

# Effect of smoking on the cardiovascular system of man

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## Abstract

The article presents the state of the cardiovascular system of smokers with different periods of tobacco smoking. From the results of our studies, we can conclude that smoking tobacco in men results in a significant increase in heart rate, systolic blood pressure, a significant reduction in P, PQ and QT times, an insignificant increase in diastolic blood pressure and a decrease in QRS duration.

## Keywords

Heart, Blood pressure, Atrial systole, Time of ventricular excitation

## Imprint

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## Introduction

Today tobacco production is one of the main branches in the economy of more than 20 countries in the world. Moreover, the tobacco industry is a source of high incomes and jobs for the population.

Tobacco plantations cover an area of over 3 million hectares. More than four million tons of raw materials of the cultivated tobacco are harvested every year. The tobacco industry was established in Russia in the second half of the 18th century. Tobacco is not a drug; however, not everyone succeeds in freeing themselves from an addiction thereto. Tobacco does not suppress consciousness and does not cause hallucinations, like drugs; however, it damages the brain in case of prolonged use. According to the WHO data, up to a third of the world's adult population are tobacco-smoking consumers.

The spread of tobacco smoking among the population was recognized as the tobacco epidemic by WHO in 2013 [1].

To our great regret, the leaders in tobacco smoking in the world are China and Russia [2-4].

Smoking, despite its harmfulness, is widespread among young people.

The presence of an external, positive, brightly colored emotional effect, despite the depth of the caused pathological effects of tobacco consumption on the body, is the reason that in Russia up to 25% of adolescents aged 12 and over smoke tobacco [5, 6].

In addition to damage caused by tobacco consumption to the health of the younger generation, this habit inhibits their growth and development [7].

N. Gerasimenko, Academician of the Russian Academy of Medical Sciences, reports that smoking is the cause of the annual death of up to 500 thousand people in Russia. According to his data, the first place in mortality in Russia is occupied by cardiovascular pathologies and cancer, which should be attributed mainly to active or passive consumption of nicotine [8].

The level of radiation received per year by a person who smokes 20 cigarettes a day is equal to 200 X-ray sessions [9].

The main factor to avoid or even prevent the start of smoking is the preference for a healthy lifestyle [10].

The degree of the parental control and participation in life plays an important role in preventing a child or an adolescent from smoking tobacco [11].

Issues related to the prevention and smoking quitting are acute in educational organizations [12].

Students should be made aware of the benefits of a healthy lifestyle [13]. An important place in the prevention of tobacco smoking among young people should be given to such a measure of influence as giving to understand and properly realize the damage caused by tobacco consumption to the organism health [14, 15].

The number of countries participating in the struggle against smoking is increasing every year.

The cardiovascular system is one of the most important parts in the body; therefore, determining its condition in smokers is an essential aspect.

The composition of tobacco leaf contains more than 4000 chemical compounds, and in a smoke aerosol found can be about 5000 chemical agents, among them 60 chemical carcinogens. About 5 million people die each year due to diseases caused by tobacco smoking worldwide.

Therefore, an identification of changes in the functional activity of the body systems in smokers is of great importance.

## Materials and methods

We conducted our research in the physiology laboratory at the Department of Human and Animal Physiology & Anatomy to identify indicators of the cardiovascular system performance in male smokers with different periods of tobacco smoking.

The studies were carried out in 30 clinically healthy men, aged from 40 to 43 years.

The male subjects were divided into six groups of 5 persons each. The reference group consisted of non-smoking men, and the test groups covered male smokers with a smoking period under 5; 10, 15, 20 and over 20 years, respectively.

To determine blood pressure and heart rate, we used a blood pressure and pulse rate meter: digital automatic tonometer OMRON M3 Expert.

The recording of the cardiac activity indicators in the examined male individuals was made using the Alton-03 electrocardiograph.

The collected experimental data were statistically processed using the Biostatistics software.

