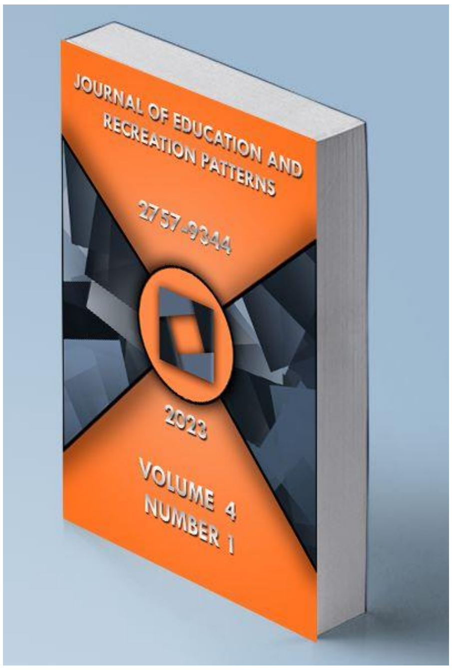

Journal of Education and Recreation Patterns (JERP)

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The Effect of Deviced Respiratory Muscle Exercises Applied to Smokers and Non-Smokers on Respiratory Functions

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ABSTRACT

Cigarette addiction, which is very closely related to the onset of respiratory disorders, causes the deterioration of respiratory functions. It is possible to increase respiratory volume and capacity by strengthening the respiratory muscles through respiratory muscle exercises. In this study, it was aimed to compare the effects of 8-week deviced respiratory muscle exercises on the respiratory functions of smokers and non-smokers. A total of 22 volunteers, including 12 healthy and sedentary smokers and 10 non-smokers, participated in the study. All participants were given deviced respiratory muscle exercises every day for 8 weeks, with 40% of the maximal inspiratory pressure (MIP) values and 30 times in the morning and evening. The respiratory functions of the participants (FVC, FEV_1, PEF, and FEV_1/FVC) were determined by spirometry at the beginning of the study and at the end of the 8^{th} week. The difference between the pretest and the posttest of respiratory functions was determined by the Wilcoxon signed rank test, and the comparison of the level of development between the groups was determined by the mixed ANOVA test. As a result of the study, it was determined that there was a statistically significant increase in favor of the posttest in both groups between the pretests and posttests of MIP, FVC, FEV_1, PEF, and FEV_1/FVC values. In addition, when the two groups were compared, it was determined that the improvement in FEV_1/FVC value was statistically higher in smokers. As a result, while it has been determined that deviced respiratory muscle exercises are an important factor in improving the respiratory functions of smokers and non-smokers, it can be recommended to use these exercises to increase the quality of life of individuals and to protect and improve their current health status.

Keywords: Lung Capacity, Respiratory Muscle Exercise, Sedentary, Smoking

INTRODUCTION

Since the lungs, which are the main organs of the respiratory system, are passive at the point of movement, they can only move thanks to the respiratory muscles (Aung et al., 2019; Shin et al., 2017). The main respiratory mechanisms in the respiratory system are the diaphragm and the muscles between the ribs (Tu et al., 2013). The main task of this system is to maintain the oxygen level in arterial blood by the exchange of oxygen (O2) and carbon dioxide (CO2) gases (Braman, 1995). In order for the amount of inhaled O2 to be more efficient, these muscles that help breathing must be strong (Santos et al., 2012). A deterioration in the respiratory muscles reduces the respiratory capacity and negatively affects daily work by preventing the transport of oxygen (De Troyer, 2012; McConnell, 2013; Tiller et al., 2019). For this reason, respiratory capacities both affect the quality of life and are accepted as an important indicator of physical fitness (Schunemann et al., 2000; Verges, et al., 2009).

Cigarette addiction, which is very closely related to the onset of respiratory disorders, causes deterioration of respiratory functions (Kim et al., 2012). In addition, according to the World Health Organization, smoking addiction increases the risk of lung diseases and plays a role in the development of many diseases (WHO, 2011). Cigarette addiction, which threatens health, doubles O2 consumption during movement. The red blood cells of smokers undergo 10% degeneration and cause a decrease in the amount of oxygen taken into the lungs. This causes lactic acid to accumulate more quickly in the blood, causing smokers to get tired more quickly. As a result, the heart has to carry more blood to the tissues and increases blood pressure (John, 1993; McMurray et al., 1985). Regardless of whether active or passive, smoking causes important problems such as stiffness in the veins, decrease in ventilation of alveoli, deterioration in diffusion capacity, increase in airway resistance and decrease in oxygen carrying capacity of blood. In addition, smoking-related cardiovascular problems and respiratory system problems cause a decrease in the muscle strength of individuals. While all these problems prevent individuals from doing their daily work, they also reduce their physical activity levels and reduce their quality of life (Rallidis & Anastasiou-Nana, 2011; McConnell, 2011; Ünver, 2022).

