J Int Acad Phys Ther Res 2018; 9(4): 1596~1601
ISSN 2092-8475

www.iaptr.org
https://doi.org/10.20540/JIAPTR.2018.9.4.1596

A Comparative Study on the Pulmonary Function between Smoking Soldier and Non-smoking Soldier

Smoking can be a significant cause of lung diseases and reduced respiratory functions. Among soldiers, smoking may have a negative impact on their health (physical strength) and well being. Information on differences in the respiratory functions of smokers and nonsmokers in the military services and the effects of the smoking duration and amount (i.e., the number of cigarettes smoked per day) would be useful. This study investigated smoking durations and smoking amounts among young male soldiers (N = 61). The forced vital capacity (FVC), forced expiratory volume in 1 sec (FEV1), and forced expiratory volume in 1 sec/forced vital capacities (FEV1/FEC) were measured FVC, FEV1, or FEV1/FEC of smokers and nonsmokers were not significantly different, and FVC and FEV1 were inversely proportional to smoking duration. Besides, the number of cigarettes smoked per day was not correlated with respiratory functions. These findings may be attributed to the effect of the strenuous physical activity (e.g., military drills) undertaken by soldiers on their respiratory functions. Despite the lack of evidence for a difference in the respiratory functions of smokers and nonsmokers, this study recommends ongoing respiratory function management through smoking cessation programs and respiratory physiotherapy to manage the respiratory functions of Korean smoking soldiers.

Key words: *FEV1, FVC, FEV1/FVC, Non-smoking soldier, Smoking soldier*

Joong San Wang, Ph.D[a], Prof., Myoung jin Choi, Ph.D[a], Prof.

Howon University, Gunsan, Republic of Korea

Received : 08 November 2018
Revised : 29 November 2018
Accepted : 03 December 2018

Address for correspondence
Myoung jin Choi, Ph.D
Department of Defense Science & Technology, Howon University, 64, Howondae 3-gil, Impi-myeon, Gunsan-si, Jeollabuk-do, Republic of Korea
Tel: 82-10-5096-6499,
Email : officesky@howon.ac.kr

INTRODUCTION

Respiratory diseases are common among soldiers serving under difficult environmental (e.g., sanitary) and climatic conditions [1]. Although smoking rates in the military services have been reduced in the Republic of Korea [2], they need to be reduced still further, given the physical and mental health problems linked to smoking. For example, previous research found a correlation between smoking onset and negativeadverse effects, such as the development of depression [3] and respiratory system diseases, culminating in chronic obstructive pulmonary diseases [4]. Research has also demonstrated the association of smoking with other diseases, such as cardiovascular diseases and lung cancer [5].

Previous studies on smoking among soldiers have focused mainly on the correlation between oral health status and smoking status [6], as well as smoking cessation programs [7]. A limitation of most previous smoking-related studies was that they did not quantify respiratory function, as they employed structured questionnaires. Soldiers in Korea undergo intensive military training in testing environments (e.g., the presence of fine yellow dust) and varying climatic conditions, with exposure to wide-ranging temperatures and precipitation levels. Soldiers who smoke may experience a reduction in respiratory function under these conditions. Respiratory function is a importantvital health index, which is widely utilized for health management in various diagnoses, such as neurological diseases [8], respiratory diseases [9], and athlete care [10, 11]. Many previous studies reported that health problems among military personnel differed from those of civilians because of the specific military

environment [12-14]. The same studies also found that health-related behaviors, such as smoking and physical activity levels of soldiers differed from those of civilians.

Smoking is one of the most common risk factors for decreased respiratory function, with the forced vital capacity (FVC), forced expiratory volume in 1 sec (FEV1), and forced expiratory volume in 1 sec/forced vital capacity (FEV1/FVC) decreased in smokers [15]. Given the impact of smoking on respiratory functions and motor ability, information on differences in the respiratory functions of smokers versus nonsmokers among soldiers could be useful in terms of improving combat competence and the health status of soldiers. Thus, the present study compared differences in the respiratory functions of young soldiers (smokers and nonsmokers) and analyzed potential factors affecting the respiratory functions of soldiers who smoked to provide foundational data on respiratory health management of these soldiers.

SUBJECTS AND METHODS

Subjects

We This study was conducted with 61 male soldiers in their 20s who served in two armed divisions located in Honam Province in rRepublic of Korea from October 2017 to June 2018. The smoking soldier werewas divided into a smoking and nonsmoking group by surveying their smoking status, smoking periods, and daily smoking amounts. Subjects who had smoked but had stopped and those who were taking respiratory or endocrine drugs or had respiratory diseases were excluded. In addition Also, subjects with any ailments, such as a cold, that could affect respiratory functions were excluded.

