

# Role of Aerobic Exercise Training in Changing Exercise Tolerance and Quality of Life in Alzheimer's Disease



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## ABSTRACT

**Aim:** Alzheimer's disease is one of the leading cause of all deaths worldwide , it contributes to a reduction in overall function and independent living and there is evidence that exercise can have an impact on the size, strength, and aerobic capacity of skeletal muscle in older people. This study was designed to detect changes in exercise tolerance and quality of life in Alzheimer's after aerobic exercise training in the form of walking and upper limbs exercises with the cycle ergometer.

**Method:** Thirty patients with mild Alzheimer, their age ranged between 65 to 72 years and were included into 2 equal groups; group (A) received aerobic walking exercise training and upper limbs exercises with the cycle ergometer at a frequency of 3 sessions per week for two months. The second group (B) received no exercise training. Measurements of six minute walking test, hand grip strength and questionnaire of the quality of life (QOL) were obtained for both groups before and after the exercise program.

**Result:** There was a significant increase in six minute walking test, hand grip strength and questionnaire of QOL of group (A), while the results of group (B) were not significant. There was a significant difference between both groups.

**Conclusion:** aerobic exercise training program in the form of walking exercise and upper limbs exercises with the cycle ergometer for patients with Alzheimer's to improve their exercise tolerance and quality of life.

**Key words:** Aerobic exercise, exercise tolerance, quality of life, Alzheimer's disease

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## Aerobik Egzersiz idmanının Alzheimer Hastalığında Egzersiz Toleransı ve Yaşam Kalitesi Üzerine Etkisi

**Amaç:** Alzheimer hastalığı dünya genelinde tüm ölümlerin önde gelen bir sebebidir, bağımsız yaşama ve genel fonksiyon görme kapasitesindeki azalmalara katkıda bulunur. Egzersizin yaşlı insanlarda kas boyutu, gücü ve aerobik kapasitesi üzerine etkilerinin olduğu yönünde kanıtlar mevcuttur. Bu çalışma Alzheimer hastalığında yürüyüş ve bisiklet ergometre şeklindeki aerobik egzersiz idmanı sonrasında yaşam kalitesi ve egzersiz toleransındaki değişiklikleri tespit etmek amacı ile dizayn edildi.

**Metod:** Yaşları 65 ile 72 arasında değişen 30 Alzheimer hastası eşit iki gruba ayrıldı. Grup A daki hastalar 2 ay boyunca haftada 3 seans olacak şekilde bisiklet ergometre ile üst ekstremitte egzersizleri ve yürüyüş idmanı yaptılar. İkinci grup (B) egzersiz idmanı yapmadı. Her iki grupta da egzersiz programı öncesi ve sonrasında 6 dakika yürüme ve el sıkma gücü testleri yapıldı ve yaşam kalitesi (YK) anket formu dolduruldu.

**Bulgular:** Grup A hastalarında 6 dakika yürüme testi, el sıkma gücü testi ve yaşam kalitesi skorlarında anlamlı derecelerde iyileşme görülürken Grup B'de anlamlı değişiklik tespit edilmedi. Her iki grup arasında anlamlı bir farklılık tespit edildi.

**Sonuç:** Yürüme ve bisiklet ergometri ile üst ekstremitte egzersizleri şeklindeki aerobik egzersiz idman programı Alzheimer hastalarında egzersiz toleransı ve yaşam kalitesini arttırmıştır.

**Anahtar kelimeler:** Aerobik egzersiz, egzersiz toleransı, yaşam kalitesi, Alzheimer hastalığı

## INTRODUCTION

An estimated 4.5 million Americans currently suffer from Alzheimer's disease (AD), and this number may triple by 2050 if no effective treatments are developed. Recent studies have shown that certain lifestyle choices, such as eating a healthy diet, and performing a minimal amount of physical exercise are associated with a lower risk of developing AD. The level of physical activity necessary to be in the low risk group in one recent study was minimal, walking at least 1.5 h per week, while another found walking 2 miles daily was the threshold (1,2).

