# Virtual Reality Reminiscence Therapy for MCI and Dementia: Effects and Trends—A Narrative Review

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## ABSTRACT

Virtual reality–based reminiscence therapy (VR-RT) leverages immersive autobiographical recall with multisensory and social features as a non-pharmacological option for older adults with MCI or dementia. This narrative review synthesized eight studies (N=177; 2019–2022) across Asia, Europe, and Oceania/North America, spanning RCTs, longitudinal, and exploratory designs. Psychological outcomes were consistently favorable—depression/anxiety decreased while morale, well-being, and social participation improved—with high acceptability and minimal adverse events; engagement and usability were strongest with personalized content and supportive onboarding. Cognitive effects were heterogeneous: several studies showed maintenance or short-term gains, others found no advantage over traditional reminiscence, and one longitudinal study suggested stabilization during intervention with post-cessation decline. Overall, VR-RT appears safe, feasible, and promising for mood and social connectedness, with preliminary evidence for cognitive stabilization but no uniform superiority; larger multi-site RCTs with active controls, longer follow-up, multidimensional and mechanism-focused outcomes, cost-effectiveness analyses, and designs emphasizing personalization, multisensory/media integration, social-VR, and ergonomic, low-load interaction are needed. In parallel, this review aims to chart emerging development trends and future directions for VR-RT.

**Keywords**：virtual reality; reminiscence therapy; dementia; mild cognitive impairment; mental well-being; cognition

## INTRODUCTION

With the rapid aging of the global population, dementia has emerged as a significant public health challenge. The World Health Organization (WHO) reports that approximately 57 million people are living with dementia worldwide, with Alzheimer's disease (AD) accounting for 60–70% of all cases [1]. Dementia is a syndrome characterized by a chronic and progressive deterioration of cognitive function. Mild Cognitive Impairment (MCI) represents an intermediate state between normal aging and dementia and is considered a prodromal stage of dementia, particularly AD. It is characterized by an objective decline in one or more cognitive domains—such as memory, attention, executive function, and visuospatial abilities—which does not yet significantly interfere with daily life activities [2]. Research indicates that approximately 5–15% of individuals with MCI progress to dementia annually [2]. However, as about half of these individuals remain stable for up to five years, this population represents a critical target for dementia prevention and an optimal window for early intervention [3].

Currently, a growing body of research is shifting toward non-pharmacological interventions,such as cognitive training, exercise therapy, and virtual reality (VR) technology. These interventions aim to alleviate symptoms by enhancing neuroplasticity and increasing cognitive reserve. For instance, systematic reviews have demonstrated that both exercise and cognitive training can improve memory, attention, and executive functions in individuals with MCI. Furthermore, combining VR with cognitive training has shown potential in promoting cognitive recovery [4][5]. These approaches offer novel therapeutic strategies for delaying disease progression and

enhancing quality of life, thereby underscoring the profound significance of conducting intervention studies in MCI and dementia populations.

Reminiscence Therapy (RT), also known as "life review" therapy, was first proposed by psychiatrist Robert Butler in 1963 [6]. This therapy involves the discussion of past activities, events, and experiences, using multisensory cues such as photographs, household objects, familiar music, and olfactory triggers to evoke autobiographical memories [7]. Recent studies have found that RT can enhance the quality of life, mood, and social engagement of individuals with dementia and MCI, while also offering improvements in cognitive function and reductions in depression and anxiety. Group reminiscence therapy, in particular, leverages social interaction and emotional support to enhance self-esteem, alleviate loneliness, and improve subjective well-being [8]. Therefore, RT serves not only as an enjoyable activity but also as a supplementary therapy to mitigate symptoms and improve quality of life, representing an important non-pharmacological intervention option for long-term care facilities and community-based care.

The technological tools for RT have evolved significantly. Initially, RT primarily relied on tangible prompts such as physical photographs, household items, old newspapers, and music [7]. With the advancement of information technology, these have been supplemented by digital and multimedia formats that integrate photos, videos, music, and narration [8]. Research suggests that multimedia approaches can be more effective than traditional prompts in improving quality of life and autobiographical memory while reducing depressive symptoms [9]. More recently, Virtual Reality (VR) has been introduced to RT, recreating familiar scenes or past eras in immersive, three-dimensional environments. VR offers a greater sense of presence and interactivity than two-dimensional screens, which can help stimulate long-term memory networks, promote emotional engagement, and activate cognitive functions [10]. Studies indicate that VR-based reminiscence therapy can effectively reduce anxiety and apathy, improve mood, and enhance verbal fluency [10][11]. Its immersive nature can elicit deeper emotional connections and more vivid memory recall. This technological evolution—from tangible media to digital multimedia and immersive VR—has provided a richer toolkit for improving the cognitive and emotional states of individuals with MCI and dementia, laying the groundwork for future personalized intervention research.

