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ORIGINAL ARTICLE

The effect of aerobic exercises of different intensities on anxiety, cigarette addiction, sleep quality, and quality of life in former smokers

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Abstract

Background There is a worldwide struggle to quit smoking and prevent relapsing. Aerobic exercises are frequently utilized to aid in smoking cessation and prevent relapse.

Aims This study aimed to investigate the effects of aerobic exercises of different intensity on the level of anxiety, smoking addiction, and quality of sleep and life in former smokers.

Methods The study included 60 people aged 18 to 45 who had quit smoking within the previous month. Individuals were randomly assigned to control (CON), mild-intensity aerobic activity (MIA), and moderate-intensity aerobic activity (MoIA) groups. The MIA group did submaximal aerobic exercises at 40% of maximum heart rate (MHR), while the MoIA group did them at 60% of MHR for 8 weeks/3 days. Participants' anxiety levels were assessed using the Beck Anxiety Scale (BAS), smoking addiction was assessed using the Fagerström Test for Nicotine Dependence and Substance Craving Scale (SCS), sleep quality was assessed using the Pittsburgh Sleep Quality Index, and quality of life was assessed using the SF-36 Short Form Scale (SF-36).

Results The SCS score of the MoIA group declined more than the MIA and CON groups, and the MIA group had a lower sleep disturbance score than other groups when the influence of exercise training was assessed over time ($p < 0.05$). Aerobic exercise had no influence on SF-36 or BAS scores ($p > 0.05$).

Conclusions The benefits of mild and moderate aerobic exercise on quality of life and anxiety are similar. However, mild-intensity aerobic exercises may be suitable for sleep difficulties while moderate-intensity aerobic exercises may be preferred for reducing smoking addiction.

Keywords Aerobic exercise · Anxiety · Nicotine addiction · Sleep hygiene · Smoking cessation

Introduction

There is a great struggle worldwide to quit smoking and prevent relapsing. Its harmful effects on human health are an indisputable truth. It causes many different types of cancer, particularly lung cancer [1]. Additionally, it can cause chronic diseases such as heart diseases, stroke, diabetes, lung diseases (emphysema, chronic obstructive pulmonary disease (COPD)), and systemic diseases such as rheumatoid arthritis, systemic lupus erythematosus (SLE), Crohn's disease, and Sjögren's syndrome [2]. Tobacco-related mortality and morbidity rates are expected to almost triple globally within 20 to 25 years [3].

There are social policies in place to help people minimize or quit smoking, such as changing the outer surface of cigarette packaging and creating booklets and commercials that explain the dangers of smoking. Individual struggles can be treated with behavioral and psychological therapies as well as pharmaceutical therapies. Motivational interviewing, acceptance and commitment therapy, and emergency management or incentive-based interventions are all examples of behavioral therapy or cognitive behavioral therapy (CBT) [4–7]. Cognitive therapy, including CBT, is a psychotherapeutic approach based on the premise that cognitive elements can maintain behavioral issues, such as beliefs that lead to automatic thoughts about particular situations [8].

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Pharmacological treatments, on the other hand, are more extensively utilized than psychological treatments because they reduce the physical symptoms of nicotine withdrawal, allowing smokers to concentrate on the behavioral and psychological components of quitting. By desensitizing nicotinic receptors, such medicines can significantly lessen the immediate reinforcing effects of nicotine from cigarettes [7].

Exercise methods are frequently utilized to help people quit smoking or avoid relapse. Aerobic workouts, in particular, are favored for a variety of reasons, including their ability to boost cardiovascular capacity, lower blood pressure, increase red blood cell count, and reduce stress and depression [9]. The efficiency of moderate- or high-intensity aerobic activities has been studied in short-term randomized controlled trials, although exercises have also been utilized in conjunction with nicotine replacement therapy [10–14]. The effectiveness of aerobic exercises has been questioned in two recent meta-analyses, with the conclusion that the level of evidence is low or inadequate (heterogeneity in clinical groups, unattended (home-based) exercise practices, exercise practices with pharmacological treatments, lack of contact as a control condition), and that new studies are needed to back it up [15, 16]. As far as we are aware, there is no study assessing the impact of aerobic activities of varying intensities on individuals who have quit smoking without further intervention. Due to increasing rates of smoking and health problems, simple and cost-effective approaches are becoming more prominent in efforts to improve people's physical health and prevent them from relapsing. When deemed necessary for this purpose, healthcare professionals will continue to employ medical or behavioral treatment techniques. When health experts offer aerobic exercise to those who have quit or wish to quit smoking, it is vital to study the physical and psychological impacts, the intensity and duration of the exercise, and the individuals' needs.

In light of this information, this study was conducted to investigate the impact of different types of aerobic activities on smoking addiction, quality of life, sleep quality, and anxiety levels in those who have quit smoking.