The decrease in respiratory functions can be eliminated with respiratory muscle exercises aimed at improving the respiratory muscles. Respiratory muscle exercises used in respiratory rehabilitation are based on reducing shortness of breath by increasing respiratory functions (Culver et al., 2017). The most commonly used methods in respiratory muscle exercises are stated as diaphragmatic (abdominal breathing) respiratory muscle exercise, pursed lip respiratory muscle exercise and deviced respiratory muscle exercise (Aktuğ et al., 2022a; Aktuğ et al., 2022b; Sukatan et al., 2022). While respiratory muscle exercises that contribute to the development of respiratory functions improve respiratory strength, this also increases healthy quality of life and physical fitness (Özdal & Bostancı, 2018; Özdal et al., 2016; HajGhanbari et al., 2013; Illi et al., 2012).

Respiratory muscles are structurally and functionally similar to skeletal muscles and therefore respond to the applied exercise load like skeletal muscles (Kraemer et al., 2002). The improvement in the strength of the diaphragm, which is the most important of the respiratory muscles, affects the respiratory functions positively (Weiner et al., 2003). Exercises to develop respiratory muscles were initially used for treatment in people suffering from asthma, chronic obstructive pulmonary disease (COPD) and airflow limitation (Beckerman et al., 2005; Weiner et al., 2004). Recently, it has been seen that it has been used to increase sportive performance and quality of life in sedentary and athletic individuals (McCarthy et al., 2015; Bostancı et al., 2019). In addition, there are studies that determine that respiratory muscle exercises improve respiratory functions in smokers (Roh et al., 2012; Kim & Lee, 2012; Bostanci et al., 2019). In a study conducted on this subject, 34 healthy individuals who smoke and do not smoke were given respiratory muscle exercise 3 times a week for 6 weeks, and it was determined that the FVC values of the smoking group increased as a result of the study (Roh et al., 2012). In another study, participants who were divided into two groups as smokers and non-smokers were given deviced respiratory muscle exercise every day of the week for 4 weeks. As a result, it was determined that the respiratory functions and respiratory muscle strength of smokers improved significantly (Bostanci et al., 2019).

In the light of this information, the aim of the study is to compare the effects of deviced respiratory muscle exercises applied for 8 weeks on the respiratory functions of smokers and non-smokers. The hypothesis of the study is that respiratory muscle exercises applied to smokers provide a higher improvement in respiratory functions than non-smokers.

METHOD

Ethics Committee Approval

For the research, ethics committee approval was obtained with the decision number E-95860085-050.02.04-329736 and dated 2022 from Niğde Ömer Halisdemir University Non-Interventional Clinical Research Ethics Committee. This study was conducted in accordance with the Principles of the Declaration of Helsinki.

Research Design

In this study, since it was aimed to determine whether the respiratory muscle exercises applied for 8 weeks were effective on respiratory functions in smokers and non-smokers, it was carried out according to the pretest-posttest design with control experimental group from quantitative research designs

Research Group

The population of the study consists of people between the ages of 30-45, who do not have any acute or chronic pulmonary and cardiovascular disease, and who have undergone health check-ups. The sample, on the other hand, consisted of 22 people selected from this population, including smokers (n:12) and non-smokers (n:10). For this reason, the sample was determined according to the simple random sampling method, which is one of the probability-based sampling methods.

