Research in Dance and Physical Education
2019. Vol. 3, No. 2, 63-69
https://doi.org/10.26584/RDPE.2019.12.3.2.63

A Dance-Based Exercise Training Will Be Better Remedy for Individuals with Alzheimer's Disease?

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Alzheimer's disease (AD) is a neurodegenerative condition characterized by loss of memory and impaired cognitive function that is seen primarily in older adults. AD is primarily characterized by excessive accumulation amyloid beta (Aβ) plaques and tau proteins leading to reduction in hippocampal volume and brain-derived neurotrophic factor levels. Although there are different pharmacological treatment approaches available for managing cognitive and balance impairments in AD, they do not provide symptom control to a large extent and are associated with a variety of adverse effects and complications. Therefore, incorporating non-pharmacological intervention strategies in order to effectively control the symptoms of AD is crucial. Aerobic exercise causes an improvement in the symptoms of AD by enhancing cerebrovascular function, perfusion and neuroplasticity in the brain. Dance is a safe and inexpensive form of aerobic exercise that is based on music and can be performed in any environment. Thus, it is necessary to study the effects of different dance forms on cognitive function and balance in AD since it is a form of exercise that is not repetitive as well as promotes social interaction and motivation in older adults.

Key word: Alzheimer's disease, Hippocampal volume, Aerobic exercise, Dance, Cognitive function, Balance.

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Introduction

Alzheimer's disease (AD), the most common cause of dementia is a neurodegenerative condition and is characterized by loss of memory and impaired cognitive function that is primarily seen in older adults (Innes, Selfe, Khalsa & Kandati, 2016; Liguori et al., 2017)). Risk factors for AD include advancing age, genetic factors, obesity, hypercholesterolemia as well as dietary and lifestyle factors like sedentary lifestyle and high saturated fat intake (Barnard et al., 2014). The most considerable risk factors of AD include excessive accumulation of senile plaques which are extracellular aggregates of amyloid beta (Aβ) peptides and intracellular aggregates of tau proteins accumulation and a significant reduction in hippocampal volume and brain-derived neurotrophic factor (BDNF) levels (MacPherson, 2017). Hippocampus plays a major role in cognitive processing and balance. A reduction in hippocampal volume induces a decrease in cerebral glucose metabolism accompanied by impairments in neuronal and vascular functions (Rehfeld et al., 2017). BDNF is a growth factor belonging to the neurotrophin family. Interaction of BDNF with its receptor tyrosine kinase B (TrkB) promotes neuronal survival, neurite outgrowth and synaptic plasticity. Thus, BDNF plays a vital role in brain morphology and cognitive performance. Reduction in BDNF levels occurs in AD as a result of increase in cortisol levels leading to down regulation of BDNF expression (Rodriguez et al., 2018). These neurodegenerative processes also influence impairments in physical performance and associated decline in quality of life (QOL).

The most common symptoms of AD include progressive worsening of the ability to memorize newly acquired information due to impaired cognition (Liguori et al., 2017). Progressive decline in cognition associated with dementia in turn gives rise to balance impairments (Toots et al., 2017). In addition, neuropsychiatric symptoms like mood disturbances, depression, anxiety, sleep disturbances, aggression are also commonly observed (Liguori et al., 2017). All these symptoms lead to increased dependency for activities of daily living (Veronese, Solmi, Basso, Smith & Soysal, 2018). Therefore, early detection and prevention of decline in cognitive and physical performance is extremely crucial (Bossers, Van der Woude, Boersma, Scherder, & Heuvelen, 2012).

The diagnosis of AD is based on clinical evaluation and the presence of positron emission tomography (PET) biomarkers (Weller et al., 2018). An increase in β-site APP-cleaving enzyme 1 (BACE1) levels in the brain is indicative of AD (MacPherson, 2017). The pharmacological treatment of AD includes management of neuropsychiatric symptoms by antidepressants, antipsychotics, anticonvulsants and cholinesterase inhibitors. However, these drugs do not provide symptom control to a large extent and are associated with a variety of complications. (Veronese et al., 2018). Therefore, it is essential to incorporate non-pharmacological intervention strategies in order to prevent or control the symptoms of AD.

