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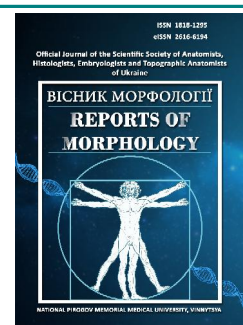
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Peculiarities of indicators of the respiratory system in women at rest and their changes during the burning of the next cigarette

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One of the important problems facing modern society is the increase in the number of people with various types of addictions, the most common of which is smoking. Smoking and its medical-demographic and economic consequences are in the circle of scientific interests of many domestic and foreign scientists. That is why the aim of the scientific article is to study the peculiarities of the state of the respiratory system in women at rest and during the burning of another cigarette. The study was conducted in the Laboratory of Medical and Biological Monitoring and Public Health at the Department of Human and Animal Physiology, Faculty of Biology and Forestry, Lesya Ukrainka Volyn National University for 60 women aged 17-21. At the first stage of the study, absolute anthropometric indicators were measured, such as height, weight, chest circumference. In the second stage women were interviewed on the Fagerström test. According to its results, the study is divided into 3 groups: Group I - women who have a history of smoking more than 3 years, burn more than 10 cigarettes per day and have a high level of dependence, Group II - women who have a history of smoking 1-3 years, up to 10 cigarettes are smoked per day and have a low and medium level of dependence, Group III - (control) women who do not smoke. The next stage of the study involved a functional diagnosis of the external respiratory system in women at rest and 15 minutes after smoking a cigarette using the functional method of pneumotachography (PTG). Registration and analysis of relevant indicators was carried out using a diagnostic automated complex "Cardio+". Statistical data processing was performed using generally accepted methods of variation statistics (because the distribution of the results was normal) using MS Excel 2007 software. This article presents a study of the state of external respiration at rest and 15 minutes after burning another cigarette, which revealed the negative effects of smoking on the respiratory system of women who smoke. The study made it possible to make a detailed analysis of indicators of respiratory function in women aged 17-21 years, smokers and compare them with non-smokers. Based on the obtained results, it was found that in women smokers (groups I and II) there is a significant decrease in volume (FVC, VC, FEV1) indicators of external respiration, as well as the Tiffeneau-Pinelli test at $p < 0.05$, compared with the group of women control group both at rest and 15 minutes after firing the next cigarette. Analysis of velocity (MEF at the level of exhalation 25 %, 50 %, 75 %, PEF) of airflow through the bronchi to the lungs indicates a gradual decrease from MEF 25 % to MEF 75 % in women of the experimental groups, but a significant decrease is observed only at the level of sight of 75 % in 15 min after burning of the next cigarette between I and III groups (at $p < 0.05$). A statistically significant difference between the values of the calculated Tiffeneau-Pinelli index, which characterizes the presence of obstructive respiratory failure, in women of groups II and III both at rest and 15 minutes after burning another cigarette. Thus, a decrease in these indicators indicates the presence of bronchial obstruction of the middle and small bronchi, as well as a violation of respiratory muscle strength and bronchial patency. It has also been shown that the reactivity (reduction) of volumetric and velocity indicators of external respiration to cigarette burning was higher in the group of women who do not smoke (control).

Keywords: smoking, women-smokers, external respiration, cigarettes, reactivity.

Introduction

Smoking is one of the most urgent problems of our time, especially young girls and women increasingly become addicted to smoking, which is characterized by a negative impact on their somatic and mental health [5, 8, 9, 11]. Today, there are many preventive types of smoking that can be used to get rid of this bad habit, one of them is social advertising, but it is only gaining its relevance [1, 5, 10, 15, 16].

According to scientific research [10], the age of the first attempt to smoke falls on 12-13 years, which is an unfavorable prognostic sign, on the one hand, from the point of view of the formation of children's health, and on the other hand, an increase in the smoking frequency of persons of working age in the future. In particular, the tobacco industry uses various manipulative tools to attract young people to smoking [6, 9]. One of the many techniques is the use of colorful logos on cigarette packs, which further encourage the purchase [2, 14, 23, 25].

