening, 1196 duplicate documents were excluded. By screening the titles and abstracts of the documents that did not meet the inclusion criteria, 464 documents were finally obtained for the next stage of screening. (3) Full-text screening: Through manual retrieval, six relevant gray literature and citation documents were included in the study. Based on the inclusion criteria and concept definition, 375 documents were excluded. (4) Final inclusion: Based on the above process, 95 documents were included in the study.

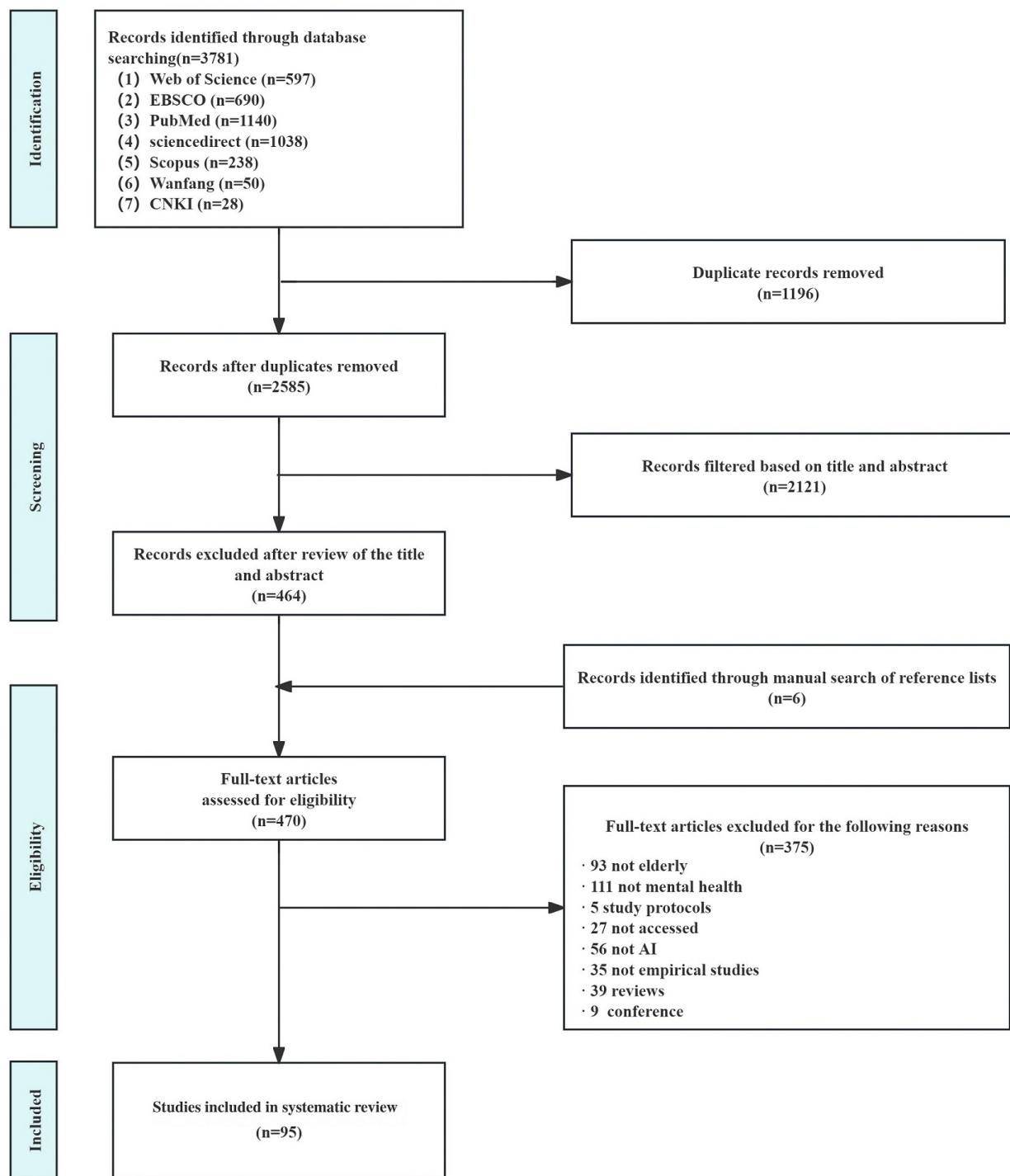


Fig. 2. PRISMA flow diagram of the selection process.

3.2 Data Sorting and Summary

The data sorting was divided into two stages. In the first stage, two scholars independently managed and screened the literature, and then one scholar evaluated the selected literature in the second stage. All differences were resolved through discussion to ensure the formation of a consensus among researchers.

The data results were first summarized from aspects such as the region, object, number of years, method, and scenario of the literature. Then, a distribution map was used to sort out these results. Subsequently, the analysis pointed to the research questions, and the summary of the data was grouped based on the process of AI intervention in the mental health of older adults, including the type of tech-

nology, intervention methods, acceptance status, and actual effect. The study focused on describing the distribution of disciplines in the literature to achieve a deep understanding of the multidisciplinary intersection characteristics of AI intervention in the field of older adults' mental health. The analysis of research from different disciplines provided empirical evidence for subsequent interdisciplinary cooperation.

4. Results

4.1 Overview of Research on AI Intervention in the Mental Health of Older Adults

4.1.1 The Geographical Distribution of Countries

Among the included studies, 25 different countries were involved, including China, the United States, and the United Kingdom. Second, many Western countries, with their well-developed older-adult-care service systems and interdisciplinary research traditions, have formed secondary research clusters. Finally, other Asian countries and Australia in Oceania have also produced a certain number of high-quality studies, but the overall proportion was relatively small.

The research participation of developing countries was relatively low, which reflected regional resource-allocation differences and technological-accessibility gaps in global AI intervention research for the mental health of older adults. In the future, international cooperation needs to be strengthened to promote the balance and inclusiveness of research.

4.1.2 Analysis of the Number of Research Papers Published

A total of 95 empirical research papers that met the criteria were included in the study, as shown in Fig. 3. Temporally, the research evolution of AI intervention in the field of older adults' mental health can be divided into three stages.

The first stage of the period from 2005 to 2019 included no studies prior to 2008. From 2008 to 2019, the number of published papers averaged fewer than 3/year. This reflected the field's exploratory stage, characterized by limited technological maturity and a low degree of disciplinary integration. The second stage, from 2020 to 2022, was the initial phase of AI Interventions for Resilience and Mental Health in Older Adult. Excluding some fluctuations, the number of published articles showed the trend of growth related to the breakthroughs in AI deep-learning technology and the prominent global demand for treating mental health issues among older adults. In the third stage, from 2023 to 2025, the number of published papers showed explosive growth. This reflected the fact that this field became a hot spot for interdisciplinary research; the trend of technology application and multidisciplinary collaborative innovation was significant.

4.1.3 Analysis of Empirical Research Methods

Among the 95 included empirical studies (Fig. 4), the research methods presented a multidisciplinary and collaborative academic feature, with quantitative research as the dominant paradigm, covering core types such as predictive analysis, randomized controlled trials, and pre- and post-treatment trials. The objectivity of the research and the effectiveness of causal inference were guaranteed by constructing data models and setting up control groups. The effect evaluation and mechanism analysis of physical health provided multidimensional methodological support.

Mixed-method research integrated the precision of quantitative data with the in-depth interpretive power of qualitative research. Some studies explored the deep psychological mechanisms of older adults' AI acceptance behavior through qualitative means such as interviews and observations. Usability and acceptance studies, as well as a few qualitative studies, focused on the real experiences and dynamic feedback in intervention practices, forming a three-dimensional research matrix of quantitative verification and qualitative interpretation.

Table 1 systematically sorts the research methods for AI intervention in the field of older adults' mental health, clarifying the core assessment foci and target orientations corresponding to different research types. Various research methods emphasized different assessments according to their analytical advantages. This classification framework can provide methodological references for interpreting the empirical results of AI intervention in the mental health of older adults and verifying the intervention's effectiveness.

4.1.4 Classification of Research Subject Types

The research subjects covered 11 types of older adult groups (Fig. 5). The core group included healthy and disease-free older adults who provided a baseline reference for research on mental health prevention and well-being improvement. The mixed group/undefined group accounted for 18%, and most of them were cross-type intervention effect comparison studies. Among the clinically relevant groups, 12% were patients with dementia or mild dementia, 6% were patients with chronic diseases, 5% were patients with depression, and 3% were patients with schizophrenia. The whole clinically relevant groups all focused on verifying the efficacy of the intervention of AI for specific psychological disorders.