Material and methods

Individuals

This study was conducted with a randomized controlled trial design between June 2020 and May 2021. Volunteers from the province of Batman who had been smoking for at least 2 years, had quit smoking during the previous month, and were between the ages of 18 and 45 were included in the study. Individuals who regularly participated in aerobic exercise or physical activity programs during the past 1 year; had systemic, cardiovascular, or neurological disease; had abused alcohol or substance; started smoking again during the trial; and did not participate in the exercise program for three or more sessions were excluded from the study. Individuals who applied to the provincial health directorate's healthy life centers and smoking cessation polyclinics in hospitals, and who were interested in participating in our study, were contacted by phone. Telephone interviews were conducted with 214 participants, and face-to-face interviews were conducted with 96 people who fit the study's requirements. Due to personal reasons, 36 of the questioned persons were excluded from the study, and the study began with 60 participants who met the inclusion requirements (Fig. 1).

A simple randomization method (closed envelope) was used to divide the participants into three groups: a control group (CON), a mild-intensity aerobic exercise group (MIA), and a moderate-intensity aerobic exercise group (MoIA). The control group was instructed to go about their daily routines as usual. The mild-intensity aerobic exercise group had a submaximal aerobic exercise program at 40% of maximal heart rate (MHR), while the moderate-intensity aerobic exercise group had a submaximal aerobic exercise program at 60% of MHR [17].

Aerobic workouts were scheduled for 8 weeks, three times a week. The exercises were delivered in the form of group sessions by a physiotherapist with 14 years of expertise, the last two of which were spent in public health. Aerobic workouts such as walking or jogging were done on the suitable outdoor ground.

The Hasan Kalyoncu University Faculty of Health Sciences Non-Interventional Research Ethics Committee approved the

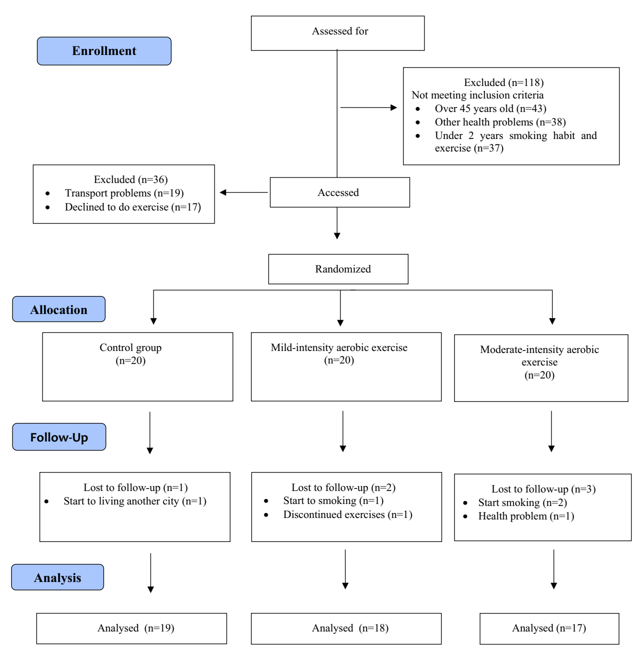

Fig. 1 Study flowchart

study with the number 2020/098. The participants were told about and signed the consent form after all of the individuals participating in the study were informed about the study's goal and content in accordance with the Declaration of Helsinki.

During the study, one person in the control group could not be reached due to being out of town, one person in the mild-intensity aerobic exercise group did not complete the exercise program, another started smoking again, two people in the moderate-intensity aerobic exercise group started smoking again, and another person was excluded from the study due to health problems. Thus, a total of 54 persons participated in the study: 19 in the control group, 18 in the mild-intensity aerobic exercise group, and 17 in the moderate-intensity aerobic exercise group (Fig. 1).

Assessments

Individuals' physical and demographic information (age, weight, height, level of education, year smoked, age at which regular smoking started, daily smoking amount) were recorded. Before beginning the trial, participants were given the Fagerström Test for Nicotine Dependence (FTND) and the Physical Activity Readiness Questionnaire (PAR-Q). The Beck Anxiety Scale (BAS) was used to assess anxiety before and after 8 weeks of aerobic exercise training, while the Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality, the SF-36 Short Form Scale (SF-36) short form was used to assess quality of life, and the Substance Craving Scale (SCS) was used to assess smoking addiction.

Fagerström test for nicotine dependence

The Fagerström Nicotine Dependence Test, which was refined from the Fagerström Tolerance test, was used to assess individuals' nicotine dependence levels, with a Turkish validity and reliability research conducted by Uysal et al. in 2004 [18, 19]. Six questions make up the Fagerström nicotine addiction test. It has a score of 0 to 10 points (0–2: very mild, 3–4: mild, 5: moderate, 6–7 advanced, 8–10: very advanced). As the test score increases, so does the addiction level [19].