Since today's teenagers are poorly informed about the impact of tobacco smoking on all organs and systems of our body [12, 13, 16, 19], there is a need for a theoretical and empirical study of the peculiarities of the state of respiratory system indicators at rest and during the smoking of the next cigarette, which on today's time is quite relevant.

The purpose of the work is to study the peculiarities of the condition of the respiratory system indicators in women at rest and during the smoking of the next cigarette.

Materials and methods

The study was conducted in the laboratory of medical and biological monitoring and public health at the Department of Human and Animal Physiology, Faculty of Biology and Forestry, Lesya Ukrainka Volyn National University. The study used a functional research method - pneumotachography and a method of statistical analysis of experimental data. Compliance of the research procedure with the legislation of Ukraine on health protection and the Declaration of Helsinki 2000, the directive of the European Society 86/609 regarding the participation of people in medical and biological research was confirmed by the commission on bioethics of the Faculty of Biology and Forestry of Volyn National University named after Lesya Ukrainka (protocol № 1 from 21.10.2016). All subjects were familiarized with the conditions of the examination and before the start of work gave written voluntary consent to participate in the study.

According to the outpatient cards, all women belonged to the group of practically healthy people. The studied women smoked Winston street light (light) cigarettes. There are 10 packs of cigarettes in the block. There are 20 pieces in a pack. The length of each cigarette is 8 cm. The nicotine content is 0.5 mg, tar - 0.6 mg. The filter is normal. 60 women aged 17-21 took part in the study, who were interviewed according to the Fagerström test. According to its results, the following groups were distinguished: Group I - women who have smoked for more than 3 years, smoke more than

10 cigarettes per day and have a high level of addiction (20 people), Group II - women who have smoked for 1-3 years, smoke up to 10 cigarettes per day and have a low and medium level of addiction (20 people), III group - (control) women who do not smoke (20 people).

To write the work, such indicators of pneumotachography as forced vital capacity (FVC, l), vital capacity (VC, l), forced expiratory volume in 1 second (FEV1, l), Tiffeneau-Pinelli index (%), maximal expiratory flow were used 25 % FVC (MEF 25 %, l/s), maximal expiratory flow 50 % FVC (MEF 50 %, l/s), maximal expiratory flow 75 % FVC (MEF 75 %, l/s), peak expiratory flow (PEF, s).

Statistical data processing was carried out using parametric methods of variational statistics using MS Excel 2007 software. Arithmetic mean (M), standard error of the arithmetic mean (m), Student's reliability criterion (t) were calculated (reliability level $p \leq 0.05$).

Results

Analyzing the data obtained during the study of external breathing parameters at rest and after 15 min after smoking the next cigarette, we noted that most indicators have statistically significant differences (at $p \leq 0.05$) in representatives of all three groups (Table 1).

During the study, it was found that the reactivity (decrease) of external breathing indicators to smoking another cigarette was higher in representatives of the control group who do not smoke (see Table 1).

The analysis of the volumetric indicators of the respiratory system in women showed that they differ significantly in all three studied groups (Figs. 1-2, see Table 1).

In women of group I (smoking experience more than 3 years), the FVC indicator is significantly lower than in non-smokers (group III), both at rest and after 15 minutes after smoking another cigarette ($p < 0.05$). Among representatives

Table 1. Indicators of external breathing of female smokers at rest and those who do not smoke, and their changes during the smoking of the next cigarette ($M \pm m$, $n=60$).

Indicators	Smoking experience >3 y.		Control group	
	rest	reactivity	rest	reactivity
FVC, l	2.403±0.296*	-0.301±0.442	3.26±0.122	-0.710±0.255
VC, l	2.786±0.302*	-0.262±0.405	3.22±0.110	-0.691±0.265
FEV1, l	2.390±0.284*	-0.332±0.410	3.166±0.120	-0.41±0.201
Tiffeneau-Pinelli index, %	83.69±8.73*	12.13±0.21	98.06±0.37	-15.98±0.92
MEF 25%, l/s	5.298±0.367*	0.089±0.465	6.398±0.200*	-1.345±0.299
MEF 50%, l/s	5.001±0.321*	-0.189±0.478	6.599±0.166	-0.903±0.491
MEF 75%, l/s	4.189±0.365*	-0.022±0.399	5.501±0.220*	-1.111±0.512
PEF, s	5.899±0.376*	0.289±0.522	8.154±0.289*	-2.390±0.401

Note: * - the data are significantly different at $p \leq 0.05$.

