The Role of Music in Enhancing Cognitive Function of Residents in Elderly Care Facilities

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Abstract: The process of population aging is accelerating continuously. In elderly care institutions, a considerable number of elderly people are experiencing a gradual decline in cognitive abilities. Their daily memory and concentration abilities have weakened to varying degrees. This condition not only aggravates the inconvenience of individual life but also unconsciously increases the operational pressure of the institution's overall care. Non-pharmaceutical attribute music intervention has the practical advantages of low implementation threshold and wide adaptability scenarios. When combined with technical means such as AI music generation and EEG index capture, and integrated with existing knowledge in neuroscience, it can to some extent activate the corresponding functional areas of the brain and delay the process of cognitive decline. This paper focuses on analyzing four implementation methods that can be directly applied to actual care. It is hoped to provide some practical references for elderly care institutions to carry out cognitive care work, and also to help the elderly improve the quality of their lives in old age.

Keywords: Music intervention; Elderly care institution; Cognitive function; AI music; Cognitive care

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Introduction

Observing the group of elderly care institutions reveals that cognitive decline is not an isolated phenomenon. Some elderly people have difficulty remembering actions they have just completed, some have difficulty maintaining stable concentration in daily communication, some gradually lose emotional connection with caregivers and relatives, and their basic life behaviors are highly dependent on external assistance. Traditional cognitive care often relies on medication control or simple companionship and physical activities by caregivers, but the actual improvement effects are often limited. Some elderly people even show obvious resistance and have difficulty forming stable cooperation. In recent years, many studies have shown that music can activate the hippocampus and prefrontal cortex in the elderly's brains, and these two structures are closely related to cognitive maintenance - the hippocampus mainly undertakes memory-related functions, while the prefrontal cortex more influences the state of concentration and emotional regulation. Integrating ACE- Step AI music model and EEG monitoring methods into it can enable music intervention to play a more significant role in cognitive care than before.

1.The significance of music in enhancing the cognitive functions of residents in elderly care homes

Music can awaken the long-forgotten memories in the brains of the elderly, stimulate the activity of the hippocampus, thereby slowing down the rate of memory decline [1]. Its ability to focus when facing external information can also be moderately improved in a musical environment. Among the elderly with declining cognitive functions, distraction and emotional restlessness are relatively common. Simple communication is difficult to sustain. In a melodic environment, many people will naturally enter a relatively stable state, and their attention will unconsciously shift towards the music itself. The external restlessness will subsequently decrease. The soothing effect of music is also not to be ignored. Negative experiences such as loneliness and unease will be reduced to a certain extent. After the emotional state stabilizes, the willingness of the elderly to participate in collective activities

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will also increase, and the overall activity of the brain will be enhanced, allowing their cognitive functions to be better maintained in this continuous stimulation. Moreover, music can assist in improving the sleep quality of the elderly. High-quality sleep can help clear the β-amyloid protein in the brain - when this protein accumulates excessively, it increases the risk of Alzheimer's disease. Among the cognitive decline groups, the frequency of sleep disorders is already relatively high. Playing a soothing piece of music before bedtime can help them fall asleep faster and improve the quality of sleep, which can also indirectly play a role in protecting cognitive functions [2].

2.Implementation Strategies for Music Intervention to Enhance Cognitive Function of Elderly Residents in Nursing Homes