Previous studies have explored the potential of Virtual Reality Reminiscence Therapy (VR-RT) in enhancing cognitive function, improving mood, and increasing quality of life. However, inconsistencies in study design, intervention methods, and evaluation metrics have led to varied conclusions regarding the effectiveness of VR-RT. Therefore, this paper aims to synthesize the current literature, identify effective trends, and provide direction for future research and practice in VR-RT interventions.

### Objectives

This review aims to achieve the following two objectives: (1) to synthesize the current empirical evidence regarding the effects of Virtual Reality Reminiscence Therapy (VR-RT) on cognitive outcomes and mental well-being; and (2) based on the existing literature, to summarize the technological trends and future research directions of VR-RT in dementia care, thereby providing a theoretical and practical reference for the design and implementation of subsequent interventions.

## METHODS

### Search Strategy and Selection Criteria

This study employs a narrative literature review methodology to summarize the effects of Virtual Reality-based Reminiscence Therapy (VR-RT) on cognitive and mental health outcomes [12]. The search strategy was not strictly systematic but was instead purposive. We began by consulting established high-quality, peer-reviewed literature, such as the Cochrane Review on reminiscence therapy for dementia, to understand the existing evidence base. Building on this foundation, we conducted targeted searches in major databases, including PubMed, Scopus, and Google Scholar, using relevant keywords (e.g., "virtual reality reminiscence therapy" "VR-RT" "dementia" and "MCI"). This was supplemented by manual screening of the reference lists of pertinent reviews and studies to ensure comprehensive coverage of VR-RT research.

The inclusion criteria for literature were as follows: (1) the study was published in English and had undergone peer review; (2) the study population consisted of older adults with dementia, Mild Cognitive Impairment (MCI), or loneliness; (3) the intervention involved reminiscence therapy implemented using virtual reality technology; and (4) the outcome measures reported on cognitive function or mental health-related results (e.g., mood, affective state). Studies that did not meet these population, intervention, or language requirements were excluded.

**Review Process**

We initiated the review process by screening the titles and abstracts of the retrieved literature to exclude clearly irrelevant studies. Subsequently, we obtained the full texts of potentially eligible articles for further evaluation. The inclusion process was primarily conducted independently by the author according to the established criteria. Any uncertainties were resolved through discussion to reach a consensus. Ultimately, a total of eight studies that met the inclusion criteria were included as the basis for this review (their characteristics are detailed in the Results section below).

Given the relatively limited number of studies included, we did not strictly adhere to the PRISMA guidelines by creating a literature screening flowchart, nor did we conduct a formal methodological quality assessment of the included studies (e.g., using scales such as the Mixed Methods Appraisal Tool, MMAT). This approach is consistent with the qualitative and integrative nature of this narrative review; our priority was to distill commonalities and differences from the findings rather than to perform a quantitative grading of the evidence quality.

## RESULTS

The literature search identified multiple relevant articles. After a rigorous screening process to exclude duplicates and studies that did not meet the inclusion criteria, a final selection of eight empirical studies, comprising a total of 177 older adult participants, was included for review. The study populations included patients with Mild Cognitive Impairment (MCI) or dementia (five studies), as well as healthy or sub-healthy older adults (three studies). Among these, two studies from Japan targeted the oldest-old and individuals with MCI, respectively [15][18]; two studies from Taiwan focused on dementia patients in long-term care facilities [16][17]; one study from South Korea utilized a digital reminiscence system [9]; and studies from the Netherlands [19], Australia [13], and Canada [14] primarily conducted exploratory research on immersive VR reminiscence applications. Overall, the publication years of the included studies ranged from 2019 to 2022, with a geographical distribution spanning three Asian countries/regions (Japan, Taiwan, South Korea) and three Western countries (the Netherlands, Australia, Canada), reflecting a diversity of cultural contexts and technological systems.

