Research article

HYGIENIC ASSESSMENT OF HEALTH RISKS FOR EMPLOYEES OF THE OMSK AMBULANCE SERVICE DUE TO TOBACCO SMOKING

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The results of many studies indicate that there is a cause-effect relationship between active tobacco smoking and risks of various diseases, lung and bronchial cancer (C34) and coronary heart disease (I25) being the most common among them. These diseases are one of the main causes of death in working age.

The aim of this study was to perform hygienic assessment of risks of lung and bronchial cancer and coronary heart disease due to active tobacco smoking. Healthcare workers employed at the Omsk ambulance station were chosen as the research object. Additional risk levels were calculated for lung and bronchial cancer and coronary heart disease in accordance with the methodical guidelines MR 2.1.10.0033-11 Assessment of Risks Associated with Impacts of Lifestyle Factors on Public Health.

Smoking was a health risk factor for 27.5 % of emergency medical services workers, including 42.5 % of men and 21.3 % of women. Sixty-six point seven percent of men aged between 31 and 40 years smoked. Prevalence of smoking among the females in the sample did not depend on age. The risk analysis revealed that smokers, equally men and women ($p > 0.1$) were the most likely to have lung and bronchial cancer and coronary heart disease. The corresponding median levels of additional risk equaled 1.45E-05 and 9.0E-06. The proportion of people with unacceptable levels of additional risks of the analyzed diseases ($> 1.4E-04$) equaled 43.3 and 53.3 % respectively among people older than 40 years. Likelihood of lung and bronchial cancer and coronary heart disease statistically significantly depends on the intensity of smoking.

Keywords: *hygiene, risk, smoking, tobacco, incidence of the population, coronary heart disease, malignant neoplasms, healthcare workers.*

Smoking is the most common form of tobacco use. Carcinogens and substances with pronounced toxic properties have been found in tobacco smoke [1]. Tobacco smoking increases the risk of respiratory infections due to structural changes in the respiratory tract and decreased immune response [2, 3] and is one of the main causes of chronic bronchopulmonary diseases [3–12].

Arterial hypertension and coronary heart disease (CAD) are significantly more frequently registered among smokers [6, 12]. Smoking is one of the main factors determining the prognosis of death from cardiovascular diseases (CVD) in the modern adult population of the Russian Federation (RF) [8]. Tobacco smoking makes a major contribution (more than 90 %) to the risks of CAD development among tobacco and alcohol users [10]. In Australia, 25 % of hospitalizations with acute coronary syndrome among persons under 65 years of age are related to smoking [11]. A direct correlation has been found between smoking intensity and the magnitude of the risk of death due to CAD[1].

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[1] Willett W.C., Green A., Stampfer M.J., Speizer F.E., Colditz G.A., Rosner B., Monson R.R., Stason W., Hennekens C.H. Relative and absolute excess risks of coronary heart disease among women who smoke cigarettes. *N. Engl. J. Med.*, 1987, vol. 317, no. 21, pp. 1303–1309. DOI: 10.1056/NEJM198711193172102

The results of numerous epidemiologic and experimental studies suggest a cause-effect relationship between tobacco use and the risks of malignant neoplasms [3, 5, 9, 13–18]. Tobacco smoking is one of the main etiologic factors in the pathogenesis of lung and bronchial cancer [5, 9, 13–15, 18, 19]. Women, all other things being equal, have a higher risk of developing lung cancer from smoking than men [13, 19], which may be due to interaction between tobacco smoke carcinogens and female sex steroids [13]. Smoking is one of the significant causes of premature death [1, 3, 11, 19, 20]. The tobacco epidemic causes significant economic losses due to treatment of smoking-related diseases as well as premature deaths due to the same cause [1].

Smoking is primarily a male habit[2] [5, 8–10, 21, 23–25, 28, 29, 32]. In 2020, 36.7 % of men and 7.8 % of women living on the planet used tobacco [1]. In 2018, the smokers accounted for 46.4 % among men and 14.6 % among women in the Russian Federation[2]. In 2022, 47 % of men and 21 % of women smoked according to the results of a monitoring survey of the country's population conducted by the All-Russian Center for Public Opinion Research (ARCPOR) [32].

The age factor has a significant impact on prevalence of smoking. This addiction is quite widespread among young people [23, 24, 26, 32]; many of them start smoking at school [24, 29]. In 2022, according to ARCPOR [32], the highest share of smokers, 37 %, was established in the aged group of 25-29 years. With age, the proportion of smokers decreases, regardless of sex [9, 21, 23, 32].

