ORIGINAL ARTICLE

RISK FACTORS ASSOCIATED WITH CANCER PATHOLOGY

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Arkadii H. Shulhai[1], Nataliia O. Terenda[1], Larysa Ya. Fedoniuk[1], Yurii M. Petrashyk[1], Nataliia Ya. Panchyshyn[1], Lesia M. Sas[1], Viktoriia V. Piliponova[2]

[1]I. HORBACHEVSKY TERNOPIL NATIONAL MEDICAL UNIVERSITY, TERNOPIL, UKRAINE

[2]NATIONAL PIROGOV MEMORIAL MEDICAL UNIVERSITY, VINNYTSIA, UKRAINE

ABSTRACT

The aim of the study is comparative assessment of the main risks of the global burden of cancer in the total burden of death.

Materials and methods: A comparative assessment of the main risks of the global burden of cancer within the overall burden of deaths was carried out based on the data of the Global Burden of Disease Study (GBD), data from the Center for Medical Statistics of the Ministry of Health of Ukraine, the National Cancer Registry of Ukraine. The methods of comparative analysis, systematic approach and system analysis, bibliosemantic and medical-statistical methods were used.

Results: Higher attributable risk of death in most nosological forms of cancer among the population of Ukraine (bronchial, tracheal and lung cancer, laryngeal, pharyngeal, lip and esophageal cancer) have been observed. Behavioral factors at the level of Ukraine, compared to the world level, are characterized by significantly higher rates of attributable risk with regard to tobacco smoking (cancer of the larynx, pharynx, lower lip, esophagus) and alcohol consumption (pharynx, liver, lower lip). Environmental and occupational factors in Ukraine do not exceed the global exposure rates, and are lower for some cancer nosologies, namely bronchial, tracheal, lung and laryngeal cancer. Unlike global trends, metabolic factors prevail among the mortality risks of patients with liver, esophageal, uterine and kidney cancer in Ukraine.

Conclusions: Behavioral, occupational, environmental and metabolic risk factors for cancer mortality have high attributable risk. Behavioral risk factors for cancer mortality have the most pronounced impact both globally and in Ukraine, and notably, for the majority of nosological forms of cancer in Ukraine mortality risks are higher compared to the global data.

KEY WORDS: behavioral risk factors, occupational risk factors, environmental risk factors, metabolic risk factors, cancer pathology

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INTRODUCTION

In Ukraine, as well as globally, cancer pathology ranks second among the causes of death of the adult population [1, 2]. The burden of cancer remains an important public health issue. Risk factors, whose impact on the development of cancer pathology can be modified, have a major effect on life expectancy adjusted for cancer-related disability [3]. Currently, a major impact on the development of cancer is attributed to modifiable risk factors, which constitute the majority among all factors associated with the development of this disease [4]. Moreover, the latter should be taken into account when developing a strategy to reduce premature mortality from non-communicable diseases, including malignant tumors. In order to effectively overcome the growing risk factors for cancer both in Ukraine and globally, comprehensive efforts are needed, which would include both therapeutic and preventive measures to reduce the combined effect of these factors on the development of tumors. Despite the fact that there are types of malignant tumors that are difficult to prevent, it is important to minimize the impact of risk factors on the development of cancer pathology. It should also be noted that primary prevention of cancer development is the most cost-effective and efficient strategy, which should be combined with broad comprehensive measures to reduce the impact of factors on the development of cancer, including developed secondary prevention strategies, screening programs and ensuring effective capacity for diagnosis and treatment of cancer patients. Thanks to existing studies of the global burden of disease and risk factors, it is possible to quantify the burden of cancer associated with modifiable risk factors and compare national and global rates using both mortality and disability-adjusted life years [5 - 8]. The study of global burden of disease, injury, and risk factors (GBD) is the only study to date that quantifies the burden of cancer associated with a broad set of modifiable risk factors for all countries, across age groups, and by sex [2]. GBD 2019, the latest iteration of the GBD study, provides an estimate of the global burden of cancer attributable to risk factors [9, 10]. The International Agency for Research on Cancer Observatory provides estimates of global, regional, and national risk-attributable

cancer burden for a subset of potentially modifiable risk factors (e.g., obesity, alcohol consumption, infections, and ultraviolet radiation), but these estimates are not provided together in a comprehensive way over time, and some potentially modifiable risk factors are not assessed as part of this effort. Studies of the global burden of cancer have identified a list of behavioral, metabolic, environmental and occupational factors associated with both mortality and disability-adjusted life years, providing new insights into the burden of cancer. Globally, a significant share of cancer deaths and years of healthy life lost due to cancer is attributable to modifiable risk factors, with behavioral factors accounting for the largest burden.

The concept of Global Burden of Disease Study (GBD), which is a global program for estimating disability and mortality from major diseases, injuries and risk factors, has been introduced since 1990 to provide information on the state of health of the population and to develop basic health strategies for disease prevention.

THE AIM

The aim of the present study was to carry out a comparative assessment of the main risks of the global burden of cancer within the overall burden of death.