Quality of life (QOL) is a widely used concept in social science and relates to various aspects of life. It can be measured in four dimensions (physical functioning, emotional distress, social health, and perceived health) in their definition of quality of life. Physical functioning included the concepts of vigor, activities of daily living (ADL), and health that interfered with activities. Emotional distress included anxiety and depression. Social health included social function, social life satisfaction, and intimacy. Finally, perceived health included general health (3). Older adults with AD can successfully participate in moderate intensity aerobic exercise. Engaging older adults with AD in aerobic exercise is important, because aerobic exercise training improves physical functioning and has the potential to alleviate AD symptoms and could significantly improve their health and quality of life (4). Physical exercise is regarded as a useful tool in this regard; cross-sectional and longitudinal studies have demonstrated that exercise has beneficial effects, such as decreasing depression, increasing overall health, and improving cognitive performance, in older adults (5).

The aim of this study was to determine to detect changes in exercise tolerance and quality of life in Alzheimer's after aerobic exercise training in the form of walking and upper limbs exercises with the cycle ergometer.

## MATERIALS AND METHODS

### Subjects

Thirty Alzheimer elderly subjects their age ranged between 65 to 72 years, free from respiratory, cardiac, kidney, liver, metabolic and neurological disorders. Subjects were not smokers and included into 2 equal groups; group (A) received aerobic walking exercise training and upper limbs exercises with the cycle ergometer at a frequency of 3 sessions per week for two months. The second group (B) received no exercise training. Informed consent was obtained from all participants. All participants were free to withdraw from the study at any time. If any adverse effects had occurred, the experiment would have been stopped. However, no adverse effects occurred, and so the data of all the participants were available for analysis.

### Evaluated parameters

**Grip strength;** Grip strength of the dominant hand was measured using three successive repetitions with a Jamar hand dynamometer (Sammons Preston Rolyan, Cedarburg, WI, USA). The elbow was flexed at a 90° angle and not allowed to contact any body part. Resting time between subsequent measurements was 30 s (6). The mean value of the two best performances was used in the analyses. The intraclass correlation coefficient

**Table 1.** Mean value, standard deviation and p-value of six minute walking test, hand grip strength and QOL in group (A) before and after treatment.

	Before	After	t-value	p value
QOL	39.66±3.71	48.28±3.42	5.04	<0.05
Six minute walk test (meter)	314.63± 21.47	405.17± 22.88	7.23	<0.05
Hand grip strength (mmHg)	147.73±6.58	164.25 ± 4.78	5.25	<0.05

QOL = Quality of life

(ICC) of the grip strength measurements has been shown to be 0.87 for absolute grip strength values. Hand grip used as an index of general muscle strength.

#### The 6-minute walk test

The 6-minute walk test was used to evaluate the elderly subject fitness. The stopwatch was started as the patient began to walk at the fastest self-selected pace that can be maintained for 6 minutes. If a patient needs to slow down or rest during the 6-minute test, he/she was permitted to do so, as this will be reflected in less distance being covered. The distance walked was recorded.

#### The LEIPAD (an acronym deriving from the first two of the three most involved universities

Lelden (the Netherlands), Padua (Italy), and Helsinki (Finland)) assessment questionnaire was used to evaluate the quality of life of elderly subjects. The LEIPAD is an assessment questionnaire specifically designed to appraise quality of life in the elderly. The project has been conducted under the auspices of World Health Organization (WHO). It meets the specific requirements of this age group and was not only valid and reliable, but was also very practical, that has been adopted internationally because it is sufficiently discriminatory to be applied to highly varied cultural settings, despite its standard, basic structure (7).

LEIPAD questionnaire has been designed to measure

main QOL dimensions or domains which are physical functions, self-care, depression and anxiety, cognitive functions, social functions, life satisfaction, the perceived personality disorder, the anger sensation, self-esteem, and the trust in god. This instrument has also been designed to be sensitive enough to pick up changes in patients' QOL resulting from any kind of intervention, be it medical, surgical, or psychosocial with a level of reliability. So LEIPAD scales adequately cover the range of quality of life domains and with a stability between the various countries seems acceptable (8).