Table 1. Demographic Information of the Participants

	Smokers	**Non Smokers**
Age (years)	38.42±8.56	33.10±6.70
Height (cm)	173.42±8.61	162.80±6.42
Body weight (kg)	78.25±14.94	67.40±19.60
Cigarette count (per day)	18.25±11.06	

Experimental Procedure

Participants were divided into two groups, smokers and non-smokers. Firstly, pulmonary function tests were performed by spirometry and then MIP measurements were made in both groups. The pressure ranges that the participants used in deviced respiratory muscle exercises were calculated according to the MIP measurement results, and the pressures that were different for each of the participants were adjusted to the respiratory muscle exercise equipment according to these values. Participants in both groups practiced deviced respiratory muscle exercise every day of the week for 8 weeks. Both pulmonary function tests and MIP measurements were repeated twice, at the beginning of the study and after 8 weeks of exercises, while the participant was at rest for at least 5 minutes. Both initial and post-test measurements were made at the same time of day, under the same physical conditions and in the same order. In the measurements, each participant was given a special bacterial filter mouthpiece.

Applied Tests and Exercises

Deviced Respiratory Muscle Exercise

Participants performed the respiratory muscle exercises with the plus (blue) model of the powerbreathe brand (Powerbreathe Plus, UK) respiratory muscle exerciser, which has a load adjustment range of 23-196 cmH_2O and whose pressure can be adjusted mechanically. Respiratory muscle exercises were applied twice, 30 times in the morning and 30 in the evening, every day of the week for 8 weeks and lasted approximately 8-10 minutes. All participants were shown the deviced respirotary muscle exercise, and after it was seen that the participants did the exercise correctly, the study began.

Maximal Inspiratory Pressure (MIP) Measurement and Pulmonary Function Test

Before starting the deviced respiratory muscle exercise, the participants' age, height, weight and gender information were entered into the K5 respirotary exercise machine (Powerbreathe inspiratory muscle trainer, Ironman K5, HaB Ltd., UK). and 30 ventilations were performed with this deviced. This measurement was applied twice and the best value was recorded in cmH_2O and included in the study. Personalized exercise load was adjusted with 40% of the MIP determined in deviced respiratory muscle exercises and applied with the powerbreathe deviced.

Pulmonary Function Test

The respiratory functions of the participants were measured with the MIR brand Spirolab Model spirometer deviced. Forced vital capacity (FVC-lt), forced expiratory volume in the first second (FEV_1-lt), peak expiratory flow rate (PEF-lt/sec), and FEV_1/FVC% were taken from the participants. In order to obtain accurate results during the measurements, respiratory functions were applied in a comfortable sitting position by attaching clips to the nose parts.

Statistical Analysis

SPSS 24 program was used in the analysis of the data. The difference between the pretest and posttest of respiratory functions was determined by Wilcoxon Signed Ranks Test. The effects of respiratory exercises on the dependent variable from each test point were tested with the mixed ANOVA test. The effect size was analyzed according to Cohen's d. The effect size of Cohen's d was classified as 0-0.2 insignificant effects, 0.2-0.5 minor effects, 0.5-0.8 medium effects, and >0.8 major effects. In the study, the level of significance was accepted as $p<0.05$.

FINDINGS

Table 2 compares the effects of 8-week respiratory muscle exercises on respiratory functions in smokers and non-smokers. In addition, it was examined in which group respiratory muscle exercises provided a higher improvement in respiratory functions.

Table 2. Comparison of Respiratory Functions within and between Groups

		Smokers			Non Smokers			
		X̄±Sd	p	Cohen's d	X̄±Sd	p	Cohen's d	Mixed Anova
MIP (cmH_2O)	Pre-test	77.12±22.03	0.002	0.64	62.79±14.01	0.005	1.24	0.778
	Post-test	91.18±21.47			78.00±10.03			
FVC (lt)	Pre-test	3.64±0.57	0.002	1.56	3.63±0.43	0.005	2.26	0.729
	Post-test	4.54±0.58			4.50±0.33			
FEV_1 (lt/sn)	Pre-test	3.27±0.60	0.002	1.25	3.20±0.30	0.005	2.81	0.913
	Post-test	3.99±0.55			3.94±0.22			
FEV_1/FVC (%)	Pre-test	81.26±1.88	0002	1.78	84.28±1.57	0.005	1.42	0.040
	Post-test	84.75±2.03			86.56±1.63			
PEF (lt/sn)	Pre-test	7.33±0.75	0.002	1.13	6.83±0.62	0.005	1.85	0.541
	Post-test	8.28±0.92			7.86±0.48			

*p<0,05

When Table 2 is examined, it was determined that there was a statistically significant increase in favor of the posttest in both groups between the pretests and posttests of MIP, FVC, FEV_1, PEF, FEV_1/FVC values. When the two groups were compared, it was determined that the improvement in FEV_1/FVC value in smokers was significantly higher. In addition, it was determined that respiratory muscle exercise had a great effect on respiratory parameters in both groups according to Cohen's d, and this effect was higher in non-smokers.