Data on the prevalence of tobacco smoking among healthcare workers are of particular interest as they are a "model" society group in terms of creating a healthy image [7, 25–30]. The level of tobacco use remains high in this occupational group [7, 23, 28, 29]. A significant proportion of smoking doctors take up the habit when getting higher medical education [24]. Very low prevalence of tobacco use has been identified among specialists in obstetrics and gynecology [25].

Predictors of giving up smoking include higher education [5, 7, 9, 21, 23, 29, 32], awareness of the consequences of smoking [7, 22, 25, 27, 29], pregnancy and having diseases that respondents believe are caused by smoking [5, 9, 32], and high prices of tobacco products [26, 32].

In 2008, World Health Organization proposed a package of measures to effectively reduce prevalence of tobacco smoking [31]. In 2013, the Federal Law "On protection of citizens' health from exposure to tobacco smoke, consequences of tobacco use or consumption of nicotine-containing products" was issued[3]. The share of smokers went down by 3.7 % among the adult population of the Russian Federation, including 4.3 % among men, from 2013 to 2018[4]. Among the taken measures, implementation of tax and price policy, social advertising and medical assistance in overcoming this bad habit made the greatest contribution to the reduction of smoking prevalence rates [30]. According to ARCPOR [32] since 2013, the proportion of smoking Russians decreased by 7 % by 2022 and amounted to 33 %. The total share of smokers among 18–24-year-olds decreased from 48 to 29 %.

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[2] Itogi vyborochnogo nablyudeniya povedencheskikh faktorov, vliyayushchikh na sostoyanie zdorov'ya naseleniya v 2013 i 2018 gg. [The results of sampling observation of behavioral factors influencing public health in 2013 and 2018]. *The Federal State Statistics Service*. Available at: https://rosstat.gov.ru/itog_inspect (October 04, 2023) (in Russian).

[3] Ob okhrane zdorov'ya grazhdan ot vozdeistviya okruzhayushchego tabachnogo dyma, posledstvii potrebleniya tabaka ili potrebleniya nikotinsoderzhashchei produktsii: Federal'nyi zakon ot 23 fevralya 2013 g. № 15-FZ [On protection of citizens' health from exposure to tobacco smoke, consequences of tobacco use or consumption of nicotine-containing products: The Federal Law issued on February 23, 2013 No. 15-FZ]. *KonsultantPlus*. Available at: https://www.consultant.ru/document/cons_doc_LAW_142515/ (February 08, 2023) (in Russian).

[4] Itogi vyborochnogo nablyudeniya povedencheskikh faktorov, vliyayushchikh na sostoyanie zdorov'ya naseleniya v 2013 i 2018 gg. [The results of sampling observation of behavioral factors influencing public health in 2013 and 2018]. *The Federal State Statistics Service*. Available at: https://rosstat.gov.ru/itog_inspect (October 04, 2023) (in Russian).

According to the results of a large-scale study in 10 regions of the Russian Federation [30], it was found that from 2013 to 2019 there was a statistically significant decrease in the rate of hospitalization for angina pectoris (by 16.6 %), myocardial infarction (by 3.5 %) and pneumonias (by 14.3 %).

The purpose of the study was to perform hygienic assessment of the risks of lung and bronchial cancer and ischemic heart disease in connection with active tobacco smoking among the employees of the emergency medical service (EMS) of the city of Omsk.

Materials and methods. Health risks for the employees of the emergency medical service in connection with active smoking were assessed in accordance with methodical guidelines MR 2.1.10.0033-11 Assessment of Risks Associated with Impacts of Lifestyle Factors on Public Health[5].

According to the results of a survey of 411 people, the median *(Me)* age was 33 years; the first quartile *(Q_1)* and the third quartile *(Q_3)* were 26 and 55 years, respectively. The analysis was conducted for 3 age groups: up to 30 years inclusive; from 31 years to 40 years inclusive; from 41 years and older. The main results of the survey are summarized in Table 1.

The intensity of smoking among smoking respondents (*n* = 113) was indirectly assessed by the average daily nicotine intake (F^S, mg). After the procedure of removing the so-called "pop-ups", 105 individual F^S values were further developed, which, depending on the position relative to the quartiles Q_1 (1.43 mg) and Q_3 (4.0 mg), were divided into three subgroups of SI: low, medium and high.

