

## How can dance be used as a therapeutic tool in treating aging diseases?

Amanda Lai

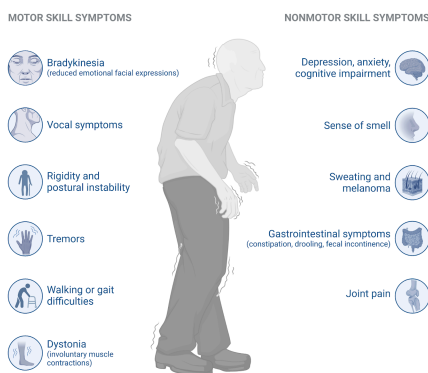
### Abstract

Dance involves a combination of physical activity and sensorimotor engagement and has proved to have a longstanding impact on adult neuroplasticity and mobility. In the elderly population, dance therapy can complement traditional pharmacological treatments for neurodegenerative and neurodevelopmental aging diseases such as Parkinson's disease (PD) and Alzheimer's disease (AD). Dance movement therapy (DMT) is closely integrated with non-specific outcomes on movement quality, interpersonal skills, cognitive capabilities, and motor outputs. This review discusses dance's effects on aerobic capacity, physical mobility, and brain function in the elderly population. It also analyzes factors such as dance style, intensity, and duration to maximize therapeutic benefit. As a growing therapeutic tool, dance plays a pivotal role in improving quality of life and preventing disease.

### Introduction

Aging is associated with various health risks and diseases due to increased molecular and cellular damage within the human body [14]. Parkinson's disease is among one of the many diseases associated with aging. It is a brain disorder that causes unintended motor control movements, such as tremors and stiffness, as well as difficulty with balance and coordination [15]. The symptoms associated with Parkinson's Disease are rooted in the loss of neurotransmitters, notably dopamine. Neurotransmitters transmit chemical messages from one nerve cell to other cells in the body [28]. Over 8.5 million individuals are diagnosed with Parkinson's disease, being the second-most common neurodegenerative disease after Alzheimer's.

#### Symptoms of Parkinson's Disease



Symptoms of Parkinson's Disease include motor and nonmotor skills<sup>[35]</sup>.

Alzheimer's disease slowly destroys memory and cognitive function, interfering with daily life and activities [16]. The ability of neurons, specialized cells that process and transmit information via electrical and chemical signals, to communicate is impaired for patients with Alzheimer's disease. The effects extend to a widespread degradation in brain function and eventual death of

neurons<sup>[27]</sup>. There are over 55 million people worldwide with dementia, and Alzheimer's disease accounts for 60-70% of cases of dementia<sup>[34]</sup>.

In addition to Parkinson's Disease and Alzheimer's Disease being critical examples of aging-associated diseases, chronic respiratory diseases (CRDs) and obesity are leading causes of global morbidity, notably among the elderly. Both yield persistent symptoms of skeletal muscle impairment and muscle limitation<sup>[12]</sup>. Chronic respiratory diseases (CRDs) impact the airways and overall structure of the lungs<sup>[17]</sup>. In the US, there is a 13.6% probability of dying between the ages 30 and 70 from associated chronic respiration diseases or cardiovascular difficulties<sup>[37]</sup>. Obesity is a chronic disease defined by excessive fat deposits that impact health. It is directly linked to an increased risk of type II diabetes and heart disease and leads to complications in bone health and reproduction due to high stress on bodily joints<sup>[18]</sup>. Heart failure and hypertension are also severe public health concerns in the USA, affecting about 25% of the adult population<sup>[13]</sup>.

Physical activity in the dance form is an effective behavioral lifestyle intervention, associated with reduced blood pressure, improved physical mobility, and better quality of life<sup>[1,12,13]</sup>. To achieve this, the Department of Health and Human Services recommends 150 minutes of moderate activity a week or 75 minutes of vigorous aerobic activity a week. Traditional pharmacological interventions remain limited in impact when used as monotherapies; therefore, dance serves as an effective complementary therapy that synergizes with pharmacologic therapies to induce sustaining effects<sup>[1]</sup>. Dance movement therapy encompasses both high-cost organized interventions as well as low-cost independent activities. A session with a dance movement therapist falls between \$60-140 for an hour, which serves as a limiting factor for those who seek professional treatment. However, in comparison to traditional pharmacological interventions for treating aging diseases, dance movement therapy yields valuable outcomes for physical and mental well-being, further illustrated in the literature review. Furthermore, in response to the COVID-19 pandemic of 2020, numerous institutions have introduced online dance movement therapy workshops and sessions such as Rejoice in Motion, an organization that encourages anyone in the world to join<sup>[30]</sup>. The vast selection of dance movement therapy programs has led to increased integration of dance into treatment plans, considering the long-term neurological and physiological benefits associated with it.