## Results and discussion

The dependence of the state of the cardiovascular system in men on the duration of tobacco smoking is shown in Table 1 and Figure 1 given herein.

The heart rate is 10.0 ( $P < 0.01$ ), 12.0 ( $P < 0.01$ ), 13.0 ( $P < 0.01$ ) and 13.0 ( $P < 0.01$ ) beats per minute higher in smokers with smoking periods under 10, 15, 20 and over 20 years as against non-smoking men having 69.0 beats per minute.

The systolic blood pressure is 18.0 mm Hg higher in men with tobacco smoking under 10 years ( $P < 0.02$ ); for male smokers with a smoking period under 15 years it is 22.0 higher ( $P < 0.01$ ), for those with the 20 year smoking period it is increased by 22.0 ( $P < 0.01$ ), and the 20-year smokers had an increase in above the parameter by 21.0 ( $P < 0, 01$ ) than in the reference group showing 120.0 mm Hg.

The level of the diastolic blood pressure with an increase in the period of smoking tobacco rises slightly. So, its value in groups with the smoking periods under 15 and 20 years is 10.0 mm Hg higher than in the reference group with 80.0 mm Hg. We should note that other researchers have obtained similar results in their stud-

ies. Smoking tobacco for a long time causes an increase in the heart rate value by 3%, the systolic blood pressure by 9% and the diastolic blood pressure by 2% [16].

V.N. Belinsky and A.K. Herman [17] believe that each cigarette smoked leads to an increase in systolic and diastolic blood pressure. According to I.V. Meshcheryakov [and others], [4], the pulse and pressure become higher after smoking a cigarette.

Obviously, the high level of the indicators of the cardiovascular system performance in smokers is due to an augmented activity of the adrenal glands under the influence of nicotine. Many scientists come to similar conclusions in their studies.

Even a small concentration of nicotine in the body leads to an increase in the release of adrenaline, raised heart rate and blood pressure [18]. The heart rate value in smokers, increasing, reaches 80-90 beats per minute. According to I.I. Belyaev [19], smoking tobacco contributes to the production of hormones by the adrenal medulla that increases the blood pressure by 20-25%.

In this case, there is a rise in the concentration of adrenaline and norepinephrine in blood. Under their influence, according to V.N. Belinsky and A.K. Herman [17], the performance of the heart is enhanced. According to D.M. Aronov [20], the effect of nicotine leads to an enhancement of the activity of the adrenal glands, to a raise in the heart rate, blood pressure and minute blood volume.

According to S.V. Anichkov [21], the enhanced activity of the cardiovascular system is due to an increase in the production of norepinephrine. According to D.M. Aronov [20], the effects of nicotine include an increased production of hormones by the adrenal glands; stimulation of the respiratory center; increased heart rate; hypertension.

The reasons responsible for an increase in the indicators of the cardiovascular system performance in smokers are as follows: enhanced excitation of the sympathetic nervous system; spasm of blood vessels; higher blood viscosity; aggregation of blood cells; deposition of fat on the walls of blood vessels [16].

The heart begins to work in an extremely high mode under the influence of these hormones. Thus, due to smoking, the hormones of the adrenal cortex set the heart to an unbearable beat rate, and in order to cope with the given load, and the heart is forced to use all its capabilities.

The heart driven by a high rhythm in its performance cannot cope with the permanent overload-

Table 1. Dynamics of indicators of the cardiovascular system performance in smokers

