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Original Research

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The role of aerobic exercise on sleep quality and sleep-related lipid profiles in the elderly with Alzheimer's disease

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Abstract

Purpose: The world is getting old. Alzheimer's disease is a progressive disease, which in case of no intervention, this ratio reaches 4 more advanced stages in people over 85 years old. Some methods have shown that they can be effective in preventing and slowing down the course of the disease. The purpose of this study was to investigate the role of aerobic exercise program on the quality and Lipid profile related to sleep in the elderly with Alzheimer's disease. **Method:** 22 elderly people with Alzheimer's disease were randomly divided into two groups of 11 people: aerobic exercise and control. The subjects in the aerobic training group practiced three sessions every week for twelve weeks and each session lasted for 45 minutes. The sleep quality of the subjects was evaluated by the Pittsburgh Sleep Quality Questionnaire (PSQI). Lipid profile related to sleep (TG, TC, LDL, HDL) was also measured by blood sampling before and after twelve weeks of aerobic training. **Results:** The results showed that the sleep quality of the subjects improved by 31% in the Pied Heroi group, which was statistically significant. In addition, there was a significant improvement in the changes of TG (p=0.034), TC (p=0.017), LDL (p=0.006), and HDL (p=0.016) in the aerobic training group. The

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results of the independent t test also showed that there was a significant difference in sleep quality between the aerobic exercise and control groups. However, no relationship was observed between changes in sleep quality and changes in Lipid variables related to sleep. **Conclusion:** It can be concluded that twelve weeks of aerobic exercise improves sleep quality along with Lipid profile related to sleep in the elderly with Alzheimer's disease and will be useful as a way to treat sleep problems in the elderly.

Keywords: Alzheimer's disease, Sleep quality, Exercise, Lipid profile, Elderly.

Introduction

Aging causes many physiological changes in humans. Arthritis, Alzheimer's, diabetes, blood pressure, cardiovascular diseases, and strokes are chronic conditions that the elderly usually face (Chan et al., 2021). With the global aging population, the prevalence of Alzheimer's disease (AD) among older adults is projected to rise from 26.6 million at present to 106.2 million by 2050. However, delaying disease onset by more than 12 months could lead to a significant reduction of 9.2 million AD cases worldwide (Lautenschlager et al., 2008). Consequently, there have been efforts to identify individuals at a higher risk of AD and explore potential interventions that could delay the progression of prodromal symptoms to full-blown dementia. Observational studies have indicated that older adults without dementia but with memory impairment are more likely to develop AD over time (Lautenschlager et al., 2008).

One of the problems that arise in parallel with old age is people's sleep disorders (Tang et al., 2020). With increasing age, the quality and structure of sleep changes due to various reasons, including disturbances in the circadian clock rhythm and changes in melatonin rhythm (Dijk & Landolt, 2019). Therefore, all these changes may lead to sleep disorders and, as a result, cognitive impairment in the elderly (Gosselin, Baril, Osorio, Kaminska, & Carrier, 2019). The most common way to treat or deal with sleep problems and prevent the onset of dementia is to use medicine. Petersen et al, involved 769 participants with mild dementia-related impairment over a 4-year period. The preliminary results of the galantine trials are still pending, but completed trials for piracetam and rofecoxib have also yielded negative results. Other preventive strategies, such as vitamin B, statin, and antihypertensive treatments, are currently being tested, but the available results are inconsistent (Rundek, Tolea, Ariko, Fagerli, & Camargo, 2022). The effectiveness of treatment methods without the use of drugs is slower than the effectiveness of taking sleeping pills, but they are more durable and do not have the side risks of drug use like addiction (Rundek et al., 2022). One of these methods is physical activity on a regular basis, which causes more relaxation and increases the core temperature of the body and is useful as a way to start and maintain a good sleep (Weinert & Waterhouse, 2007). Researchers have found that changes in lifestyle, especially regular participation in exercise and good sleep hygiene, have positive effects on the concept of HRQoL in the elderly. It seems that there is a relationship between exercise and sleep can have reciprocal effects on somatic outcomes (Lang et al., 2016). Studies have also shown that people with sleep-related problems are also physically inactive, while participation in sports activities can improve sleep quality in adults (Gothe et al., 2020). On the other hand, regular physical activity reduces adult mortality, improves quality of life, and is useful in chronic heart failure, obesity, and diabetes (Alves et al., 2016). Several studies have also shown that regular physical activity improves sleep patterns and affects the quality of life of the elderly (Gothe et al., 2020; Reid et al., 2010). For instance, Hall. reported that higher levels of physical activity over a 2-year period among 18,766 women participating in the Nurses' Health Study were associated with better scores (Hall, 2014). Rolland et al. found that men who walked at least 3 km per day had a 1.8 times lower risk of developing dementia compared to sedentary men over a 6-year follow-up period (Rolland, van Kan, & Vellas, 2008).