## Literature Review

Dance has numerous neurological and physical implications for the human body. Neurologically, it increases cognitive and kinesthetic intelligence, enhances mind-body connection with a musical supplement, increases brain-derived neurotrophic factor (BDNF) levels, improves executive functions, expands spatial memory with greater gray and white matter volume, mitigates levels of anxiety, and elevates counts of social interaction and measured enjoyment<sup>[1, 4, 5, 11, 13, 20, 21, 22]</sup>. This review paper will explore the impacts of Dance Movement Therapy (DMT) on the neurological and physical scale while considering factors upon integration, including potential barriers of entry and other restrictive factors.

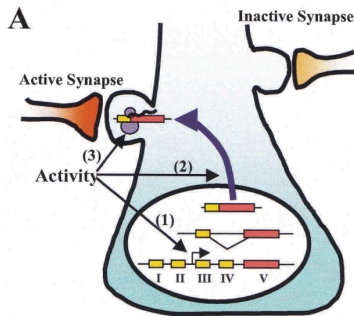
As a repeated activity, dance can be used as a complementary treatment to increase cognitive, kinesthetic, and a relatively new term, bodily intelligence. Bodily intelligence has implications

beyond kinesthetic intelligence in that it involves dynamic responses from the environment as well as the human body experience. Bodily sensations are processed and used to adapt to the environment through movement. Analysis of the unity of dance and movement with increased levels of bodily intelligence showcases the valuable role of DMT (Dance Movement Therapy) in medical environments. In a study where 69 participants from varying social divisions, ages (18 to 54 years), and professional backgrounds participated in a 20-hour unifying personal development program over three days through dance and movement (UPPDM). Workshops throughout the program integrated “a series of techniques” aiming to unify “unpsychic, somatopsychic, interpersonal, and transpersonal” components, ultimately connecting the mind and body. Somato psychology relates to connection to the body, interpersonal relates to connections between people, and transpersonal relates to communication beyond the person. Older subjects displayed higher levels of body intelligence than younger individuals, confirming the initial hypothesis that kinesthetic and bodily intelligence are correlated, but with the consideration of aging processes<sup>[5]</sup>. Despite the age range corresponding to impact, the usage of dance extends to coordination among different body systems. This yields the effectiveness of dance as a therapeutic tool in treating aging diseases, such as Alzheimer's and Parkinson's.

Dance as an activity involves complex coordination among the physical, cognitive, and rhythmic systems, fostering a mind-body connection accompanying rhythmic movements. Thus, it has advantages over traditional repetitive strength and balance programs that often are provided as a stand-alone therapy<sup>[11]</sup>. This is evident in a pilot randomized trial of a cultural dance program targeted towards Native Hawaiians and Pacific Islanders, displaying that the hula dance form enhanced hypertension control supplemented by the use of music and rhythmic motions. Hula serves a critical purpose in Hawaiian and Pacific Islander cultural practices. The benefits yielded were consistent among the varying levels of hula intensity<sup>[13]</sup>. The upbeat hula music, in correspondence to the dance program, enabled the integration of the mind and body systems. Music has the capacity to trigger memories, awaken emotions, and intensify social bonding<sup>[31]</sup>. For patients with Parkinson's or Alzheimer's and those who seek social assurance, music supplemented with dance therapy is a valuable and customizable opportunity.