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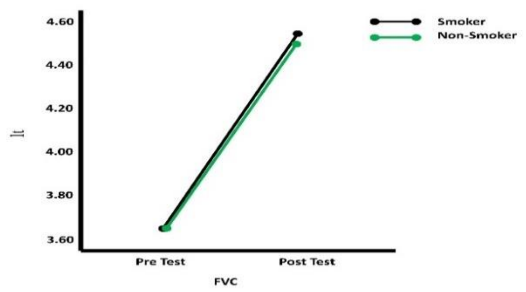

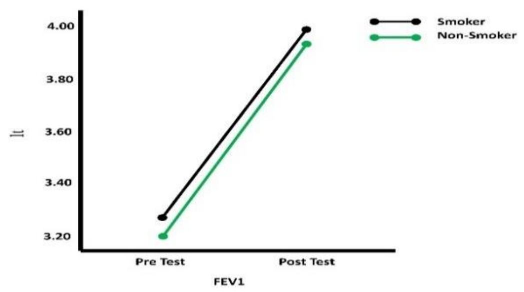

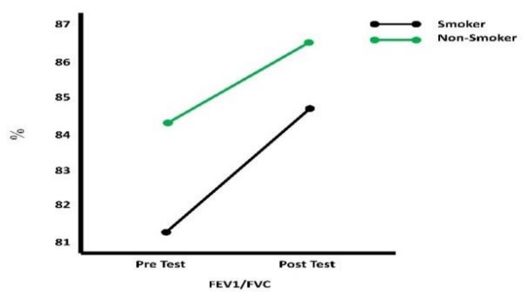

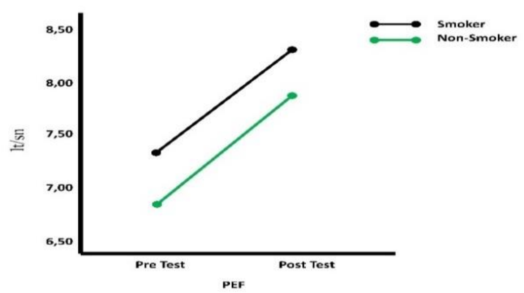

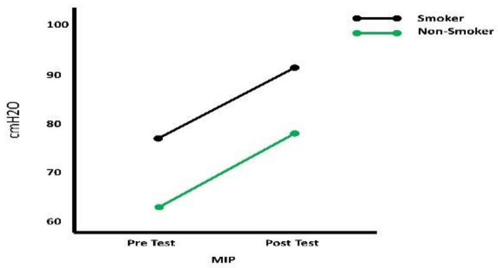

Figure 1. Comparison of Respiratory Functions between Groups

DISCUSSION

Smoking reduces the ability of the lungs to work and this is due to various substances found in cigarette smoke (Dalack et al., 1993). Carbon monoxide (CO), one of these substances, is 200 times more interested in hemoglobin than oxygen. Thus, CO reduces the oxygen carrying capacity of hemoglobin and decreases the oxygen concentration reaching the tissues (Krupski, 1991). Smoking reduces cardiopulmonary function (Baydur et al., 2001), reduces respiratory functions and lung function (Guyton, 1986). For this reason, the most important harmful effects of smoking are cardiopulmonary, asthma and neuromuscular diseases (Santos, 2012). Mustafaoglu et al. (2022) included 54 smokers, 65 non-smokers, and 183 substance abusers in a study and evaluated the respiratory functions, respiratory muscle strength and functional capacities of the participants. As a result of the study, it was determined that the parameters of FVC, FEV1, FEV1/FVC, PEF and FEF25-75 were lower in smokers compared to non-smokers. In addition, MIP and maximal expiratory pressure (MEP) values, which show respiratory muscle strength, were found to be lower in smokers than in non-smokers (Mustafaoğlu et al., 2022).