Physical activity readiness questionary

In this questionnaire, which determines the cardiovascular risks of individuals before exercise, the following questions are asked [20]:

- Have you been told by your doctor that you have a cardiac issue and that you should only engage in physical activity that has been prescribed by a doctor?
- Do you feel pain in any part of your chest while doing physical activity?
- Have you had pain in any part of your chest in the last month while not engaging in any physical activity?
- Do you ever lose your balance due to dizziness or lost consciousness?
- Have you lately been told by your doctor that you need to take medication for your high blood pressure or heart condition?
- Are there any other reasons why you should not engage in physical activity?

Beck anxiety scale

It was developed by Beck et al. in 1988 to assess people's anxiety levels; Ulusoy et al. conducted a Turkish validity and reliability assessment for it in 1998 [21, 22]. The Beck Anxiety Scale is a 21-item Likert-type scale with a score of 0 to 3 that asks about symptoms from the previous week. No answer is worth 0 points, light responses are worth 1 point, moderate responses are worth 2 points, and severe responses are worth 3 points. The total score obtained from the scale is deemed minimum anxiety/normal if it is between 0 and 7 points, mild anxiety if it is between 8 and 15 points, moderate anxiety if it is between 16 and 25 points, and severe anxiety if it is between 26 and 63 points [22].

Pittsburgh sleep quality index

Buysse et al. established the Pittsburgh Sleep Quality Index in 1989 to assess individuals' sleep quality, and Ağargün et al. conducted a Turkish validity and reliability research for it in 1996 [23, 24]. The first 19 items of the Pittsburgh Sleep Quality Index are answered by the individual, while the latter 5 questions are completed by the individual's bed partner or roommate, with the 19th question being whether they have a bed partner or roommate. The scale questions are rated on a scale of 0 to 3, with 0 equaling never, 1 equaling less than once a week, 2 equaling once or twice a week, and 3 equaling three or more times a week. The scale's 18 scored questions are divided into seven subdomains. Sleep latency, sleep duration, habitual sleep efficiency, sleep disorder, sleeping drug use, and daytime dysfunction are all factors that affect sleep quality. The scale total score is calculated by adding the total scores of the seven subdomains. The overall score is a number between 0 and 21. "Poor sleep quality" [24] is indicated by a total score of more than 5.

SF-36 Short form scale

Individuals' quality of life was measured using the SF-36 (short form), which was designed by Ware et al. at RAND Corporation in 1992 and whose Turkish validity and reliability assessment was completed by Koçyiğit et al. in 1999 [25, 26]. The SF-36 is a 36-question short-form quality-of-life scale with eight subdomains. Physical function (10 questions), social function (2 questions), role difficulty due to physical problems (4 questions), role difficulty due to emotional problems (3 questions), mental health (5 questions), vitality (4 questions), pain (2 questions), and general health perception (5 questions) are some of the topics covered by the subdomains. The SF-36 short-form quality-of-life scale asks about both good and bad things. These subdomains' scores range from 0 to 100, with scores close to 100 indicating that the individual's general health status is good and scores near 0 indicating that the individual's general health condition is poor.

Substance craving scale

Individuals' smoking addiction levels were assessed using the Penn Alcohol Craving Scale, which assesses the desire to drink alcohol. Evren et al. conducted a validity and reliability research for it in Turkey. This scale consists of five questions, each of which is responded with a score ranging from 0 to 6 [27].

Exercise training

In order to establish the appropriate heart rate range during aerobic activity, the maximum heart rate formula "MHR = 220 − Age" was employed initially, followed by the Karvonen formula (intensity of strain target heart rate = intensity of strain × (maximum heart rate − resting heart rate) + resting heart rate) [28]. Individuals' resting heart rates were measured in the supine position for 10 min without any activity using a Polar M400 exercise watch.

The workout took 45 min to complete, including a 10-min warm-up, 30-min aerobic exercise, and a 5-min cool-down. The warm-up consisted of 5 min of vigorous walking followed by 5 min of stretching exercises (3 repetitions/20 s). Stretching exercises were done in an active stretching style with the gross muscles such as the quadriceps, hamstrings, hip flexors, and gastro-soleus muscles. Walking for 5 min at a slower pace was used as a cool-down exercise before the exercises were completed.

The mild aerobic exercise group walked for 30 min three times a week at a submaximal heart rate of 40% of maximal heart rate for 8 weeks. For the same durations, our moderate-intensity aerobic exercise group completed brisk walking/jogging at a submaximal heart rate of 60% of maximal heart rate.

The heart rate was constantly monitored during the exercise via a Polar M400 exercise watch and computer program, allowing participants to reach and maintain their goal heart rate. Those with a heart rate reserve of ± 5 were asked to modify the intensity of the activity through verbal stimulation.