#### The aerobic treadmill exercise training

The aerobic treadmill-based training (Enraf Nonium, Model display panel Standard, NR 1475.801, Holand) was developed in accordance with aerobic exercise guidelines for older adults from the American College of Sports Medicine and the National Institute on Aging (9) and (10). The protocol include 5 minutes of warm-up activities (lower body stretches and marching in place at a casual pace), 10-30 minutes of moderate-intensity cycling (with moderate intensity defined as 60%-65% of maximal heart rate, MHR = 220 - age), and 10 minutes of cool-down activities (slowing cycling and stretches). Participants are expected to complete this protocol 3 times a week for 2 months under the guidance and supervision of a trainer. Over the 24 sessions, trainers work to gradually increase a participant' cardio-respiratory capacity to reach the target intensity and duration.

**Table 2.** Mean value, standard deviation and p-value of six minute walking test, hand grip strength and QOL in group (B) before and after treatment.

	Before	After	t-value	p value
QOL	40.12±4.11	41.21±4.23	1.24	>0.05
Six minute walk test (meter)	316.75±20.61	320.26±21.82	1.16	>0.05
Hand grip strength (mmHg)	149.34±6.34	150.76±4.8	1.87	>0.05

QOL = Quality of life

**Table 3.** Mean value, standard deviation and p-value of six minute walking test, hand grip strength and QOL in group(A) and group (B) after treatment.

	Group (A)	Group (B)	t-value	p value
QOL	48.28±3.42	41.21±4.23	3.53	<0.05
Six minute walk test (meter)	405.17±22.88	320.26±21.82	5.71	<0.05
Hand grip strength (mmHg)	164.25±4.78	150.76±4.8	5.6	<0.05

QOL = Quality of life.

**The cycle ergometer exercise training**

Cycle ergometer (Tunturi, Holand) was used for doing strengthening exercises for upper limbs by moving the arm of the ergometer in a circular maneuver . It is a metal device consisting of rounded (circular) stainless part connected with stainless arm for hand grip. The rounded part has a valve for increasing or decreasing the resistance according to patient’s ability . It was started for 10min. and increased gradually till 30min. It was divided into 10min. of warm up, 10min. of circuit training and 10min. to cool down. Intensity was increased gradually according to patient tolerance.

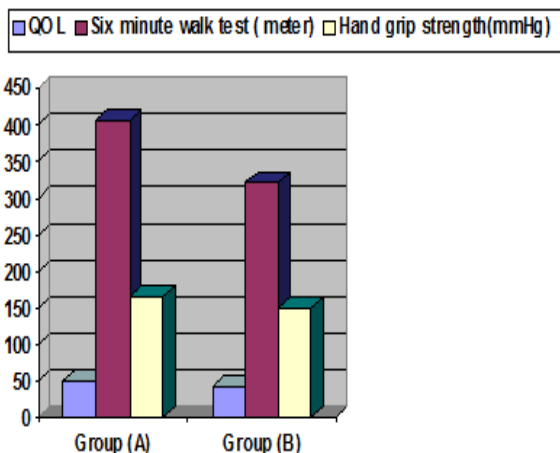
**Statistical analysis**

The mean values of six minute walking test, hand grip strength and QOL obtained before and after two months in both groups were compared using paired "t" test. Independent "t" test was used for the comparison be-

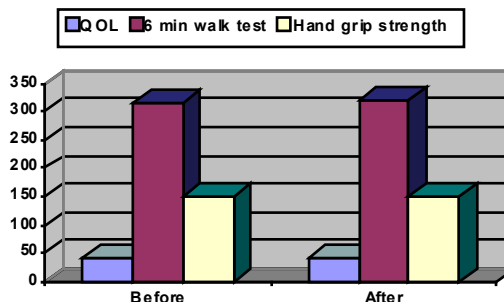
tween the two groups (p<0.05).

**RESULTS**

Thirty Alzheimer elderly subjects , their age ranged between 65 to 72 years and were included into 2 equal groups ; group (A) received aerobic walking exercise training and upper limbs exercises with the cycle ergometer at a frequency of 3 sessions per week for two months. The second group (B) received no exercise training . to determine changes in quality of Life and pulmonary functions in mild Alzheimer’s after a designed pulmonary rehabilitation program. Measurements of six minute walking test, hand grip strength and QOL obtained before and after two months in both groups were compared . The mean six minute walking test, hand grip strength and QOL values were significantly increased in group (A), while the results of group (B) were not sig-



**Figures 1.** Mean value, standard deviation and p-value of six minute walking test, hand grip strength and QOL in group (A) before and after treatment.