In addition to the fostered mind-body connection, dance has exhibited notable benefits as a form of exercise. As a whole, exercise has been deemed to support an increase in Brain-derived neurotrophic factor (BDNF) levels. BDNF has a crucial role in neurons' maintenance, growth, and survival<sup>[4]</sup>. In a dance training program for older patients with Parkinson's disease, after just ten days of assisted intensive training, a significant increase in BDNF levels in the brain was observed that remained consistent after four weeks<sup>[1]</sup>. The multidisciplinary nature of the dance training treatment enhanced BDNF tyrosine receptor kinase B signaling in lymphocytes, a type of white blood cell playing a key role in the immune system, indicating a reduction in the severity of Parkinson's disease (PD) symptoms. This is possible as tyrosine receptor kinase B is expressed throughout the nervous system, and when bound to BDNF, promotes cell development, maturity, and survival<sup>[19]</sup>. BDNF tyrosine receptor kinase B also facilitates synapse formation, playing a critical role in cognitive processes associated with learning and memory<sup>[20]</sup>. The increased BDNF levels are a notable outcome of dance utilized as a therapeutic tool, as seen with its application of symptom relief for patients with Parkinson's Disease. Another outcome of increased BDNF observed following the act of dance is improved executive functions and spatial memory<sup>[4]</sup>. Studies have investigated how varying dance styles

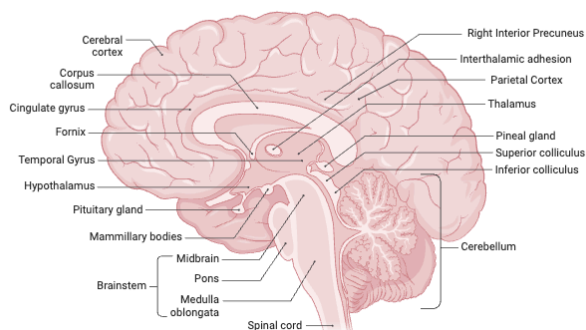
have impacted outcomes, including Argentine Tango, a partnered ballroom dance, and its usage in patients with PD as a treatment component. The movements showed improvements in working memory as well as a reduction in depressive symptoms <sup>[1]</sup>. In its usage as a therapeutic therapy, dance can be adapted to ease symptoms, such as tremors.



Transcription is dependent on movement activity. There is an impact on the following: (1) translocation of mRNA, (2) translation, (3) mRNA selective binding points<sup>[4]</sup>.

Another impact dance has on the neurological scale is an increase of gray and white matter volume. A study organizing six weeks of dynamic balance training was correlated with gray matter changes in the right anterior precuneus, left inferior parietal cortex, and left middle temporal gyrus <sup>[1]</sup>. These three brain regions correspond to various functions: the right anterior precuneus with stimulus orientation and social awareness, the left inferior parietal cortex with tool use and language processing, and the left middle temporal gyrus with depression and healthy controls <sup>[21]</sup>. As a complement therapy, dance has a rising role in treatment therapies for aging diseases, notably PD with its correlation on the neurological plane.

### Anatomy of the Brain



Created in BioRender.com bio

The anatomy of the brain is depicted, as exercise movement impacting the anterior precuneus, parietal cortex, and temporal gyrus. The figure is adapted, and created with BioRender.com<sup>[36]</sup>.

As a creative art, dance had evident impacts on reducing anxiety and stress levels. Creative Arts Therapies (CATs) are an innovative way to prevent stress; this definition encompasses art, music, dance/movement, and drama therapy. In all studies analyzing DMT or dance interventions, stress signs were significantly reduced among its subjects. The stress was tested

with saliva samples to measure cortisol levels <sup>[22]</sup>. Dance serves as an enjoyable form of movement for patients, increasing the quality of life through managing stress and anxiety levels. Furthermore, for patients with dementia and Parkinson's Disease, dance was seen to increase social interaction and enjoyment among residents and care staff once integrated as a complement therapy. Dancing is gaining popularity as a community-based intervention, with specific models that promote community inclusivity <sup>[1]</sup>. Fun and exciting activities engage patients with treatment activities, thus better addressing the predominant symptoms of aging diseases, such as the motor symptoms of PD. In addition to its neurological impact, dance movement therapy yields benefits on a physical scale.