At the stage of factor-effect analysis using recurrent equations[5], individual values of additional risk (R_i) of developing diseases were calculated: lung and bronchial cancer (LBCa), oral cavity cancer (OCCa), esophageal cancer (ECa), gastric cancer, pancreatic cancer (PCa), bladder cancer (BCa), cervical cancer (CCa), coronary heart disease (CAD), and chronic bronchitis (CHB).

Individual values of additional risk of diseases caused by active smoking were qualitatively assessed in accordance with the criteria specified in Clause 8.6. MR 2.1.10.0033–11[5].

The Mann – Whitney (*U*), Kruskel – Wallis (*H*) and λ-test proposed by A.N. Kolmogorov and N.V. Smirnov were calculated to assess the statistical significance of the differences between the independent groups. A *p* value of no more than 0.05 was taken as the critical level of statistical significance.

T a b l e 1

EMS employees' attitudes towards smoking: survey results

Age, years	Total			Men			Women			*p*
	n	smokers		*n*	smokers		*n*	smokers		
		n	%		*n*	%		*n*	%	
Younger than 30	180	41	22.8	49	14	28.6	131	27	20.6	> 0.1
31–40	101	39	38.6	36	24	66.7	65	15	23.1	< 0.001
41 and older	130	33	25.4	35	13	37.1	95	20	21.1	< 0.05
Total	411	113	27.5	120	51	42.5	291	62	21.3	< 0.001

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[5] MR 2.1.10.0033-11. Otsenka riska, svyazannogo s vozdeistviem faktorov obraza zhizni na zdorov'e naseleniya: Metodicheskie rekomendatsii, utv. Rukovoditelem Federal'noi sluzhby po nadzoru v sfere zashchity prav potrebitelei i blagopoluchiya cheloveka, Glavnym gosudarstvennym sanitarnym vrachom Rossiiskoi Federatsii G.G. Onishchenko 31 iyulya 2011 g. [Assessment of Risks Associated with Impacts of Lifestyle Factors on Public Health: Methodical guidelines, approved by G.G. Onishchenko, the Head of the Federal Service for Surveillance over Consumer Rights Protection and Human Well-being, the RF Chief Sanitary Inspector on July 31, 2011]. *KODEKS: electronic fund for legal and reference documentation.* Available at: https://docs.cntd.ru/document/1200111974/titles (February 08, 2023) (in Russian).

Results and discussion. As shown in Table 1, smoking is a health risk factor for 27.5 % of EMS employees, including 42.5 % of men and 21.3 % of women ($p < 0.01$). Among men aged between 31 and 40 years, 66.7 % smoked, which is significantly higher than among men in the "younger" and "older" age subgroups (28.6 %); $p < 0.001$) and over 40 years of age (37.1 %; $p < 0.01$). Prevalence of smoking among women was not significantly associated with age ($p > 0.1$).

The proportion of smokers among doctors and paramedical workers was 28.3 % and 28 %, respectively ($p > 0.1$). In the group of doctors, 35.5 % of men and 20.7 % of women smoked ($p > 0.1$). In the paramedical group, 45.5 % of men smoked, while only 21.6 % of women smoked ($p < 0.01$).

The intensity of smoking among men and women (Table 2) was almost the same ($U = 1066$; $p > 0.1$). The age factor did not have a statistically significant effect on the SI of smoking EMS employees either ($H = 3.1$; $p > 0.1$), although there is a slight downward trend in median SI values from the "junior" to the "senior" subgroup, both in general and among men and women.

According to Table 3, the distribution of F^S values among men is shifted towards high smoking intensity (29.5 %) due to a decrease in the proportion of persons with relatively low and medium SI to 25.0 % and 45.5 %, respectively. The female part of the sample is dominated by employees with low and medium SI. In general, however, the sex difference in the distribution of individual SI values in the analyzed sample is insignificant ($\lambda = 0.93$; $p > 0.1$).

According to the data given in Table 4, smoking employees of the EMS are most likely to develop LBCa and CAD. The median additional risk values for these diseases were 1.4E-05 and 9.1E-06, respectively. Likelihood of other diseases associated with smoking was significantly lower: from 9.9E-07 (pancreatic cancer) to 2.6E-06 (chronic bronchitis).