Statistical analysis

The data was statistically analyzed using the Statistical Package for Social Sciences (IBM Corp. Armonk, NY, USA) version 22 program. Frequency, percentage, and arithmetic mean ± standard deviation (X ± SD) were used to present the data. The Kolmogorov–Smirnov test was used to determine if the data were homogeneously distributed or not. Before the training, the Kruskal–Wallis test was employed to compare the non-normally distributed data. The effect of aerobic activities and time was assessed using a two-way analysis of variance (ANOVA). Small (0.2), medium (0.5), and large (0.8) effect sizes (η^2) were defined [29]. $p < 0.05$ was chosen as the statistical significance level. The number of people was determined using the G*Power analysis program. The 92% confidence interval was determined as a minimum of 17 participants for each group when $d > 1.20$ in the analysis.

Results

Our groups had statistically similar physical and smoking characteristics at the start of the investigation ($p > 0.05$) (Table 1). On the other hand, the mild-intensity aerobic exercise and control groups had higher FTND and SCS scores than the moderate-intensity aerobic exercise group ($p < 0.05$) (Tables 1 and 2), and the mild aerobic exercise group had a higher sleep disturbance Pittsburgh Sleep Quality Index (PSQI) subdomain score than the control group ($p < 0.05$) (Table 2).

People with under-graduate and post-graduate degrees were 45% in the control group, 85% in the moderate aerobic activity group, and 35% in the mild aerobic exercise group, according to the participants' educational information. High school and lower education levels were predominantly in the mild-intensity aerobic exercise group, while university and graduate students were mostly in the moderate-intensity aerobic exercise group. According to our study's demographic data, 63% of all participants were married, while 37% of them were single. In the mild aerobic activity group, the number of married people was found greater (Table 3).

The two-way repeated measure (ANOVA) revealed a significant main effect of time and exercise ($p < 0.01$ each), as well as a significant exercise × time interaction for SCS ($p < 0.01$). A pairwise comparison with Bonferroni corrections demonstrated that the moderate-intensity aerobic exercise group's SCS score decreased more than that of the mild-intensity aerobic exercise and control groups ($p < 0.01$), and the effect size was deemed moderate (Table 2; Fig. 2).

In addition, a significant main effect of time and exercise × time interaction was found for PSQI ($p < 0.01$ and

Table 1 The comparison of baseline nicotine addiction and physical and smoking characteristics between groups. Data are presented as mean ± SD

	CON	MIA	MoIA	Kruskal–Wallis		
	Pre-test	Pre-test	Pre-test	*z*	*p*	Pairwise comparison
Age (year)	32.10 ± 6.77	33.10 ± 5.07	34.00 ± 5.15	1.075	0.548	-
Height (cm)	175.25 ± 6.25	174.95 ± 5.95	175.55 ± 57.28	0.004	0.998	-
Weight (kg)	77.05 ± 10.45	79.35 ± 12.63	79.15 ± 9.29	0.767	0.682	-
BMI (kg/m^2)	25.17 ± 3.91	25.92 ± 4.06	25.70 ± 2.82	1.016	0.602	-
Smoking started age (year)	14.40 ± 6.93	15.90 ± 6.67	17.05 ± 6.19	1.314	0.518	-
Years smoked (year)	13.70 ± 6.85	15.25 ± 6.29	15.80 ± 5.88	0.692	0.707	-
Cigarettes/Day	23.10 ± 16.67	22.20 ± 7.93	17.70 ± 5.28	3.319	0.190	-
FTND (score)	4.90 ± 3.04	5.95 ± 2.39	3.55 ± 1.85	9.641	0.008*	CON = MIA < MoIA

Cm centimeter, *Kg* kilogram, *Kg/m^2* kilograms per square meter, *BMI* body mass index, *FTND* Fagerström Test for Nicotine Dependence, *CON* control, *MIA* mild-intensity aerobic exercise, *MoIA* moderate-intensity aerobic exercise

*$p < 0.05$

$p < 0.05$, respectively). However, the pairwise comparison with Bonferroni corrections demonstrated that there was no difference between the groups for the exercise and time interaction ($p > 0.05$), and the effect size was deemed small (Table 2). The PSQI score was reduced in all groups at the conclusion of study when time effect was considered ($p < 0.01$) (Fig. 2). On the other hand, a significant main effect of time was found only for BAS ($p < 0.01$) (Table 2). The BAS score was reduced at the end of study in all groups ($p < 0.01$) (Fig. 2).

When the subdomains of PSQI were analyzed, the two-way repeated measure (ANOVA) revealed a significant main effect of exercise and time for sleep disturbance ($p < 0.05$ and $p < 0.01$, respectively), with no significant effect of the exercise × time interaction ($p > 0.05$). The sleep disturbance score of the mild aerobic exercise group reduced more so than that of the control group when exercise effect was considered ($p < 0.05$), and the effect size was deemed small (Table 2) (Fig. 2). Significant main effects of time and the exercise × time interaction were also discovered for sleep latency ($p < 0.01$, each). This subdomain score was reduced in all groups at the end of study ($p < 0.01$), but pairwise comparison with Bonferroni corrections demonstrated no difference between groups for the exercise and time interaction ($p > 0.05$), and the effect size was deemed small (Table 2; Fig. 2). The two-way repeated measure (ANOVA) showed only significant main effects of time for sleep quality and daytime sleep dysfunction of PSQI subdomains ($p < 0.01$, each) (Table 2; Fig. 2).