The study designs were predominantly quantitative. Three were randomized controlled trials (RCTs) [18][9][14], while others were longitudinal observational or exploratory intervention studies [15][16]. Six studies featured a control condition [15][16][18][9], and three were non-controlled studies focused on system development or preliminary validation [13][17][19]. The studies generally demonstrated the positive effects of Virtual Reality Reminiscence Therapy (VR-RT) in enhancing cognitive function, emotional states, and social engagement. Moreover, most studies reported no significant adverse effects.

**Psychological Outcomes of Virtual Reality Reminiscence Therapy**

Multiple studies have demonstrated that Virtual Reality Reminiscence Therapy (VR-RT) contributes to the improvement of mood and mental well-being among older adults. For instance, a randomized controlled trial by Moon et al., involving 49 persons with dementia, compared digital VR-RT with conventional narrative therapy. The results showed that after eight sessions over four weeks, the depression scores of the VR group were significantly reduced, and this improvement was sustained four weeks post-intervention (between-group effect: $F=7.62$, $p=0.001$, partial $\eta^2=0.17$) [9]. Similarly, a three-month longitudinal study by Huang et al. on 20 patients with dementia also observed a significant decrease in depression levels post-intervention ($p=0.008$) [16]. Furthermore, VR-RT has been shown to be effective in alleviating anxiety in older adults. A crossover trial by Niki et al. with oldest-old adults (mean age 87, n=10) found that even a single, brief immersive VR reminiscence experience could immediately reduce participants' state anxiety levels. The State-Trait Anxiety Inventory (STAI)

scores decreased from approximately 36 to 27 after the first session and further down to 23 after the second (P=0.001 after the first session, P<0.001 after the second) [15].

Table 1 Overview of VR-RT

| Study (Author, Year) | Country/Region | Study Design | Sample (n, Grouping) | System Overview |
|---|---|---|---|---|
| Veldmeijer (2020) | Netherlands | Participatory Design Research (Prototype Development) | 23 older adults (21 completed) | A 1950s–60s style living room environment, incorporating six of the participant's nostalgic items (music, photos, etc.) to trigger personal memories. |
| Baker (2020) | Australia | Participatory Action Research (PAR) | 16 older adults (divided into 4 groups, 2-3 people per group) | Social VR Virtual Classroom: An environment where elderly users gather as digital avatars, using virtual conversation starters and personal nostalgic items to share school life memories. |
| Sun (2024) | Canada | Mixed-Methods Exploratory Study (Co-design) | 7 participants (3 patients with cognitive impairment + 3 caregivers + 1 nursing staff) | VR Reminiscence Therapy Prototype: A prototype for feasibility testing in dementia care, allowing users to browse personal photo albums and play beloved music/videos for a multi-sensory experience. |
| Niki (2021) | Japan | Randomized Crossover Trial (Single-center) | 10 nursing home residents (2-group crossover design) | Immersive VR Video: Two VR scenarios (live-action video and computer-generated imagery) themed around nostalgic scenes from Japan's Shōwa era (1955–1980), which participants view immersively using an HMD (Head-Mounted Display). |
| Huang (2022) | Taiwan | Longitudinal Observational Study | 20 patients with dementia | VR Nostalgic Content (HTC VIVE Pro headset): A virtual 1960s–80s old Taiwanese village house scene that integrates personal photos, narratives, and music. Users can perform interactions such as turning on a radio to play music, looking through photos, and feeding chickens. |
| Tsao (2019) | Taiwan | System Development Research | None (System prototype design) | VR+AR Reminiscence System: Developed on Unity, this system uses a mobile phone or VR glasses to present 3D models of old Taiwanese architecture, triggering nostalgic video/audio interactions. It aims to stimulate the memories of the elderly through multi-dimensional triggers. |
| Tominari (2021) | Japan | Randomized Controlled Trial (Double-blind) | 52 participants (VR group 26, control group 26) | Tablet VR Panoramic Reminiscence: An intervention using an iPad to display panoramic images for reminiscence, compared with a traditional photo group; all participants were older adults with Mild Cognitive Impairment (MCI). |
| Moon (2020) | South Korea | Randomized Controlled Trial (Double-blind) | 49 participants (Digital RT group 25, control group 24) | Android Digital Reminiscence App: A mobile application platform developed for group reminiscence therapy, allowing multiple users to participate simultaneously and supporting the upload of personal materials as digital content to trigger memories. |