T a b l e 2

Distribution of smoking employees by smoking intensity depending on age and sex (F^S, mg/day)

| Age, years | All smokers | | | Including | | | | | | | | p |
| | | | | men | | | | women | | | | |
	n	Me	Q_1	Q_3	n	Me	Q_1	Q_3	n	Me	Q_1	Q_3	p
Younger than 30	38	3.22	1.43	4.00	11	3.60	1.71	5.57	27	3.14	1.27	3.80	> 0.1
31–40	37	2.29	1.14	4.69	22	2.29	1.14	4.77	15	2.40	1.57	3.94	> 0.1
41 and older	30	1.26	1.14	3.14	11	1.59	1.23	5.20	19	1.20	1.14	2.80	> 0.1
p		> 0.1				> 0.1				> 0.1			
Total	105	2.29	1.14	4.00	44	2.29	1.27	5.3	61	2.23	1.14	3.77	> 0.1

T a b l e 3

Distribution of smoking employees of the EMS depending on the intensity of smoking and sex

| SI | F^S, mg/day | | All smokers | | including: | | | | p |
| | | | | | men | | women | | |
	$min – max$	Me	n	$\%$	n	$\%$	n	$\%$	
low	0.29–1.14	0.97	31	29.5	11	25.0	20	32.8	> 0.1
average	1.2–4.69	2.6	54	51.4	20	45.5	34	55.7	
high	4.8–10.13	7.54	20	19.0	13	29.5	7	11.5	
total	0.29–10.13	2.29	105	100	44	100	61	100	> 0.1

T a b l e   4

Indicators of individual additional risk of certain diseases in the group of smoking employees of the Omsk Secondary Health Care Department, in relative units

Indicator	LBCa	CAS	SCa	OCCa	ECa	CCa	BCa	PCa	CHB
n	105	105	105	105	105	61	105	105	105
Me	1.4E-05	9.0E-06	1.4E-06	2.0E-06	1.9E-06	2.3E-06	2.4E-06	9.9E-07	2.6E-06
Q_1	6.2E-06	3.3E-06	6.0E-07	8.6E-07	9.0E-07	7.8E-07	1.1E-06	4.4E-07	1.3E-06
Q_3	3.9E-05	3.9E-05	3.9E-06	5.1E-06	4.6E-06	1.1E-05	6.8E-06	2.4E-06	5.8E-06

Given that the recurrence equations used in the calculation of the additional risk associated with smoking are of the same type and differ only in the value of the empirical coefficients reflecting likelihood of a particular disease, as well as the above-mentioned literature data, we considered it possible to limit ourselves analyzing the dependence between LBC and CAD risks in smoking employees of the EMS and such factors as sex, age, and smoking intensity. The main results are presented in tables 5 and 6.

All individual values of R_{LBCa} in smoking EMS employees ranged from 3.20E-07 to 1.09 E-03 (n = 105; Me = 1.4E-05). Sex had no statistically significant effect on the risk of CAD (U = 1122.5; p > 0.1), although the median values of R_{LBCa} among men overall (1.6E-05) were slightly higher than those of their female smokers (1.2E-05).

Of the analyzed factors, age had the greatest influence on LBC likelihood in smokers: overall (H = 64.5; p < 0.01); among men (H = 20; p < 0.01) and women (H = 39.5; p < 0.01). In the "younger" age subgroup, there were no individuals with unacceptable R values of LBC (> 1.0E-04), while in the "older" subgroup, the proportion of individuals with such risk levels was 43.3 % (45.5 % and 42.1 %, respectively, among men and women). Sex differences between R_{LBCa} values turned out to be statistically insignificant in all compared age subgroups (p > 0.1).

T a b l e   5

Some results of analyzing LBC and CAD risks in smoking employees of the EMS depending on age and sex

Age, years	All smokers			Including:						p
				men			women			
	Me	People with R_i > 1.0E-04		Me	People with R_i > 1.0E-04		Me	People with R_i > 1.0E-04		
		n	%		n	%		n	%	
Lung and bronchus cancer										
Younger than 30	5.8E-06	0	0.0	7.5E-06	0	0.0	4.2E-06	0	0.0	>0.1
31–40	1.9E-05	1	2.7	1.7E-05	0	0.0	2.1E-05	1	6.7	>0.1
41 and older	7.5E-05	13	43.3	4.2E-05	5	45.5	7.5E-05	8	42.1	>0.1
p	<0.01			<0.01			<0.01			
total	1.4E-05	14	13.3	1.6E-05	5	11.4	1.2E-05	9	14.8	>0.1
Coronary heart disease										
Younger than 30	2,8E-06	0	0.0	3.3E-06	0	0.0	1.8E-06	0	0.0	>0.1
31–40	1,3E-05	1	2.7	1.2E-05	0	0.0	1.4E-05	1	6.7	>0.1
41 and older	1,5E-04	16	53.3	6.4E-05	5	45.5	1.6E-04	11	57.9	>0.1
p	<0,01			<0.01			<0.01			
total	9,0E-06	17	16.2	1.2E-05	5	11.4	7.1E-06	12	19.7	>0.1