When the subdomains of SF-36 were evaluated, there was no influence of exercise training over time on SF-36 subdomain scores ($p > 0.05$ each). Using the two-way repeated measure (ANOVA), only a significant main effect of time for physical role limitation, emotional role limitation, and vitality was found ($p < 0.01$ each) (Table 4; Fig. 3).

Discussion

In this study, we looked at the effects of mild and moderate aerobic exercise intensity on smoking addiction, quality of life, sleep quality, and anxiety levels in former smokers during an 8-week period. Our findings showed that mild and moderate-intensity aerobic exercises did not change the quality of life and anxiety of former smokers. However, mild-intensity aerobic exercise reduced sleep disturbance more so than control conditions. Therefore, moderate-intensity aerobic exercise decreased smoking addiction better than mild-intensity aerobic exercise and control conditions over time.

According to researches, quitting smoking improved lung function, made an individual feel more functional, and enhanced their quality of life and sleep [30, 31]. Individuals above the age of 40 had a clearer attitude about quitting smoking than those of other age groups [32]. The fact that all of the participants in our study were under the age of 35 may indicate that they had this desire at a younger age.

Individuals' overall knowledge of their general health status improved as their education level rose; thus, their capacity to quit smoking improved as well [33]. When we questioned the participants in our study, we discovered that as their education level improved, they did more research or read about the dangers of smoking and got more conscious. With a better understanding of the impacts of smoking on society and general health, it has been discovered that those with a higher level of education are more likely to seek out smoking cessation clinics. In this regard, our findings back previous research that imply that as education levels rise, so does the need for smoking cessation.

Being married has also been linked to an increase in the desire to quit smoking [34]. When we looked at the marital status distribution in our study, we discovered that more than

Table 2 The comparison of anxiety level, smoke addiction, and sleep quality scores. Data are presented as mean ± SD

	CON		MIA		MoIA		ANOVA Effect size (η^2)			Pairwise comparison (Bonferroni)
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Exercise	Time	Exercise time	Groups
Substance Craving Scale	21.75 ± 5.37	14.68 ± 3.71	22.50 ± 5.05	15.00 ± 3.14	18.85 ± 2.80[bc]	5.59 ± 1.73	0.44**	0.91**	0.47**	CON = MIA < MoIA
Beck Anxiety Scale	15.80 ± 8.22	12.58 ± 6.53	17.50 ± 8.60	13.11 ± 7.01	20.00 ± 9.36	14.12 ± 7.02	0.01	0.49**	0.07	ns
PSQI (total)	6.40 ± 2.01	3.95 ± 1.75	7.35 ± 2.60	4.33 ± 1.91	7.20 ± 3.16	3.53 ± 1.37	0.02	0.87**	0.11*	ns
PSQI (subdomains)										
Sleep quality	1.30 ± 0.73	0.84 ± 0.50	1.50 ± 0.61	0.83 ± 0.38	1.60 ± 0.75	0.76 ± 0.56	0.00	0.57**	0.07	ns
Sleep latency	1.65 ± 0.81	1.37 ± 0.83	1.60 ± 1.14	1.06 ± 1.00	2.05 ± 0.69	1.12 ± 0.49	0.01	0.52**	0.17**	ns
Sleep duration	0.35 ± 0.49	0.05 ± 0.23	0.60 ± 0.75	0.22 ± 0.43	0.55 ± 0.94	0.06 ± 0.24	0.03	0.01	0.00	ns
Sleep efficiency	0.10 ± 0.31	0.00 ± 0.00	0.05 ± 0.22	0.00 ± 0.00	0.05 ± 0.22	0.00 ± 0.00	0.03	0.05	0.03	ns
Sleep disturbance	1.55 ± 0.51	1.11 ± 0.57	2.10 ± 0.55[a]	1.39 ± 0.50	1.75 ± 0.55	1.12 ± 0.33	0.11*	0.57**	0.05	CON < MIA
Sleep medication	0.00 ± 0.00	0.00 ± 0.00	0.10 ± 0.45	0.06 ± 0.24	0.15 ± 0.67	0.00 ± 0.00	0.01	0.02	0.02	ns
Daytime sleep dysfunciton	1.45 ± 0.76	0.58 ± 0.61	1.40 ± 0.68	0.78 ± 0.55	1.05 ± 1.05	0.47 ± 0.51	0.05	0.54**	0.02	ns

Pre-test differences between groups (Kruskal–Wallis test)

Cm centimeter, *Kg* kilogram, *Kg/m*^{2} kilograms per square meter, *BMI* body mass index, *PSQI* Pittsburgh Sleep Quality Index, *CON* control, *MIA* mild-intensity aerobic exercise, *MoIA* moderate-intensity aerobic exercise, *ns* non-significant

