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Investigating the relationship between respiratory indices and sleep quality in active elderly women with Alzheimer's disease

Mohaddseh Bashtani *
Msc student of psychology, department Psychology, faculty human science, Islamic Azad University of Chalous, Iran.

Parvaneh Rahimi Ghazi
MSc of Exercise Physiology, Department of Physical Education, Islamic Azad University, Borujerd Branch, Borujerd, Iran.

Nazanin Zahra Azizi
Msc student of psychology, department Psychology, faculty human science, Islamic Azad University of Chalous, Iran.

Elahe Khodashenas
Msc student of psychology, department Psychology, faculty human science, Islamic Azad University of Chalous, Iran.

Bita Hoseinzade
Msc student of psychology, department Psychology, faculty human science, Islamic Azad University of Chalous, Iran.

Kamian Khazaei
Assistant Professor of psychology, department Psychology, faculty human science, Islamic Azad University of Chalous, Iran.

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* Corresponding Author: mohaddesehbashtani@gmail.com

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Abstract

Purpose: Sleep quality decreases with age, and as a result, sleep complaints are common in the elderly, especially for inactive people with Alzheimer's disease. Therefore, the aim of this study was to investigate the relationship between respiratory indices and sleep quality in active and inactive elderly women with Alzheimer's disease. **Method:** In this research, 24 elderly women with Alzheimer's disease (with an average age of 72.3±7.25 years, height 158.23±6.12 cm and weight 70.23±8.12 kg) voluntarily and after obtaining consent, they participated in two active (12 people) and inactive (12 people) groups. Respiratory indices were measured using a Micro Lab Spirometer. The Pittsburgh questionnaire was used to check sleep quality. Independent t-tests and Pearson's correlation coefficient were used to analyze the data. **Results:** The average score of sleep quality in the active group was significantly lower than the inactive group (p=0.013). Also, the parameters of expiratory volume with pressure in the first second (p=0.046), maximum voluntary ventilation (p=0.021), forced vital capacity (p=0.033), strong expiratory flow 25 to 75% in the active group was significantly higher than the inactive group. **Conclusions:** According to the results, it seems that sports activity can be an effective factor in improving the quality of sleep and the functioning of the respiratory system in patients with inactive Alzheimer's disease.

Keywords: Alzheimer's disease, pulmonary function, Sleep quality, Active.

Introduction

Sleep plays an important role in regulating metabolic, immunological and homeostasis functions (Garbarino, Lanteri, Bragazzi, Magnavita, & Scoditti, 2021). Also, sleep is one of the important elements in the day and night cycles, which is associated with the restoration of physical and mental powers (Foster, 2020). This active, repetitive and reversible behavior helps several important functions in the body, including growth and repair, learning and strengthening memory (Rahmati et al., 2022). On the other hand, one of the most important known effects of sleep is the involuntary control of breathing through the rehabilitation of the central nervous system (CNS) (Albaiceta et al., 2021). If the energy required by the CNS is not provided, the respiratory function dependent on the central nervous system is affected and leads to disorders such as fatigue, drowsiness, reduced coordination and concentration, muscle stiffness and increased risk of infection (Nikooie et al., 2013). Short sleep duration, poor sleep quality, and increased sleep time are all associated with excessive food intake, poor diet quality, and obesity in older women (Holla, Prasad, & Pal, 2022). On the other hand, observing sleep hygiene is an important factor in the prevention of Alzheimer's (Cordone, Scarpelli, Alfonsi, De Gennaro, & Gorgoni, 2021). Researches in this field have shown that the decrease in sleep duration and its quality is associated with the increase in Alzheimer's disease and respiratory disorders (Briguglio et al., 2020).