Indicators	Non-smokers	Smokers				
		Under 5 years	Under 10 years	Under 15 years	Under 20 years	Over 20 years
Heart rate, beats per minute	69,0±1,00	76,0±2,95	79,0±1,82***	81,0±1,73***	82,0±2,24***	82,0±2,03***
Systolic pressure, mm Hg	120,0±3,30	132,0±3,81	138,0±3,26**	142,0 ±3,26***	142,0±3,67***	141,0±3,62***
Diastolic pressure, mm Hg	80,0±3,23	86,0±2,70	88,0±2,79	90,0 ±2,70	90,0±3,03	88,0±2,70
P, s	0,08±0,005	0,08±0,007	0,07±0,008	0,07±0,007	0,06±0,005°	0,06±0,007
PQ, s	0,15±0,010	0,14±0,010	0,13±0,008	0,13±0,007	0,12±0,007	0,12±0,007
QRS, s	0,08±0,007	0,07±0,007	0,07±0,008	0,07±0,008	0,06±0,007	0,06±0,003°
QT, s	0,37±0,009	0,35±0,011	0,34±0,013	0,33±0,007°°	0,32±0,009°°	0,31±0,008°°°

Note: \*\* – P <0,02; \*\*\* – P <0,01; ° – P > 0,05; °° – P > 0,02; °°° – P > 0,01

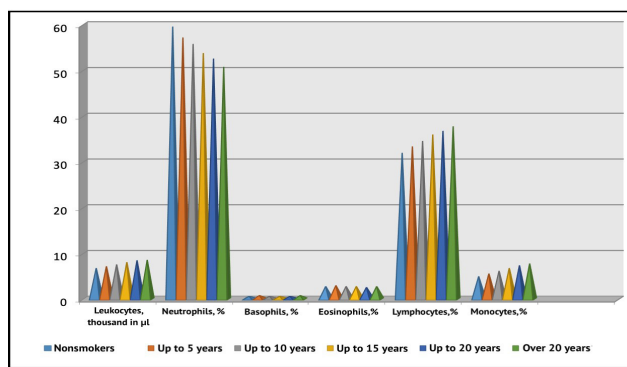


Figure 1. The influence of tobacco smoking on the state of the cardiovascular system in male individuals

ing, and, as a result, the following disturbances in its activity occur: increased arterial blood pressure; angina pectoris; myocardial infarction; various rhythm disorders. The time of atrial systole is 0.02 s (P > 0.05) shorter in men who smoke tobacco under 20 and over 20 years as against 0.08 s found in non-smokers.

In groups of men, who smoke tobacco under 20 and over 20 years, the time of excitation from the atria to the ventricles is 0.03 s shorter as compared with 0.15 s recorded in the reference group individuals. The ventricular excitation coverage in male smokers with a tobacco smoking period over 20 years is reported to be 0.02 s faster (P > 0.05) as against 0.08 s recorded in the non-smokers.

The time of ventricular systole is 0.04 s (P > 0.02), 0.05 (P > 0.02) and 0.06 (P > 0.01) shorter in men under the 15-, 20- and over 20-year smoking period than that in the reference group individuals. There is no data on effects of tobacco smoking produced on the electrocardiogram indicators in male smokers in the available reference literary sources.

## Conclusions

Tobacco smoking is the cause of a significant increase in the heart rate and systolic blood pressure, a significant reduction in the time of atrial systole time, in the excitation and ventricular contraction coverage in male smokers.

The heart rate values, gradually increasing in smokers, reaches their maximum value of 82.0 beats per minute (P <0.01) in groups with the smoking period under 20 and over 20 years.

The values of the maximum blood pressure are 22.0 mm and 21.0 (P <0.01) Hg higher in male smokers with a period of tobacco smoking under 20 and over 20 years (P <0.01) as against those recorded in the non-smokers.

The time of atrial contraction in men who smoke tobacco under 20 years is 0.02 s (P > 0.05) less than in non-smoking male individuals.

A reduction in the QRS and QT times in the group of smokers under the 20 year smoking period is 0.02 s (P > 0.05) and 0.06 (P > 0.01), respectively, as compared with the reference group individuals.

## Statement on ethical issues

Research involving people and/or animals is in full compliance with current national and international ethical standards.

## Conflict of interest

None declared.

## Author contributions

The authors read the ICMJE criteria for authorship and approved the final manuscript.

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