All the subjects were fully informed of the purpose and intention of the study after receiving permission from their commanding officers, and all provided voluntary consent to participate in the study. The general characteristics of the participants are presented in Table 1.

Table 1. General characteristics of the subjects

Characteristics		Smoking soldier (N, %)	Non-smoking soldier (N, %)	t	p
Age (months)		22.03±0.91	21.66±0.79	1.745	.086
Weight (Kg)		70.34±9.10	71.94±9.41	-.670	.505
Height (m)		174.69±4.66	174.47±5.12	.175	.861
Duty period of soldiers (months)		11.45±5.86	9.38±5.47	1.395	.168
Smoking period (month)	1 to 6	2(6.9)	0(0.0)	-	-
	7 to 12	2(6.9)	0(0.0)	-	-
	13 to 24	4(13.8)	0(0.0)	-	-
	25 to 36	0(0.0)	0(0.0)	-	-
	More than 37	21(72.4)	0(0.0)	-	-
	Total	29(100.0)	32(100.0)	-	-
Number of cigarette (/day)	0	0(0.0)	0(0.0)	-	-
	Less than 5	5(17.8)	0(0.0)	-	-
	6 to 10	12(42.9)	0(0.0)	-	-
	11 to 20	11(39.3)	0(0.0)	-	-
	More than 21	0(0.0)	0(0.0)	-	-
	Total	29(100.0)	32(100.0)		

Values are Mean±Standard Deviation, *p<.05

Measurement Methods

The study was performed in conjunction with the cooperation of the commanders of the armed units. There was no pressure to the chest or abdomen prior to before the measurement of lung functions. All the subjects were instructed not to smoke, drink, or exercise before the measurements. The FVC, FEV1, and FEV1/FVC were measured using the Fitmate MED (COSMED, Italy) system. Prior education before the measurements was conducted by the same physiotherapist. The same physiotherapist conducted prior education before the measurements.

The respiratory measurement method was explained before the measurements, and the subjects were familiarized with the examination method through three successive practice sessions. During the measurements, the subjects adopted an upright sitting posture, gazing forward. All the subjects wore nose plugs prior to before the measurements to prevent the necessarypermanent breathing loss during the measurements and bit the mouthpiece with their lips [9]. To ensure good hygienic practice and prevent any possible contamination, each mouthpiece was disposable. To measure lung function, each soldier took a breath for a while during a rest period according to the researcher's instruction and then executed maximum inspiration, followed by forced expiration. The researcher encouraged the subjects to breathe normally during the measurements.

Data analysis

All the data obtained in this study were statistically processed using a statistical program (SPSS 21.0/PC, USA), and means and standard deviations were calculated, utilizing descriptive statistics for the general characteristics of the subjects. The difference in the respiratory functions of the smoking and nonsmoking soldiers was determined using an independent t-test. In addition, among the smokers, Pearson's correlation analysis was conducted to analyze the correlation of the respiratory functions with the duty period of the soldier, smoking duration, and daily smoking amount. The statistical significance level for all data was set to $\alpha = .05$.

RESULTS

Comparison of pulmonary functions between smoking soldier and non-smoking soldier

There was no statistically significant difference in the FVC, FEV1, or FEV1/FVC between the smokers and nonsmokers〈Table 2〉.

Table 2. Comparison of pulmonary functions between smoking soldier and non-smoking soldier

Variable	Smoking soldier	Non-smoking soldier	t	p
FVC(ℓ)	4.68±0.59	4.60±0.65	.503	.617
FEV1(ℓ)	3.91±0.52	3.91±0.53	-.023	.982
FEV1/FVC(%)	83.38±5.81	83.47±8.10	-.049	.961

Values are Mean±Standard Deviation, *p<.05
FVC: forced vital capaity, FEV1: forced expiratory volume in 1 second

Table 3. Correlation between of general characteristics and pulmonary functions in smoking soldier

Variable	Duty period of soldiers (months)	Smoking period (yr)	Number of cigarette(/day)
FVC(ℓ)	.150(.437)	-.046(.812)	.159(.409)
FEV1(ℓ)	.326(.085)	-.072(.709)	.218(.256)
FEV1/FVC(%)	.408(.028)	.032(.869)	.236(.218)

r(p), *p<.05

Correlation between of general characteristics and pulmonary functions in smoking soldier

Although the FVC and FEV1 of the smokers decreased in accordance with following an increase in the smoking duration, which exhibited a negative correlation between FVC and FEV1 and smoking duration, the result was not statistically significant. The duty period of the soldier and daily smoking amount showed no significant correlation with the FVC, FEV1, or FEV1/FVC〈Table 3〉.

