The Effect of Exercise on Alzheimer's Disease

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ABSTRACT

Alzheimer's disease (AD) is a progressive neurodegenerative disease, from which there is no recovery. It begins with impaired memory and judgement and progresses to the point where those affected can no longer care themselves. Although the cause of AD is unknown, two significant abnormalities occur in the brain of its victims: neurofibrillary tangles and amyloid plaques. It has been well established that exercise improves mood and general well-being, however this paper will focus on the effect of exercise on AD. It will show that exercise can improve physical functioning of an individual with AD, however more importantly it will focus on how exercise can prevent and/or delay the onset and progression of AD. In addition we will discuss how much exercise is necessary to reduce the risk of AD, despite there being no established exercise prescription at this time.

INTRODUCTION

Alzheimer's disease (AD), the 4th leading cause of death, affects 4.5 million people in the United States and is expected to increase to 13.2 million by the year 2050. AD is a progressive neurodegenerative disease, from which there is no recovery. It begins with impaired memory and judgment and progresses to the point where those affected can no longer care for themselves. (Desai, 2005).

Although the cause of AD is unknown, research has found that two significant abnormalities occur in the brain of its victims: neurofibrillary tangles and amyloid plaques. Neurofibrillary tangles are found in the cytoplasm of abnormal neurons. They consist of twisted nerve cell fibers, which result from the alteration of Tau, a protein which helps support nerve cell structure. These tangles are resistant to chemical or enzymatic breakdown and remain in the brain tissue even after the neuron it began in has died or disappeared (Porth, 2004).

Amyloid plaques are sticky patches formed by insoluble proteins-Beta amyloid-surrounded by the debris of dying nerve cells. These plaques are found in areas of the cerebral cortex associated with intellectual function. Elevated levels of beta amyloids are also associated with a decrease in the enzyme choline acetyltransferase which is required for the synthesis of acetylcholine, a neurotransmitter associated with memory (Porth, 2004).

Initial clinical manifestations of AD are attributed to forgetfulness, emotional upset, or other illness. The individual becomes progressively more forgetful over time, particularly in relation to recent events. Memory loss increase as the disorder advances and the individual becomes disoriented and confused. The ability to concentrate declines. Abstraction, problem solving, and judgement gradually deteriorate. These mental status changes induce behavioral changes, including: irritability, agitation, and restlessness. The individual may become anxious,

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depressed, hostile, emotionally labile, and prone to mood swings (Porth, 2004).

BENEFITS OF EXERCISE

Research has shown that regular physical activity, regardless of the sex or age of the participant, has multiple beneficial effects, including but not limited to, decreasing: mortality rates, coronary artery disease, risk of colon cancer, diabetes, risk of obesity, risk of hypertension, as well as increasing mood and reducing depression (Centers for Disease Control and Prevention, 2003). Exercise is especially important for those with AD as many studies have associated this disease with physical deterioration such as malnutrition, higher risk for falls and fractures and rapid decline in mobility, compared to aged matched controls (Teri et al, 2003). Studies (Arkin, 2003, Rolland et al., 2007) have found that individuals with AD who participated in exercise sessions of one hour twice a week, showed significant improvement in aerobic fitness, duration and upper and lower body strength, as well as slower physical decline.

One study (Teri et al, 2003) looked at the effects of exercise on physical performance for those with a diagnosis of AD. Patients in this study were either assigned to a combined exercise and caregiver training program or to routine medical care. Three months into the program patients in the exercise group showed improved scores for physical role functioning compared to the routine medical care group whose scores actually declined. At 2 years, the exercise group continued to show better physical role functioning scores compared to the routine medical care patients. These studies prove that although a person has a diagnosis of AD, it is possible to progress on a physical level. This is improvement can be beneficial for those caring for an individual with AD, as it enables the person to remain more physically independent and less dependent on the caregiver.

PSYCHOLOGICAL BENEFITS OF EXERCISE

Most research done on the psychological benefits of exercise conclude that exercise improves mood, and reduces anxiety and depression (Hassmen et al., 2000). Palmer, 2005, Sarbadhikari et al 2006). During exercise endorphins are released into the bloodstream and bind

to the opioid receptors in the brain. They have an antagonistic effect on the receptors and therefore block the release the neurotransmitter molecules from the nerve terminal thereby blocking the signals of pain (Porth, 2004). The endorphin effect also causes a feeling of euphoria, reduces anxiety, tension, anger and confusion, all of which are present in individuals with AD.

It is of greater benefit to those with AD is repetitive exercises, such as walking, indoor bicycling, and activities such as folding laundry are encouraged. These exercises may decrease anxiety as there is no need for decision making or recalling what task comes next. In addition, it channels a tendency for restlessness and wandering, which are characteristics of the disease, into a beneficial activity.

Teri et al. (2003), which was previously discussed for it study on physical progression, also looked at how exercise affected the patients psychologically. It was found that at three months, patients in the exercise group had improved Cornell Depression Scale for Depression in Dementia (designed for assessing depression in elderly residents with dementia) scores and showed a trend for less institutionalization due to behavioral disturbance. For patients with higher depression scores at baseline, those in the exercise group showed significant improvement at 3 months on the Hamilton Depression Rating Scale (test measuring the severity of depressive symptoms in individuals) and maintained that improvement at 24 months. Those in the routine medical care group showed higher depression ratings and continued to show steady decline.