VR-RT has also shown advantages in enhancing positive emotions and subjective well-being. In an eight-week controlled study by Tominari et al. involving 52 older adults with MCI, although the VR group did not show a significantly greater overall cognitive improvement compared to the photo-based control group (both groups showed improved MMSE scores post-intervention, with no statistically significant between-group difference), the VR group demonstrated a more substantial increase in subjective well-being. Specifically, their scores on the revised Philadelphia Geriatric Center (PGC) Morale Scale improved significantly more than those of the control group, which showed no marked change [18]. Similar findings have emerged from qualitative research. Veldmeijer et al. conducted a VR reminiscence intervention with older adults experiencing loneliness (n=6), and participants generally reported improved mood afterward. A typical feedback was, "It feels like a relief to talk about this" [19]. Some participants even resumed hobbies or established new social connections following the experience [19]. The study by Tsao et al. also confirmed that a combined VR/AR reminiscence therapy can enhance the mental health and life satisfaction of older adults [17]. In summary, VR-RT can alleviate anxiety and depression while boosting well-being and positive social emotions.

Although a few studies have noted that immersive scenes can occasionally trigger sad memories [19], the overall consensus among researchers is that the therapy has a high safety profile, with positive emotional effects being predominant.

## Cognitive Function Outcomes of Virtual Reality Reminiscence Therapy

The impact of VR-RT on cognitive function has yielded inconsistent results across studies. Some research indicates that VR-RT can maintain or improve cognitive performance in older adults in the short term. In a study by Tominari et al., 52 older adults with Mild Cognitive Impairment (MCI) were randomly assigned to an eight-week reminiscence therapy using either VR panoramic images or traditional static photos. At the conclusion of the intervention, the cognitive scores (e.g., MMSE) of both groups had improved from baseline, but the between-group difference was not statistically significant. Notably, however, only the VR group showed a significant trend of cognitive enhancement compared to their pre-intervention performance, while the improvement in the photo group was more limited. This suggests that the immersive nature of VR reminiscence may offer some cognitive benefits [18]. Conversely, in a four-week randomized controlled trial by Moon et al., no significant differences were found in cognitive scale scores between the digital VR group and the conventional control group (repeated measures ANOVA between-group effect: $F=0.13$, $p=0.821$) [9]. Furthermore, a three-month VR-RT study by Huang et al. on 20 individuals with dementia found that cognitive function scores remained stable and not significantly different from baseline immediately after the intervention. However, a follow-up assessment 3-6 months after the intervention ceased revealed a trend of continued cognitive decline. This finding suggests that VR intervention might play a role in stabilizing cognition during the treatment period (i.e., delaying further decline), though it may not be sufficient to produce significant long-term cognitive improvement [16].

Beyond overall cognitive scores, some studies have observed that VR-RT positively influences specific cognitive processes. A VR/AR reminiscence system developed by Tsao et al. demonstrated in a small-scale trial its effectiveness in evoking past memories and stimulating cognitive engagement among older adults [17]. A design study by Veldmeijer et al. also reported that unfamiliar retro objects presented within an immersive VR environment unexpectedly activated participants' thinking and problem-solving abilities, a stimulus that helped retrieve forgotten memory fragments [19]. Therefore, VR-RT can, to some extent, engage the cognitive processing of older adults through rich sensory stimulation.

In conclusion, the current evidence suggests that VR-RT has a stabilizing or even mildly beneficial effect on cognitive function during the intervention period, but it has not yet demonstrated a significant advantage over traditional reminiscence methods. Given the limited sample sizes and varied results in the existing research, the efficacy of VR-RT in enhancing cognitive function warrants further investigation.