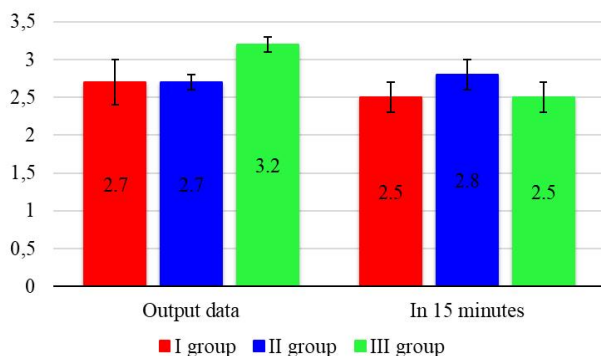


Fig. 1. Comparative analysis of the VC indicator in women of the I, II and III groups and their changes during the smoking of the next cigarette.

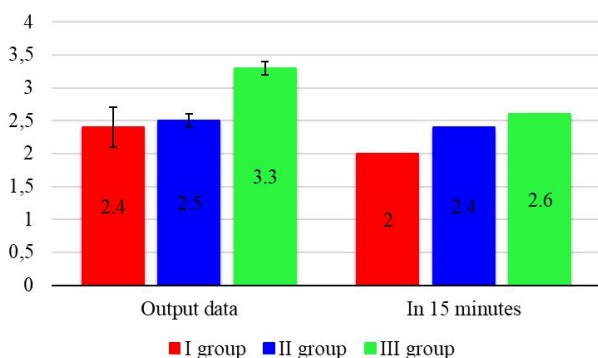


Fig. 2. Comparative analysis of the FVC indicator in women of the I, II and III groups and their changes during the smoking of the next cigarette.

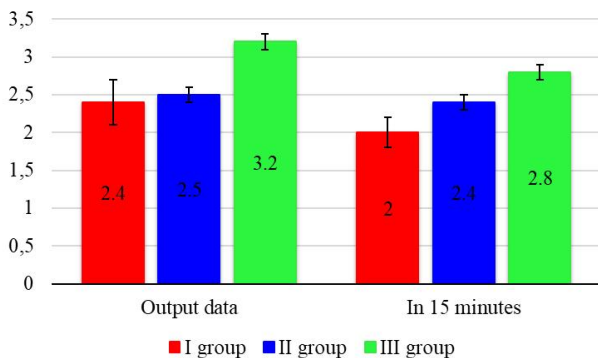


Fig. 3. Comparative analysis of the FEV1 index in women of groups I, II and III and their changes during smoking the next cigarette.

of II (smoking experience from 1 to 3 years) and III groups, significant differences in this indicator were observed only in a state of rest. This indicator decreased in all three groups, but it was significantly lower in the group I. We observe a similar trend when analyzing changes in the VC indicator (see Figs. 1-2).

The FEV1 indicator in female smokers of both groups is lower than in the control group, at $p < 0.05$ in a state of rest (Fig. 3). After smoking the next cigarette, the indicator significantly decreases in all groups, however, significant differences were established only between I (smoking

experience over 3 years) and III groups of women.

The Tiffeneau-Pinelli sample calculation indicators (the ratio of FEV to FVC) make it possible to dynamically assess the efficiency of external breathing of the examinees. In this study, we observed significant differences between the indicators of II (smoking experience from 1 to 3 years) and III groups both at the initial data and after 15 minutes after smoking another cigarette (Fig. 4).