ROLE OF EXERCISE IN THE DELAY/PREVNTION OF AD

Over the past decade, a number of studies have shown the benefits of exercise on brain health and function, particularly in aging populations. Exercise participation has consistently emerged as a key indicator of improved cognitive function and lower risk of cognitive impairment, AD and dementia in general (Cotman 2002).

Smith & Friedland (1998) retrospectively examined the exercise habits of 373 people-126 with Alzheimer's and 247 healthy people. They found that individuals with AD has lower levels of physical activity earlier in life. More recent studies (Wang et al., 2006) followed a larger group of people (2,288) over the age of 65 for 6 years and came to the same conclusion. Lower levels of physical performance were associated with an increased risk of dementia and AD, whereas higher levels of physical function appeared to play a protective role and delayed the onset of AD.

An interesting observation was also made by Wang et al (2006), which may help predict AD before any cognitive signs actually appear. Researchers observed that among subjects without apparent cognitive deficits, those with poor balance, gait disturbance and poor handgrip were more likely to develop dementia, which is a form of AD. Therefore, the study suggests that a simple way of predicting Alzheimer's risk in the future might be to test how an elderly person walks, the strength of their grip, and their level of balance when standing.

Exercise may also delay or prevent AD, as it has been shown to decrease the amyloid plaques in the brain, as suggested by a recent study (Aldard et al., 2005). This study used TgCRND8 mice, transgenic for the human amyloid precursor protein, to directly examine the interaction between exercise and AD. The study found that five months of voluntary exercise resulted in a delay of the progression of AD, as evidenced by a decrease in beta amyloid plaques

in the frontal cortex, the cortex at the level of the hippocampus and the hippocampus, the brain region central to learning and memory.

Lifestyle changes are key to slowing the onset and progression of AD. The good news about this is that it might not be too late for those who have lived sedentary lifestyles. Lifestyle changes do not necessarily have to occur in the early years of life in order to see the benefits of exercise on AD, as observed by Rovio et al. (2005). This study looked at the long term association between midlife (mean age of 50 years) leisure-time physical activity and risk of AD. Upon follow up (mean age 71.6 years), it was found that individuals who participated in a leisure-time physical activity at least twice a week had 60% less chance of developing AD compared with sedentary people, even after adjusting for a wide array of potential factors.

There are several possible ways in which physical activity may protect against AD. First, the effect could be mediated through various vascular risk factors (e.g., hypertension, hypercholesterolemia, diabetes, obesity) that have been found to contribute to the development of AD. Physical activity is important in promoting overall and vascular health. There may also be several neurobiological mechanisms linking leisure-time physical activity to AD. Recent studies have indicated that physical activity affects several gene transcripts and neurotrophic factors that are important for the maintenance of cognitive functions. (Rovio et al., 2005, Sarbadhikari et al. 2006).

These findings are supported by animal research which demonstrates that exercise can increase neuronal survival and resistance to brain insult, promote brain vascularization, stimulate neurogenesis, enhance learning and contribute to maintenance of cognitive function during aging (Cotman, 2002).

Although many studies have shown the benefits of exercise on AD, no exercise prescription has yet to be established. Based on the research articles obtained, this paragraph will review the findings of how much, or rather how little, exercise is necessary to prevent or delay AD.

It was found that 15 minutes of moderate exercise 3 times a week was the least amount of exercise required to show a beneficial effect on AD (Larson et al, 2006). Exercise in this study reduced the risk of developing dementia by 30%. The study suggests that even a short brisk walk ever day might ward off the disease. Rovio et al (2005) reported that 20 minutes of exercise that caused sweating and strained breath, biweekly reduced the risk of AD by 60%. The most common forms of exercise participated in during this study was walking and cycling. Stevens et al. (2006) had his subjects exercise for 30 minutes three times a week for a total of 12 weeks and found that exercise slowed the rate of cognitive decline as well as physical decline related to dementia.

In a Harvard study completed in 2004, women who walked at a pace of 21-30 minutes per mile for two to three hours a week did better on cognitive tests than inactive women. To get the same benefits, it recommends: walking 1-2 hours each week at a pace of 15 minutes per mile, bike, and swim laps or play tennis for 1 hour each week, or jog for 30 minutes- 1 hour each week at a pace of 10 minutes per mile. Studies show that as the amount of time spent exercising increased the protective effect of exercise increased proportionately (Larson et al., 2006).

CONCLUSION

From this paper we can conclude that exercise plays a significant role in preventing or delaying Alzheimer's disease. However, if this conclusion is so true, why don't we have a set exercise prescription and why isn't the public aware of this? Could it be that some of these studies have somewhat of a subjective nature to them that make the validity questionable?

The problem that may arise with some studies is that measurements of exercise are self-reported. Everybody knows that overall exercise is good for you and that in order to maintain our health we are supposed to partake in it. This fact may influence some people to exaggerate about how much exercise they partake in so that they don't look bad to the public eye. In addition, what may be considered moderate exercise for one person may be high or low intensity for the next. Moderate exercise should be a defined and measurable factor so it can be reproduced to get the same beneficial outcome.

Despite all this, exercise still remains an important part of a healthy physical and psychological lifestyle. Even if the accuracy of some of these studies are in question, overall, there were too many positive outcomes for those with AD to disregard it. Therefore, let us continue exercising our way to a sound mind and body.

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