Table 2 Psychological Outcomes of VR-RT

| Study (Author, Year) | Psychological Assessment Tool | Pre-intervention Results | Post-intervention Results | Statistical Significance (P-value/Effect) |
|---|---|---|---|---|
| Veldmeijer (2020) | Non-standard scale (Interview) | — | Increased sense of happiness and meaning (qualitative feedback) | — |
| Baker (2020) | Non-standard scale (Interview) | — | Participants reported an increased sense of social connection | — |
| Sun (2024) | None | — | — | — |
| Niki (2021) | State-Trait Anxiety Inventory (STAI) | 36.1±7.2 | 1st time after watching VR: 26.8±4.9 (P=0.001); 2nd time: 23.4±2.8 (P<0.001) | P=0.001 (First time), P<0.001 (Second time) |
| Huang (2022) | Center for Epidemiologic Studies Depression Scale (CES-D) | 6.15±5.73 | 3.15±4.26 (P=0.008) | P=0.008 (Significant decrease) |
| Tsao (2019) | None | — | — | — |
| Tominari (2021) | Revised Philadelphia Geriatric Center Morale Scale (PGC) | VR group: 14.20±2.75; Control group: 13.26±3.51 | VR group: 13.48±2.90; Control group: 14.04±3.30 | The magnitude of improvement in the VR group was significantly better than the control group. |
| Moon (2020) | Depression Scale (name not specified) | — | — | F=7.62, P=0.001 (Depression significantly decreased) |

Table 3 Summary of the Cognitive Function Outcomes of VR-RT

| Study (Author, Year) | Psychological Assessment Tool | Pre-intervention (mean ± SD) | Post-intervention (mean ± SD) | Statistical results (p-value, significance) | Interpretation |
|---|---|---|---|---|---|
| Veldmeijer (2020) | – (no cognitive measures) | — | — | — | No cognitive outcomes reported (design study) |
| Baker (2020) | – (no cognitive measures) | — | — | — | No cognitive outcomes reported (design study) |
| Sun (2024) | – (focus on usability/co-design) | — | — | — | Cognitive effects not assessed |
| Niki (2021) | MMSE (Japanese version) | 28.5 ± 1.8 | – (not re-measured) | – (not re-measured) | High baseline cognition; no follow-up measure |
| Huang (2022) | Center for Epidemiologic Studies Depression Scale (CES-D) | MMSE 15.57 ± 4.76; CASI 58.80 ± 12.48; CDR 6.50 ± 1.61 | MMSE 16.29 ± 4.07; CASI 57.50 ± 12.40; CDR 6.86 ± 1.28 | MMSE Δp=.67; CASI Δp=.50; CDR Δp=.10 (all ns) | No significant immediate change in cognition |
| Tsao (2019) | None | — | — | — | No cognitive outcomes reported |
| Tominari (2021) | Revised Philadelphia Geriatric Center Morale Scale (PGC) | VR: 12.56 ± 3.90; Control: 14.20 ± 2.75 | VR: 13.52 ± 2.93; Control: 13.48 ± 2.90 | VR group pre–post p<.01; control p=.08; between-group p=.45 | VR group showed significant MMSE gain; control did not |
| Moon (2020) | Depression Scale (name not specified) | – (data not reported) | – (data not reported) | F=0.13, p=.821 (no significant change) | No significant cognitive change |

Table 4 Summary of Impacts

| Study (Author, Year) | Psychological Impact | Cognitive Impact | Other Impacts |
|---|---|---|---|
| Veldmeijer (2020) | ↑ (Increased subjective well-being) | → (No significant change) | → |
| Baker (2020) | ↑ (Enhanced social connection) | → (No significant change) | ↑ (Increased engagement) |
| Sun (2024) | → (Not measured) | → (Not measured) | ↑ (System usability) |
| Niki (2021) | ↓ (Significant decrease in anxiety) | → (Not measured) | → |
| Huang (2022) | ↓ (Depression relief) | → (No immediate change) | → |
| Tsao (2019) | → (Not measured) | → (Not measured) | ↑ (Social satisfaction) |
| Tominari (2021) | ↑ (Increased subjective well-being) | → (No difference between groups) | → |
| Moon (2020) | ↓ (Significant decrease in depression) | → (No significant change) | ↑ (Increased participation) |

## Other Impacts of Virtual Reality Reminiscence Therapy

VR-RT has generally demonstrated high levels of acceptability and engagement among participants. In the controlled trial by Moon et al., researchers additionally assessed engagement during the therapy sessions and found that the digital VR group showed significantly higher levels of active engagement during the final session compared to the control group [9]. A study in Australia by Baker et al. similarly indicated that VR helps to enhance social participation among older adults. This five-month study involved 16 participants aged 70–81 using a social VR application called "School Days" to reminisce about their school experiences. Participants were able to engage actively in virtual group discussions for extended periods, and even geographically dispersed individuals established interactive connections through VR [13]. A co-design study by Veldmeijer et al. further highlighted that the design process itself became a meaningful social activity. By co-creating nostalgic scenes, participants rediscovered the experience of teamwork and a sense of social role, which helped alleviate their feelings of loneliness and enhance their social motivation [19]. Furthermore, the validation results from the VR/AR system developed by Tsao et al. showed that such immersive nostalgic experiences have the potential to improve older adults' satisfaction with social interaction and positively impact their quality of life [17].