On the other hand, short sleep duration may cause changes in appetite hormones and increase a person's tendency to overeat high-calorie foods, which seems to be related to these changes. It is worth mentioning that HDL, TG, and TC were also indirectly measured with metabolic measures, such as a cross-sectional study on 8860 subjects with an age range of 40 to 45 years, and it was observed that there is a significant relationship between physiological factors and sleep duration; It was found that people with lower blood HDL, TG, TC levels have shorter sleep than people with normal levels of these higher blood HDL and TG, TC factors (Pooranfar et al., 2014). Also, Numerous observational studies have shown that individuals who engage in regular physical activity throughout their lives are less likely to experience dementia decline and memory loss compared to those leading sedentary lifestyles (Brown, Peiffer, & Martins, 2013; McPhee et al., 2016). On the other hand, scientific evidence has shown that short sleep is a risk factor for heart attack. Therefore, in addition to changing the exercise program, it causes major changes in body composition (amount of body fat and body fat-free weight), sleep position, the possible consequence of which is a decrease in the incidence of heart failure. However, the existing evidence is insufficient. As a result, the aim of this study was to investigate the role of physical activity on sleep quality and Lipid profile related to sleep in the elderly with Alzheimer's disease.

Method

The method used in this research is semi-experimental. The statistical sample of the present study was 22 elderly people with Alzheimer's disease with an age range of 72.6±10.4 years and they were selected in a targeted non-random way and were randomly divided into two groups of 11 people: aerobic exercise and control. After recording the personal characteristics, the height and weight of the subjects were measured using a caliper and a medical scale, respectively. The first blood sample was taken after 12 to 14 hours of fasting in the amount of 5 ml from the vein of the forearm. The amount of metabolic variables in blood serum was determined after blood centrifugation by a spectrophotometer and according to a special formula. After blood sampling and while resting, the sleep quality questionnaire was completed by the subjects. The aerobic exercise protocol included low to moderate intensity aerobic exercise for 8 weeks, 3 sessions per week and each session was 45 minutes, which included brisk walking and weight bearing exercises. All training sessions start with ten minutes of warming up and stretching and end with five minutes of cooling down. The nature of the training was progressive in intensity. In the first week, the subjects trained with an intensity of 45%-55% of the maximum heart rate, in the second week with an intensity of 50%-60% of the maximum heart rate, and in the last four weeks with an intensity of 65% of the maximum heart rate. Caronen's equation was used to determine the target heart rate of exercise (Darvakh & Mousavian, 2016).

Activity heart rate= desired intensity× (maximum heart rate - resting heart rate) + resting heart rate.

In this formula, the intended intensity is the intensity of the exercises between 45-65% of the maximum heart rate of the exercise. The maximum heart rate was also calculated from the formula "age - 220". During the entire exercise, the intensity of each subject's activity was controlled by a Polar heart rate monitor. All training sessions were done under the supervision of a doctor in the gym with a temperature of 20-25 degrees centigrade. The control group did not do any exercise program and continued their normal activity and diet. After the end of twelve weeks of physical activity and 48 hours after the training period in the condition of 12 hours of fasting, blood samples were taken from the subjects again and the sleep quality questionnaire was also completed and the amount of variables was calculated. Descriptive statistics (mean ± standard deviation) were used to describe the data. After confirming the normality of data distribution by Kolmogorov-Smirnov test, correlation t-test and independent t-test were used to check intra-group and inter-group differences, respectively. The relationship between research variables was also determined using Pearson's correlation coefficient. All data were analyzed using SPSS version 23 software and the significance level ($p < 0.05$) was considered.

