1-2011

Exercise as a Primary, Secondary and Tertiary Intervention in Alzheimer's Disease

Sara Duerr
St. Catherine University

Title: Exercise as a Primary, Secondary and Tertiary Intervention in Alzheimer's Disease

Submitted To:
Vicki Ericson, DNP RN CNP.
NURS 8000
Scholarly Paper
May 23, 2011

Submitted By:
Sara Duerr, BSN, RN
ID# 439329

Introduction

Alzheimer's disease (AD) is the most common form of dementia in the U.S., accounting for 5.4 million cases in 2011(Alzheimer's Association [AA], 2011). Left untreated, the number of people afflicted by AD is expected to increase fourfold by 2050 (Bassil & Grossberg, 2009). According to the American Psychiatric Association (2000), AD is a deteriorating neurodegenerative disorder characterized by cognitive deficits, including amnesia [memory loss], apraxia [inability to carry out motor activities], agnosia [inability to recognize objects], aphasia [disturbances in language] and loss of executive function [high-level abilities that influence basic abilities] (American Psychiatric Association,2000). Currently, there are no recommended prevention strategies for AD; instead, treatments work towards improving symptoms or stabilizing cognitive decline for a few months to a few years. Therefore, attempts to identify strategies aimed at prevention remain a key approach for this rapid growing disease (Bassil & Grossberg, 2009).

Primary, secondary and tertiary interventions are needed for prevention and protection from many health problems. Primary prevention is an important factor in delaying the onset, and sometimes preventing many chronic diseases and health conditions. The goal of secondary prevention is to ameliorate the effects of illness or injury, while tertiary prevention aims to improve patients' quality of life in the disease state (Nadloo & Wills, 2000). A role of the primary care provider, specifically advanced practice nurses (APN), is to focus on prevention and wellness care, emphasizing primary and secondary preventive strategies. The treatment and management of chronic illnesses are the goals of tertiary prevention. Current research suggests, in the case of AD, that exercise may be an effective approach in primary, secondary and tertiary prevention (United States Preventative Services Task Force [USPSTF], 2003).

The purpose of this paper is to review, synthesize, and analyze current studies on the effects physical exercise has on lowering the risk for developing AD. It will examine how routine exercise may prevent or attenuate the symptoms of AD in the elderly.

Epidemiology

Americans are living longer, and this longevity contributes to a rise in age-related diseases, such as AD. According to the Alzheimer's Disease Facts and Figures (2011), an estimated 5.4 million Americans 65 years and older have AD; 13% of the population in that age group. The greatest proportional increase in incidence rates of AD and dementia occurs between the ages of 75 to 84 years (AA, 2011). In 2010, about 2.4 million people 85 years and older (approximately 47% of AD cases) were afflicted with AD. By 2030, the disease is estimated to reach 7.7 million Americans aged 65 and older (AA, 2011).

The Discovery of AD

While age-related mental deterioration has been recognized throughout history, it was not until 1906 when Alois Alzheimer, a German physician, labeled it as a disease. He noted a unique type of mental deterioration in his patients. This type of cognitive decline differed from senile dementia in that it occurred in the sixth decade of life, with the presence of focal symptoms such as aphasia, apraxia, agnosia, severe psychosis, and consequential rapid progression of the disease. From autopsies of these patients Alzheimer found neurodegeneration and numerous senile plaques in the brain. In addition, he discovered almost one-third of the cortical cells had lysed. In 1910, Alzheimer's director, Emil Kraepelin coined the term "Alzheimer's disease," a term still used to refer to the most common form of senile dementia (Yamaguchi, 2007).

Pathophysiology

Neurofibrillary tangles and amyloid plaques, found primarily in the basal forebrain, amygdala, hippocampus, and the cerebral cortex, are the primary brain abnormalities seen on autopsy in patients with AD. Neurofibrillary tangles occur when microtubular structures in the axon process of a neuron are loosened as a result of the dysfunction of tau proteins. The loosened microtubules create tangles, which disrupt cell function and cause the entire neuron to die. Neuritic amyloid plaques occur when amyloid precursor proteins split forming protein beta amyloid (A-beta). The A-beta breaks apart from the cell membrane and dissolves into fluid surrounding the neuron. The non-dissolving A-beta folds, called fibrils and create clusters that form plaques. While a small amount of plaque formation is a normal aging process of the human brain, in the AD-afflicted brain, the plaques displace brain cells and initiate an inflammatory response, which damages cell interiors, resulting in cell lysis (Uphold & Graham, 2003). Cell regeneration, or neurogenesis, can correct the loss of some of the lysed neuronal cells, but not all. Brain-derived neurotrophic factor (BDNF), a growth factor, promotes neurogenesis by stimulating neuronal proliferation and differentiation (Cotman & Berchtold, 2002).

The balance of neuronal network activity is the homeostasis of neuronal cell degeneration and regeneration. In neurological disorders such as AD, homeostasis is unbalanced and degeneration is accelerated, causing an inefficient replacement of depleted cells. This disruption causes alterations in the cognitive functions of higher learning, such as memory, reasoning behavior, emotional control, and executive function. (Uphold & Graham, 2003). During clinical evaluation, the health care provider must consider each of these functions to determine the correct diagnosis of the disease.