It is known that respiratory muscle exercises have a positive effect in improving respiratory muscle strength and respiratory functions (Weiner et al., 1999). Like skeletal muscles, the strength and endurance of respiratory muscles can be increased (Pardy, Reid & Belman, 1988). Respiratory muscle exercises are an exercise method that applies a significant load to the inspiratory muscles and strengthens the respiratory muscles (Silva et al., 2013). Due to the strength-increasing effect of respiratory muscle exercises on the inspiratory muscle, they reduce the perception of dyspnea as a result of the decrease in inspiratory muscle strength in individuals with cardiopulmonary disease and provides an increase in exercise capacity (Hill et al., 2010). When the literature is examined, it is seen that there is a lot of research on the harmful effects of smoking on lung functions in sick individuals, while studies on how respiratory muscle exercise can improve lung functions in normal smokers are limited (Lee et al., 2011; Kim & Lee, 2012). The aim of this study, which was carried out with these considerations, is to compare the effects of deviced respiratory muscle exercises applied for 8 weeks on the respiratory functions of smokers and non-smokers. As a result of our study, it was determined that there was a significant increase in favor of the posttest in both groups between the pretests and posttests of MIP, FVC, FEV1, PEF, FEV1/FVC values (table2). According to these results, the most striking finding was that the improvement in FEV1/FVC value in smokers was significantly higher when the two groups were compared. The close relationship between smoking and respiratory dysfunction is widely accepted in studies (Roh et al., 2012). Respiratory muscle exercises are known to provide benefits to reduce respiratory dysfunction. In a similar study conducted for this purpose, it was aimed to compare the effects of respiratory muscle exercises on PEF and respiratory muscle strength in smokers and non-smokers. Respiratory muscle exercise was applied to the participants twice a week for 5 weeks, and as a result, it was determined that both groups' PEF and respiratory muscle strength increased (Lee et al., 2011). Another study examined whether 8 weeks of balloon blowing exercise improved lung function in 30 young healthy smokers. As a result of the study, it was stated that balloon blowing exercise significantly improved VC, ERV, IRV, FVC, FEV1, FEV1/FVC, PEF parameters (Kim & Lee, 2012). On the other hand, Bostanci et al. (2019) examined the effects of 4-week respiratory muscle exercises on respiratory function and respiratory muscle strength in both healthy smokers and non-smokers. As a result of the study, it was determined that MIP, MEP, FEV1, FVC, FEV1/FVC%, MVV, SVC and IC respiratory functions improved in smokers. On the other hand, Bostanci et al. (2019) argued that the increased lung volumes as a result of the study were due to the strong neck muscle and the relationship between the upper thorax and the inspiratory muscle (Tenório et al., 2013). Therefore, it was thought that the improvement in respiratory functions was related to the increase in inspiratory muscle strength (Bostancı et al., 2019).

Since the effects of smoking on the respiratory tract occur in a long time and in direct proportion to the pack-year, young or low-intensity smokers can have asymptomatic and normal respiratory function values. As a matter of fact, there are studies reporting that early changes in small airways cannot be detected by respiratory function and that different methods should be used (Ceylan et al., 2006; Lee et al., 2000). In one study, the FVC, FEV1, FEV1/FVC, PEF and FEF25-75 values obtained in asymptomatic smokers did not differ significantly compared to non-smokers, but the lung carbon monoxide diffusing capacity (DLCO) and alveolar volume-corrected DLCO (DLCO/VA) values were significantly lower. (Ceylan et al., 2006). Tanaka et al. (2003) reported that the prevalence of asymptomatic people with normal pulmonary function values is high among smokers and that they can be detected by evaluating the widths of air-entrained areas on computed tomography images (Tanaka et al., 2003).

CONCLUSION

In our study, it was determined that 8 weeks of deviced respiratory muscle exercise significantly improved respiratory muscle strength and respiratory functions in both smokers and non-smokers. Considering that the deterioration in respiratory functions of smokers over time is higher than non-smokers, it is recommended that especially smokers should practice respiratory muscle exercises to protect their respiratory functions and strength of respiratory muscles. Additionally, could suggest that respiratory muscle exercises should be included in smoking cessation programs to prevent respiratory dysfunction.

Limitations of the Research

Since this study investigated the effect of deviced respiratory muscle exercises in smokers and nonsmokers, the control group was not included in the study. At the same time, FVC, FEV_1, FEV_1/FVC and PEF were examined in respiratory function parameters and other parameters (MVV, IC, VC, FEF25-75 etc.)

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