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Exploring the Efficacy of Video Games for Dementia Healthcare

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Abstract: Dementia, also known as major neurocognitive disorder, is a clinical syndrome caused by pathological changes in the brain, primarily characterized by intellectual impairment, language deficits, motor dysfunction, and personality alterations. Currently, patients and their families are increasingly adopting alternative therapeutic approaches for dementia management. As a low-cost, non-invasive intervention, video games have recently been integrated by healthcare professionals into treatment and rehabilitation protocols for various conditions. This article reviews the current research progress of video games in multiple aspects such as dementia screening, cognitive ability improvement, physical fitness enhancement, behavioral and psychological symptom management, and health education. The results show that video games demonstrate positive potential in enhancing patients' cognitive function and improving their quality of life. In the future, efforts should be made to further promote the deep integration of video games with intelligent technologies, establish a clinical standardization system, expand application scenarios, and pay attention to elderly-friendly designs, so as to fully leverage the value of video games in the full-process management of dementia and provide support for building a dementia-friendly society.

1. Introduction

Video games are a form of entertainment crafted with programming code and electronic technology, made accessible through electronic devices like computers, game consoles, and mobile phones. They incorporate multiple media formats, including video, audio, and text. As a mode of brain–computer interaction, excessive immersion in video games may influence human neural function. Research indicates that players are required to perceive and evaluate various stimuli within a virtual setting and then execute rule-based responses. This sequence of interactions can prompt functional or structural adaptations in the brain, with different video game genres eliciting distinct neural effects[1-2]. As a result, health professionals have begun to explore video games as a therapeutic tool in disease management, with notable advancements documented in oncology, physical rehabilitation, and neurological disorders[1,3-4]. Their use is especially prominent in the realm of mental and neurological healthcare.

Dementia is a common neurodegenerative disorder predominantly affecting older adults. At present, it is estimated that over 55 million people worldwide suffer from dementia, with approximately 10 million new cases each year[5]. Beyond pharmacological interventions, non-pharmacological approaches play a crucial role in dementia management and can be integrated throughout all stages, including prevention, diagnosis, treatment, and care[6]. In a retrospective study, Zheng J et al. investigated the effects of gaming on individuals with dementia, proposing that gaming can effectively enhance cognitive abilities, improve coordination, and alleviate behavioral and psychological symptoms in this population[7]. Compared to traditional treatments, video games offer a safer, more convenient, and cost-effective non-invasive intervention, serving as an effective tool to improve cognitive and executive functions in older adults and people with dementia[8]. Furthermore, research indicates that the integration of video games with Virtual Reality (VR) technology has been applied in dementia care. Leveraging the immersive nature of VR and the interactive advantages of gaming, this combination can provide superior immersion, interactivity, and imaginative engagement for individuals with dementia, effectively enhancing various care scenarios such as diagnosis, entertainment, and rehabilitation[5].

2. Application of Video Games in Dementia Management

2.1 Cognitive Ability Screening

Early screening and monitoring of cognitive function are crucial for the prevention and treatment of cognitive impairment. Traditional dementia-related screening heavily relies on pen-and-paper tests and face-to-face assessments. In China, the diagnosis of cognitive impairment typically involves an initial assessment conducted by general practitioners or professionals trained in formal scale evaluations, followed by a series of complex clinical examinations by specialists to confirm the diagnosis. This process is cumbersome, time-consuming, and resource intensive.

As an emerging tool, video games have been increasingly applied in the screening and monitoring of cognitive function in recent years. In 2022, the Shanghai Mental Health Center, in collaboration with relevant technical departments, developed a gamified screening tool called the "Golden Three-Minute Cognitive Assessment" (TCSA) for the public. This tool employs a tiered screening model, consisting of an initial screening and a comprehensive screening phase. The assessment covers domains such as language, orientation to time and place, calculation, short-term memory, attention, and working memory. Participants can self-administer the test on their mobile phones. The initial screening tasks can be completed in approximately three minutes to identify individuals at risk of cognitive impairment. If the results suggest potential risk, a more comprehensive screening can be conducted, which takes about eight minutes to complete. The process is straightforward and engaging, and the tool has undergone reliability and validity testing while being promoted across multiple communities[9].