Clinical Presentation and Diagnostics

According to the American Psychiatric Association (2000), multiple cognitive deficits must be present for the diagnosis of AD. To identify the disease progression in a patient, Dr. Barry Reisberg, clinical director of New York University's Aging and Dementia Research Center, developed the Functional Assessment Staging (FAST) scale (Table 1), which outlines the seven major clinical stages of AD. The staging process identifies common patterns of symptom progression from the first sign of memory loss to death, and provides a standard for professionals to document the decline of the disease (Reisberg, 1999).

TABLE 1: FAST scale

FAST Scale Stage	Score	Characteristics
Normal adult	**1**	**No functional decline.**
Normal older adult	**2**	**Personal awareness of some functional decline.**
Early AD	**3**	**Mild cognitive impairment (MCI) showing noticeable deficits in demanding job situations.**
Mild AD	**4**	**Assistance required in complicated tasks such as handling finances and planning parties.**
Moderate AD	**5**	**Assistance required in choosing proper attire.**
Moderately severe AD	**6**	**Assistance required in dressing, bathing, and toileting. Urinary and fecal incontinence progresses.**
Severe AD	**7**	**Speech ability declines to about a half-dozen intelligible words. Progressive loss of abilities to walk, sit up, smile, and hold head up.**

(Goetz, 2007).

To be diagnosed with AD, the onset of the cognitive deficits must be gradual, and a continuation of cognitive decline must occur. Diagnostic criteria for AD include a progressive

loss of memory and at least one other cognitive deficit that interferes with social or occupational functioning. As the disease worsens and the patient progresses through each stage, memory capacity continues to slowly decline, as do language skills, praxis, and orientation. The patient is also unable to learn new information and recall previously learned information. In addition, a patient may present with psychiatric symptoms such as depression, psychosis, agitation, and personality changes (Smith, 2002).

By the middle to late stages of the disease, many mental and physical disabilities become apparent. Aggression, combativeness, hyperactivity, and disinhibition are the most common behavior changes, occurring in 50% of AD patients. Though less common, paranoia, delusions and hallucinations can also occur. Physical decline in patients is evident as they develop gait imbalance, wandering behaviors, motor disturbances, and incontinence (Smith, 2002).

Diagnosing AD requires a comprehensive history and examination including the patient's mental and physical states. Specific attention is paid to the patient's ability to perform daily activities and retain recent information. The results will help determine whether further testing is needed to make a definitive diagnosis, as well as to rule out differential diagnoses (Uphold & Graham, 2003).

Diagnostic imaging such as computed tomography (CT) scans, magnetic resonance imaging (MRI) and positron emission tomography (PET), may play a role in the diagnosis of AD. A CT scan can exhibit changes in the brain that are characteristic of AD, including atrophy. An MRI can show structural and functional changes in the brain associated with AD. It can also help to identify other diagnoses such as tumors and strokes that may cause symptoms of dementia. PET scans can help evaluate the progression and may also differentiate AD from other forms of dementia (Uphold & Graham, 2003).

Neuropsychological testing can be used to examine the relationship between the brain and the patient's behavior. Commonly, these tests are used for patients with memory or concentration loss, recollection of words and names, understanding language, visual-spatial issues, and a variety of other symptoms. One such test, the Mini-Mental Status Exam (MMSE), can help in the diagnosis of conditions that affect thinking, emotion, and behavior such as in AD. It can also help recognize additional diagnoses, including depression and anxiety, and cognitive problems caused by medicines, substance abuse, strokes, and tumors (U.S. National Institute of Health [NIH], 2011).

Besides the MMSE, other tests are also used in assessing the stage or severity of AD. Once the patient is diagnosed with AD through any of the screening tools listed below (Table 2), the health care provider can offer options for treatment.

TABLE 2: Types of screening tools

Name of Test or Tool	**Description**
The Mini-Cog (cognitive) Exam	Signs of memory loss and cognitive declined is tested. The patient is asked to draw a simple clock with the hands showing a given time. The patient must also attempt to remember and repeat back, several unrelated words.
The 7-Minute Neurocognitive Screen	To determine if cognitive deterioration is caused from normal aging or dementia four areas are tested: word recall; date and time skills; verbal skills; drawing a clock.
The Mini-Mental State Exam (MMSE)	Skills such as recall, simple calculations, and language are assessed.
Cognitive Abilities Screening Instrument (CASI)	Quantitative assessment is focused on attention, concentration, orientation, short-term memory, long-term memory,

	language abilities, visual construction, list-generating fluency, abstraction, and judgment.
AD Assessment Scale cognitive subscale (ADAS-cog)	The severity of AD symptoms—memory, language, praxis, attention and other cognitive abilities—is measured based on the completion of 11 tasks.

(Lorentz, Scanlan, & Borson, 2002).

Pharmacological Management in AD

While pharmacological treatments stabilize or slow the rate of cognitive decline in mild (FAST scale score, four) to moderate AD (FAST scale score, five) patients, the treatments have little effect on improving symptoms in the later stages when the neurons are severely damaged. Doneprezil (Aricept), Rivastigmine (Exelon), and Galanmine are first-line cholinesterase inhibitors used to treat cognitive deficits in patients with mild to moderate AD (Claudio, Bruno, Allard, Leon & Florencia, 2010).