Alzheimer's disease is one of the common diseases of old age, which with the increase of the country's elderly population as an important phenomenon in the not-so-distant future, will affect various dimensions of society, especially the country's health system, and will pose many challenges to health workers and families (Scheltens et al., 2021). Alzheimer's is a chronic, progressive and debilitating disease that causes disorders in cognitive functions, personality, thought and perception (Srivastava, Ahmad, & Khare, 2021). Today, more than 18 million people in the world are suffering from this disease and every year one million people are added to the number of these patients. Demographic studies of the elderly confirm the global prevalence of Alzheimer's disease (Mggdadi, Al-Aiad, Al-Ayyad, & Darabseh, 2021). It is predicted that in the year 2050, there will be around one hundred million elderly people with Alzheimer's in the world (Nandi et al., 2022). Alzheimer's disease is the most common type of dementia, and its symptoms include progressive and irreversible loss of memory, thinking, reasoning, and other brain functions (Li et al., 2022). As the disease progresses to later stages, sufferers are eventually unable to care for themselves independently and require the support of a caregiver, either at home or in a long-term care facility (Kokorelias et al., 2022). Alzheimer's causes sleep problems that can be disruptive for both the patient and caregivers. People with Alzheimer's experience sleep disturbances, including shorter or more fragmented sleep, changes in the biological clock and sleep cycle, and some sleep disturbances (Urrestarazu & Iriarte, 2016). Making changes to the patient's daily schedule and nighttime habits may improve these sleep problems (Peter-Derex, Yammine, Bastuji, & Croisile, 2015). Changes in sleep quality and duration are common in older age. However, sleep disturbances in people with Alzheimer's are often more severe and complex. There may be a reciprocal relationship between sleep problems and other Alzheimer's symptoms. This means that lack of sleep can worsen other symptoms such as delusions, restlessness, and disorientation, which in turn can make it more difficult to sleep (McCleery, Cohen, & Sharpley, 2014).

Sports activity improves lung function and increases maximum oxygen consumption in inactive people with Alzheimer's disease by increasing the ability and coordination of respiratory muscles, especially exhalation muscles, and by increasing some capacities and lung volumes (Yu, Savik, Wyman, & Bronas, 2011). According to the results of Garcia et al. research, in people who followed an active lifestyle for 19 months, their FEV1 (Forced expiratory volume in 1 second) improved by 50 milliliters and their Forced vital capacity (FVC) improved by 70 milliliters (Xiao et al., 2021). But in people who continued a sedentary lifestyle, FVC and FEV1 decreased by 30 and 20 milliliters, respectively. Recently, Yo-Han et al showed that training and strengthening respiratory muscles significantly increased sleep quality and improved respiratory function in stroke patients (Hanscombe et al., 2021). A few researches in the country have investigated the relationship between sleep quality and pulmonary function, especially in female athletes and non-athletes with Alzheimer's disease, and considering the favorable effects of exercise and physical activity on sleep quality and lung volumes, it seems that the correlation and It is important to compare this important physiological index with respiratory function in active and inactive people with Alzheimer's disease (Tescione, Misiti, & Digennaro, 2022). Therefore, the aim of this research was to investigate the relationship between respiratory indices and sleep quality in active and inactive elderly women with Alzheimer's disease.

Method

This research was a descriptive-analytical correlation study. Among the eligible people, 12 elderly women with active Alzheimer's disease (who, according to the physical activity level questionnaire, had participated in aerobic sports activities (such as walking) at least 3 times a week before the start of the research for 3 years) and 12 female patients with inactive Alzheimer's disease (who had no history of regular sports activity) with an average age of 72.3±7.25 years, height 158.23±6.12 cm and weight 70.23±8.12 kg as were selected as available. Before the study, a trained interviewer completed standardized questionnaires to obtain information on demographic characteristics, smoking, respiratory symptoms, and self-reports of lung disease. All subjects completed the consent form to participate in the research. Then, all the necessary points about the nature and method of conducting the research and how to cooperate were presented orally to the subjects, and one day before the spirometer tests, all the subjects were familiarized with how to perform spirometer. All people's weight was measured in a fasting state using a Seca model 813 digital scales made in Germany with an accuracy of 0.1 kg without shoes and with minimal clothing. Height measurement in centimeters using an inflexible tape measure with an accuracy of 0.1 cm and between 8 and 10 in the morning (at the same time as weight measurement) without shoes while standing with the back to the wall and the heels, hips, shoulders and The back of the head was in contact with the wall, it was done. The inclusion criteria were age over 65 years, Alzheimer's disease and gender. Exclusion criteria were people under 65 years of age, people with chronic obstructive pulmonary disease (COPD), asthma, emphysema, neuromuscular disease, cardiac or thoracic surgery, or any history of respiratory disease, as well as those with significant memory loss were excluded from the study. Because their ability to sign the consent form and fully participate in all aspects of the study was considered limited.