Substantial breakthroughs have also been achieved in dementia diagnosis research in other countries. Beginning in 2015, a team led by Sonia Valladares Rodríguez from the University of Vigo in Spain has been developing a suite of games named "Panoramix" , which offers unprecedented potential for the diagnosis and assessment of dementia[10]. Panoramix is a collection of video games in which participants interact via a touchscreen to evaluate different types of cognitive function. The suite comprises seven mini-games, each targeting a specific cognitive domain: "Episodix" for episodic memory,"Attentix" for attention," Executix" for executive functions, "Workix" for working memory, "Semantix" for semantic memory, "Procedurix" for prospective memory, and "Gnosix" for recognition. The research team suggests that video games, combined with machine learning, hold significant promise for the early diagnosis of dementia and could potentially be integrated into clinical practice as a diagnostic technology in future dementia

management[11]. Separately, an Austrian company has developed "Cogniplat," an electronic game system designed to detect mild cognitive impairment in older adults. This system includes 14 games aimed at assessing key cognitive domains such as visuospatial skills, recognition, attention, language ability, working memory, perceptual ability, and executive functions, making it suitable for the preliminary screening of dementia[12].

2.2 Cognitive Improvement

Video games not only provide entertainment but also play a significant role in enhancing cognitive function. A controlled study targeting adults aged 60 and above revealed that older adults with video game experience exhibited higher activation in certain brain regions compared to their counterparts. A brain magnetic resonance imaging (MRI) studies of older video game players have similarly indicated that those with gaming experience show increased activation in specific brain areas[8], suggesting that appropriate video game engagement may positively influence behavioral performance and brain activation in the elderly. Video games thus hold promise as an effective tool for improving cognitive abilities in older adults.

He Meng ling also proposed that long-term video game training can indeed alter functional connectivity in the brain and enhance corresponding cognitive abilities. She further conducted experiments investigating the relationship between different types of video game training and brain plasticity. The findings demonstrated that distinct forms of video game training induce varied changes in cognitive plasticity[1]. In a Korean study, a group of older adults with mild cognitive impairment underwent a four-week video game intervention, which resulted in significant improvement in their cognitive function[13].Therefore, future research should further explore the mechanisms underlying the cognitive benefits of video games, while continuously refining training methodologies to more effectively harness their potential value.

2.3 Physical Fitness Improvement

In the process of dementia care, enhancing patients' physical fitness not only helps improve their quality of life but can also slow the progression of the condition to some extent. Therefore, some video games with motion sensing can be utilized for rehabilitation training in dementia care[14]. Compared with traditional video games, combining traditional sports activities with video games increases entertainment, interactivity and security. Patients with dementia can adjust the game intensity according to their own abilities, meeting their demand for physical exercise and promoting both physical and mental health. Yun Tianqi synthesized evidence on the effectiveness of exergames in individuals with dementia, noting that exergames can help reduce fat, increase muscle mass, strengthen bones, optimize physical function, and mitigate frailty in patients with dementia. Particularly, they contribute to improvements in attention, concentration, memory, and reaction ability, representing an excellent form of exercise[15]. In one study, a Multi-sensory Rehabilitation Interactive Game System (MRIGS) was developed for older adults with dementia, combining video games with multi-sensory rehabilitation content to exercise physical functions. This system utilizes a grip-assist device, coupled with different colors and tactile stimuli, to achieve multi-sensory training effects involving visual, auditory, and tactile modalities[16].

2.4 Behavioral and psychological Symptom Management

Behavioral and psychological symptoms of dementia, such as apathy, agitation, depression, and anxiety, are prevalent and profoundly distressing for both individuals with dementia and their caregivers. As a reliable intervention strategy, non-pharmacological approaches are increasingly

exploring the utility of video games. The therapeutic potential of video games in managing psychological conditions, including depression and anxiety, is anchored in their capacity to induce a state of high engagement and immersion. This immersive quality can effectively capture and sustain attention, thereby diverting focus from distressing stimuli, reducing agitation, and redirecting behaviors into structured, goal-oriented virtual activities[17]. Furthermore, by providing tailored sensory stimulation and fostering a sense of accomplishment through in-game achievements, video games emerge as a promising and customizable avenue for alleviating challenging neuropsychiatric symptoms in dementia. It is crucial to note, however, that the application of video game interventions requires careful calibration. However, during the game, it is also necessary to control the time and intensity. Excessive use may cause negative effects on the body[18].