In the AD brain, the amyloid plaques and neurofibrillary tangles destroy cholinergic neural cells which transmit acetylcholine, a neurotransmitter involved in cognitive and memory functions. The results are a progressive and significant loss of brain function. Treatment using cholinesterase inhibitors prevent the action of the acetylcholinesterase to improve levels of acetylcholine. By maintaining higher levels of acetylcholine, the drug provides mild and temporary improvement in cognition immediately after initiation of the treatment. However, the duration of the improvement varies and all patients with AD will continue to decline, despite treatment (Claudio et al., 2010).

The American College of Physicians and The American Academy of Family Physicians have developed guidelines on the use of Doneprezil, Rivastigmine, and Galanmine based on

current research. The guidelines suggest a need for additional research on the effectiveness of pharmacologic management of AD and note that none of the three medications prevent the progression of AD (Qaseem et al, 2008). Birks and Flicker (2006) found the positive benefits of cholinesterase inhibitors were minor, had a short effect, and had many side effects. The above studies found the overall effects of the cholinesterase inhibitors were minute and difficult to detect.

While pharmacological management slows the rate of cognitive decline over the first 12 months, after three years, the rate of cognitive decline continues and the disease progresses (Petersen et al., 2005). Pharmacological therapy provides limited benefit for Alzheimer's treatment. Therefore, more research is needed for improved pharmacological as well as non-pharmacological strategies that have longer-lasting effects on delaying AD progression.

The Role of Exercise in AD

Exercise is a structured physical activity performed with the objective of improving or maintaining physical fitness. Physical activity is defined specifically as any "bodily movement produced by skeletal muscles that results in energy expenditure and is positively correlated with physical fitness" (Caspersen, Powell, & Christenson, 1985). Aerobic exercise involves continuous and rhythmic use of large muscles for at least 15 minutes three or more times per week, with a 60% increase in resting heart rate. Regular participation in aerobic exercise intensifies the heart's capacity to deliver oxygen to vital organs, including the brain (Nelson et al., 2007), and is essential to the physiologic mechanisms of the neurological system (Colcombe & Kramer, 2003).

The synapses in the hippocampus can potentially be remodeled by exercise-induced neurogenesis through the elevation of brain-derived neurotrophic factor (BDNF) (Pereira et al.,

2007; Vaynman & Gomez-Pinilla, 2006). Brain-derived neurotrophic factor has been shown to stimulate neurogenesis (Kempermann, Kuhn, & Gage, 1998) and has also been found to have a crucial role in synaptic transmission, growth, and neuroplasticity (Cotman &Berchtold, 2002). Neuroplasticity refers to the brain's capacity to develop new neuronal and synaptic interconnections. As a result, remodeling can occur in particular regions of the brain, specifically in the hippocampus and cortex, the area of the brain responsible for learning and memory (Cotman & Berchtold, 2002).

The effects of BDNF protein on AD have been a focus in research for decades. Cotman & Berchtold (2002) have found a strong association between physical activity on neuroplasticity, neuroprotection, and neurogenesis, processes implicated in the prevention and treatment of AD. Decreased levels of amyloid plaques in the frontal cortex, the cortex, and the hippocampus of mice, in response to exercise resulted in improvements in cognition, the rate of learning, and an increase in growth factor hormones (Adlard, Perreau, & Cotman, 2005). Serum insulin-like growth factor 1 (IGF-1), produced in the liver, stimulates the induction of brain-derived neurotrophic factor (BDNF) and contributes to hippocampal plasticity and neurogenesis in the adult brain. BDNF promotes neurogenesis by stimulating neuronal proliferation and differentiation, and increasing the growth of blood vessels and cerebral blood volume, an important factor in the neurobiology of exercise (Cotman & Berchtold, 2002).

A study conducted by Christensen, Marcussen, Wortwein, Knudsen, and Aznar (2008) showed injection of beta-amyloid protein (AB) to simulate AD in rats decreased BDNF levels and impaired BDNF regulation. The reduction of BDNF seen in AD has been shown to affect the hippocampus by weakening synaptic strength and decreasing protection of hippocampal neurons. Hippocampal function is compromised early on in the course of AD, and is considered the

principal cause of the memory problems that characterize this disease (Christensen et al., 2008). The observation of reduced BDNF levels in the AD brains led to the hypothesis that the progression of Alzheimer's could be slowed or stopped if brain levels of BDNF could be increased (Hof & Morrison, 2004).

Animal studies can provide information on the effects of exercise on BDNF that is challenging to obtain in human studies. A prospective study was conducted on mice by Adlard et al. (2005) to determine how age and exercise affect the induction of BDNF across the span of life. It was found across all (mice) age groups that BDNF showed a significant increase after seven days of exercise. In fact, the oldest age group showed the highest induction of BDNF, recognizing the capability of neurogenesis to occur in later life. Results of the animal studies suggest that exercise enhances cognitive function

In humans, routine exercise is associated with an increase in cognitive function, a plausible result of increased BDNF levels (Hall, Smith, & Keele, 2001). Pereira et al. (2007) found an increase in cerebral blood volume in the hippocampus after individuals participated in 3 months of an exercise program. The rise of cerebral blood volume was associated with an improved performance on a verbal learning and memory test. The increase of cerebral blood volume was discovered in the same study which found exercising mice to have an increase in neurogenesis, suggesting cerebral blood volume could potentially serve as a biomarker for neurogenesis in humans (Pereira et al., 2007).