2.1 Personalized Music Customization Strategy Based on AI Music Model

Music content that meets the real needs of the elderly is a key link in promoting cognitive function improvement. The care team of the nursing home can use the ACE-Step AI music model to customize the music pieces. This model does not require the users to have professional music creation and music theory knowledge, but can generate highly adaptable music content for the elderly in the institution. The overall cost is relatively controllable, and it has a certain possibility of implementation in grassroots nursing homes [3]. Before starting the work, the caregivers need to conduct a preliminary review of the individual conditions of the elderly, including age group, past life trajectory, music preference type, and current cognitive function status. All this should be collected and recorded in a simple form. Some elderly people have special life experiences from a certain period, and they have a natural affinity for specific musical works from that era. Some elderly people are influenced by regional culture and are more likely to accept local operas and traditional folk art forms. Elderly people with a deeper degree of cognitive decline have a lower acceptance of complex melodies, and instrumental music with a gentle rhythm is often more likely to generate positive feedback. Such information is often hidden in the details of daily communication and can be recorded and retained in the elderly's dedicated care manual for subsequent reference. Caregivers can rely on the lightweight and operational ACE-Step AI music model to import the individual information of the elderly that has been sorted out into the system platform. The system will generate music content based on the data characteristics. The childhood living environment and regional characteristics of the elderly will be reflected in the melody arrangement. The combination of natural sound effects and soothing melodies can activate their dormant memories to a certain extent. Elderly people with anxious emotional states and difficulty concentrating will receive music pieces with a low tempo and weak stimulation, helping them gradually stabilize their emotions and concentrate their attention. This model is prioritized for deployment on local terminal devices in the nursing home, which can reduce the risk of information leakage of the elderly. The interface design of the model should be simplified, and caregivers, after basic process training, can complete information entry and music piece generation. The overall operation threshold should be kept at a low level. The emotional state and cognitive level of the elderly are not fixed, and caregivers need to update the information within a fixed period and adjust the system input parameters to keep the music plan adapted to the current state of the elderly, maintaining the targeted and effectiveness of the intervention content [4].

2.2 Dynamic Music Intervention Strategy Combined with Electroencephalogram Monitoring

In traditional music intervention scenarios, the caregivers' judgment of the adaptability of the music pieces mostly relies on subjective experience and external behavioral observation. It is difficult to accurately capture the brain responses of the elderly under auditory stimulation, and the intervention effect often has a certain fluctuation range. Some adjustment behaviors even lack reliable basis [5]. If combined with electroencephalogram monitoring technology, the caregivers can understand the brain activity of the elderly when listening to music in real time. They can adjust the music plan according to the actual situation, making the music intervention more precise and effective. There is no need to introduce those complex and cumbersome electroencephalogram monitoring devices. Choosing small, lightweight, and easy-to-operate portable devices is sufficient, such as head-worn electroencephalogram

monitoring devices. This type of device is relatively lightweight, and the discomfort during the elderly's wearing process is low, without causing obvious psychological pressure. During the music playback period, the caregivers assist the elderly in wearing the device, and the changes in electroencephalogram-related indicators will be captured in real time. The fluctuations of alpha waves and theta waves can directly reflect the brain's activity level. An increase in alpha wave values often indicates an improvement in cognitive activity and a general stabilization of emotions; an abnormal increase in theta waves suggests that the elderly have a more scattered attention and may have an anxiety tendency in the emotional aspect. These physiological indicators provide a basis for judging the intervention effect. If the alpha waves show a gradual strengthening trend during the monitoring process, it can be considered that the current music type is more compatible with the elderly's state, and the original playback plan can be maintained; if the theta waves remain at a high level for a long time, it may indicate that the complexity of the melody and the playback rhythm are beyond the acceptance range of the elderly. At this time, it is necessary to replace the music type promptly, and preferentially choose a rhythm that is gentle and the structure is simple. Also, the playback duration and volume can be appropriately adjusted. During the process of assisting the elderly to wear the device, the caregivers need to complete the function explanation in a gentle tone, convey the information that the device is safe and harmless, reduce the resistance of the elderly due to uncertainty, and improve the cooperation degree. The monitoring equipment needs to establish a regular disinfection mechanism, do a good job in cleaning and maintenance, and reduce the health risks caused by cross-contact among the elderly. The combination of electroencephalogram monitoring and music intervention, to a certain extent, compensates for the blindness of the traditional mode, making the intervention path closer to the real physiological state of the elderly, and may play a more stable promoting role in the improvement of cognitive function [6].