2.5 Health Education on Dementia

Currently, public awareness of dementia has significantly improved compared to the past; however, access to dementia-related health education remains limited[19]. Misunderstandings and stigma toward dementia still persist among some population groups. For people living with dementia and their family members, how to better engage in self-care has also become a major challenge. Video games play a pivotal role in public health education. A video game titled "Dementia Awareness Game," developed by researchers in the United Kingdom, aims to improve public attitudes toward dementia. The game is designed to be user-friendly, with each session lasting approximately 90 seconds. Players are required to follow a predetermined path to reach the terminal, during which they must respond to a series of dementia-related questions. These questions are intended to assess players' understanding of dementia, including their attitudes and behavioral perceptions. Correct answers earn points, and additional bonus points are awarded upon completing the route. Players can publish their scores on the platform or participate with friends[20]. This game has been trialed in several countries, and multiple studies indicate that public attitudes toward people living with dementia improved significantly after playing it [21].

Furthermore, in terms of educating individuals with dementia themselves, maintaining a healthy lifestyle is crucial for slowing disease progression. A team from South Korea developed a gamified smartphone application designed to enhance health education among people with dementia. Users learn health-related knowledge through the application and conduct online self-administered health assessments. During the process, they receive different performance rankings, which serve as incentives to encourage participants to achieve higher health goals[22]. Video games with such health education objectives could be promoted in communities, healthcare institutions, and other settings in the future, helping both the public and individuals with dementia deepen their understanding of the condition.

3 Future Suggestion

3.1 Technology Integration and Intelligent Enhancement

The deep integration of video games with cutting-edge technologies represents a core future trend. VR/AR technologies will further optimize the capacity for personalized adaptation in games. In the future, training difficulty and content could be dynamically adjusted based on patients' real-time cognitive data and physical status, enabling precise intervention[23]. The immersive advantages of VR/AR technologies will be increasingly amplified; by constructing familiar life scenarios or rehabilitation environments, these technologies can reduce patients' cognitive load and enhance training adherence. Multisensory interaction technologies will also continue to advance, incorporating features such as haptic feedback and voice guidance to enrich the gaming experience

while simultaneously strengthening rehabilitation outcomes.

3.2 Clinical Standardization and Evidence System Development

Currently, video game interventions lack unified clinical standards. Future efforts should focus on establishing standardized protocols covering game design, intervention duration, and target populations. In the future, more large-scale clinical trials will be needed to clarify the intervention effects of different types of video games on patients with dementia at different disease stages and to form a clear intervention mechanism. Concurrently, promoting the standardization of the regulatory review and approval process for video game based digital therapeutics is essential, facilitating the clinical recognition and widespread adoption of high quality intervention tools.

3.3 Application Scenario Expansion and Service Network Construction

The application of video games will extend from hospital settings to communities and households, forming a comprehensive "screening intervention management" service chain. Leveraging regional cognitive impairment prevention networks, a coordinated model can be established where community healthcare institutions issue "digital prescriptions," training is conducted at home, and hospitals provide dynamic monitoring. For caregiver populations, developing dedicated video games or interactive modules can help alleviate caregiving stress, enhance caregiving skills, and ultimately build a collaborative health management ecosystem involving patients, caregivers, and medical institutions.

3.4 Equity Enhancement and Accessibility Optimization

Addressing the digital divide among older adults is crucial for widespread adoption. Future game design must prioritize age-friendly adaptations, such as simplifying user interfaces and adding assistive features, to lower the barrier to use. Furthermore, promoting the dissemination of video game intervention tools in remote areas, aided by primary healthcare networks, will be key to achieving equitable and accessible cognitive health services [24].

4. Conclusion

Dementia poses a significant global health challenge in the context of population aging, highlighting the crucial importance of exploring and innovating non-pharmacological interventions. With their unique advantages of engagement, accessibility, and non-invasiveness, video games have demonstrated considerable value across multiple domains of dementia care, including cognitive screening, functional rehabilitation, and health education. Nevertheless, the application of video games in dementia management still faces several pressing challenges. To address these issues, future efforts should focus on enhancing personalized intervention capabilities through technological innovation, establishing a solid clinical application foundation via standardized research, expanding service networks to achieve comprehensive coverage, and ensuring equitable access through age-friendly adaptations and cost optimization strategies. With advancing interdisciplinary collaboration, video games are poised to become an integral component of dementia prevention and management systems and ultimately contributing to the development of a dementia friendly society.

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