Exercise as a Prevention Strategy

It has long been established that physical exercise is beneficial for a number of age related conditions such as osteoporosis, cardiovascular disease, and diabetes mellitus (Williamson & Pahor, 2010). Emerging evidence suggests that physical activity may provide

health protective benefits on neurological diseases such as AD. A potential health benefit of regular exercise in the aging population is the prevention or delay in the loss of cognitive and physical function in AD (Booth, Chakravarthy, Gordon, & Spangenburg, 2002). Three forms of prevention measures; primary, secondary, and tertiary aim to prevent the onset or progression of AD using exercise as a non-pharmacological treatment.

Primary Prevention

It estimated that delaying the onset and progression of dementia for one year would result in 9.2 million fewer cases of the disease by 2050 (Brookmeyer, Johnson, Ziegler- Graham and Arrighi, 2007). Exercise as a preventative strategy has been effective in protecting young and middle-age adults from cognitive decline in their later years (Laurin, Verrault, Lindsay, MacPherson and Rockwood, 2001).

Being more physically active early in life has been found to reduce the risk of developing dementia (Rovio, Karehol & Helkala, 2005; Yaffe, Barnes, Nevitt, Lui & Covinsky, 2001), and can be a protective tool against the development of the disease (Friedland et al., 2001). When compared to their more sedentary peers Rovio, et al.,(2005), Ravaglia et al., (2008), and Larson et al., (2006) concluded that elderly people who are more physically active are at less risk of developing AD. Moreover, people with higher levels of baseline physical activity are possibly less likely to develop cognitive decline (Yaffe, Barnes, Nevitt, Lui and Covinsky, 2001).

Besides integrating an exercise routine early in life, repeated moderate exercise can be a deterrent to AD. Lifestyle changes, including regular walking have been shown to improve memory and cognition and may prevent or slow the cognitive decline associated with AD (Yaffe et al.,2001; Ravaglia et al., 2008). Women who walked at least one and a half hours a week performed better on memory tests two years later than those who walked less than 40 minutes a

week (Weuve, Kang, Manson, Breteler, Ware & Grodstein, 2004). Engaging in regular moderate activity has been associated with retaining cognitive function (Ravaglia et al.,2008) and slowing down cognitive decline in the elderly (Yaffe et al., 2001).

Secondary Prevention

Secondary prevention entails identification of AD in its early stages. This enables the health care provider to use interventions such as exercise to treat or manage the disease's progression (USPSTF, 2003). Secondary prevention can be utilized in stage 2 (very mild cognitive decline) and stage 3 (mild cognitive impairment). Research has shown that individuals with MCI have an increased risk of developing AD within two to three years (AA, 2010; Lautenschlager et al., 2008). Consequently, people with MCI may delay or possibly even prevent the onset of AD by engaging in physical activity (Yaffe et al., 2001; Middleton, Kirkland, & Rockwood, 2008). Lutenschlager et al. (2008) found improved scores on the ADAS-cog screening test in elderly with MCI when they participated in 2.5 hours of moderately intense exercises over three-50 minute sessions/week for 24 weeks (Lautenschlager et al., 2008). While several studies have found a beneficial relationship between exercise and cognition, Middleton et al. (2008) questioned whether the intensity of exercise was associated with increased benefits in subjects with mild cases of dementia. Those who participated in moderate to high intensity exercises were at less risk for further impairment. Collectively, the studies suggest physical activity can benefit cognitive function in participants diagnosed at baseline with mild cognitive impairment (van Uffelen et al., 2008).

Tertiary Prevention

Without appropriate intervention, AD patients will continue to experience cognitive and functional decline. Functional decline is a major risk factor for hospitalization,

institutionalization, and mortality (Yu, Kolanowski, Strumpf, & Eslinger, 2006). Therefore, physical activity as a tertiary intervention can be a useful strategy in therapeutic management. The desired outcome of therapeutic management is to prolong functional independence and prevent further complications of AD. Exercise has been shown to be an effective intervention when the course of neurodegeneration and neuropathology have already occurred (Yu et al., 2006; Erickson & Kramer, 2008). In a randomized control trial, Rolland et al. (2007) compared two groups of patients with mild to moderate AD. The exercise treatment group participated in a one-hour exercise program, consisting of walking, strength training, and balance and flexibility twice weekly for 12 months. The control group received routine medical care. Activities of daily living (ADL) were assessed using the Katz Index of ADLs. Results suggested a significantly slower decline in ADL scores in AD patients who participated in regular exercise than those who solely received routine medical care.

To illustrate the prevention of further functional decline in the latter stages of AD, a meta- analysis of studies conducted by Heyn, Abreu, and Ottenbacher (2004) reviewed 30 randomized trials and found exercise could be beneficial to people with mild to severe AD. The participants averaged 3.6 exercise sessions per week with a mean duration of 45 minutes, consisting primarily of walking. The authors concluded that these findings could be useful in establishing exercise guidelines for older adults diagnosed with AD. To summarize, physical activity as a tertiary intervention can potentially be a useful strategy in therapeutic management.