The subjective satisfaction of older participants with VR-RT is generally high, with most studies reporting positive feedback on the VR experience. In the study by Niki et al., the satisfaction of oldest-old adults with a single VR reminiscence session averaged 7–8 out of 10, with no participants reporting serious discomfort, dizziness, or other side effects [15]. An exploratory study by Sun et al. documented participants' experiences, with a common description from a person with dementia being, "It was like a fantasy world where you could see the stars in the sky. I enjoyed it" [14]. This study also quantitatively assessed the system's usability and immersion. The results showed that while the System Usability Scale (SUS) scores for persons with dementia were lower (mean 53.3, around the 50th percentile), their care partners rated it higher (mean 80, at the 80th percentile). The median SUS score for all participants was 69, which falls within the "good" usability range [14]. This suggests that with proper training and interface optimization, most older adults with cognitive impairments can adequately operate VR equipment. Concurrently, the sense of presence and immersion provided by the VR environment was validated, with the high level of immersion being considered a major advantage of VR-RT. It enhances the enjoyment and appeal of the therapy, thereby encouraging emotional investment from the participants.

Existing studies widely support the feasibility and safety of VR-RT in older populations. Most research reports good participant adherence and no serious adverse events. For example, an immersive VR trial conducted with a group of participants up to 87 years old did not result in any significant motion sickness or physical discomfort [15]. The study by Sun et al. also indicated that, with some guidance, even older adults with cognitive impairments could operate the VR system with minimal assistance [14]. Research teams have improved comfort by adjusting the fit and weight of head-mounted displays and have recommended optimizations for the specific needs of older users—for example, allowing the use of reading glasses to see the virtual display clearly and simplifying the button functions on hand controllers to reduce operational difficulty [14]. Overall, these empirical studies demonstrate that VR reminiscence therapy is user-friendly and well-accepted by older adults. In addition to improving cognitive and mental health, VR-RT offers older populations richer immersive experiences and opportunities for social interaction, serving as a valuable supplement to traditional reminiscence therapy.

# DISCUSSION

The future development of Virtual Reality Reminiscence Therapy (VR-RT) is trending toward a multidimensional deepening of its application. Future research and practice should advance synergistically across five key directions: technological innovation, ntervention design, user-centered optimization, methodological rigor, and exploration of underlying mechanisms.

## Technological Innovation

The primary objective on the technological front is to enhance the system's immersion and usability while expanding its application models. First, optimizing hardware and software to achieve higher-fidelity audiovisual experiences, more intuitive controls, and cross-platform compatibility is fundamental to broadening the technology's reach. Second, the emergence of social VR introduces a new dimension to interventions, allowing geographically dispersed older adults to "gather" as virtual avatars for shared reminiscence activities. This holds immense potential for fostering unique social interactions and alleviating loneliness. Finally, as a form of Digital Therapeutics (DTx), VR-RT has an inherent advantage for remote implementation. In the post-pandemic era, exploring its role as a highly accessible, cross-regional digital health solution is of great significance for optimizing elderly care service models.

## Intervention Design

The future of intervention design lies in integrating multi-modal interactions with highly personalized content and optimizing intervention protocols. On one hand, incorporating multisensory elements within the VR environment—such as music, historical footage, voice-overs, and interactive 3D objects—can more effectively evoke deep-seated memories and enhance emotional resonance. On the other hand, personalization is crucial for maximizing intervention efficacy. Achieving "tailor-made" immersive experiences is vital for the therapy's success [10]. Furthermore, the "dosage" of the intervention—including its frequency, session duration, and overall length—requires scientific optimization. Existing research suggests that the emotional benefits of short-term interventions may not be sustainable. Therefore, future studies should systematically explore optimal intervention protocols that can maintain long-term efficacy, for example, by incorporating consolidation phases or adjusting the intervention density.