The sleep quality of the subjects was checked using the standard Pittsburgh sleep quality index (PSQI) questionnaire (Zitser et al., 2022). In Hasanzadeh et al.'s study, the validity and reliability of this questionnaire was evaluated and relatively high reliability was reported with Cronbach's alpha coefficient of 0.78 to 0.82 (source) (Hassanzadeh, Namdarian, Elahi, & Majidpour, 2014). This questionnaire has seven components to describe the subjective quality of sleep, delay in falling asleep, total sleep duration, efficiency and adequacy of sleep (based on the ratio of actual sleep duration to the total time spent in bed), sleep disorders (waking up at night), the amount of sleeping pills consumed and inappropriate performance during the day (problems experienced by a person during the day due to insomnia). The score of each question is between 0 and 3, so that a score of 0 indicates a normal situation, a score of 1 indicates a mild problem, a score of 2 indicates a moderate problem, and a score of 3 indicates a severe problem. The sum of the scores of the seven components forms the total sleep quality score of a person, which ranges from 0 to 21. Also, a score greater than 6 indicates poor sleep quality. In the present research, the Pittsburgh sleep quality questionnaire was completed by the subjects in a time efficiency of 5 to 10 minutes in uniform conditions and according to the instructions on how to fill this questionnaire.

Respiratory indices were measured based on the criteria published by the American Thorax Society (American ATS-Society Thorax) using Sangyo Fukuda model spirometer made in Japan (Ingenito et al., 2001). Spirometer is a powerful tool to evaluate lung function. Three days before the measurement of respiratory parameters during a briefing session, the subjects were asked to refrain from intense sports activity and taking drugs that are effective in the test (such as theophylline, aminophylline and corticosteroids) (source) (Sheldon, Heaton, Palmer, & Paul, 2018) and the instructions provided by the research researchers comply with the present (including not smoking, not eating heavy food (such as high-fat foods) and not doing sports with an intensity greater than 70% of the maximum heart rate (at least 6 hours before performing the spirometer test). Before performing the spirometer test, the characteristics of each subject such as Age, sex, height, weight were defined for the device and then the spirometer test was performed in a straight sitting position to obtain 3 acceptable Spiro grams from each person according to the American Thoracic

Society (ATS) criteria and the Spiro gram with the highest values for the three performance tests. Pulmonary should be used in the research (Graham et al., 2019).

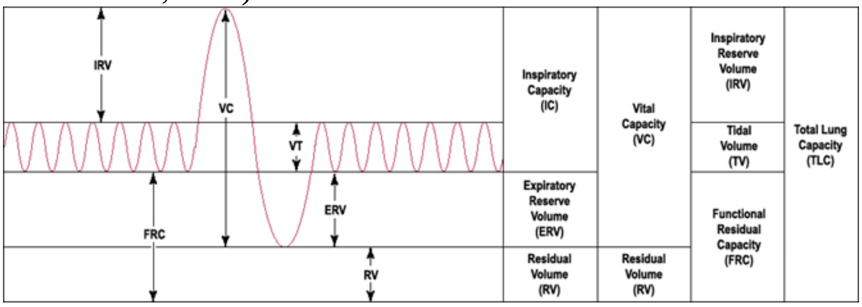

Figure 1: Standard lung volumes and capacities

Three pulmonary function tests including forced vital capacity (FEV), Maximum Voluntary Ventilation (MVV), and Vital Capacity (VC) were performed on all elderly women with Alzheimer's disease.

Forced vital capacity test (FVC)

The most important spirometer maneuver is FVC. To measure FVC, the patient inhales maximally, then exhales as quickly and completely as possible. Normal lungs can normally empty more than 80% of their volume in six seconds or less. Forced expiratory volume in one second (FEV1) is the volume of air exhaled in the first second of the FVC maneuver. In this movement maneuver, the FVC curve will be obtained, through which the percentage of FEV1 index and the amount of FVC, 25 to 75% forced vital capacity and The forced mid-expiratory flow (FEF25-75%) value can be measured in one second.

Vital Capacity (VC) test

To perform this test, the examinee fills the lungs to the limit with a full inhale and then a deep and slow exhalation to empty all the air in the lungs to the remaining volume. By doing this test, you can get all the basic pulmonary volumes and capacities, including Vital Capacity (VC) (liters), Tidal Volume (TV) (liters), Inspiratory Reserve Volume (IRV) (liters), and Expiratory Reserve Volume (ERV).

Maximal voluntary ventilation (MVV) Test

Maximum voluntary ventilation is defined as the maximum volume of gas that the subject can ventilate per minute. The examinee performs rapid inhaling and exhaling for 10 to 15 seconds, and the MVV (liter/minute) curve is obtained for one minute. 3 acceptable tests were performed for each person, and the spirogram that had the highest values was used in this research.