Limitations of the Studies

Although there has been research to show improvements in AD with exercise as an intervention, a number of these studies have limitations. The majority of studies reviewed were limited by their sample sizes, the age disparity among the subjects, and inconsistent exercise

methods and interventions. Age is also a limiting factor simply because of the nature of the study. An increased incidence of illness and disease, disabilities, other age-related complications, and death led to the reduced number of available participants. Also, the studies lacked a homogenous standard of measurement of both exercise (mode, intensity, and duration) and cognitive testing. The methods for data collection was also a limiting factor in that many of the studies were based on self-reported information from the subjects about their activity levels. Consequently, there was a failure to measure specific duration, intensity, and frequency of the physical activities.

Conclusion of the Literature Review

The studies reviewed the effects of physical activity on cognitive function in animals and humans, and show a correlation between exercise and the ability to slow or possibly prevent cognitive decline in the elderly. These findings suggest that neurogenesis is active throughout the span of life. Researchers (Laurin et al., 2001; Rovio et al., 2005, Ravaglia et al., 2008; Lautensclager et al., 2008; Middleton et al., 2008; Yu et al., 2006; Rolland et al., 2007; Heyn et al., 2004) have observed that when physical exercise is implemented as a treatment option among the elderly, three actions might occur: the onset of the disease may be prevented through primary intervention; the disease may be delayed with secondary intervention; and AD may be reversed with tertiary prevention. The research findings can be incorporated into the treatment plan and health education of all ages — but specifically, the elderly .

Educating and Counseling Patients

Health care providers look for ways to educate and motivate the older adult to overcome barriers that prevent them from engaging in regular exercise routines. They can inform older adults on AD prevention and provide literature on the benefits of physical exercise. In addition,

they can give guidance on how to incorporate an exercise routine into their daily lives (Ravaglia et at., 2008).

An exercise program should be pleasurable and engaging. Health benefits can be gained with short, simple exercises, such as walking. Understanding the relationship between exercise and cognition could provide motivation for healthy older adults to begin an exercise regimen (Ravaglia et al., 2008). In patients with moderate to severe AD, Heyn (2003) found using a multisensory exercise program that includes physical and cognitive stimuli may decrease resting heart rate, increase exercise engagement, and preserve function in patients with AD.

Implications for Practice

The USPSTF in 2003 stated there was insufficient evidence to support the need of routine screening for dementia in primary care (Boustani, Peterson, Hanson, Harris, & Lohr, 2003). However, the American Academy of Neurology recommends routine monitoring and screening of patients suspected of cognitive impairment (Petersen et al., 2001). Based on these findings, health care providers must decide whether to routinely screen older patients for cognitive deficits. Benefits to the 10-minute screening generally result in early detection of the disease, which could result in early intervention, lower health care costs, and an enhanced quality of life (Weimer & Sager, 2009).

When health care providers promote lifestyle changes such as routine exercise, they often face resistance from the patients. Although benefits of physical exercise for the elderly have been well documented, the intimidation of difficult or painful exercise may prevent them from beginning an exercise program. Additionally, the provider may stereotype the elderly as unwilling to exercise or unable to learn the exercise. Health care providers might also fear that exercise could harm their elderly patient. As is true for any age, barriers to exercise might also

include concern over other obligations, inadequate exercise space, self-consciousness, fear of injury, or lack of an exercise partner. Health care providers play a role in helping to motivate and encourage their patients to engage in healthy behaviors like regular exercise (Elley, Kerse, Arroll, & Robinson, 2003).

At every contact point, providers might want to consider promoting exercise as a preventative measure not only for heart disease and other chronic disease, but for AD as well (Purcell, Piccinini, & Vallis, 2005). Primary care providers who advised patients about physical fitness found a 12% to 50% increase in exercise participation. To promote exercise as an effective strategy, providers could utilize a "green prescription" (Elley et al., 2003; Swinburn et al, 1998). A "green prescription" includes a contract on a standard prescription pad which includes mode, intensity, and frequency of exercise, in which the patient agrees to participate in an exercise program (Elley et al., 2003). Follow-up appointments can be made by phone, and a quarterly newsletter can remind patients to maintain their workout regime. Patients who were repeatedly reminded over the course of several months were more likely to continue an increased activity level than those who were not reminded (Elley et al., 2003).

Exercise Guidelines for Older Adults

Health benefits of routine exercise have been well established (e.g., 30 minutes of brisk walking at least five days per week). Based on the recommended guidelines, Yaffe et al. (2001) found that walking corresponded with a 34% reduction in the risk of developing cognitive impairment. Yet, few older adults achieve the daily minimum recommended amount of 30 minutes of moderately intense activity. The Centers for Disease Control (CDC) surveillance data found about 40% of adults aged 65 and older were inactive, meaning they engage in no leisure

time, household, or transportation physical activity (U.S. Department of Health and Human Services [HHS], 2008).

The 2008 Physical Activity Guidelines for Americans advises older adults to be as physically active as their abilities allow (HHS, 2008). In 2008, the HHS published guidelines on the amount of physical activity recommended for older adults to maintain their health and fitness levels. For significant health benefits, the guidelines recommend most older adults participate in at least 150 minutes of moderately intense aerobic activity, 75 minutes of vigorously intense aerobic activity, or an equivalent combination of each per week. The American College of Sports Medicine (2007) recommends aerobic and muscle-strengthening activity for healthy aging. For some patients, low-impact activities such as stretching exercises, swimming, or other water activities have been beneficial (Nelson et al., 2007). Presently, there are no exercise guidelines specifically for patients with AD; however, Elsawy and Higgins, (2010) found elderly patients with chronic illnesses or disabilities gained substantial health benefits when they engaged in non-strenuous physical activities, such walking.