In addition, studies also involved special groups such as those with mild cognitive impairment, mobility issues, susceptibility to infection, veterans, older adults living alone, and those with different physiological conditions, social backgrounds, and psychological needs. Inclusion of multiple populations provided multisample support for the universality and precise adaptation of AI intervention technology and also met the stratified needs of older adult mental health intervention.

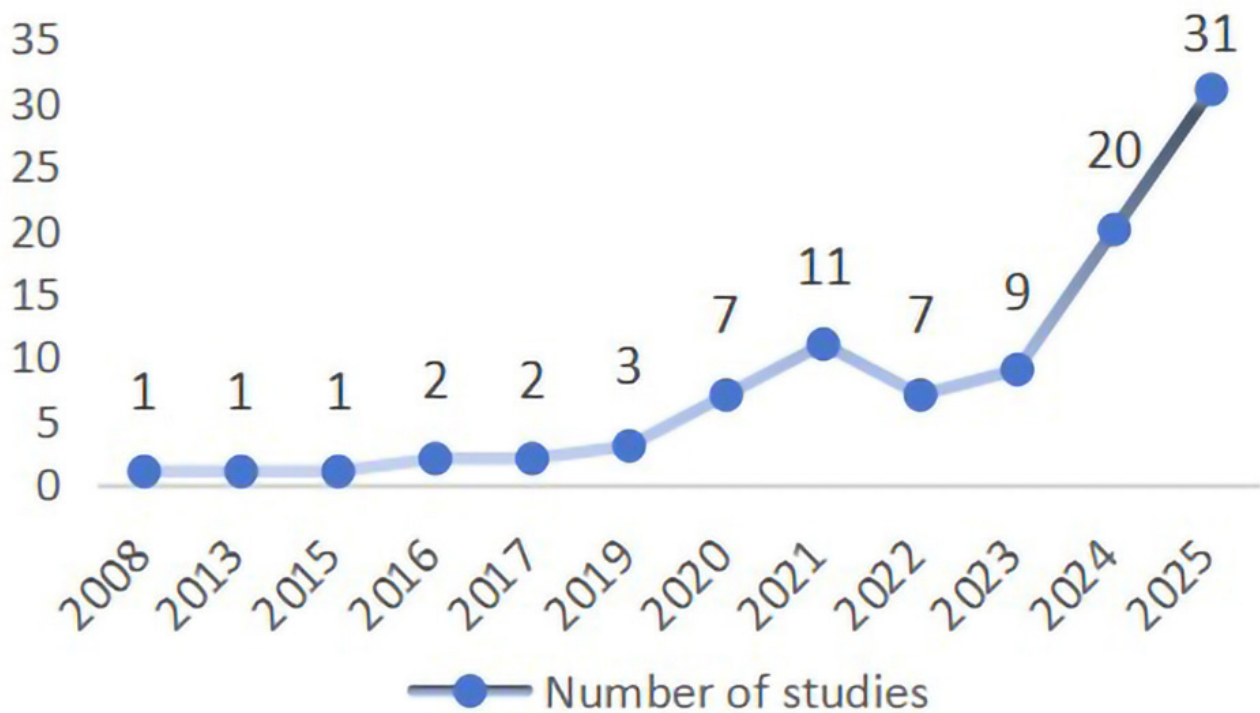


Fig. 3. The number of empirical intervention studies included after screening by year.

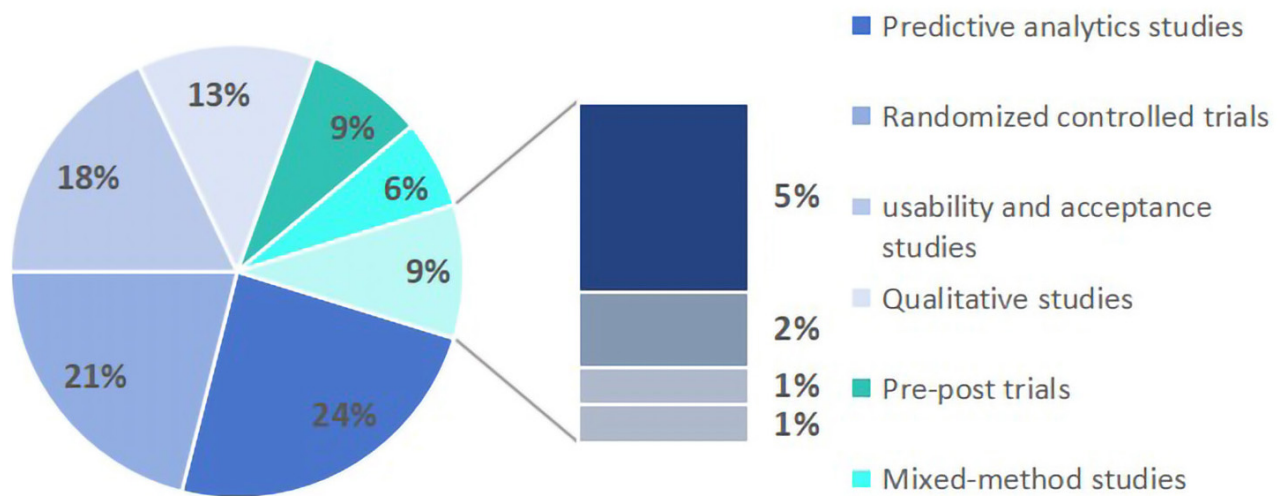


Fig. 4. The proportions of studies by type.

4.1.5 Multidisciplinary Collaboration in Research Fields

Among the 95 studies, the research scenarios reflected a multifaceted and collaborative approach (Fig. 6). The community was often used as the central intervention field, including grassroots units such as urban community service centers and township older-adult-care service stations. These settings relied on the advantage of being close to the daily life of older adults.

Long-term care institutions were the second largest core scenario. These institutions focus on the concentrated care needs of the disabled, semi-disabled, and older adults

living alone, and provide professional and continuous AI intervention services. In addition, the selection of hybrid scenes has become an important supplement. By integrating resources from multiple scenarios such as communities, institutions, families, and medical institutions, the service limitations of a single scenario were remedied, and the ecological validity and universality of research results were enhanced. Finally, some studies also involved characteristic scenarios such as geriatric departments in hospitals and senior activity centers. A full-scenario intervention system covering older adults with different living conditions was

Table 1. Defining the assessment priorities and target outcomes for each type of method.

Study type	Evaluation focus	Core goals
Predictive analytics studies	Use AI technology to predict the likelihood of future events or states occurring	An algorithm or model that identifies effective predictors of an individual's future mental health risk
Randomized controlled trials	Evaluate the causal effects of AI technology interventions by randomly assigning participants to either the intervention group or the control group	Provide the highest level of evidence to prove whether AI intervention is effective for mental health in older adults
Usability and acceptance studies	Evaluate the quality of users' interaction with AI technology and their willingness to use the technology	Identify usability barriers in product design to ensure that AI tools are easy for older people to use and adopt
Qualitative studies	Explore and understand the implications behind the experiences, perspectives, motivations, and behaviors of older people in AI-tech interventions for mental health	Generate rich themes, narratives, and theoretical frameworks to explain AI-intervened mental health in older adults
Pre-post trials	Measure the mental health of the same group of older adults to assess changes before and after the AI technology intervention	Preliminary evidence suggests that the intervention may be effective, showing significant improvements in key indicators of mental health among older adults
Mixed-method studies	Combine quantitative and qualitative methods to study AI-powered mental health interventions	While quantifying the magnitude of the effects of AI intervention on mental health in older adults, gain a deep understanding of the processes and contexts in which the effects are produced
Survey studies	Systematically collect data from large samples using standardized questionnaires	Describe the characteristics of older adults and explore the relationships between AI technology interventions in older adults' mental health variables
Cross-sectional studies	Collect data at a single point in time to describe the current state of AI technology intervention in mental health of older adults or to examine the associations among the variables	Provide a "snapshot" of a specific point in time, such as understanding the existing association of AI technology intervention in mental health of older adults between users and non-users
Quasi-experimental studies	Evaluate the effect of the intervention when randomization is not possible	Provide strong evidence of effect in real-world conditions to assess the effect of AI intervention on mental health in older adults when randomization is not feasible
Population studies	Study the distribution, determinants and patterns of mental health-related events at the large-scale population level	Identify public health trends and risk factors to provide a basis for policy

formed, providing an empirical basis for the scenario-based adaptation of AI technology.

4.1.6 Summary of Core Research Dimensions

Table 2 shows the systematic review of the core dimensions of empirical research on AI intervention in the field of older adults' mental health, covering four core modules: research subjects; types of AI technologies; intervention paths; and cross-disciplinary coverage. The characteristics presented not only reflected the current research status in this field but also revealed the deep alignment between technology application and the mental health needs of older adults.