**Figures 2.** Mean value, standard deviation and p-value of six minute walking test, hand grip strength and QOL in group (B) before and after treatment.

nificant (Table 1 and 2 and Figure 1 and 2). There was a significant difference between both groups after treatment (Table 3 and Figure 3).

## DISCUSSION

The results of this study confirmed that aerobic exercise could be considered a valuable method to improve exercise tolerance and quality of life in Alzheimer's after aerobic exercise training in the form of walking and upper limbs exercises with the cycle ergometer, these results agreed with the previous studies in this area. An estimated 4.5 million Americans currently suffer from Alzheimer's disease, and this number may triple by 2050 if no effective treatments are developed. Several studies have shown that certain lifestyle choices, such as eating a healthy diet, and performing a minimal amount of physical exercise are associated with a lower risk of developing AD. The level of physical activity necessary to be in the low risk group in one recent study was minimal, walking at least 1.5 h per week (11), while another found walking 2 miles daily was the threshold (12).

Cross-sectional and longitudinal studies have demonstrated that exercise has beneficial effects, such as decreasing depression, increasing overall health, and improving cognitive performance, in older adults. Regular physical exercise is one such intervention that may protect healthy elders from cognitive decline and dementia and has tremendous potential to enhance the physical, emotional, and social well being of persons with AD (13).

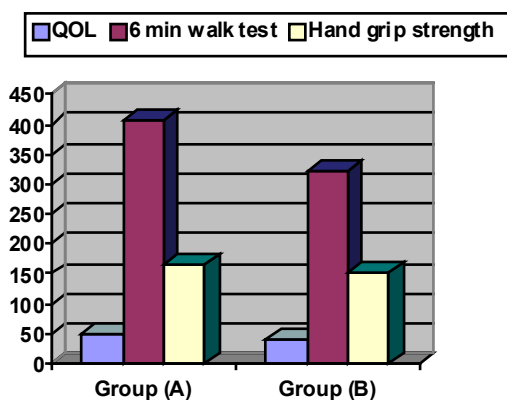
In the elderly population, there is a strong relationship between the level of physical activity and cognition (14,15). A group of 23 moderate to severe AD patients participated in a program of endurance exercise that consisted of walking and riding an exercise bicycle had a positive effect on cognition, in particular attention, memory, communication, executive functions, and global mental functioning in older persons with cognitive impairment (16).

Application of treadmill walking exercise three times weekly for 8 weeks resulted in increased exercise endurance and twelve minute walking test. Improvements may be due to one or more of the following factors: improved aerobic capacity, or muscle strength or both, increased motivation and improved ventilatory muscle function (17). Patients with mild to severe Alzheimer's disease benefited from a 7-week physical activity program in regards to the risk of falls, cognitive function and nutritional status (18,19).

Older subjects engaging in moderate to high levels of physical activity were less likely to develop cognitive impairment or dementia. Older women performing physical activity of greater intensity than walking more than 3 times a week seemed to benefit the most from the protective effect of physical activity against Alzheimer's disease (9). A recent meta-analysis examined and supported the positive effect of physical fitness training on cognitive function of older adults (20). Regular walking exercise has been associated with significant reductions in the levels of dependence and disability in older adults. The relations among physical fitness levels, specifically aerobic fitness, cognition, and physical health in older adults, is well established. There is also empirical support for exercise improving physical fitness, behavior, cognition, communication and functioning in older people with cognitive impairments (21,22).

This is surprising, as regular physical activity is recommended for patients with dementia not only to support physical health, but also to improve quality of life and behavioral and psychological symptoms (23). Physical activity amongst patients with Alzheimer's disease is inversely correlated with cerebral blood flow to the temporal and parietal lobes. This was interpreted as being an indication that physical active patients have a higher brain reserve (24).

In conclusion, it is recommended to perform aerobic exercise training program in the form of walking exercise



Figures 3. Mean value, standard deviation and p-value of six minute walking test, hand grip strength and QOL in group(A) and group (B) after treatment.

and upper limbs exercises with the cycle ergometer for patients with Alzheimer's to improve their exercise tolerance and quality of life.

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