DISCUSSION

Smokers are characterized by lower FEV1 and FVC than those of nonsmokers [16]. However, we study on young soldiers found no significant difference in the respiratory functions of smokers versus those of nonsmokers. This result can be attributed to the age and physical activity level of the study population. For male soldiers in their 20s, respiratory muscle exercises improve lung functions [17], and aerobic exercises increase their FEV1 and FEV1/FVC [18]. Soldiers undertake a range of physical activities, such as running and sports, aimed at enhancing their physical strength. Thus, they represent a special particular group. Both were walking and jogging influence FEV1, FVC, and FEV1/FVC%, whereas physical activities increase FEV1 and FVC [19]. Due to the high level of varied physical activities and ongoing training in this military environment, there were no significant differences in the FVC, FEV1, and FEV1/FVC of the smokers versus the nonsmokers.

In a previous study on athletes, there was no significant difference in the respiratory exchange rate of smokers and nonsmokers at rest or at maximum exercise [20]. There was also no difference in the recovery times of the smokers versus nonsmokers, although the maximum exercise time was longer in the nonsmoking athletes than in the athletes who smoked [20]. Based on the literature, the maximum exercise time of soldiers who smoked would be expected to be shorter than that of nonsmoking soldiers.

Previous research reported that an increase in physical activities and smoking cessation led to improvements in cardiorespiratory fitness and respiratory functions [19]. In a long-term follow-up study of male smokers, Anthonisen et al. [15] found a reduction rate in the FEV1 of 66.1 ml annually (FEV1 rate of decline of 66.1 ml/year) over 11 consecutive years. In contrast, among those who stopped smoking at the start of the 11-year study, the reduction rate in the FEV1 was 30.2 ml/year, resulting in a significant difference in the FEV1 value of the smokers versus the non-smokers.

The present study found no significant difference in the respiratory functions of soldiers who smoked versus those who did not smoke. Nevertheless, smoking cessation is advisable for long-term health management. As shown in previous studies, for never-smokers, in terms of concerning lung function, the physical exercise showed a positive dose-response with FVC and FEV1 [10]. For smokers, the FVC and FEV1 declined as the daily smoking amount (the number of cigarettes smoked per day) increased [16]. In the present study, the FVC and FEV1 of the soldiers who smoked showed an inverse association with the smoking duration, although this finding was not statistically significant. In addition Besides, the FVC and FEV1 increased in accordance with following an increase in the number of cigarettes smoked per day in contrast to that found in a previous study. The smoking duration influenced the FEV1, with long-term smoking reducing the FEV1. The reduction in the FEV1 increases in conjunction with a higher smoking rate, as well as the number of cigarettes per day to very low deficient amounts, had smaller declines in the FEV1 as compared to that of those whose smoking amount was not changed significantly [21].

The fact that smoking is an important a significant risk factor for a reduction in the FEV1 [22] should encourage smoking cessation. Given the risk of long-term smoking reducing respiratory function [15], proactive strategies targeting smoking cessation among soldiers are needed. The presence of a roommate who smokes or a role model (e.g., a commanding officer in the military) may increase new-onset smoking among newly enlisted military personnel [23]. As a measure to manage nonsmokers and encourage smoking cessation among soldiers, it is recommended that identifying smoking status of newly enlisted military personnel and improving military service environments by managers in the army forces will be helpful to reduce the smoking rate in the armed forces positively. If the current respiratory disease is soldiers, the treatment of the respiratory system and physical therapy of respiratory system for respiratory function improvements also needed to be considered.

The combat power of soldiers varies depending on striking power, defense defensive ability, tactical understanding, and the commander's leadership, and amounts of physical activity differ, depending on the soldier's own branch of the military service. Thus, the

findings of the present study cannot be extrapolated to all combat soldiers in all armed forces. In addition Also, as this study was conducted with only male soldiers, the results cannot be generalized to all female soldiers. An additional limitation is that the study did not propose an alternative to improve respiratory functions as a cross-sectional study.

CONCLUSION

In conclusion, the results of this study revealed no significant difference in the respiratory functions of soldiers who smoked versus those who did not smoke. Nevertheless, smoking cessation programs and respiratory physiotherapy are recommended for improving the respiratory functions and long-term health of soldiers.

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