Sleep quality protocol

The standard Pittsburgh sleep quality index (PSQI) questionnaire was used to check the sleep quality of the subjects. 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 used 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, where 0 indicates a normal situation, 1 indicates a mild problem, 2 indicates a moderate problem, and 3 indicates a severe problem. The sum of the scores of the seven components forms the total sleep quality score of the person, which ranges from 0 to 21. Also, a score greater than 6 indicates poor sleep quality.

Results

According to the results of the Shapiro-Wilk test, the distribution of data in all variables was normal in both the control and experimental groups ($P<0.05$). The subjects' anthropometric data are shown in Table 1.

Table 1: Anthropometric information of subjects

Variables	mean and standard deviation	
	aerobic training	control group
Age (years)	71.33 ± 9.34	70.34 ± 8.46
Height (cm)	159.67 ± 8.35	158.85 ± 7.55
Weight (kg)	69.77 ± 9.16	70.55 ± 10.44
BMI (kg/m2)	26.77 ± 2.10	27.55 ± 3.41

The results of the correlated t test showed that in the aerobic exercise group, the total score of the Pittsburgh sleep quality questionnaire decreased from 6.9 to 4.5, which indicates a 35% improvement in the sleep quality of the subjects. While in the control group, this score increased from 7.8 to 8.5, which indicates a 7.7 percent decrease in the sleep quality of the subjects. Also, there is a significant difference between the pre-test and post-test values of HDL (P=0.016), TC (P=0.017), LDL (P=0.006), and TG (P=0.034) of the aerobic exercise group. In the control group, there was no significant difference between the pre-test and post-test values of the measured variables.

Table 2: Changes in blood index levels in the research groups

Variables	group	steps	Mean ± standard deviation	P. valiu
TG (mg/dl)	control	pre-test	181/00±70/69	P=0/215
		Post-test	183/50±67/18	
	aerobic training	pre-test	158/31±51/14	P=0/034
		Post-test	131/91±42/08	
TC (mg/dl)	control	pre-test	175/40±77/80	P=0/578
		Post-test	176/80±34/46	
	aerobic training	pre-test	178/20±34/89	P=0/017
		Post-test	144/80±25/79	

LDL (mg/dl)	control	pre-test	114/00±21/18	P=0/206
		Post-test	104/14±31/04	
	aerobic training	pre-test	127/40±21/30	P=0/006
		Post-test	98/90±32/9	
HDL (mg/dl)	control	pre-test	33/35±7/93	P=0/816
		Post-test	32/45±8/89	
	aerobic training	pre-test	35/50±8/81	P=0.016
		Post-test	46/50±11/10	

Pearson's correlation coefficient test was used to measure the relationship between changes in sleep quality and changes in TG, TC, and HDL as a result of twelve weeks of aerobic exercise. According to Table 3, the correlation between changes in sleep quality and changes in TG, TC, and HDL is not significant at the 0.05% level.

Table 3. Relationship between quality changes with TG, TC, HDL changes in aerobic exercise group

		HDL (mean difference)	TC (mean difference)	TG (mean difference)
average difference in sleep quality	Correlation coefficient Pearson	-0.081	-0.250	-0.800
	P valiu	0.524	0.325	0.684

Discussion

Sleep quality in elderly people with Alzheimer's disease is one of the major problems in the world. Recently, the effects of lipid profile on sleep quality in people with Alzheimer's disease have attracted special attention. However, it is well known how the quality of sleep escapes under the influence of lipid profile. Considering that it is necessary to identify the developmental and protective factors of sleep disorder, exercise may be one of the effective factors in preventing the decrease in sleep quality. This study was conducted in order to investigate the effect of aerobic exercise on sleep quality and Lipid profile related to sleepin the elderly with Alzheimer's disease, and the results showed that twelve weeks of aerobic exercise at the rate of 3 days of exercise per week has a significant effect on improving sleep quality, lipid profile (decrease of TG, VLDL, LDL and TC and also increase of HDL) of the elderly with Alzheimer's disease.

According to the results of the present study, between the pre-test and post-test changes in sleep quality, as a result of twelve weeks of aerobic training, there was a 35% improvement in sleep quality. This issue is consistent with the results of the research of Chen et al. (2007), Abai et al. (2008) that the changes in sleep quality due to aerobic activity were significant [Chen, 2010 #1007]. In the researches of Abai et al, Chen et al, 21 and 4 months were considered. However, it can be seen that the sleep quality of the subjects has improved significantly even in this short period (Chen, Liu, Huang, & Chiou, 2012).