First, the dimensions of the research subjects exhibited distinct heterogeneity and specificity. Studies covered

11 groups, including healthy older adults, patients with dementia or mild dementia, and those with anxiety and depression. Among them, the proportion of healthy and disease-free older adults was 39%, which confirmed the research orientation of the full-chain mental health service covering prevention, intervention, and rehabilitation. The focus on special groups with diseases such as dementia and schizophrenia reflected the precise response of technology to the vulnerable areas of mental health among older adults.

Second, the classification of AI technology types was based on the development context and application scenarios of the technology. The gradient distribution from basic AI support technologies to multi-AI integration technologies highlighted the trend from algorithm empowerment to multimodal interaction. Among all AI technology types,

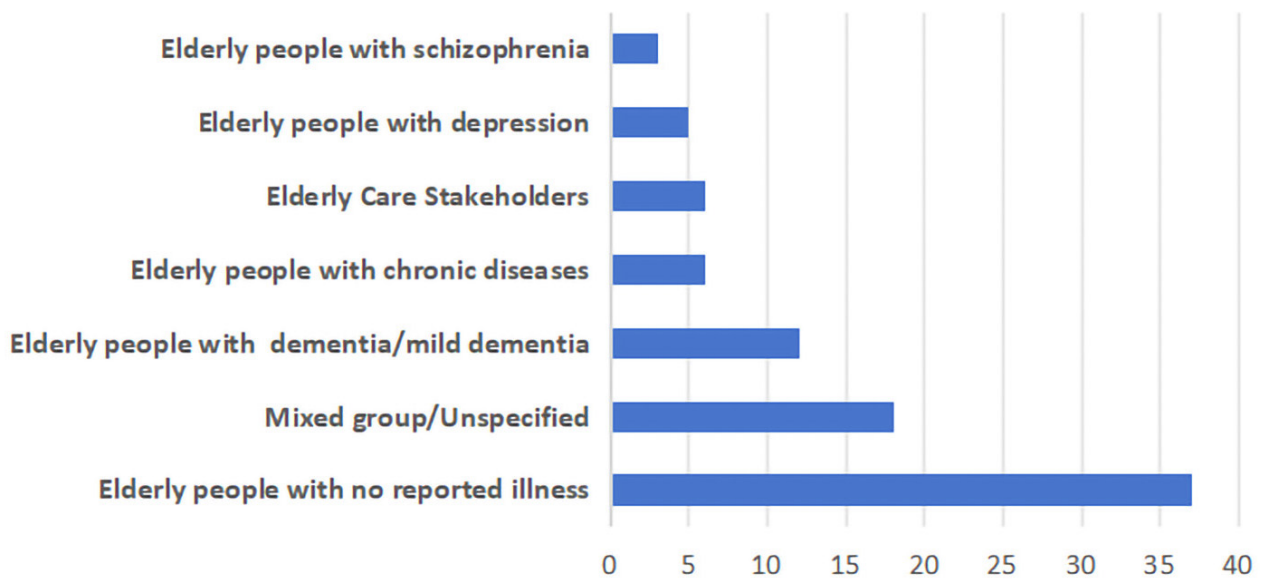


Fig. 5. Number of studies by main participants.

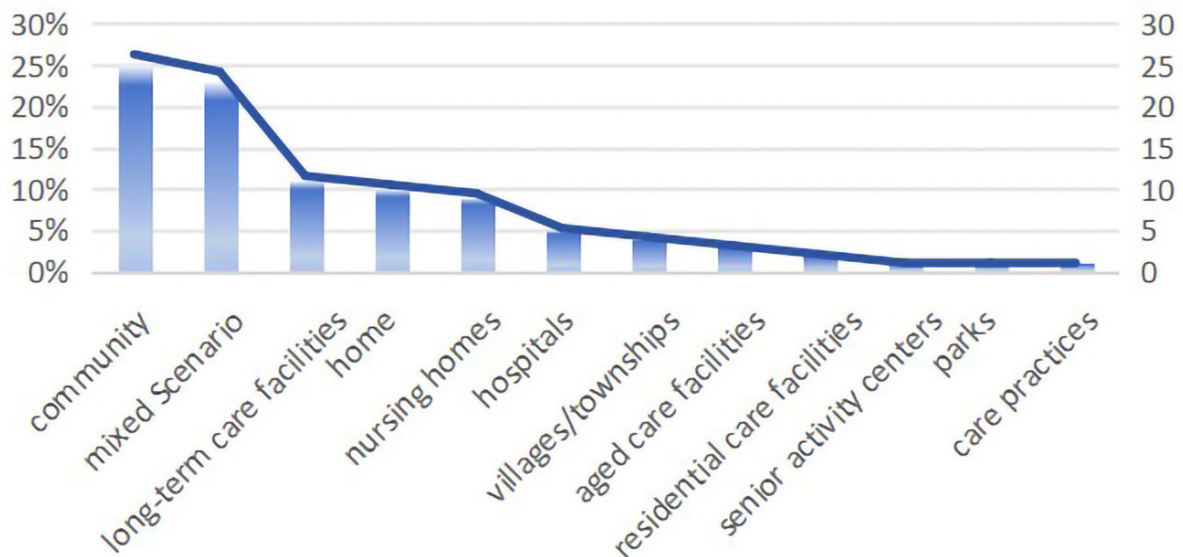


Fig. 6. Number of studies by settings.

robot technology was dominated by social robots, reflecting the core demands of the older adult group for emotional companionship and social connection.

Third, the nine types of intervention paths constructed a multidimensional and collaborative intervention system. The combination of personal emotional support and enhanced social interaction highlighted the core position of psychological support in intervention. In addition, the precise matching of paths, such as mental-illness prediction and cognitive-function intervention, with specific techniques has achieved a triangular interaction among technical functions, intervention goals, and group needs.

Finally, interdisciplinary coverage reflected the essence of disciplinary integration in this field. The five-

dimensional framework of clinical medicine, psychiatry, psychology, sociology and social work, and computer science and engineering broke down the disciplinary barriers of traditional mental health intervention, forming a full-chain disciplinary collaborative network covering technology research and development, clinical application, psychological adaptation, and social support.

4.2 A Comprehensive Framework for AI Intervention in the Mental Health of Older Adults

4.2.1 Selection and Functional Positioning of AI Technologies

Seven types of AI technology were summarized in the present study, as shown in Table 3. The table includes basic

Table 2. Main characteristics of the literature involving AI intervention in the mental health of older adults.

Categories	Characteristics	References (partial)
Number of studies by participants	Healthy older adults without diseases	Imkome et al., 2025; Murayama and Takase, 2025
	Mixed group/unspecified	Lin et al., 2022; Yuan et al., 2025
	Older adults with dementia/mild dementia	Chen et al., 2024; Wu et al., 2025
	Older adults with chronic diseases	Blavette et al., 2025; Reed et al., 2025; Shade et al., 2025
	Older adults care stakeholders	Otaka et al., 2024; Tobis et al., 2021; Waycott et al., 2022
	Older adults with anxiety/depression	Chen et al., 2020; Chou et al., 2024; Lee et al., 2021
	Older adults with schizophrenia	Allahgholi and Mazhari, 2025
	Older adults with cognitive impairment	Kim et al., 2025; Lee and Davis, 2020; Lin et al., 2025b
	Other specific older adult groups	Brandl et al., 2024; Lane et al., 2016
	Mobility difficulties	Su, 2025
AI types	Older adults susceptible to infections	Loveys et al., 2021
	Basic AI support technologies	Byeon, 2021; Lin et al., 2022; Nejadshamsi et al., 2025
	Multimodal AI integration technologies	Brandl et al., 2024; Chang et al., 2025; Chung et al., 2025
	Voice assistants	Kim, 2021; Shade et al., 2025; Yan et al., 2024
	Robots	Imkome et al., 2025; Murayama and Takase, 2025
	Virtual reality	Barsasella et al., 2021; Chi et al., 2017; Liu et al., 2025b
	Intelligent care systems	Jansen et al., 2025
AI intervention pathways	Hybrid/other AI technology applications	Waycott et al., 2022; Yang and Kuang, 2025
	Individual emotional support	Banks et al., 2008; Deepaisarn et al., 2024; Jøran-son et al., 2015
	Enhanced social interaction	Fraune et al., 2022; Tobis et al., 2023b; Wolfe et al., 2025
	Cognitive function intervention	McCarren and Kuoppamäki, 2025; Moyle et al., 2017; Nagata et al., 2025
	Mental illness prediction	Hatton et al., 2019; Lin et al., 2024; Yadav and Bhutia, 2025
	Daily care assistance	Blavette et al., 2025; Lane et al., 2016; Tobis et al., 2023a
	Promoting physical health	Chang et al., 2025; Gudala et al., 2022; Zhang et al., 2024;
	Mental health assessment	Bautista-Salinas et al., 2019; Li, 2023; Lin et al., 2025a
	Multiple function integration	Fields et al., 2021; Stara et al., 2023
Covering subjects	Mental illness identification	Lee et al., 2024
	Clinical Medicine and Psychiatry	Lee et al., 2024; Lin et al., 2025b; Rutkowski et al., 2020
	Psychology	Badal et al., 2021; Li et al., 2025
	Sociology and Social Work	Byeon, 2021; Tanioka et al., 2021; Tobis et al., 2021
	Computer Science and Engineering	Kim et al., 2023; Lin et al., 2025a; Papadopoulos et al., 2022

AI support technologies, multi-AI integration technologies, robots, voice assistants, virtual reality, intelligent care systems, and Hybrid/other AI technology applications. This classification was based on the development trajectory of

AI technology and the characteristics of actual research and application.