The analysis of the speed indicators of the respiratory system indicates their gradual decrease from the maximum volumetric speed at the level of 25 % to the maximum volumetric speed at the level of 75 % in women of all three groups (Figs. 5-7, see Table 1). Moreover, MEF indicators

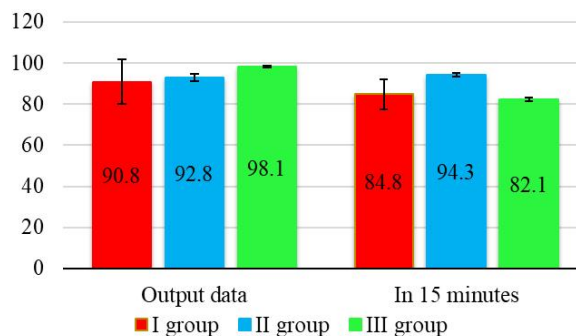


Fig. 4. Comparative analysis of the Tiffeneau-Pinelli test in women of groups I, II and III and their changes during smoking the next cigarette.

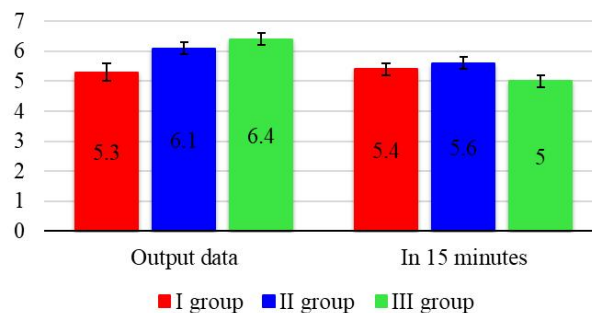


Fig. 5. Comparative analysis of the MEF indicator at the level of 25 % in women of the I, II and III groups and their changes during the smoking of the next cigarette.

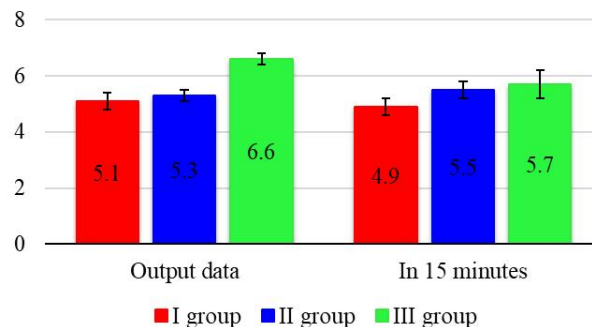


Fig. 6. Comparative analysis of the MEF indicator at the level of 50 % in women of the I, II and III groups and their changes during the smoking of the next cigarette.

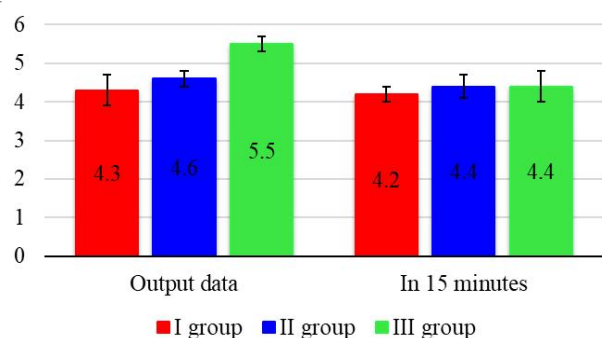


Fig. 7. Comparative analysis of the MEF indicator at the level of 75% in women of groups I, II and III and their changes during smoking the next cigarette.

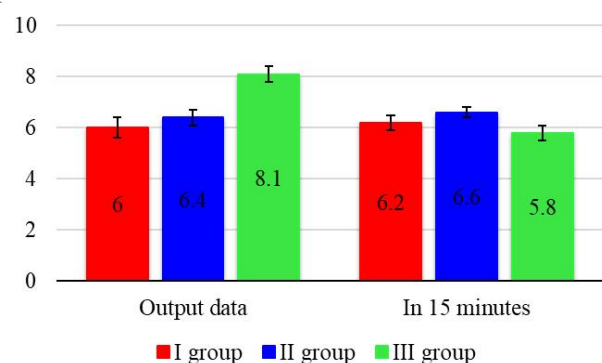


Fig. 8. Comparative analysis of the PEF indicator in women of groups I, II and III and their changes during smoking the next cigarette.

are at the level of 25 %; 50 %; 75 % higher in the control group (at $p < 0.05$), which indicates better pulmonary ventilation.