2.3 Scenario-based music integration strategy for daily care

In the routine care processes of nursing homes, the natural integration of music intervention can alleviate the work pressure of the care team to a certain extent, allowing the elderly to perceive the positive effects of music in a relatively relaxed state. The difficulty of long-term persistence will be reduced, and the positive effect on cognitive improvement will gradually become more evident [7]. During the elderly's awakening stage in the morning, the care staff can play lively but not noisy music while tidying up the bed and assisting with morning cleaning. This helps slowly awaken the sluggish nerves and reduces the double fatigue of the body and mind during morning wake-up, promoting the faster recovery of the elderly's consciousness to a clear level. During this process, the elderly can also make slight body movements in coordination. Through the combination of simple movements and the melody, the cerebral cortex receives certain stimulation, providing auxiliary support for maintaining cognition. In the recovery period after breakfast, low-intensity instrumental music can play a role in stabilizing emotions. The care staff can also use this atmosphere to guide the elderly to recall the just-ended meal content in a relaxed environment, completing gentle exercises for short-term memory. During the afternoon, when the elderly are prone to mental lethargy and distraction, choosing classic music that the elderly accept more is a more appropriate arrangement. While playing the music, the care staff can encourage the elderly to sing along softly. In the process of recalling the words and expressing through vocalization, it can mobilize memory reserves and language organization abilities. This process often brings unexpected effects in delaying cognitive decline. The care staff can use simple verbal prompts to encourage the elderly to think and express actively. There is no need to design complex procedures; natural communication guidance is sufficient. During the preparation for bedtime, gentle and soothing music can reduce neural excitability, relax the accumulated physical and mental tension of the day, and have certain positive significance for improving the speed and stability of sleep. Stable sleep itself can also provide indirect support for the protection of cognitive functions. For sections prone to resistance, such as rehabilitation exercises and medication administration, pairing familiar and pleasant music can weaken negative feelings to some extent, making the care process smoother and more efficient. The positive significance of music for cognition can also continue to be exerted

in these small scenarios [8].

2.4 Simple Interactive Music Guidance Strategy Led by Caregivers

Music intervention cannot merely rely on the passive listening of the elderly. Only by guiding the elderly to actively participate can the relevant brain regions be fully activated, and the improvement of cognitive function will be more significant [9]. As caregivers are the group that interacts with the elderly most frequently, leading the interaction and guidance by them is more in line with the actual situation of the institution, has lower implementation difficulty, and does not require the additional recruitment of professional music therapists. The nursing home should provide simple training for caregivers, focusing on training them on how to guide the elderly to participate in music interaction, how to select appropriate interaction methods based on the elderly's cognitive level, and how to adjust the guidance methods according to the elderly's reactions. For example, training caregivers on how to guide the elderly to clap and stomp along with the music, how to guide the elderly to hum songs, recall lyrics, and conduct simple communication with the music, so as to exercise the elderly's language expression ability and memory. When caregivers guide the elderly to participate in interaction, they must combine the elderly's cognitive level and proceed step by step, not seeking quick results. For elderly with severe cognitive decline, there is no need to ask them to remember lyrics and sing along completely. Just guiding them to clap and nod along with the music is sufficient. This can also exercise the elderly's attention and physical coordination ability. For elderly with relatively better cognitive status, they can be guided to hum songs, recall lyrics, and even be allowed to sing a few favorite sections and share their experiences when listening to this song. This can better exercise the elderly's memory and language expression ability. Additionally, caregivers can organize 10-15-minute small-scale music interaction activities every day, have the elderly sing and clap together, or carry out simple music games, such as "Guess the Song Name Based on the Melody". The caregiver plays a segment of the song melody and asks the elderly to try to guess the song name. Using positive feedback to enhance their participation willingness, verbal affirmation or slight encouragement can also increase their active cooperation. Patience and respect are particularly important throughout the process. Forced participation is likely to trigger psychological resistance, which may hinder the overall intervention work. The details of the elderly's participation status and preferred forms need to be recorded in time. These real feedbacks can provide a basis for optimizing the guidance strategy, continuously improving the alignment of the intervention content with the elderly's needs, and steadily strengthening the overall effect [10].

3.Summary

Music, as a non-invasive, easy-to-operate, and low-cost non-drug intervention method, when combined with cutting-edge technologies such as AI music generation and EEG monitoring, can be used in the cognitive function improvement work for the elderly in nursing homes. It can not only awaken the brain activities of the elderly, slow down cognitive decline, but also help with emotional regulation and improvement of sleep quality. It can also enhance the quality of life of the elderly in their later years to a certain extent. Currently, there are still problems in the music intervention work in elderly nursing homes, such as random selection of music, insufficient personalization, lack of professional guidance, and inadequate long-term implementation. Therefore, this article focuses on outlining four implementation plans to specifically address the shortcomings of the current work and enable music to play a more stable role in improving cognitive function. With the continuous development of technology, it is expected that there will be more simple, practical, and cost-effective music intervention models that can truly integrate into the cognitive care work in elderly nursing homes and help more elderly people with cognitive decline improve their living conditions.

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