Among the AI technologies, robots were the most widely used, mainly included in three categories:

Table 3. Main technologies of AI intervention in the mental health of older adults.

AI types	Characteristics	References (partial)
Basic AI support technologies	Machine Learning	Byeon, 2021 ; Li et al., 2025 ; Nejadshamsi et al., 2025
	Deep Learning	Lee et al., 2024 ; Lin et al., 2025a ; Wang et al., 2025
	Computer Vision	Kim et al., 2023
	Natural Language Processing	Badal et al., 2021
Multimodal AI integration technologies	Electronic Mental Health Screening	Brandl et al., 2024
	Intelligent Mobile Application	Chung et al., 2025
	Intelligent Sensing Analysis	Bautista-Salinas et al., 2019
	Digital Twin Data Processing	Chang et al., 2025
Voice assistants	Personality Voice Assistant	Yan et al., 2024
	Smart Speaker	Kim, 2021
Robots	Chatbot	Imkome et al., 2025 ; McCarren and Kuopamäki, 2025 ; Wolfe et al., 2025
	Social robot	Lane et al., 2016 ; Murayama and Takase, 2025 ; Otaka et al., 2024
	Nursing robot	Wu et al., 2026
Virtual reality	VR course	Barsasella et al., 2021
	Digital human	Liu et al., 2025b
	Digital pet	Chi et al., 2017
Intelligent care systems	Intelligent Care Intervention Program	Guo et al., 2025
	Smart Care Call System	Jansen et al., 2025
Hybrid/other AI technology applications	Eg: Multitype AI Technologies	Waycott et al., 2022

care/health care robots, social robots, and chatbots. Among them, social robots are the most numerous, and the brand categories mentioned are also the most extensive. In particular, a seal-shaped robot named PARO ([Chen et al., 2022](#); [Chen et al., 2024](#); [Lane et al., 2016](#)) has become the main experimental product in most studies.

Basic AI support technologies were mainly supported by AI technologies such as machine learning and deep learning. In research, these technologies were mostly targeted at older adults with mental illnesses, and through model construction, they aimed to achieve medical monitoring and mental illness prediction. In recent years, the increasingly diversified development of technology, sensor devices, mobile applications, and digital twins has provided a new impetus for the cross-integration of AI-combined technologies. The selected literature indicated a rapid increase in the application of these technologies between 2024 and 2025, demonstrating their rising popularity and research interest. In contrast, virtual reality, voice assistant, and intelligent-care-system technologies have grown relatively slowly and are mostly targeted at fixed groups, such as older adults living alone and those undergoing rehabilitation training.

4.2.2 AI Intervention Design and Implementation Path

In the design of actual AI intervention methods, in combination with specific AI technology categories (Fig.

7), the AI intervention paths of the selected literature in the research could roughly be divided into nine categories: individual emotional support (27.4%); enhanced social interaction (14.7%); cognitive function intervention (13.7%); prediction of mental illness (13.7%); daily care assistance (9.5%); promotion of physical health (5.3%); mental health assessment (5.3%); mental illness identification (4.1%) and mixed functions of multiple types (6.3%). It is worth noting that the implementation paths of most AI technologies exhibited a comprehensive and diverse characteristic. For a more in-depth analysis, only the more distinctive and prominent functional categories from the literature were selected for discussion.

Overall, the matching degree between AI functions and intervention paths was relatively high. Most chatbots and social robots play a core role in individual emotional support and in enhancing social interaction. In the implementation paths of mental illness prediction and assessment, basic AI technologies represented by machine learning have built a rich set of predictive analysis models. However, AI technologies centered on cognitive-function intervention mostly take older adult patients with dementia as the main research subjects, reflecting the precise matching among technology, intervention, and population.

In the practical application of technology, different AI technologies play different roles. AI technology, which is functionally positioned to promote physical health, usually

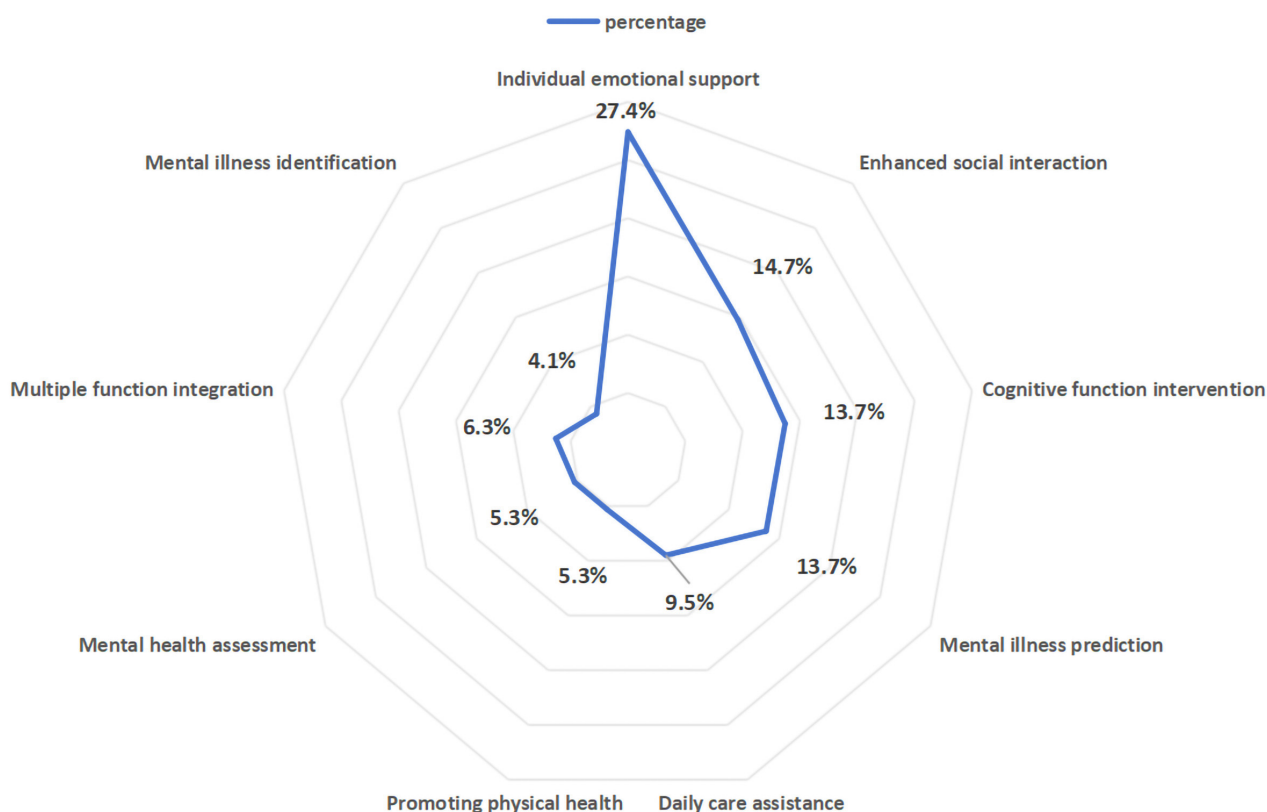


Fig. 7. Implementation of AI intervention in the mental health of older adults.

plays an auxiliary role designed to promote the intelligence, precision, and efficiency of existing services or activities (Chang et al., 2025). Some scholars have also combined AI with distinctive traditional fitness programs, such as Tai Chi (Zhang et al., 2024) or Baduanjin (Su, 2025).

4.2.3 Acceptance, Accessibility, and Suitability for Older Adults

To better illustrate the actual process of AI intervention in the mental health of older adults, 17 usability and acceptance studies were included, as well as five assessment surveys conducted by other older adult mental health stakeholders. In addition, most of the selected studies conducted pre-evaluations on the acceptance and adaptability of AI products in terms of research methods and subject screening to ensure good research results.