AD is one of the most feared illnesses of aging; people are afraid to lose not only their independence, but also their quality of life (Larson et al., 2006). Fear of a debilitating disease such as AD might motivate older adults, as well as the general public, to incorporate physical exercise into their daily routine.

Recommended Internet Sites

A document released by a coalition of 50 health organizations was developed to increase physical activity among America's aging population, and recommended regular exercise as a health benefits for the elderly. The National Blueprint: Increasing Physical Activity Among Adults Aged 50 and Older (http://www.agingblueprint.org/overview.cfm) identifies the major

barriers to physical activity, encourages participation by older adults, and outlines strategies for increasing physical activity levels. The document contains studies substantiating evidence that physical activity can extend years of active independent life, minimize disability, and improve the quality of life.

The World Health Organization Guidelines for Physical Activity of Older Persons/Active Ageing (http://www.who.int/ageing/en/) website provides guidelines to explore opportunities for health and physical fitness participation to enhance the quality of life in the elderly.

The Alzheimer's Disease Education and Referral Center (www.alzheimers.org) is a website intended for patients, their family members and caregivers. It provides information on AD, drug therapy, and innovative research. The site provides free literature, a search engine for health care professionals, and directs families to local support services.

Alzheimer's Disease and Related Disorders Association, Incorporated (www.alz.org) offers helpful information to health care professionals, patients, and caregivers, and provides educational material for AD and related disorders. Local chapters can help caregivers find services such as respite programs and day care for AD patients.

Conclusion

In summary, numerous research studies have shown a relationship between exercise and its positive effect on cognition in the elderly. The primary intervention of regular physical activity throughout a person's life can potentially reduce the likelihood of acquiring AD. Screening tools in secondary prevention for early detection and level of progression of AD, allows for a targeted method of treatment, such as walking or aerobic exercise. Tertiary prevention, through exercise, can enhance quality of life in the later stages of AD by preventing further decline, maintaining cognitive function and reducing dependency on caregivers. These

preventative measures can be utilized to de-escalate the epidemic of AD. With exercise guidelines in place for older adults, healthcare providers can promote lifestyle changes for the prevention and delayed progression of AD.

References

Adlard, P.A., Perreau, V.M., & Cotman, C.W. (2005). The exercise-induced expression of BDNF within the hippocampus varies across life –span. Neurobiology of Aging, 26, 511-520.

Alzheimer's Association. (2011). Alzheimer's Association Report: 2011 AD facts and figures. Alzheimer's and Dementia. Retrieved April 10, 2011, from http://www.alz.org/documents_custom/report_alzfactsfigures2010.pdf.

American Psychiatric Association. (2000). (4th ed). American Psychiatric Association: *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision*. Washington, DC.

Bassil, N., & Grossberg, G.T. (2009). Evidence-based approaches to prevention Alzheimer's disease, part 1. Primary Psychiatry,16 (6),29-37.

Birks, J., & Flicker, L. (2006). Donepezil for mild cognitive impairment. *Cochrane Database System Review.19* (3) CD006104.

Booth, F.W., Chrkravarthy, M.V., Gordon, S.E., & Spangenburg, E.E. (2002). Waging war on physical inactivity; using modern molecular ammunition against an ancient enemy. *Journal of Applied Physiology, 93*, 3-30.

Boustani, M., Peterson, B., Hanson, L., Harris, R., Lohr, K.N.; U.S. Preventation Services Task Force. (2003). Screening for dementia in primary care: a summary of the evidence for the U.S. Preventive Services Task Force. *Annals of Internal Medicine,138*(11),927-37.

Brookmeyer, R., Johnson, E., Ziegler-Graham, K., Arrighi, H.M. (2007). "Forecasting the global burden of Alzheimer's disease". *Alzheimer's and Dementia, 3* (3),186-191.

Caspersen, C., Powell, K., & Christenson, G. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health related research. *Public Health Reports*, *100*, 126-131.

Christensen, R., Macussen, A.B., Wortwein, G., Knudsen, G.M., & Aznar, S. (2008). $AB_{(1-42)}$ injection causes memory impairment, lowered cortical and BDNF levels and decreased hippocampal 5-HT $_{2A}$ levels. *Experimental Neurology,210*,164-171.

Colcombe, S.J., Erickson, K.I., Scalf, P.E., Kim, J.S., Prakash, R., Mcauley, E., et al. (2006). Aerobic exercise training increases brain volume in aging humans. *Journal of Gerontology: Series A, Biological Sciences and Medical Sciences, 61*(11),1166-70.

Colcombe, S., & Kramer, A.F. (2003). Fitness effects on the cognitive function of older adults: a meta-analytic study. *Psychological Science , 14* (2), 125-130.

Claudio, C. A., Bruno, M. A., Allard, S., Leon, W., & Florencia, I.M. (2010). Cholinergic involvement in Alzheimer's disease. a link with NGF maturation and degradation. *Journal of Molecular Neuroscience 40,* 230-235.

Cotman, C.W. & Berchtold, N.C. (2002). Exercise: a behavioral intervention to enhance brain health and plasticity. *Trends in Neurosciences. 25* (6) 295-300.

Elley, C.R., Kerse, N., Arroll, B., & Robinson, E. (2003). Effectiveness of counseling patients on physical activity in general practice: cluster randomized control trial. *British Medical Journal,326* (7393), 793.