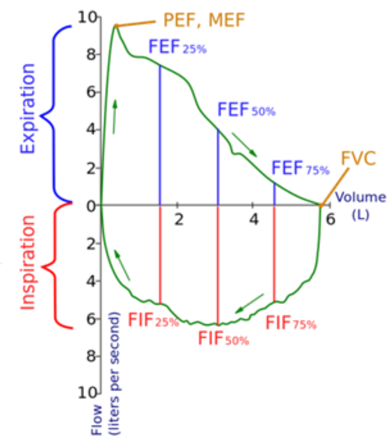

Figure 2: Maximal voluntary ventilation (MVV) Test

After data collection, SPSS version 26 software was used for statistical analysis. Shapiro-Wilk test was used to check the normal distribution of data in two groups. After determining the normality of the data, independent t-test was used to compare the average of two groups. Also, Pearson's correlation coefficient test was used to check the correlation between variables. The significance level of the present research tests was considered.

Results

Table 1 shows the descriptive information of the subjects in two active and inactive groups. The results of the independent t test showed that between the two active and inactive groups in the mean score of sleep quality and FVC, ($p<0.01$), MVV ($p=0.021$), FEV1 ($p=0.006$), There is a significant difference between ($p=0.013$) and ($p=0.025$) FEF25-75%, which means that the sleep quality of the active group was better than the sleep quality of the inactive group (Table 2). Pearson's correlation coefficient showed a significant positive correlation between sleep quality score and body mass index r=0.672 in inactive group. which indicates a decrease in sleep quality with an increase in body mass index.

Table 1: Comparison of mean and standard deviation of general and physiological characteristics in two groups of active and inactive women with Alzheimer's disease.

Variable	Active group	Inactive group	p-value
	Mean ± SD	Mean ± SD	
Age (years)	72.34 ± 6.32	72.30 ± 6.66	0.532
Height (cm)	155.62 ± 7.33	155.15 ± 7.22	0.765
Weight (kg)	63.77 ± 6.16	66.35 ± 7.41	0.021*
BMI (kg/m2)	26.77 ± 2.10	29.25 ± 2.85	0.037*
Lipid (%)	30.33 ±3.34	32.34 ± 3.46	0.042*

Table 2: Comparison of mean and standard deviation of respiratory indices and sleep quality score in two groups of active and inactive women with Alzheimer's disease.

Variable	Active group	Inactive group	p-value
	Mean ± SD	Mean ± SD	
FVC (liter)	2.34 ± 0.72	2.02 ± 0.66	0.032*
FEV1 (liter)	2.19 ± 0.33	1.87 ± 0.22	0.045*
MVV (liter/min)	77.57 ± 6.16	71.35 ± 4.41	0.021*
FEF25-75% (%)	2.77 ± 0.90	2.05 ± 0.45	0.037*
Sleep quality score	30.33 ±3.34	34.34 ± 3.46	0.042*

Discussion

The results of the present research showed that there is a significant difference between the average respiratory indices and sleep quality scores in active and inactive women groups. Also, a significant positive correlation was observed between the score of sleep quality with body mass index and fat percentage in the inactive group. It seems that the quality of sleep in the inactive group is reduced as a result of a sedentary lifestyle and sports activity has a favorable effect on different levels of sleep quality in the group. has active The

American Sleep Disorders Association considers exercise and physical activity to be an important part of sleep health and refers to exercise as a non-pharmacological intervention to improve sleep (Wang & Boros, 2021). According to the findings of the present study, Rubio et al. reported that regular exercise improves sleep quality (Rubio-Arias, Marín-Cascales, Ramos-Campo, Hernandez, & Pérez-López, 2017). Dolezal et al, In a review, concluded that sleep and exercise have significant positive effects on each other and that exercise can be an effective intervention for those who do not have adequate sleep quality (Dolezal, Neufeld, Boland, Martin, & Cooper, 2017). Quist et al investigated the effect of different intensities of exercise on sleep quality and concluded that daily high and moderate intensity aerobic exercise for 13 weeks increases sleep duration and improves sleep quality in overweight men (Quist et al., 2019). On the other hand, Myllymäki et al reported that an intense exercise training session at the end of the night did not have a significant effect on the sleep quality of the subjects (Myllymäki et al., 2012). Some of the traditional theories presented that improve sleep as a result of exercise are: thermoregulation theory, body recovery and energy conservation hypothesis.

Changes in central body temperature under the influence of physical activities stimulate the anterior hypothalamus and increase the quality of sleep, as well as changes in hormone levels caused by physical activities, including growth hormone, melatonin, cytokines, interleukin 1, prolactin 100 and tumor necrosis factor. prostaglandin D2 have a favorable regulatory effect on the quality of sleep (Stutz, Eiholzer, & Spengler, 2019). On the other hand, sports activity increases with the rapid eye movement-NON stage of sleep (in which the low heart rate and brain metabolism decrease significantly) and with the decrease in the sleep stage (Rapid eye movement) in which the heart rate decreases. faster and brain metabolism is the same as the waking period) and also by reducing the latency period of sleep, which is the time interval between the beginning and the first stage of sleep, it improves the quality of sleep. In this research, the subjects of the active group regularly participated in regular sports activities 3 times a week, which was probably one of the influencing factors on the sleep quality index (Baron, Reid, & Zee, 2013).