## User-Centered Experience

Centering the design on the older adult user and optimizing their overall experience is paramount to the success of the therapy. First, it is essential to lower the barrier to technology adoption. Simplifying hardware, designing intuitive user interfaces, and providing thorough demonstrations, training, and on-site support for older adults new to VR (especially those with MCI or AD) can effectively mitigate technology anxiety and improve acceptance and confidence. Second, close attention must be paid to the user's physiological and psychological comfort. This includes ensuring head-mounted displays are comfortable to wear, employing seated operation to prevent cybersickness, and having care staff present to provide a sense of security and emotional support. Finally, ethics and safety are non-negotiable. Given that reminiscence can trigger strong emotional responses (e.g., sadness, anxiety), research protocols must include clear risk management and mitigation strategies. The therapeutic team must be equipped to promptly identify and address negative emotions, ensuring the entire process is safe and beneficial for the user.

## Methodological Rigor

To establish a solid evidence base for VR-RT, future research methodologies must adhere to higher standards. First, this involves increasing sample sizes and employing rigorous study designs. Conducting multi-center, large-scale randomized controlled trials (RCTs) is essential to validate the therapy's effectiveness, which will help test its effects across different populations and care settings, thereby enhancing the robustness and generalizability of the findings. Second, direct comparative effectiveness research should be conducted. Studies should be designed to directly compare VR-RT with traditional reminiscence therapies (e.g., group discussions, use of tangible props) to clearly delineate the specific added benefits conferred by VR technology. Third, cost-

effectiveness analyses are needed. Systematically evaluating the economic investment and health outcomes of VR-RT and comparing them with conventional interventions will provide crucial evidence for decisions regarding its large-scale implementation.

**Exploration of Underlying Mechanisms**

Uncovering why and how VR-RT works is the theoretical cornerstone for guiding future practice optimization. Current research has observed the advantages of VR in enhancing subjective well-being, but the underlying mechanisms remain unclear. Future research should focus on two core pathways. The first is the cognitive-affective mechanism: investigating how the immersion and rich sensory stimulation of VR influence cognitive processes such as attention, memory retrieval, and emotional regulation to ultimately improve the mental state of older adults. The second is the social interaction mechanism, particularly within social VR applications. It is crucial to analyze how peer interactions in a virtual environment affect older adults' sense of social connectedness, belonging, and overall mental health. Elucidating these deeper mechanisms will enable us to design intervention protocols with greater precision, thereby maximizing their therapeutic efficacy.

## CONCLUSION AND FUTURE OUTLOOK

In summary, Virtual Reality Reminiscence Therapy (VR-RT) has demonstrated a positive impact on the cognitive and mental health outcomes in dementia care. A substantial body of empirical evidence indicates that VR-RT can alleviate negative emotions such as anxiety, depression, and apathy in older patients, while enhancing their mood, subjective well-being, and social engagement. Furthermore, interventions have been well-tolerated, with no serious adverse effects reported. Regarding cognition, some studies have observed improvements from baseline in cognitive assessments (e.g., total MMSE score, verbal fluency) following VR-RT intervention. However, the results are inconsistent across studies, and VR-RT has not yet shown a universally significant advantage over traditional reminiscence therapy.

Technologically, the application of RT is evolving from traditional tangible materials to digital multimedia and now to immersive virtual environments, which leverage 3D scenes to provide a stronger sense of presence and interactivity to evoke memories and emotions. Recent trends include the development of multisensory reminiscence systems that integrate 360° panoramic imagery and augmented reality ; the creation of social VR platforms that enable geographically dispersed older adults to participate in shared reminiscence activities ; and the use of participatory design to involve persons with dementia and their care partners in the co-creation and optimization of VR-RT protocols, thereby enhancing personalization and meaningfulness. Overall, as a multisensory and interactive non-pharmacological intervention, VR-RT has shown significant effects in improving the mental health and social satisfaction of older adults.

In terms of future research design, it is recommended to conduct larger-scale randomized controlled trials with active control groups to compare the effects of VR with traditional reminiscence therapy. Additionally, extending the follow-up period to assess long-term efficacy and incorporating multi-dimensional outcome measures—including cognition, mood, and quality of life—are crucial next steps. Through continued exploration and optimization in these directions, the intervention models and evidence base for VR-RT will be further strengthened, providing more scientifically robust and effective support for promoting the cognitive function and mental well-being of older adults.

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