Elsawy, B. & Higgins, K.E. (2010). Physical activity guidelines for older adults . *AmericanFamily Physician,81* (1), 55-59.

Erickson, K.I. & Kramer, A.F. (2008). Exercise effects on cognitive and neural plasticity in older adults. *British Journal of Sports Medicine. 43,* 22-24.

Friedland, R.P., Fritsch, T., Smyth, K.A., Koss, E., Lerner, A.J., Chen, C.H., et al. (2001).Patients with Alzheimer's disease have reduced activities in midlife compared with healthy control-group members. *The Proceedings of the National Academy of Sciences of the United States of America, 98*(6), 3440-3445.

Goetz, C.G. (2007) Chapter 5: *Textbook of Clinical Neurology, 3rd ed.* Philadelphia: Elsevier Saunders

Hall, C.D., Smith, A.L.,& Keele,S.W. (2001). The impact of aerobic activity on cognitive function in older adults: A new synthesis based on the concept of executive control. *European Journal of Cognitive Psychology, 13*(1/2),279-300.

Heyn, P. (2003). The effect of a multisensory exercise program of engagement , behavior, and selected physiological indexes in persons with dementia. *American Journal of Alzheimer's disease and Other Dementias*. *18*, 247-251.

Heyn, P., Abreu, B.C., & Otterbacher, K.J. (2004) The effects of exercise training on elderly persons with cognitive impairment and dementia: a meta analysis. *Archives of Physical Medicine Rehab, 84,* 1694-1704.

Hof, P. & Morrison, J. (2004). The aging brain: morphomolecular senescence of cortical circuits. *Trends in Neuroscience, 27(*10); 607-613

Kramer, A.F., & Erickson, K.I. (2007). Capitalizing on cortical plasticity: influence of physical activity on cognition and brain function. *Trends in Cognitive Sciences, 11*(8), 342-348.

Kempermann, G., Kuhn, H.G., & Gage, F.H. (1998). Experience-induced neurogenesis in the senescent dentate gyros. *The Journal of Neuroscience*, *18*(9),3206–3212.

Lahiri, D.K. & Maloney, B. (2010). The "Learn" (Latent Early-Life Associated Regulation) model integrates environmental risk factors and the developmental basis of Alzheimer's disease and proposes remedial steps. *Experimental Gerontology. 45*, 291-296.

Larson, E.B & Langa, K.L. (2008). The rising tide of worldwide dementia: a triumph, and now an opportunity. *Lancet, 37* (9637), 430-432.

Larson, E.B., Wang, L., Bowen, J.D., McCormick, W.C., Teri, L., Crane, P., et al. (2006). Exercise is associated with reduced risk for incident dementia among persons 65 years of age and older. *Annals of Internal Medicine, 144*(2), 73-81.

Laurin, D., Verreault, R., Lindsay, J., MacPherson, K. & Rockwood, K. (2001). Physical activity and the risk of cognitive impairment and dementia in elderly persons. *Archives of Neurology. 58*,498-504.

Lautenschlager, N., Cox, K., Flicker, L., Foster, J., van Bockxmeer, F., Xiao, J., et al. (2008). Effect of physical activity on cognitive function in older adults at risk for Alzheimer disease. *Journal of the American Medical Association , 300* (9), 1027-1037.

Long, P.W., (2011). *Dementia. The ICD-10 Classification of Mental and Behavioural Disorders World Health Organization*. Retrieved March 5, 2011, from World Health Organization ICD-10 Internet Mental Health: www.mentalhealth.com

Lorentz, W.J., Scanlan, J.M., & Borson, S. (2002). Brief screening tests for dementia *Canadian Journal of Psychiatry,47*(8),723-733.

Middleton, L., Kirkland, S., & Rockwood, K. (2008). Prevention of CIND by physical activity: Different impact of VCI-ND compared with MCI. *Journal of the Neurological Sciences,* 269, 80-84.

Naldoo, J. & Wills, J. (2000). *Health promotion: Foundations for practice, 2nd edition.* Edinburgh, Baillere Tindall Publ.

Nelson, D.E., Bland, S., Powell-Griner, E., Klein, R., Wells, H.E., Hogelin, G., et al. (2002). State trends in health risk factors and recipient of clinical preventive services among US adults during the 1990's. *Journal of the American Medical Association, 287*(20), 2659-2667.

Nelson, M., Rejeski, W. J., Blair, S., Duncan, P., Judge, J., King, A., et al. (2007). Physical activity and public health in older adults: Recommendations from the American College of Sports Medicine and the American Heart Association. *Medicine & Science in Sports & Exercise, 39* (8), 1435-1445.

Pereira, A.C., Huddleston, D. E., Brickman, A. M., Sosunov, A. A., Hen, R., McKhann, G.M., et al. (2007). An *in vivo* correlate of exercise-induced neurogenesis in the adult dentate gyrus. *Proceedings of the National Academy of Sciences of the United States of America, 104*(13), 5638–5643.

Petersen, R.C., Thomas, R.G., Grundman, M., Bennett, D., Doody, R., Ferris, S., et al. (2005). Vitamin E and Donepezil for the treatment of mild cognitive impairment. *New England Journal of Medicine, 352*(23), 2379-88.