Although there are differences in AI technology and positioning, and although the methods and specific expressions adopted by each study varied, most of the literature still showed relatively consistent results concerning the acceptance of AI intervention in the mental health of older adults. Our summary revealed that the factors influencing the acceptance and accessibility of AI technology intervention for mental health among older adults mainly included the following: affinity (Tobis et al., 2023a); perceived intelligence (Wang et al., 2024); perceived ease of use; perception security; high cost performance (Gudala et al., 2022);

external help and support (Waycott et al., 2022); and smooth technical configuration (Blavette et al., 2025; Nagata et al., 2025).

The perspective of stakeholders further validated such research findings. Due to the distinctiveness of some of the research subjects, a small number of studies relied on the observation and interview perspectives of caregivers and the relationship networks of some geriatric experts, computer developers, and other related groups, in order to obtain more accurate results. Such literature often focused more on social support, such as the influence of assistance from families, organizations, and care institutions, on the psychological intervention of AI technology for older adults (Waycott et al., 2022). However, studies have shown that even for social robots, their social function scores are lower than their assistive function scores, and there is a correlation between the two (Tobis et al., 2021).

4.2.4 AI Intervention Effects and Evidence Intensity

In the evaluation of the effect of AI intervention on the mental health of older adults, the vast majority of studies adopted questionnaire interviews, long-term follow-ups, and before and after data collection to obtain horizontal or vertical results, and used the usage rate and satisfaction of older adults as the main basis for judgment (Blavette et al., 2025). Therefore, although some studies raised corrective feedback or possible risks, the research results showed a

Table 4. Research topic clustering classification table involving AI intervention in the mental health of older adults.

Clustering topic	Subclustering	Reference (Partial)
The efficacy and risk management of AI clinical intervention	Intervention for dementia/cognitive impairment	Chen et al., 2024 ; Kim et al., 2025
	Intervention for chronic psychological problems	Chang et al., 2025 ; Su, 2025 ; Yan et al., 2024
	Depression/anxiety management	Lee et al., 2021
AI psychological assessment mechanism and human-computer interaction	Mental illness predictive screening	Chung et al., 2025 ; Kim et al., 2023
	Development of evaluation tools	Bautista-Salinas et al., 2019 ; Murayama and Takase, 2025 ; Nejadshamsi et al., 2025
	Human-computer interaction optimization	Blavette et al., 2025 ; Nagata et al., 2025 ; Wang et al., 2024
AI empowers social support and well-being improvement	Social and emotional support	Reed et al., 2025 ; Shade et al., 2025
	Community home welfare	Liu et al., 2025b
Ethical norms and sustainability development of AI intervention	Data security and privacy protection	Costa et al., 2017
	Technical fairness	Wu et al., 2026
	Sustainable design	Alharbi et al., 2023

strong intervention effect of AI technology in the field of mental health for older adults. A few qualitative studies also made detailed descriptive summaries of the specific intervention benefits, such as enhancing social engagement, virtual departure from nursing homes, rediscovering personal interests, and providing entertainment ([Waycott et al., 2022](#)).

However, AI technology is not foolproof in terms of the benefits of intervening in the mental health of older adults. Although we used empirical studies as the screening condition, and the overall strength and effectiveness of the literature evidence were relatively strong, the proportion of experimental or quasi-experimental research paradigms with strong evidence levels was approximately 55%. In our study of the effect of AI intervention, the research methods in the literature were generally consistent, involving fewer evaluation levels, and faced the predicament of insufficient methods. Some studies had already discovered this possible vulnerability, such as the development of the assessment tool questionnaire used by social robots in older adults' care ([Tobis et al., 2021](#)). However, in the future, this field should produce more possible methodological interventions to demonstrate the practical benefits of AI intervention, and various specific AI technologies and intervention methods.

4.3 Focus Areas of AI Intervention in the Mental Health of Older Adults

To further understand the hot issues in the research on AI intervention in the mental health of older adults, a keyword-theme cluster analysis was conducted. Taking the period from 2005 to 2025, a key theme clustering network diagram was generated, as shown in Table 4. Four themes and eleven sub-clusters of research were obtained. By analyzing the theme clusters in the field of AI intervention in the mental health of older adults research, the similarities and differences in the research foci of different scholars could be observed.

4.3.1 Theme One: Efficacy and Risk Management of AI Clinical Intervention

The theme of AI clinical intervention efficacy and risk management focused on the clinical scenarios of mental health in an older adult population. It centered on the verification of intervention effects and risk prevention and control for specific psychological disorders. The core areas included intervention for dementia/cognitive impairment, intervention for chronic psychological problems, and management of depression/anxiety. Through the precise intervention and dynamic monitoring enabled by AI technology, scientific support was offered for clinical mental health services for older adults.

First, dementia/cognitive impairment is a prevalent mental disorder among older adults. AI technology, with its interactive and continuous advantages, has become a core means of clinical intervention in this field. Such interventions are designed to improve cognitive function, stabilize emotions, and enhance the quality of life, mainly through technological carriers such as social robots and intelligent care systems. [Chen et al. \(2024\)](#) found that the group-based PARO social robot intervention had a significant positive impact on the cognitive function and autonomic nervous system function of older adults with mild dementia, which was verified through a randomized controlled trial; it proved to be effective in slowing down the cognitive decline process in older adults in care institutions. [Kim et al. \(2025\)](#) showed that the application of social-assistance robots among older adults with cognitive impairment, living in the community, not only improved depressive symptoms but also activated cognitive functions through continuous social interaction, providing a feasible path for cognitive-impairment intervention in home settings.

Second, chronic-psychological-problem intervention focused on the persistent psychological distress and long-term accumulated psychological disorders related to

chronic diseases in older adults. The aim was to achieve dynamic regulation of psychological states through multi-modal intervention and remote monitoring by AI technology. Such interventions often combine the chronic disease background of older adults, such as chronic pain and comorbid chronic diseases, to construct an integrated intervention plan for both physiology and psychology. Yan et al. (2024) suggested that long-term interaction between older adults and the potential of personal voice assistant (PVA) devices can help reduce loneliness. Chang et al. (2025) used the combination of AI and digital-twin remote medical technology to improve the psychological stress related to chronic diseases among older adults in rural areas of China through physiological-index monitoring and psychological-support intervention. In addition, some scholars have integrated traditional health-preservation methods such as Tai Chi with AI and virtual reality technology, which not only enhanced the physical functions of older adults with frailty but also alleviated chronic psychological distress, such as long-term accumulated anxiety and helplessness, through mindfulness training (Su, 2025). Finally, depression/anxiety is the most common mental disorder among older adults. AI technology builds a diversified clinical intervention system through functions such as emotional support, behavior activation, and risk warning. Such interventions cover different severity levels of depression/anxiety symptoms, from mild mood counseling to moderate to severe symptom assistance treatment, with technological carriers including social robots, chatbots, and voice assistants. Lee et al. (2021) pointed out that the application of passive-sensing technology in late-life psychological treatment provided a new monitoring perspective for depression/anxiety intervention. By continuously collecting physiological signals and behavioral data of older adult patients, early identification and intervention adjustment of depression/anxiety symptoms could be achieved. Relevant studies showed that AI intervention had good acceptance in the management of depression/anxiety, and its intervention effect had been verified through pre- and post-treatment comparisons and long-term tracking. Furthermore, the AI intervention can effectively reduce the side effects of traditional clinical intervention and increase the intervention participation of older adults. In addition, personalized adaptation design for different scenarios further reduced intervention risks and enhanced the universality of clinical application.

4.3.2 Theme Two: AI Psychological Assessment Mechanism and Human-Computer Interaction

The core theme of the AI psychological assessment mechanism and human-computer interaction focused on three major directions: the development of precise assessment tools for the mental health of older adults, the early prediction and screening of mental disorders, and the improvement of the adaptability of human-computer interaction. By integrating multidisciplinary technologies and the

psychological characteristics of older adults, a scientific, efficient, and age-oriented AI intervention support system could be constructed.