*$p < 0.05$; **$p < 0.01$

[a]$p < 0.05$ CON vs. MIA

[b]$p < 0.05$ CON vs MoIA

[c]$p < 0.05$ MIA vs. MoIA

Table 3 The demographic characteristics of participants

	CON		MIA		MoIA	
	(*n* = 20)	Percent (%)	(*n* = 20)	Percent (%)	(*n* = 20)	Percent (%)
Education level						
Primary school	3	15	2	10	0	0
High school	8	40	11	55	3	15
University	8	40	6	30	12	60
Master/PhD	1	5	1	5	5	25
Martial status						
Single	10	50	5	25	7	35
Married	10	50	15	75	13	65
Count of children						
0	10	50	8	40	11	55
1	3	15	3	15	4	20
2	3	15	5	25	3	15
3	2	10	3	15	1	5
4	1	5	1	5	1	5
5	1	5	0	0	0	0

CON control, *MIA* mild-intensity aerobic exercise, *MoIA* moderate-intensity aerobic exercise

half of the participants were married. There are a variety of reasons for this, including the fact that their partners do not smoke, their spouses and children who are exposed to second-hand smoke suggest or encourage them to quit, the fear that cigarette smoke will cause health problems in family members, and the fear that their children will start smoking in the future.

Although its effect on the mechanism of depression is unknown, it is assumed that smoking increases the risk of depression due to extended nicotine exposure, desensitization of nicotinic acetylcholine receptors in the limbic system, and effects on serotonin pathways [35, 36]. In non-smokers, regular exercise and aerobic exercise have been shown to prevent depression and improve mental health [37–39].

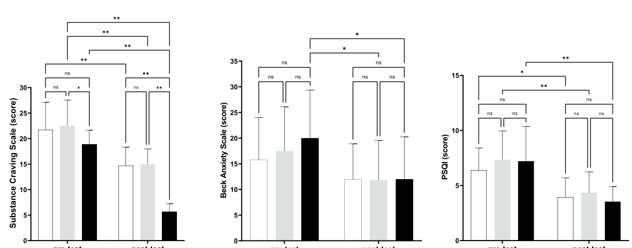

Fig. 2 Score changes of SCS (substance craving scale), BAS (Beck Anxiety Scale) and PSQI (Pittsburgh Sleep Quality Index) scales. The mild intensity aerobic exercise (MIA) and control groups (CON) showed greater pre-test SCS scores than the moderate intensity aerobic exercise (MoIA) group ($p < 0.05$). Two-way repeated measure (ANOVA) showed a significant main effect of time and exercise ($p < 0.01$), as well as a significant exercise × time interaction for SCS ($p < 0.01$). There was also found a significant main effect of time and exercise × time interaction for PSQI ($p < 0.01$). However, there was only found a significant main effect of time for BAS ($p < 0.05$). White column: control, gray column: mild-intensity activity group, black column: moderate-intensity activity group. *$p < 0.05$, **$p < 0.01$

Changes in cortisol levels are suggested to be responsible for these favorable effects during aerobic activities [40, 41]. According to a recent meta-analysis, aerobic exercise has a large and significant effect on depression, whereas mixed therapies (aerobic and anaerobic exercise) had no effect [42]. Exercise for 10–14 weeks for 45–60 min reduced depression in those with depression, according to a 2012 guideline [43]. The activity frequency in studies of aerobic exercise and depression is 3 days per week [44, 45]. In our study, we exercised at the same frequency; however, this had no influence on anxiety levels. It is possible that this is related to the short study period (8 weeks). Our participants who undertook moderate aerobic activity, on the other hand, had a lower urge for nicotine or cigarettes, indicating that we had accomplished the necessary physiological changes. Nicotine stimulates the release of dopamine by binding to nicotinic acetylcholine receptors in the brain. Dopamine is perceived as a calming and pleasurable substance in individuals. When a person stops smoking, they feel deprived of this chemical, which makes them want to start smoking again. Depressive behaviors, as well as stress and anxiety levels, are known to rise in people who stop smoking. As a result, antidepressants and nicotine replacement therapy are used to help people quit smoking, and exercise can be added to the mix [46]. As previously stated, there is a strong link between nicotine or cigarette cravings and anxiety. Although our moderate-intensity aerobic exercise program reduced participants' smoking addiction more, this did not appear to be reflected in their anxiety. Future studies examining different aerobic exercise intensities and different psychosocial elements of anxiety may be proposed.