Table 6

Some results of analyzing LBC and CAD risks in smoking employees of the EMS depending on smoking intensity and sex

SI	All smokers			including:						p
				men			women			
	Me	People with $R_i > 1.0E\text{-}04$		Me	People with $R_i > 1.0E\text{-}04$		Me	People with $R_i > 1.0E\text{-}04$		
		n	%		n	%		n	%	
Lung and bronchus cancer										
low	9.4E-06	2	6.5	9.4E-06	0	0.0	5.9E-06	2	10.0	>0.1
medium	1.3E-05	6	11.1	1.7E-05	2	10.0	1.1E-05	4	11.8	>0.1
high	3.7E-05	6	30.0	4.1E-05	3	23.1	3.4E-05	3	42.9	>0.1
p	<0.01			<0.01			<0.05			
total	1.4E-05	14	13.3	1.6E-05	5	11.4	1.2E-05	9	14.8	>0.1
Coronary heart disease										
low	7.4E-06	5	16.1	7.4E-06	0	0.0	5.3E-06	5	25.0	>0.1
medium	7.7E-06	6	11.1	1.2E-05	2	10.0	6.6E-06	4	11.8	>0.1
high	2.6E-05	6	30.0	3.0E-05	3	23.1	2.0E-05	3	42.9	>0.1
p	<0.05			>0.1			>0.1			
total	9.0E-06	17	16.2	1.2E-05	5	11.4	7.1E-06	12	19.7	>0.1

CAD risks in smoking employees of the EMS ($n = 105$; $Me = 9.0E\text{-}06$) ranged from 1.1E-07 to 3.7E-03. Men had slightly higher risks ($Me = 1.2E\text{-}05$) than their female counterparts ($Me = 7.1E\text{-}06$) but the differences were not significant ($U = 1103.5$; $p > 0.1$).

The "Age" factor had a considerable statistically significant effect on CAD likelihood in smoking employees of the EMS: in general ($H = 75.9$; $p < 0.01$); men ($H = 28.0$; $p < 0.01$); women ($H = 24.6$; $p < 0.01$). In the "younger" age subgroup, there were no individuals with unacceptable R_{CAD} values, while in the "middle" and "senior" subgroups, the proportion of individuals with such risk levels was 2.7 % and 53.3 %, respectively. Sex differences between values of R_{CAD} the compared age subgroups were insignificant ($p > 0.1$).

Smoking intensity had a statistically significant effect ($H = 15.2$; $p < 0.01$) on likelihood of lung and bronchial cancer in smoking EMS: median R_{LBCa} values consistently increased as smoking intensity increased, from 9.4E-06 in the subgroup of employees with relatively low individual F^S values to 1.3E-05 and 3.7E-05 in the subgroups with medium IR and high IR. In the subgroup of employees with high IR, the proportion of individuals with unacceptable R_{LBCa} values was 30 %, which was significantly higher than in the subgroup of employees with relatively low SI (6.5 %; $p < 0.001$) and medium SI (11.1 %; $p < 0.05$).

Likelihood of coronary heart disease in smoking employees showed a slightly lower, but still statistically significant direct correlation with SI ($H = 7.8$; $p < 0.05$); median R_{CAD} values were almost equal in the subgroups with relatively low and average SI (7.4E-06 and 7.7E-06, respectively), and the median was 2.6E-05 only in the subgroup of employees with high SI. The proportion of individuals with unacceptable R_{CAD} values was almost equal in all subgroups with different SI ($p > 0.1$).

Conclusion. Smoking is a health risk factor for 27.5 % of emergency medical service personnel, including 42.5 % of men and 21.3 % of women. Smokers accounted for 66.7 % among men aged between 31 and 40 years. Prevalence of smoking did not de-

pend on age in the female part of the sample. The proportion of smokers among physicians and paramedics was 28.3 % and 28 %, respectively ($p > 0.1$). Smoking intensity of the respondents did not show statistically significant dependence on sex and age factors. Based on the results of risk analysis, it was found that smokers were most likely to develop lung and bronchial cancer and ischemic heart disease. The proportion of people with unacceptable levels of additional risks of the analyzed diseases ($> 1.4E-04$) equaled 43.3 % and 53.3 % respectively among people older than 40 years. Likelihood of lung and bronchial cancer and coronary heart disease was statistically significantly related to smoking intensity.

Competing interests. The authors declare no competing interests.

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