First, the prediction and screening of mental disorders in older adults focused on identifying potential signals of mental illness through AI technology, thereby achieving early risk identification. Recent research has mostly built prediction models based on multisource data, including behavioral data, physiological indicators, and text information. Chung et al. (2025) analyzed the open text messages of older adults' mobile applications using the BERT and BER Topic models, effectively achieving clinical-depression screening and providing a non-invasive and convenient assessment path for older adults in the community. Kim et al. (2023) used facial expression recognition technology to accurately track depressive symptoms in older adults, breaking through the limitations of traditional assessment methods that relied on subjective reports. Those studies collectively demonstrated that AI technology can capture the hidden characteristics of mental illness in older adults, providing data support for early intervention and compensating for the shortcomings of traditional screening regarding timeliness and coverage. Second, the development of assessment tools optimized the rigor and adaptability of mental health assessment for older adults, focusing on solving the problems of complex operation and insufficient cultural adaptability of traditional tools in the older adult population. Research directions mainly included the development of new assessment tools and the AI optimization of traditional tools. Bautista-Salinas et al. (2019) developed an intelligent emotion-monitoring tool based on wearable devices, which could capture the emotional fluctuations of older adults in daily life in real time, providing continuous data support for dynamic assessment. Nejadshamsi et al. (2025) designed the HOPE model based on the cognitive characteristics of older adults, and trained machine-learning algorithms with Wi-Fi motion-sensor data to accurately predict the risk of depression. In the optimization of traditional tools, Murayama and Takase (2025) used AI technology to enhance the cultural adaptability and accuracy of assessment tools, thereby significantly improving the targeting of assessment by incorporating local demographic characteristics and health indicators. The development and optimization of these tools provided more diverse and efficient options for mental health assessment in older adults, aligning with their physiological and psychological characteristics. Finally, the optimization of human-computer interaction focused on enhancing the adaptability of AI technology to older adults. It mainly revolved around three dimensions: operational convenience, emotional resonance, and personalized adaptation. Nagata et al. (2025) developed a dialogue robot for older adults living alone who had cognitive impairments, and significantly improved usability by optimizing voice recognition accuracy and simplifying instructions. Blavette et al.

(2025) suggested that AI systems could enhance emotional connections with older adults by integrating empathy design and natural-language-processing technology. For instance, some social-assistance robots can adjust their response methods based on the language expression and emotional state of older adult users, enhancing the targeting of emotional support (Blavette et al., 2025). Wang et al. (2024) designed and developed the GoodTimes interactive multimodal photo album application, which uses AI to have personalized conversations with users and tell stories about their photos, aiming to improve the psychological well-being of older adults by helping them recall past experiences.

4.3.3 Theme Three: AI Empowering Social Support and Well-Being Enhancement

The theme of AI empowering social support and well-being enhancement focused on optimizing the quality of social connections and expanding the boundaries of life experiences for older adults through technology. It centered around two sub-themes: social and emotional support and community and home well-being. The research logic aligned with the core concerns of sociology and social work regarding the well-being of older adults. The goal was to achieve a dual improvement in mental health and quality of life through resource integration and scenario adaptation.

Social-emotional support is a crucial requirement for the mental health of older adults. AI technology, through personalized interaction, multimodal feedback, and scene adaptation, breaks the time and space limitations and supply-shortage problems of the traditional support model, and reconfigures the supply form of emotional connection. Studies have shown that AI intervention effectively alleviates the loneliness and social isolation problems of older adults by simulating interpersonal interaction and providing continuous companionship. The research of Shade et al. (2025) on older adults with chronic pain indicated that personalized voice-assistant intervention (CVA-E group) significantly reduced the loneliness-scale score through customized meditation, music preference matching, and other content, and showed better emotional adaptability than did the standardized intervention group, confirming the enhancing effect of personalized design on the effectiveness of emotional support. Multimodal technology further enriched the realization path of emotional support. The application of generative AI expanded the supply boundary of support content. The HARMONEE project used generative AI images to provide reminiscence therapy for long-term-care older adults by restoring past-life scenes, thereby helping cognitively intact older adults maintain social memory and compensate for the shortage of physical materials in traditional reminiscence therapy (Reed et al., 2025). However, communities and homes are the core living domains for older adults, and the intelligent upgrade of welfare services in these areas is a key implementation path

of AI empowerment for older adults' welfare. AI technology integrates health monitoring, daily care, and psychological support functions in order to build a full-chain service system for prevention, intervention, and rehabilitation. That facilitates the transformation of welfare services from fragmented supply to systematic integration, and takes into account universality and the needs of special groups. At the community level, AI technology enhances social integration through resource integration and activity empowerment. Virtual travel experiences satisfy the inner needs of older adults, enhance their happiness, and thereby improve their travel confidence and willingness. Its core value lies in breaking physical space limitations and providing a low-cost, high-coverage, new form for community welfare services (Liu et al., 2025b).

4.3.4 Theme Four: Ethical Norms and the Sustainable Development of AI Intervention

This topic focuses on the ethical risk management and long-term application guarantee of AI technology in older adults' mental health intervention, centering on three sub-directions: data security, technological fairness, and sustainable design. It is a key research area that balances technological innovation and humanistic care, filling the previous research gap that only focused on effects and mechanisms.

First, data security and privacy protection are the core ethical concerns of AI intervention. Research has indicated that the commercial deployment of older adults' care platforms in the field of assisted living environments has increased sharply, but many of them neglect user privacy and data protection. As cognitive assistants, these platforms need to transmit a large amount of personal privacy data, which can easily endanger users' basic rights. Therefore, Costa et al. (2017) have sorted out the core rights, legal guarantees, and potential ethical issues of data protection and transmission, analyzed the contradictions between technological development and legal ethics, and proposed targeted solutions to avoid data security risks. Second, technological fairness focuses on the digital divide among older adult groups. Researchers have conducted empirical analyses, based on questionnaire data and OLS models, on the optimization of rural older adults' care resource allocation driven by digital intelligence in China. The authors pointed out that the satisfaction of rural older adults with the smart older adults' care services provided by the government significantly affected their willingness to participate. However, currently, smart older adults' care services have problems such as insufficient supply and poor adaptability, reflecting the technological-fairness dilemma of uneven application and insufficient resource accessibility of digital technology in the rural older adults' care field (Wu et al., 2026). Finally, the sustainable design of long-term intervention focused on the long-term operation and dynamic optimization of AI intervention. Research has mostly fo-

cused on the verification of short-term intervention effects, whereas the improvement of older adults' mental health requires long-term and continuous technical support. One study found that AI tools, without regular function updates and personalized adjustments, have had a rapid decline in usage rate after 6 months. That study also found that by using IoT smart carpets and AI technology to enhance the sustainability of fall-detection for older adults living alone, timely alarms and notifications to caregivers effectively reduced the risks after a fall, helping older adults to live safely and independently (Alharbi et al., 2023).

4.4 A Comprehensive Model of AI Intervention in the Mental Health of Older Adults From an Interdisciplinary Perspective

4.4.1 Clinical Medicine and Psychiatry: Efficacy Verification and Risk Management

Among the selected papers, 24 articles mainly focused on interventions at the clinical medicine and psychiatry levels. In this field, geriatrics, psychiatry, and nursing were the main constituent themes. Regarding the research subjects, the literature frequently focused on older adults with dementia/mild dementia, chronic pain, anxiety/depression, cognitive impairment, schizophrenia, and some with other more severe diseases. Therefore, in the core intervention implementation, most of the literature centered on verifying the intervention effects of AI technology on various diseases. In contrast, research in the field of nursing often paid more attention to the intervention response after AI technology warnings, that is, using AI tools for daily psychological care of older adults as the basic scenario, with the focus on necessary risk management as the key research topic.

4.4.2 Psychology: Psychological Assessment Mechanism and Quality of Human-Computer Interaction

Among the selected papers, 19 articles mainly focused on interventions at the psychological level. Psychology, as another core theme in this study, had a relatively high focus in discipline journals and in prominent core journals. In terms of specific research types, studies revolved around the psychological aspects of older adults' depression and anxiety, cognitive behaviors such as dementia and cognitive impairment, and involved empirical research and design on assessment mechanisms and intervention plans. It also involved combining traditional psychological methods, such as mindfulness and reminiscence, with AI technology for intervention. On this basis, digital psychology emerged as another important discipline category, focusing on the acceptance, accessibility, and adaptability of older adults; the matching of "AI technology to meet the mental health needs of older adults" was emphasized, aiming to further improve the quality of human-computer interaction from the perspective of geriatric psychology.

4.4.3 Sociology and Social Work: Quality of Life, Social Support, and Well-Being

Among the selected papers, 18 articles mainly focused on interventions at the sociological and social work levels. Public health, social work, and a few articles were included on urban construction and tourism management with more distinctive features. Although those articles accounted for a relatively small proportion of the total, they were distributed across a wider range of journals. However, they often took the improvement of social well-being as the core research focus. Specifically, public health mainly included AI technology interventions in mental health screening for older adults, with a few articles focusing on the more widespread public health issue. Social work articles often focused on the care of vulnerable groups and social work intervention, social support, and older adults' well-being were regarded as research topics with broader benefits.