One physical implication that dance movement therapy proved to yield was improved gait variability and speed, and improvements in balance, walking, mood, and general coordination. Dance styles range from quick and fast movements to slower, calm transitions. The options for dance interventions are vast, leaving room to focus on addressing various symptoms. Regions of focus can include movement initiation, postural control, walking, flexibility, social interaction, and perceived degree of fun <sup>[1]</sup>. One study utilized the 6MWT Test (6-minute Walk Test) post-integration of dance therapy and noted increased gait speed and resistance <sup>[9]</sup>. Individuals diagnosed with Alzheimer's often have gait impairments, and appropriately adjusted dance therapies in intensity would treat gait and balance deficits <sup>[23]</sup>. Similar relevance is notable for patients with Parkinson's Disease who may observe gait change due to bradykinesia limiting motor control and body movement range <sup>[24]</sup>. Notable improvements are also evident in balance, walking, mood, and overall coordination due to increased physical activity from DMT <sup>[6,11]</sup>. Dance serves to ease patients back into movement. This is suitable for beginning with light moderate movements and increasing in intensity through a designed program.

The movement associated with dance has been revealed to improve systolic and diastolic blood pressure,  $\dot{V}O_2$  peak, and overall exercise capacity. Studies have found that social support and music can lower blood pressure and improve stress management <sup>[5]</sup>. With increased blood pressure being associated with an aging risk, dance is an accessible treatment to improve systolic and diastolic blood pressure levels. Dance therapy revealed a decrease in cardiovascular risk factors rooted in a reduction in the lipid profile <sup>[9]</sup>. General movement induced by dance involves both vertical and lateral movement involving dynamic control and balance, enhancing agility <sup>[33]</sup>. As a rehabilitation method, dance targets patients with poor cardiovascular health and effectively supports integration into more intensive activities.

### **Barriers to Accessing DMT**

There are varying levels of intensity dance provides, ranging from pre-professional levels to recreational lessons. Socioeconomic barriers are among the obstacles many may encounter when attempting to incorporate dance movement into their livelihood. The cost and location of dance services are challenges to enabling accessibility for diverse groups. A case study in Poznan, Poland revealed disproportionate groups experiencing difficulty accessing sports and recreational facilities. Facility infrastructure and equipment also lie an extension of regional socioeconomic status, with lower-income communities facing a lack of maintenance and outdated structures <sup>[25]</sup>.

Another barrier to dance implementation is disease-specific symptoms. For instance, over 40% of patients with Parkinson's disease have presented personality changes including apathy or issues with social interaction due to a breakdown of impulse control <sup>[38]</sup>. This is an impact of dopaminergic drugs, such as levodopa, used to treat Parkinson's disease's impact to dopamine levels. Patients impacted by this would benefit greatly from Dance Movement Therapy.

Dance as an art form and movement activity has varying regional definitions, proportionally differing in purpose and program. Numerous studies have covered the stylized movement of African dance; some have been performed in community settings, and others have been utilized as protest <sup>[26]</sup>. Many physical activity programs are designed for the individual and are less appealing to those seeking an integrated community-based feel <sup>[13]</sup>. Varying levels of intensity are not suitable for patients with severe cases of aging disease, including but not limited to Parkinson's Disease (PD) and Alzheimer's Disease (AD). In response, dance movement therapy programs can be adapted and fit to the individual's capacity and needs.

## Conclusion

Dance/Movement Therapy is defined as the usage of movement to integrate an individual's emotional, cognitive, physical, spiritual, and social systems of an individual. On a physical scale, DMT works the vestibular and cardiovascular system. On the psychological scale, embodied expression improves body image and self-confidence. The exploration process of dance as an art form enables emotion regulation, impulse control, and correspondence to reality. Self-efficacy is also increased from the navigation of one's own body in aesthetic movement and overall flow <sup>[22]</sup>.

The net benefits of Dance Movement Therapy are clear, yet the research biases must be considered. Various sample groups, such as that of a study observing a short-term DMT program on patients with breast cancer, were limited, limiting the strength of the applications <sup>[10]</sup>. Overall, dance as a supplemental intervention has been proven in countless studies to yield positive impacts on symptoms of aging diseases <sup>[1]</sup>. As an adjustable medium of therapy in intensity and prominent accessibility to diverse groups, DMT has a promising place in rehabilitation and therapeutic usage for elderly patients <sup>[7]</sup>. Further research is necessary to define what specific movement variations/organized routines would yield the most benefit.

## Methods

I utilized a variety of databases including EBSCO Explora, Google Scholar, and PubMed, leading with keywords "Dance Movement Therapy" and "Aging Diseases". The inclusion criteria were narrowed to studies conducted and peer-reviewed within the last 15 years.

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