Petersen , R.C., Stevens, J.C. Ganguli, M. Tangalos, E.G. Cummings, J.L. & Dekosky, S.T. (2001). Practice parameter: early detection of dementia: mild cognitive impairment (an evidence based review). Report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology, 56* (9), 1133-1142.

Purcell, J., Piccinini, H. & Vallis, M. (2005). Health Professional Counselling to Support Behaviour Change: Physical activity counseling: Let's get moving. *Cancer Information for Primary Caregivers.2*(5)

Qaseem, A., Snow, V., Cross, J.T., Forciea, M.A., Hopkins, R., Shekelle, P. et al and the Joint American College of Physicians/American Academy of Family Physicians Panel on Dementia. (2008). Current Pharmacologic Treatment of Dementia: A Clinical Practice Guideline from the American College of Physicians and the American Academy of Family Physicians. *Annals of Internal Medicine,148*,5

Ravaglia, G., Forti, P., Lucicesare, A., Pisacane, N., Rietti, E., Bianchin, M., et al. (2008) Physical activity and dementia risk in the elderly: findings from a prospective Italian study. Neurology,70(19 Pt 2),1786-94.

Reisberg, B. (1999). An Atlas of Alzheimer's disease. An atlas of Alzheimer's disease: the encyclopedia of visual medicine series. MJ de Leon (Ed). *The Encyclopedia of Visual Medicine Series.* Pearl River, NY: Carnforth: Parthenon Publishing.

Rovio, S., Karehol, I., & Helkala, E.L.(2005). Leisure-time physical activity at midlife and the risk of dementia and Alzheimer's disease, *Neurology 4*, 705-711.

Rolland, Y., Rival, L., Pillard, F., Lafont, C., Riviere, D., Albarede, j., et al. (2000). Feasibility of regular physical exercise for patients with moderate to severe Alzheimer disease. *The Journal of Nutrition, Health & Aging , 4* (2), 109-113.

Smith, A.D. (2002) 'Imaging the progression of Alzheimer pathology through the brain,' *PNAS, 99*(7),4135-4137.

Swimburn, B.A., Walter, L.G., Arroll, B., Tilyard, M.W., & Russell, D.G. (1998). The green prescription study: a randomized control trial of written exercise advice provided by general practitioner. *American Journal of Public Health. 88(*2). 288-291.

Uphold, C.R. & Graham, M.V. (2003). Clinical guidelines in adult health (3rd ed.). Gainesville, FL: Barmarrae Books.

U.S. Department of Health and Human Services (2002)*Physical Activity and Older Americans: Benefits and Strategies*. Agency for Healthcare Research and Quality and the. Retrieved April 10,2011 from: http://www.ahrq.gov/ppip/activity.htm

U.S. National Institute of Health. National Institute on Aging. Alzheimer's Information. (2011). Retrieved April 10,2011 from: http://www.nia.nih.gov/Alzheimers/AlzheimersInformation/Diagnosis/

U.S. Preventative Service Task Force. (2002). Behavioral counseling in primary care to promote physical activity: recommendation and rationale. *Annals of Internal Medicine, 137*, 205-207.

Van Uffelen, J.G., Paw, M., Hopman-Rock, M., & van Mechelen, W. (2008). The effects of exercise on cognition in older adults with and without cognitive decline: a systemic review. *Clinical Journal of Sport Medicine, 18 (*6), 486-500.

Vaynman, S. & Gomez□Pinilla, F. (2006). Revenge of the "sit": How lifestyle impacts neuronal and cognitive health though molecular systems that interface energy metabolism with neuronal plasticity. *Journal of Neuroscience Research, 84*, 699□715.

Vaynman, S., Ying, Z., & Gomez-Pinilla, F. (2004). Hippocampal BDNF mediates the efficacy of exercise on synaptic plasticity and cognition. *European Journal of Neuroscience, 20,* 2580–2590.

Weimer, D., & Sager, M.A. Early identification and treatment of Alzheimer's disease: social and fiscal outcomes. *Alzheimer's & Dementia* 5 (3),215–226.

Weuve, J., Kang, J. H., Manson, J.E., Breteler, M. M. B., Ware, J. H., & Grodstein, F. (2004). Physical activity, including walking and cognitive function in older women. *Journal of the American Medical Association,292*(12),1454-1461.

While, A. (2009). The Challenge of Dementia. *British Journal of Community Nursing, 12* (2), World Health Organization. (2001). *International classification of functioning, disability, and health*. Geneva: WHO. Retrieved June 30, 2010, from Who Health Organization: http://www.who.int/classifications/icf/en/

Williamson, J., Pahor, M. (2010) Evidence Regarding the Benefits of Physical Exercise. Archives of Internal Medicine,*170*(2),124-125.

Yaffe, K., Barnes, D., Nevitt, M., Lui, L.Y., & Covinsky, K. (2001). A prospective study of physical activity and cognitive decline in elderly women: women who walk. *Archives of Internal Medicine, 161*(14),1703-1708.

Yamaguchi, H. (2007). Alzheimer pathology during the past 100 years. *Psychogeriatrics, 7*, 109-113.

Yu, F., Kolanowski, A.M., Strumpf, N.E., & Eslinger, P.J. (2006). Improving cognition and function through exercise intervention in Alzheimer's disease. *Journal of Nursing Scholarship, 38* (4), 358-365.