4.4.4 Computer Science and Engineering: Algorithm Performance and Human-Computer Interaction Design

Among the selected papers, 34 mainly focused on interventions at the computer science and engineering levels. This type of literature accounted for more than one-third of all studies, mainly covering computer science and technology, biomedical engineering, and software engineering. Specifically, research in computer science and technology was the most numerous, with the main focus on basic AI support technologies such as machine learning and deep learning, with most articles adopting predictive analysis research. Biomedical-engineering research mainly revolved around multi-AI combined technologies, such as wearable smart devices and electronic mental-health detection. Software-engineering research was more diverse and closely integrated with other disciplines, such as the construction and maintenance of intelligent care systems and the development of intelligent mental-health apps, with research themes shifting more towards human-computer interaction design from the algorithm-performance end.

AI intervention in the mental health of older adults was a comprehensive disciplinary perspective on the entire intervention process. Therefore, as shown in Fig. 8, a comprehensive model for AI intervention in the mental health of older adults was constructed. The model was divided into two major levels: the inner circle and the outer circle. There is a mutual flow between the two, forming a criss-cross pattern.

Specifically, the inner circle of the model includes two core components: AI and older adults' mental health; their interaction is achieved through intervention. Among the inner circle, AI technology mainly forms the actual intervention design and the implementation path through its specific selection and positioning, influencing older adults' mental health. Older adults influence the selection and use of AI technology based on the core principles of acceptance, accessibility, and adaptability. The interaction between

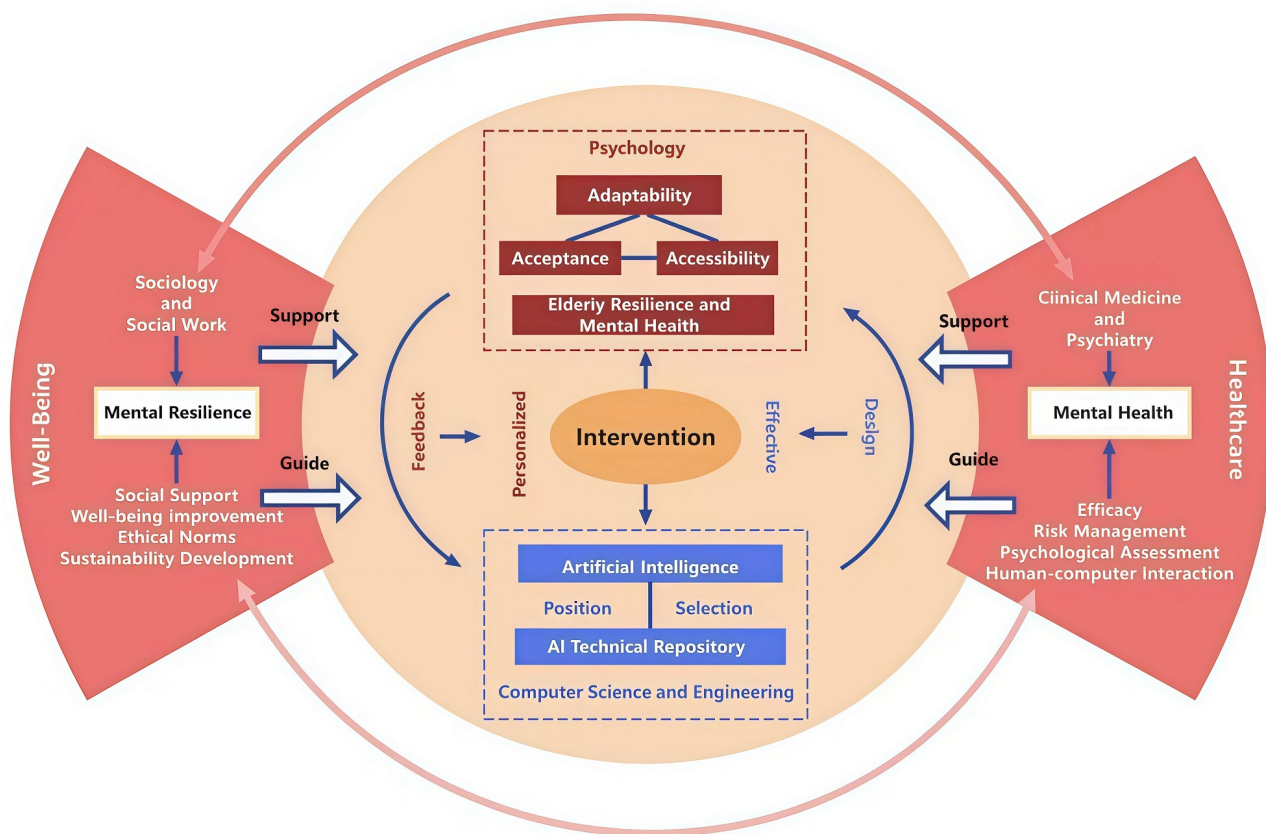


Fig. 8. A Comprehensive model of AI intervention in the mental health of older adults.

the two is reflected in the integration of the technology-acceptance model and human-computer interaction theory. The interaction within the inner circle integrates the disciplinary characteristics of psychology and computer science engineering, focusing on the matching of the core functions of AI technology and the psychological needs of older adults to ensure the effectiveness and personalization of the intervention measures. The outer circle considers medical care, health, and social welfare as the main comprehensive scenarios. Under the joint shaping of the successful aging theory and the Sociotechnical Systems Theory, the model realizes the value orientation and support system guidance of intervention. Medical health and social welfare not only integrate the core essentials of sociology and social work, clinical medicine, and psychiatry, but also extend the intervention chain of the inner circle to the social support system, medical health services, and ethical and legal considerations, ensuring the comprehensiveness and sustainability of the intervention.

Overall, AI intervention for older adults' mental health is a comprehensive process involving multiple disciplines. Therefore, the comprehensive framework emphasizes the collaborative role of multiple disciplines throughout the entire chain of AI intervention for older adults' mental health. In practical applications, interventions must ensure rigor and effectiveness, remain responsive to the real

needs of older adults, and be aligned with broader social benefits, thereby supporting the long-term sustainability of these interventions.

5. Discussion

5.1 Connection With Previous Studies

The present study was closely related to the recent research on the use of AI to intervene in the mental health problems of older adults, and also expanded the boundaries of the research. Previous studies have laid the foundation for this research in three core features: exploration of technology application, attempts at interdisciplinary integration, and construction of research frameworks.

First, in terms of technology application, the literature has mainly focused on the impact of specific AI technologies on the mental health of older adults in order to verify the feasibility of AI in scenarios such as cognitive-function-decline intervention and emotional support. We further systematically collated these scattered technological practices, summarized seven AI technologies and nine intervention paths, and clarified the matching logic between technology selection and intervention goals, which responded to the call in previous reviews for overall technology application research. Second, regarding interdisciplinary integration, scholars have long emphasized the need for interdisciplinary cooperation in the mental health intervention

of older adults, and some studies have initially explored the integration of computer science, medicine, and psychology. We expanded the disciplinary scope to sociology and social work, constructed a four-dimensional disciplinary collaboration framework, and revealed the differences in research focuses among different cultural backgrounds. This supplemented the insufficient analysis of disciplinary integration in the research literature. Finally, in terms of research frameworks, previous scope-defining reviews mostly adopted exploratory theoretical frameworks to explore the feasibility of AI intervention, thereby lacking a systematic summary of the entire intervention process. We followed the guidance of the PRISMA framework, integrated the complete chain of technology selection, intervention implementation, acceptance evaluation, and effect verification, refined four core research themes, and constructed a two-layer comprehensive theoretical model. This not only filled the research gap produced by content fragmentation in this field but also provided a unified analytical framework for subsequent empirical and theoretical research.

Overall, we used the concern of previous research on the core issue of matching technological empowerment with the needs of older adults, and broke through the limitations of previous research, such as single technology, single discipline, and fragmented research, to promote the development of research towards systematization, interdisciplinary integration, and practice orientation.

5.2 Research Innovation Points and Characteristics

We first depicted a panoramic view of the process research on AI intervention in the mental health of older adults. Then, a theoretical AI intervention model in the mental health of older adults was constructed by sorting academic fields, establishing a theoretical basis, and defining concepts. Through a review of four features: the selection and functional positioning of AI technology; the design and implementation path of AI intervention; the acceptance, accessibility, and adaptability of older adults; and the effect and evidence strength of AI intervention, the framework summarized four themes of AI intervention in the mental health of older adults and answered the research questions itemized in section 2.3.