The results showed that twelve weeks of aerobic training led to a significant increase in HDL in people with Alzheimer's disease. In relation to the changes in HDL, it can be stated that HDL plays a protective role more than being a metabolic factor, which is effective in the health of arteries and preventing their clogging by transferring cholesterol from the vessel wall to the liver and removing them (Bardagjy & Steinberg, 2019). They say that regular exercise training by increasing lipoprotein lipase, transferring it to the capillary endothelium, connecting it to the surface of the lumen and accelerating the breakdown of lipoproteins rich in triglycerides increases the transfer of surface compounds to HDL, which in the long run increases the HDL mass (Reiner, 2018). The reduction of lipid profile risk factors after exercise can be caused by the increase of lipoprotein lipase levels and the decrease of triglyceride lipase (Gordon, Chen, & Durstine, 2014). Studies have shown that aerobic exercises reduce total body fat percentage, body mass index, wtwelve and circumference of thighs, waist and arms and also have a great effect on LDL, TG, TC and HDL levels (Heydari, Freund, &

Boutcher, 2012; Reljic, Konturek, Herrmann, Neurath, & Zopf, 2020). Of course, it seems that the reason for the inconsistent results depends more on the difference in research methodology. For example, in the research of Heydari et al. (2012) who investigated the effect of 12 weeks of intermittent high-intensity training on the body composition indices of obese young men, the changes in lipid levels were not significant in the two training and control groups (Heydari, Boutcher, & Boutcher, 2013). Also, there is a belief that regular sports activity improves lipolysis by increasing the sensitivity of beta-adrenergic receptors in fat tissue and increasing the uptake and oxidation of fat in muscles, leading to an improvement in lipid profile (Rodrigues, Prímola-Gomes, Peluzio, Hermsdorff, & Natali, 2021). Adaptation to exercise by increasing blood volume (plasma), decreasing blood concentration and increasing maximum oxygen consumption can have a positive effect on lipid profiles. The limitations of the present study include the inability to accurately control the subjects' nutrition and physical activities in the times outside the time of sports training. it is suggested that in future studies, the effect of changes in the volume and intensity of sports training on the lipid profile of the elderly patients can be compared with their daily physical activities.

Conclusion

Currently, in the Iranian elderly society, the inability to sleep and sleep well is a health concern. Current evidence shows that exercise and physical activities have an effect on the quality of sleep of the elderly and improve their quality of life. However, the physiological function of sleep in regulating normal hormonal and metabolic processes is not fully understood. Therefore, more studies are needed in the field of sleep quality and lifestyle of Iranian elderly.

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Conflict of Interests

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

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References

Alves, A. J., Viana, J. L., Cavalcante, S. L., Oliveira, N. L., Duarte, J. A., Mota, J., . . . Ribeiro, F. (2016). Physical activity in primary and secondary prevention of cardiovascular disease: Overview updated. World journal of cardiology, 8(10), 575.

Bardagjy, A. S., & Steinberg, F. M. (2019). Relationship between HDL functional characteristics and cardiovascular health and potential impact of dietary patterns: a narrative review. Nutrients, 11(6), 1231.

Brown, B., Peiffer, J., & Martins, R. (2013). Multiple effects of physical activity on molecular and cognitive signs of brain aging: can exercise slow neurodegeneration and delay Alzheimer's disease? Molecular psychiatry, 18(8), 864-874.

Chan, A. K. Y., Tamrakar, M., Jiang, C. M., Lo, E. C. M., Leung, K. C. M., & Chu, C.-H. (2021). Common medical and dental problems of older adults: a narrative review. Geriatrics, 6(3), 76.

Chen, M.-C., Liu, H.-E., Huang, H.-Y., & Chiou, A.-F. (2012). The effect of a simple traditional exercise programme (Baduanjin exercise) on sleep quality of older adults: a randomized controlled trial. International journal of nursing studies, 49(3), 265-273.

Darvakh, H., & Mousavian, A. S. (2016). Study of some CVD intensifying lipids over a period of aerobic exercise in the open and closed environment. International Journal of Medical Research & Health Sciences, 5(8), 356-361.

Dijk, D.-J., & Landolt, H.-P. (2019). Sleep physiology, circadian rhythms, waking performance and the development of sleep-wake therapeutics. Sleep-wake neurobiology and pharmacology, 441-481.