However, a decrease in the value of the MEF indicator at the level of 25% is observed in the I (smoking experience over 3 years) and II (smoking experience from 1 to 3 years) groups, and in the I group it slightly increases after smoking another cigarette.

During MEF at the level of 75 %, a reliable decrease in the value of this indicator was established after 15 minutes between I (smoking experience over 3 years) and III groups (at $p < 0.05$).

Initial data of PEF in female smokers (I and II groups) are significantly lower, compared to individuals of the control group (Fig. 8, see Table 1).

The value of this indicator is especially low in women who have been smoking for more than 3 years and smoke more than 10 cigarettes per day and have a high level of addiction (Group I - 103 %). After smoking another cigarette in 15 minutes we note a significant decrease in the values of the indicator between I (smoking experience over 3 years) and III groups.

Discussion

An analysis of the indicators of the respiratory system in young women at rest and their changes during the smoking

of the next cigarette was revealed, which indicates that most of the speed and volume indicators have a reliable difference between the comparison groups in representatives of all three groups.

It was investigated that in women who smoke (I and II groups) at rest and 15 minutes after smoking the next cigarette there is a decrease in the Tiffeneau-Pinelli test, as well as volume and speed indicators of external breathing, which indicates a slight violation of bronchial patency, since the smoking experience is 3 - 5 years. Also, smoking causes spasm of blood vessels, to which the body responds by increasing pressure and heart rate, resulting in rapid breathing, shortness of breath, and coughing.

It is worth noting that a large number of scientists who study the impact of smoking on the functional state of a young organism claim that teenagers are sufficiently aware of the harmful effects of smoking on health. As the literature analysis showed, the prevalence of smoking among young people varies from 25 % to 50 % [15]. According to Pasko K. A. et al. [15], up to 92 % of the interviewed teenagers answered that smoking harms health and is the cause of many diseases. The obtained results indicate the presence of moderate tobacco addiction in a significant number of teenagers. One of the reasons for the fact that attempts to quit smoking turned out to be useless or with a temporary effect in 29 % of the interviewed teenagers. Apparently, the main reason for failure is weak motivation and tobacco addiction [4, 6, 15, 16].

A significant number of scientific works are devoted to the study of functional changes in the body of male adolescents and young adults during smoking [5, 7, 17, 22, 25].

It should be noted that there are quite a number of works devoted to the study of the impact of tobacco products on the respiratory system, in particular of men (with accompanying diseases), in which the negative impact of the components of tobacco smoke on the state of individual organs and systems is noted [3, 6, 7, 12, 13, 17-19, 21-25].

However, studies of the impact of tobacco smoking on the functional state of the respiratory system in healthy young women aged 17-21 years with different smoking experience and the manifestation of reactivity in response to smoking another cigarette are relevant and less studied [20]. However, the analysis of literary sources in recent years indicates that, against the background of the reduction in the prevalence of smoking of ordinary cigarettes, electronic cigarettes are becoming more and more popular, in particular, among teenagers and young people, which is a reason for further research into their effects on the body in comparison with ordinary cigarettes [4, 10, 11]. Therefore, further research on this topic, in our opinion, should be directed to the study of the effects of smoking electronic cigarettes or vapes on the respiratory system.

Conclusion

Based on the studies of external breathing at rest (initial data) and after smoking another cigarette, it was

established that female smokers (I and II groups) have a decrease in volume and speed indicators of external breathing, as well as the Tiffeneau-Pinelli test. This indicates a violation of bronchial patency and strength of

respiratory muscles - bronchial obstruction of medium and small bronchi. At the same time, the reactivity (decrease) of external breathing indicators to smoking another cigarette was higher in the representatives of the control group.

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ОСОБЛИВОСТІ ПОКАЗНИКІВ ДИХАЛЬНОЇ СИСТЕМИ В ЖІНОК У СПОКОЇ ТА ЇХ ЗМІНИ ПІД ЧАС ВИПАЛЮВАННЯ ЧЕРГОВОЇ СИГАРЕТИ

Шевчук Т. Я., Апончук Л. С., Пикалюк В. С., Олішкевич О. О.