Aerobic exercise is the most popular type of exercise used to reduce the desire to start smoking again. Isometric exercise,

Table 4 The comparison of subdomain scores of SF-36 quality of life scale. Data are presented as mean ± SD

	CON		MIA		MoIA		ANOVA Effect size (η^2)			Pairwise comparison (Bonferroni)
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Exercise	Time	Exercise time	Groups
Physical functioning	84.50 ± 9.30	89.74 ± 7.90	83.75 ± 9.72	91.11 ± 5.57	81.50 ± 11.82	92.06 ± 6.14	0.01	0.00	0.00	ns
Bodily pain	66.13 ± 20.37	68.95 ± 16.34	68.25 ± 20.84	71.25 ± 19.33	60.25 ± 22.05	73.53 ± 18.54	0.01	0.00	0.01	ns
Physical role limitation	33.75 ± 34.67	77.63 ± 20.23	38.75 ± 40.13	68.06 ± 26.85	43.75 ± 41.26	73.53 ± 31.21	0.00	0.36**	0.06	ns
Emotional role limitation	41.67 ± 32.22	77.19 ± 22.37	36.67 ± 28.41	68.52 ± 24.18	45.00 ± 36.31	76.47 ± 15.65	0.01	0.36**	0.02	ns
Mental health	59.00 ± 16.20	67.16 ± 12.04	57.40 ± 18.32	65.78 ± 14.01	56.60 ± 16.01	69.65 ± 10.01	0.00	0.02	0.00	ns
Social functioning	58.75 ± 19.49	59.87 ± 15.35	48.13 ± 24.76	60.42 ± 16.18	53.13 ± 22.53	64.71 ± 12.68	0.02	0.01	0.00	ns
Vitality	47.50 ± 21.31	62.11 ± 15.84	40.50 ± 18.63	59.44 ± 11.87	45.00 ± 18.71	64.12 ± 12.65	0.02	0.19**	0.00	ns
General health	51.25 ± 18.70	58.95 ± 16.04	49.50 ± 18.84	60.83 ± 13.85	47.25 ± 19.57	58.53 ± 15.69	0.01	0.04	0.00	ns

There were not found pre-test differences between groups (Kruskal–Wallis test)

CON control, *MIA* mild-intensity aerobic exercise, *MoIA* moderate-intensity aerobic exerciser, *SF-36* Health quality life short form

$^*p < 0.05$; $^{**}p < 0.01$

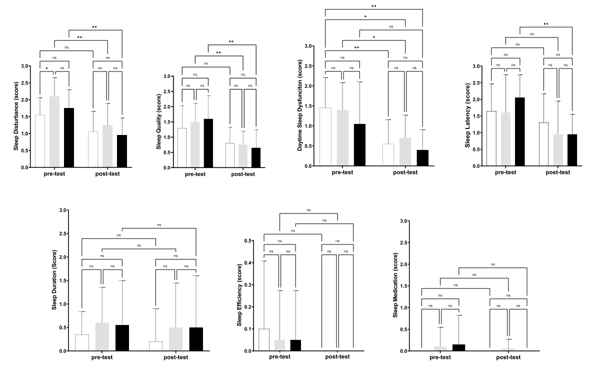

Fig. 3 Score changes of subdomains of the PSQI scale. The mild intensity aerobic exercise (MIA) showed greater pre-test sleep disturbance scores than control group (CON) ($p < 0.05$). Two-way repeated measure (ANOVA) showed a significant main effect of exercise for sleep disturbance ($p < 0.01$). There was also found a significant main effect of time for sleep quality, sleep latency, sleep disturbance, and daytime sleep dysfunction ($p < 0.01$, each). However, there was only seen a significant exercise × time interaction for sleep latency ($p < 0.05$). White column: control, gray column: mild-intensity activity group, black column: moderate-intensity activity group. $^*p < 0.05$, $^{**}p < 0.01$

yoga, and resistance exercises have all been studied [16]. Exercise training is described as "a chance to re-establish a sense of security surrounding powerful physiological sensations" [47, 48] and is seen as a coping method for managing cigarette cravings. Bernard et al. looked at the influence of exercise on the desire to start smoking again after 8 weeks (10 sessions), and found no difference [47]. However, in this study, the type of aerobic exercise was left up to the participants' own choices (swimming, walking, running, etc.). After 12 weeks, a specialized exercise program (mild to moderate progression/30 min) designed to help women with depression quit smoking lowered their willingness to start smoking again [49]. Due to disparities in exercise burden and methodology, progression in a single group, and gender differences, we were unable to compare our findings.

No long-term effects of exercise or activity therapies have been documented in studies evaluating withdrawal symptoms or the urge to relapse [47, 50–52]. Another study found that exercise significantly reduced the desire to restart smoking [53]. Usher et al. stated that exercise counseling could help with psychological factors in their study on the effect of exercise counseling (home program, 7 weeks/5 days/30 min) on the urge to start smoking again. They speculated that the decrease in cigarette dependence could be attributable to the psychogenic effects of exercise as a result of increased adrenocorticoid and opioid release [52]. It has been stated that a person who engages in active exercise during the smoking cessation period is less likely to repeat this undesirable behavior since continuing to smoke has a negative impact on him [53].