Gordon, B., Chen, S., & Durstine, J. L. (2014). The effects of exercise training on the traditional lipid profile and beyond. Current sports medicine reports, 13(4), 253-259.

Gosselin, N., Baril, A.-A., Osorio, R. S., Kaminska, M., & Carrier, J. (2019). Obstructive sleep apnea and the risk of cognitive decline in older adults. American journal of respiratory and critical care medicine, 199(2), 142-148.

Gothe, N. P., Ehlers, D. K., Salerno, E. A., Fanning, J., Kramer, A. F., & McAuley, E. (2020). Physical activity, sleep and quality of life in older adults: influence of physical, mental and social well-being. Behavioral sleep medicine, 18(6), 797-808.

Hall, C. (2014). The Relationship between Cognitive Stimulating Activities, Physical Activity and Cognitive Impairment in Women following Adjuvant Chemotherapy for Breast Cancer. University of Cincinnati,

Heydari, M., Boutcher, Y. N., & Boutcher, S. H. (2013). The effects of high-intensity intermittent exercise training on cardiovascular response to mental and physical challenge. International Journal of Psychophysiology, 87(2), 141-146.

Heydari, M., Freund, J., & Boutcher, S. H. (2012). The effect of high-intensity intermittent exercise on body composition of overweight young males. Journal of obesity, 2012.

Lang, C., Kalak, N., Brand, S., Holsboer-Trachsler, E., Pühse, U., & Gerber, M. (2016). The relationship between physical activity and sleep from mid adolescence to early adulthood. A systematic review of methodological approaches and meta-analysis. Sleep medicine reviews, 28, 32-45.

Lautenschlager, N. T., Cox, K. L., Flicker, L., Foster, J. K., Van Bockxmeer, F. M., Xiao, J., . . . Almeida, O. P. (2008). Effect of physical activity on cognitive function in older adults at risk for Alzheimer disease: a randomized trial. Jama, 300(9), 1027-1037.

McPhee, J. S., French, D. P., Jackson, D., Nazroo, J., Pendleton, N., & Degens, H. (2016). Physical activity in older age: perspectives for healthy ageing and frailty. Biogerontology, 17, 567-580.

Pooranfar, S., Shakoor, E., Shafahi, M., Salesi, M., Karimi, M., Roozbeh, J., & Hasheminasab, M. (2014). The effect of exercise training on quality and quantity of sleep and lipid profile in renal transplant patients: a randomized clinical trial. International journal of organ transplantation medicine, 5(4), 157.

Reid, K. J., Baron, K. G., Lu, B., Naylor, E., Wolfe, L., & Zee, P. C. (2010). Aerobic exercise improves self-reported sleep and quality of life in older adults with insomnia. Sleep medicine, 11(9), 934-940.

Reiner, Ž. (2018). Triglyceride-rich lipoproteins and novel targets for anti-atherosclerotic therapy. Korean circulation journal, 48(12), 1097-1119.

Reljic, D., Konturek, P., Herrmann, H., Neurath, M., & Zopf, Y. (2020). Effects of whole-body electromyostimulation exercise and caloric restriction on cardiometabolic risk profile and muscle strength in obese women with the metabolic syndrome: A pilot study. J. Physiol. Pharmacol, 71, 89-98.

Rodrigues, A., Prímola-Gomes, T., Peluzio, M., Hermsdorff, H., & Natali, A. (2021). Aerobic exercise and lipolysis: A review of the β-adrenergic signaling pathways in adipose tissue. Science & Sports, 36(1), 16-26.

Rolland, Y., van Kan, G. A., & Vellas, B. (2008). Physical activity and Alzheimer's disease: from prevention to therapeutic perspectives. Journal of the American Medical Directors Association, 9(6), 390-405.

Rundek, T., Tolea, M., Ariko, T., Fagerli, E. A., & Camargo, C. J. (2022). Vascular cognitive impairment (VCI). Neurotherapeutics, 19(1), 68-88.

Tang, M., Li, D., Liew, Z., Wei, F., Wang, J., Jin, M., . . . Ritz, B. (2020). The association of short-term effects of air pollution and sleep disorders among elderly residents in China. Science of The Total Environment, 708, 134846.

Weinert, D., & Waterhouse, J. (2007). The circadian rhythm of core temperature: effects of physical activity and aging. Physiology & behavior, 90(2-3), 246-256.

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