Однією з важливих проблем, з якими стикається сучасне суспільство, є збільшення кількості людей з різними видами залежності, найпоширенішою з яких є тютюнопаління. Тютюнопаління та його медико-демографічні й економічні наслідки перебувають у колі наукових інтересів багатьох вітчизняних та зарубіжних учених. Саме тому метою наукової статті є дослідження особливостей стану показників дихальної системи в жінок у стані спокою та під час випалювання чергової сигарети. Дослідження проведено в лабораторії медико-біологічного моніторингу та громадського здоров'я на кафедрі фізіології людини і тварин факультету біології та лісового господарства Волинського національного університету імені Лесі Українки на 60 жінках віком 17-21 років. На першому етапі дослідження були виміряні абсолютні антропометричні показники, такі як зріст, маса, окружність грудної клітки. На другому етапі, жінки проходили анкетування за тестом Фагерстрема. За його результатами досліджуваних поділено на 3 групи: I група - жінки, які мають стаж паління понад 3 роки, за добу випалюють понад 10 сигарет і мають високий рівень залежності, II група - жінки, які мають стаж паління 1-3 роки, за добу випалюють до 10 сигарет і мають низький та середній рівень залежності, III група - (контрольна) жінки, які не палять. Наступний етап дослідження передбачав проведення функціональної діагностики системи зовнішнього дихання в жінок у спокої та через 15 хв. після випалювання сигарети з використанням функціонального методу пневмотахографії (ПТГ). Реєстрацію та аналіз відповідних показників здійснювали за допомогою діагностичного автоматизованого комплексу "Кардіо+". Статистична обробка даних проводилася з використанням загальноприйнятих параметричних методів варіаційної статистики (оскільки розподіл отриманих результатів був нормальним) за допомогою програмного забезпечення MS Excel 2007. У даній статті представлено дослідження стану показників зовнішнього дихання в стані спокою та через 15 хв після випалювання чергової сигарети, яке дало змогу виявити негативний вплив тютюнопаління на дихальну систему організму жінок, які палять. Проведене дослідження дало змогу зробити детальний аналіз показників функції зовнішнього дихання, в жінок, віком 17-21 років, що палять та порівняти їх з не курцями. На основі одержаних результатів було встановлено, що у жінок-курців (I та II груп) відбувається достовірне зниження об'ємних (ФЖЄЛ, ЖЄЛ, ОФВ1) показників зовнішнього дихання, а також проби Тіфно при $p < 0,05$, порівняно з групою жінок контрольної групи як у стані спокою, так і через 15 хв. після випалювання чергової сигарети. Аналіз швидкісних (МОШ на рівні видиху 25 %, 50 %, 75 %, ПОШ) показників потоку повітря по бронхах до легень вказує на поступове їх зниження з МОШ 25 % до МОШ 75 % у жінок дослідних груп, але достовірне зниження спостерігається лише на рівні видиху 75 % через 15 хв. після випалювання чергової сигарети між I і III групами (при $p < 0,05$). Досліджено статистично значиму різницю між значеннями розрахункового показника індексу Тіфно, що характеризує наявність обструктивної дихальної недостатності, в жінок II і III груп як у стані спокою, так і через 15 хв після випалювання чергової сигарети. Таким чином, зниження даних показників свідчить про наявність бронхіальної обструкції середніх і дрібних бронхів, а також про порушення сили дихальних м'язів та бронхіальної прохідності. Також доведено, що реактивність (зниження) об'ємних і швидкісних показників зовнішнього дихання на випалювання сигарети була вищою у групи жінок, котрі не палять (контрольна).

Ключові слова: тютюнопаління, жінки-курці, зовнішнє дихання, сигарети, реактивність.

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For publication, scientific articles are accepted only in English only with translation on Ukrainian, which contain the following necessary elements: UDC code; title of the article (in English and Ukrainian); surname, name and patronymic of the authors (in English and Ukrainian); the official name of the organization (institution) (in English and Ukrainian); city, country (in English and Ukrainian); structured annotations (in English and Ukrainian); keywords (in English and Ukrainian); introduction; purpose; materials and methods of research; research results; discussion; conclusions; bibliographic references.

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