Exercise and AD

Exercise is known to play a vital role in preventing and delaying the development of AD and acts as an intervention for AD primarily through mechanisms that enhance vascular physiology, hippocampal volumes and neurogenesis (Cass S.P., 2017). It prevents decline in cognitive function by causing an improvement of cerebrovascular function, perfusion and neuroplasticity in the brain (Toots et al., 2017). Moderate to high intensity aerobic exercise enhances cerebral perfusion and metabolism causing reduction in Aβ plaques and causes up-regulation of neurotrophins and hippocampal neurogenesis leading to improvement in cognition. Studies have shown that aerobic exercise maintains white matter integrity and cardiorespiratory fitness. This induces an increase in hippocampal volume by preventing hippocampal decay. Besides, aerobic exercise reduces the production of ROS thereby facilitating hippocampal neurogenesis and cognitive improvement (Cui, Lin, Sheng, Zhang & Cui, 2018). These mechanisms are triggered as a result of increase in cardiorespiratory function in response to aerobic exercise that induces an increase in maximal oxygen uptake in turn reducing the production of ROS and improving mitochondrial function (Cass S.P.,2017). Salisbury & Yu (2017) conducted a study to determine the effects of 6 months aerobic exercise on cognition in individuals with AD and found that there was a reduction in cognitive decline associated with improved aerobic fitness. Sobol et al. (2018) conducted another study to investigate the effects of 16 weeks moderate-high intensity aerobic training on cardiorespiratory fitness and associated cognitive function in AD and aerobic exercise training improved maximal oxygen consumption and cognitive function. Apart from enhanced cardiorespiratory fitness, another important mechanism that works towards the improvement of cognition through aerobic exercise includes increase in the levels of growth hormones and a resultant increase in hippocampal volume and function (Maliszewska-Cyna et al., 2017). Morris et al. (2017) conducted a study to assess the effects of 26 weeks aerobic exercise training in individuals with AD. Results showed that the intervention enhanced bilateral hippocampal volume in addition to cardiorespiratory fitness and associated memory performances. Besides, exercise causes an increase in BDNF levels that promotes neurogenesis and synaptic plasticity. It also promotes angiogenesis by increasing the levels of vascular endothelial growth factor (VEGF). Insulin-like growth factor (IGF-1) uptake increases in response to physical exercise that causes cell proliferation and hippocampal neurogenesis (Maliszewska-Cyna et al., 2017). Therefore, the primary mechanisms associated with aerobic exercise in AD include improved cognitive function, increase in cerebral blood flow and volume, reduction in ROS production as well as up regulation of BDNF and other growth factors. All these factors promote hippocampal neurogenesis and function in turn reducing Aβ and tau accumulation (Cui et al., 2018). Consequently, aerobic exercise plays a key role in improving hippocampal function and delaying or preventing the

onset of cognitive impairments. However, repetitive traditional exercise training can get monotonous and boring after a certain time, especially in case of older adults who lack social interaction and motivation. Dance-based exercise intervention can improve their participation in physical activity compared to other forms of exercise training that is a key factor to be considered in elderly population.

Dance training and AD

Dance is a unique form of exercise based on music that is safe, inexpensive and can be performed in any environment (Aplert et al, 2007). Above all repetitive step movements enhance memory and cognitive function (Lazarou et al., 2017). This is thought to be due to an increase in the gray matter thickness (Porat et al., 2016). There are different types of dance forms such as cultural dances, jazz, salsa, contemporary, and ballroom that have been shown to be beneficial for improving cognition and balance in AD. According to the previous research, 5-7 months contemporary dance intervention improved attentional control compared to motor-skill learning (Coubard, Duretz, Lefebvre, Lapalus, & Ferrufino, 2011). Alpert et al. (2007) determined the effects of 15 weeks jazz dance training on balance, cognition and mood in healthy, community-dwelling elderly women and there was a significant improvement in balance, but not mood and cognitive function in postmenopausal women. Lazarou et al. (2017) examined the effects of ten months international ballroom dance training on cognitive function in older individuals with mild cognitive impairment. There was a significant improvement in cognitive function in the dancing group while performance deterioration was seen in the control group. A case study was conducted by Abreu & Hartley (2013) which studied the effects of 12-week salsa dance training on balance and falls risk in an elderly individual with AD. The functional balance and gait speed in dance group were improved through 24 sessions during12 weeks. A recent study was reported the effects of 18 months dance intervention compared to fitness training on hippocampal volume and balance in individuals with AD (Rehfeld et al., 2017) and showed significant improvement of hippocampal volume in both groups but balance improvements were only observed in the dance group. Zhu et al. (2018) studied the effects of 3 months combined aerobic dance training consisting of complex movement and found significant improvement memory and processing speed in the training group when compared to control group. Borges et al. (2017) assessed the effects of 12 weeks ballroom dance training on balance, cognition and functional autonomy in individuals with dementia. It was found that ballroom dancing improved balance, functional autonomy of ADL and mental state. Consequently, there are a wide variety of dance forms and intervention strategies that affect either balance or cognition, or both in individuals with AD as well as encourage enjoyment of the activity and a consequential improvement in their quality of life.

Conclusion

The management of Alzheimer's disease should primarily include aerobic exercise in addition to pharmacological treatment in order to obtain effective treatment outcomes without any adverse effects occurring from the drugs. Dance is a safe, convenient, inexpensive and enjoyable form of aerobic exercise that motivates older adults with AD to participate in physical activity and become socially active. Previous research has shown that aerobic exercises, particularly in the form of different aerobic dance forms can improve cognition and balance in AD by enhancing hippocampal volume, BDNF levels and reducing ROS production. It may be concluded that dance-based exercise constitutes the most significant non-pharmacological treatment to improve cognitive function and balance in individuals with AD.

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Received: October 31, 2019
Reviewed: November, 29, 2019
Accepted: December, 19, 2019