5.2.1 Characteristics of the AI Intervention Process for Older Adults' Mental Health

We showed that the process of AI intervention in the mental health of older adults is not the independent effect of a single technical point or intervention method, but rather the result of multistage interaction embedded in a complete intervention chain. In terms of the selection and positioning of AI technology, basic AI support technologies, multi-AI combination technologies, voice assistants, robots, virtual reality, intelligent care systems, and a few hybrid/other AI technologies constitute the main types in current research. These have generated different intervention paths such as

individual emotional support, enhanced social interaction, cognitive-function intervention, mental-disease prediction, daily-care assistance, promotion of physical health, mental-health assessment, and mixed functions. The matching degree between the AI technologies and intervention paths is an important factor that affects the actual acceptance, accessibility, and adaptability of older adults.

5.2.2 Key Factors Influencing Older Adults' Acceptance of AI Intervention

Factors such as affinity, perceived intelligence, perceived ease of use, perceived safety, cost-effectiveness, external support, and smooth technical configuration have a significant impact on the actual psychological acceptance process of older adults. Acceptance, as an important benefit-evaluation indicator, is involved in the evaluation of AI intervention effects.

5.2.3 Four Core Themes of AI Intervention in the Mental Health of Older Adults

Four core themes were extracted through keyword clustering analysis. First, AI clinical intervention efficacy and risk management focused on three clinical scenarios: dementia/cognitive impairment, chronic psychological problems, and depression/anxiety. Precise intervention and risk control are achieved through technologies such as social robots and intelligent monitoring systems, providing scientific support for clinical services. Second, AI psychological-assessment mechanisms and human-computer interaction focused on psychological disease prediction and screening, assessment tool development, and human-computer interaction optimization, thereby breaking through the subjectivity and adaptability limitations of traditional assessment and constructing a scientific and efficient assessment support system. Third, AI empowerment of social support and well-being improvement focused on social-emotional support and community home well-being. AI empowerment expanded social connections and integrated life-service resources through technology in order to achieve dual improvement in older adults' mental health and quality of life. Last, ethical norms and sustainable development of AI intervention focused on three major directions: data security and privacy protection; technical fairness and accessibility; and the sustainability of long-term intervention. It filled the gap in previous research regarding ethical and long-term considerations. Empirical research has shown that the application of AI in this field has achieved remarkable results and unique advantages. By establishing clear ethical norms, ensuring data security, and optimizing technical accessibility, the process lays a solid foundation for the sustainable development of AI intervention in the mental health of older adults. The four themes are interrelated and have their own foci, jointly constituting the core research areas of AI intervention in the mental health of older adults.

Overall, we further expanded the integration of existing literature in this field. By including a large number of high-intensity empirical studies, it demonstrated that the actual effect of AI intervention on the mental health of older adults has been significant and has had unique advantages. However, the overall methodological insufficiency and ambiguous type classification of the literature also posed a certain limitation to this conclusion.

5.2.4 Multidisciplinary Research Paths, Foci, and Differences

Due to the various intervention-chain scopes covered by different studies and their connections with their actual disciplinary fields, we further presented a review of the research themes and knowledge maps of AI intervention in the mental health of older adults from a multidisciplinary perspective. This addressed another key issue in the field: What are the paths, foci, and differences in AI intervention in the mental health of older adults research from the perspectives of different disciplines? Through classification and summary, four major disciplinary types were derived: clinical medicine and psychiatry focusing on efficacy verification and risk management; psychology focusing on psychological assessment mechanisms and human-computer interaction quality; sociology and social work focusing on quality of life, social support, and well-being; and computer science and engineering providing algorithm performance and human-computer interaction design support. This finding further promoted the research orientation towards a comprehensive and multidisciplinary approach in AI intervention for older adults' mental health, shifting from previous point-to-point studies focusing on single processes or disciplines, to a more practical face-to-face concern. The inclusion of sociology and social work further broadened the research scope of the topic, guiding the integration of more comprehensive and interdisciplinary fields.

5.2.5 Construction of an Integrated Theoretical Model

We resulted in the construction of a universal integrative theoretical model. First, the interactive relationship between the inner and outer rings of this model incorporated the two core elements of AI and older adults' mental health, with intervention as the main connecting link. This integrated the disciplinary characteristics of psychology, computer science, and engineering and emphasized that the technical positioning should be in line with the core logic of perceived usefulness and perceived ease of use in the technology acceptance model. Second, it considered the subjective experiences of older adults in terms of acceptance, accessibility, and adaptability, reflecting the dynamic interactive nature of human-computer interaction theory that is people-oriented. Third, it integrated the core meanings of sociology and social work, clinical medicine, and psychiatry. This enabled the depiction of the comprehensive scenario of the issue from the dual perspectives of

medical health and social welfare, highlighting the value orientation of the three-dimensional integration of successful aging theory and the core idea of dynamic synergy between technology and social factors in the Sociotechnical Systems Theory, demonstrating the openness and diversity of the issue itself. In summary, this model not only provided a unified analytical framework for the field of AI intervention in the mental health of older adults, but also revealed, through an interdisciplinary perspective, the complementary mechanisms of different disciplines in addressing this issue.

In actual intervention projects, the model can achieve the coordination of the inner-loop modules through the input and guidance of the outer-loop disciplines. For instance, clinical medicine and psychiatry, as core disciplines, provide the "psychological assessment" standards for the project; sociology and social work, as core disciplines, offer "social support" and "ethical norms" for the AI technology intervention in the mental health and resilience of older adults; and computer science and engineering, as core disciplines, are responsible for "selecting" appropriate technical models to achieve human-machine interaction with older adults. On this basis, project design is no longer a single technological development or clinical plan formulation, but a systematic blueprint.

5.3 Limitations of the Study

We had several limitations. First, literature screening was limited to empirical studies, resulting in the selected literature being concentrated in fields such as computer science and engineering, clinical medicine, and psychiatry, whereas research in sociology and social work, which often focuses on theory and philosophical speculation, was underrepresented. Second, the AI intervention for older adults' mental health was comprehensive, with its research scope intertwined with digital technology, older adults' physical and mental health care, medical intervention, and older adults' quality of life and happiness, together forming a complex issue of technology-based interventions for older adults' health. Some studies integrated AI with multiple digital technologies and conducted intervention effect evaluations based on the overall health status of older adults, which increased the difficulty of data screening and raised the risk of data-selection bias. Third, we used the narrative-synthesis method to systematically sort and analyze the discipline types of the included literature. Although this method helped clarify the research status in various fields, it lacked the rigor of quantitative analysis of other comprehensive research methods, such as meta-analysis (Xian et al., 2024). Fourth, we did not include a formal bias risk and quality assessment for the included individual studies, which may have affected the overall reliability of the research conclusions and the persuasiveness of the research results. Fifth, the languages of the included literature in the study were limited to Chinese

and English, and this language-range restriction may have led to the omission of some high-quality related studies published in other languages, thereby weakening the comprehensiveness and universality of the research results to a certain extent.

6. Conclusions

This study integrated 95 empirical studies from 2005 to 2025. Through the review of academic fields, the establishment of theoretical foundations, and the definition of concepts, this study enabled the construction of a theoretical framework for AI intervention in the mental health of older adults. The research results showed that this field has gone through a nascent stage, an initial development stage, and a period of rapid growth. The intervention of AI has formed a complete process covering seven types of technologies, nine implementation paths, and seven key acceptance factors. The research method is dominated by quantitative research, and the research subjects cover various older adult groups as well as multiple application scenarios. Four core theme clusters have gradually emerged. Interdisciplinary collaboration across clinical medicine, psychology, sociology, and computer science has been fundamental. There was a scarcity of literature on interdisciplinary research, indicating insufficient integration between technological design and the psychological characteristics of older adults. A two-layer comprehensive model was constructed that provided a comprehensive analytical framework.

In the future, research should focus on strengthening interdisciplinary collaboration mechanisms, integrating the psychological characteristics of older adults into the design of closed-loop optimization technologies, increasing policy support for interdisciplinary research, enhancing the accessibility of AI intervention in community and family environments, and improving the technical literacy of caregivers. These steps will promote the transformation of human-centered AI technology and ensure that the technology can be applied sustainably and fairly to address the unmet mental health needs of older adults.

Availability of Data and Materials

The data supporting this study's findings are available from the corresponding author upon reasonable request.

Author Contributions

LX was responsible for research design and data collection and analysis. XYH was responsible for research method design. LHM was responsible for research review and research design analysis. DML was responsible for design and validation. All authors participated in the writing of the original manuscript, as well as the review and editing of the manuscript, and approved the final version. All authors are responsible for all aspects of the work.

Ethics Approval and Consent to Participate

Not applicable.

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Conflicts of Interest

The authors declare no conflicts of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at <https://doi.org/10.31083/BP48709>.

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