It is stated that smokers experience sleep problems such as difficulty falling asleep, falling asleep early, waking up early, and being sleepy throughout the day. It has been reported that people who smoke more than 40 cigarettes a day, defined as heavy smokers, have a higher risk of sleep disturbance [54]. In this regard, smoking negatively affects sleep quality [55]. It has been revealed that after the smoking cessation attempt, there is an increase in the number and duration of awakenings in smokers during abstinence periods. Such sleep disturbances tend to decrease over time, but may persist for several weeks and increase in severity [56]. Attempts to alleviate these symptoms with pharmacological agents have produced mixed results. The use of nicotine gum has had some success, but sleep problems have been exacerbated by transdermal patches due to nicotine absorption, often at night [57, 58]. In our study, nicotine replacement was not applied, and sleep quality improved in all our groups, and sleep disturbance was reduced more in our mildly severe group. However, while withdrawal from nicotine or cigarettes decreased more in our moderate-intensity aerobic exercise group, this was not reflected in sleep quality or impairment. Exercise is known to have several beneficial effects, such as ease of falling asleep, depth of sleep, and daytime alertness [59]. It has been reported that progressive aerobic exercise for 8 weeks significantly improves sleep quality [60]. The effects of exercise on the thermoregulatory system, sympathovagal balance, growth hormone, and BNDF increase sleep quality [61]. Regular aerobic exercise is thought to affect sleep quality as it causes a decrease in body temperature (heat dissipation by vasodilation), observed likewise during sleep, and an increase in recovery period [62]. Studies have shown that sympathetic activation decreases and parasympathetic activation increases during sleep [63]. Exercise improves vagal modulation, reducing sympathetic activity and affecting circadian rhythm [61]. Sympathetic activation of 2 months of vigorous aerobic exercises performed in sedentary individuals decreased, and autonomic adaptation was achieved. The same study showed the opposite result and increased sympathetic activity in extremely vigorous exercise [64]. The important thing here is the response to the appropriate dose; it can be said that the burden is better tolerated by these individuals at the point of why mild exercises reduce sleep disturbance better.

Cigarette smoking is said to produce additional symptoms such as depression, anxiety, and sleep disturbances, all of which lower a person's quality of life [65]. While the short- and medium-term impacts of nonsmokers, ex-smokers, and current smokers are comparable, the long-term consequences may differ [66]. In a research of 519 adults, Emamvirdi et al. discovered that nonsmokers had improved vitality, emotional well-being, social function, and overall health characteristics compared to smokers [67]. It has been discovered that when the amount of smoking increases, the quality of life score decreases [68]. While general health, vitality, and mental health have improved in those who have quit smoking, their emotional role has improved less [69]. Aerobic exercise, for example, is an element of smoking cessation therapies that may contribute to changes in quality of life [16]. Although the aerobic exercise in our study had no effect on psychosocial or physical well-being in the short term, we believe it will be crucial to follow up on the long-term outcomes.

Limitations

One of our study's limitations is the subjective evaluation of the parameters; if we could have utilized more objective methods (measurement of nicotine in saliva, measurement of carbon monoxide, etc.), we could have offered more information for our study. Furthermore, because the Beck Anxiety Scale only measures an individual's anxiety level for the previous week, and due to the many anxiety-related factors, the impact of our study on anxiety may be restricted. Another restriction is that, despite our best efforts, only male individuals participated in our study, with no female participants. The reason for this is presumed to be that men play a predominate sociocultural role in the area where our research is conducted, they smoke more than women, and women do not wish to exercise with men. The Fagerström Test for Nicotine Dependence was developed to examine nicotine addiction; however, because many of the questions are oriented towards smokers, it is not the best test for assessing addiction in those who have quit smoking. Due to the lack of a particular scale that assesses smoking relapse/nicotine dependence in people who have completely stopped smoking, we used the substance craving scale to assess this aspect. Researchers can develop a more precise and appropriate scale in this regard.

Conclusion

Smoking cessation may be aided by stating that smoking is not a normal activity and applying various ways to smoking in addition to medical techniques, such as exercise. The benefits of mild and moderate aerobic exercises on anxiety and quality of life are comparable. Mild aerobic exercise can be more effective in minimizing sleep disturbances, while moderate aerobic exercise may be more effective at reducing the desire to restart smoking. Long-term studies including high-intensity aerobic exercises should be conducted regarding this area.

Author contribution A.S: design of the study, literature search, data collection, manuscript writing. S.U: design of the study, data analysis, final approval, and drafting of manuscript.

Data availability Not applicable.

Code availability Not applicable.

Declarations

Ethics approval This study was approved by the Ethics Committee for Non-Invasive Research Studies of Hasan Kalyoncu University Faculty of Health Sciences (approval number 2020/098).

Ethical publication statement All authors confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

Consent for publication All authors consent to the publication of the manuscript and are aware of its submission.

Conflict of interest The authors declare no competing interests.

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