In the present study, the mean indices of FEV1, FVCU, MVV, FEF 25-75% were higher in the active group compared to the non-active group. It seems that this increase was the result of sports activity in the active group. According to the findings of this research, Abdollah Zadeh and Tartibian also reported that MVV, VC, FVC, MEF25%, MEF75% are more in active people than inactive people (B Tartibian, Yaghoobnezhad, & Abdollahzadeh). Also, Khosravi et al. reported that eight weeks of endurance sports activity caused a significant increase in FEF-25 and %75 FEV1, PEF, MVV FEV1, %FEV1 of inactive subjects, but the increase in FEV and FVC was not statistically significant (Khosravi, Tayebi, & Safari, 2013). FVC and VC maneuvers are among the most important lung functional maneuvers. Obstruction in the airways or weakness of the respiratory muscles, including the diaphragm, intercostal muscles, and the abdominal muscle group, change the values of FEV and 1 FVC. The increase in lung volume and capacity due to exercise is mostly related to the expansion of the bronchi, the increase in the diameter of the respiratory tracts and the decrease in the resistance of the respiratory tracts. It seems that the local release of chemical mediators from the resident and non-resident cells of the respiratory tract during physical activity increases the diameter of the respiratory tract and leads to an increase in FEV1.

On the other hand, the increase in shear stress in the pulmonary vessels caused by physical activities brings about the activation of powerful vasodilators such as nitric oxide from the endothelium and causes a decrease in the resistance of the pulmonary vessels and dilation of the wall of the pulmonary capillaries (de Freitas Brito et al., 2018). Also, the effect of physical activities in increasing the permeability of blood gas carriers, transferring red blood cells and plasma proteins to the alveolar space, regulating pulmonary hemodynamics through humeral vascular dilators and surfactant production is important. Increasing the production of surfactant by increasing the diameter of respiratory tracts and reducing air resistance increases the values of VC, FVC, and FEV (Bakhtyar Tartibian, Sharifi, & Ebrahemi-Torkmani, 2019).

In the present study, no significant correlation was found between sleep quality score and lung volume and capacity. Most of the researches have investigated the correlation between sleep quality and respiratory parameters in patients in clinical conditions, and very few researches have investigated the relationship between sleep quality, especially in active and inactive elderly women with Alzheimer's disease. And according to the findings of this research, Abdullah Zadeh and Tartibian reported that there is no significant correlation between sleep quality scores and lung volumes and capacities in active and inactive people (B Tartibian et al.). According to the results of the present research, sports activity, due to its non-invasive and cost-effectiveness, and also the difference of the changes caused by exercise compared to the type of effect caused by drugs, can be among valuable, low-cost and appropriate practical solutions in treatment. and the improvement of common diseases such as respiratory disorders and sleep disorders in people with Alzheimer's disease in our country (despite heavy medical and specialized costs). The small volume of samples, the lack of full-time access to the subjects and the different mental and physical states of the subjects when answering the questions and spirometer tests are the limitations of the present research that can affect the results obtained. Therefore, it is suggested to conduct similar research with larger samples, people with different age ranges, more control over the subjects and other factors affecting the research results.

Conclusions

The results of this research showed that active people have better sleep quality than inactive people. Also, a significant correlation was observed between the sleep quality score with the body mass index and body fat percentage in the inactive group, which shows that with the increase in the subjects' fat percentage, their sleep quality also decreases. The results of the present research also showed that the respiratory indices measured in active people were more than inactive people. According to the results of the present research, it seems that sports activity can be an effective factor in improving sleep quality and pulmonary function in inactive people.

Conflict of Interests

The authors declare that they have no conflict of interests to disclose.

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ORCID

Mohaddseh Bashtani **https://orcid.org/**
Parvaneh Rahimi Ghazi **https://orcid.org/**
Nazanin Zahra Azizi **https://orcid.org/**
Elahe Khodashenas **https://orcid.org/**
Bita Hoseinzade **https://orcid.org/**
Kamian Khazaei **https://orcid.org/**

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How to Cite: Corresponding Author: mohaddesehbashtani@gmail.com
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