MATERIALS AND METHODS

A comparative assessment of the main risks of the global burden of cancer within the overall burden of deaths was carried out based on the data of the Global Burden of Disease Study (GBD), which is a global program for assessing disability and mortality from major diseases, injuries and risk factors, data from the Center for Medical Statistics of the Ministry of Health of Ukraine, the National Cancer Registry of Ukraine. At the same time, the data on the burden of disease in Ukraine and in the world based on gender and localization of malignant neoplasm were taken into account, attributive risk factors for the development of oncological pathology were studied.

In addition, methods of comparative analysis, systematic approach and system analysis, as well as biblio-semantic and medical-statistical methods were used.

RESULTS

According to the data of the Center for Medical Statistics of the Ministry of Health of Ukraine, in 2019, from among the entire population of Ukraine, 77,481 people died from malignant tumors, which is 198.2 per 100 thousand people.

Studies of the global burden of disease have identified forms of malignant tumors globally that account for more than one percent of the total number of deaths. In particular, according to GBD 2019 data, the most common causes of death for men were: tracheal, bronchial and lung cancer, colon and rectal cancer, stomach, prostate, esophageal and liver cancer. Moreover, at the global level, mortality from the above forms of cancer – except for colon and rectal cancer mortality—exceeds mortality rates in Ukraine (Figure 1). According to the National Cancer Registry of Ukraine, within the structure of malignant tumor mortality in men in Ukraine, the following are shares of the main nosological forms of malignant tumors: tracheal, bronchial and lung cancer – 16.5%, prostate cancer – 12.9%, colon and rectum cancer – 7.7%, stomach cancer – 7.4%, bladder cancer – 6.9%.

The highest female mortality both globally and in Ukraine is the mortality from breast cancer (Figure 2). The next largest causes of female mortality globally are tracheal, bronchial and lung cancer, colon and rectal cancer, stomach cancer and cervical cancer.

In Ukraine, the share of cancers other than colon, rectal and stomach cancer within the structure of cancer mortality is much lower. In the structure of cancer mortality among the female population of Ukraine, the share of deaths from breast cancer is 23.8%, uterine cancer – 11.1%, colon cancer – 7.5%, cervical cancer – 6.3%, ovarian cancer – 5.8%.

Cancer GBD studies have identified mortality risk factors, which are generally split into three groups: environmental and occupational, behavioral, and metabolic. These risk factors are associated with 44.4% of deaths globally among all cancer deaths. In 2019, the total number of years of healthy life lost due to cancer-related premature death and disabling illness associated with these risk factors was 105 million for both sexes combined, accounting for 42.0% of all cancer-related healthy life lost. GBD estimates that men had 67.5 million (60.8-75.1) cancer-related healthy life years lost due to risk factors, or 48.0% (45.3-51.5), and women had 37.6 million (32.8-43.1), or 34.3% (30.9-38.7).

Behavioral risks are considered to be the leading risk factors associated with cancer deaths (Table I). In particular, behavioral factors in Ukraine were 7.2% more associated with bronchial, tracheal and lung cancer, 14.1% – laryngeal cancer, 22.9% – pharyngeal cancer, 11.9% – lip cancer, 19.5% – esophageal cancer.

Among the behavioral factors most strongly associated with cancer mortality and characterized by significantly higher rates of attributable risk in Ukraine compared to global data, tobacco smoking and alcohol consumption should be highlighted.

Thus, compared to the global data, smoking in Ukraine is 8.5% more associated with lung cancer, 8.3% – esophageal cancer, 13.5% – laryngeal cancer, 20.4% – pharyn-

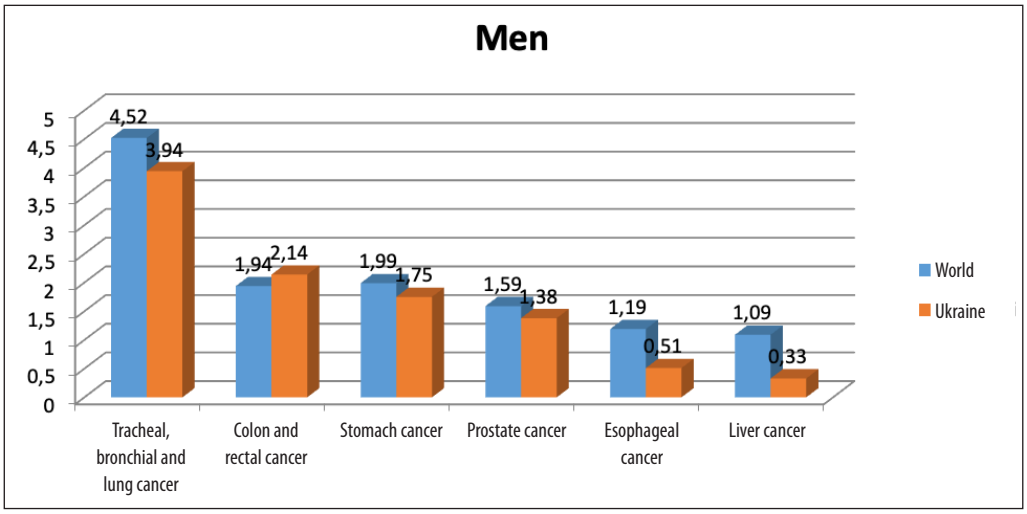

Fig. 1. Share of male mortality from certain types of cancer in the total number of deaths.

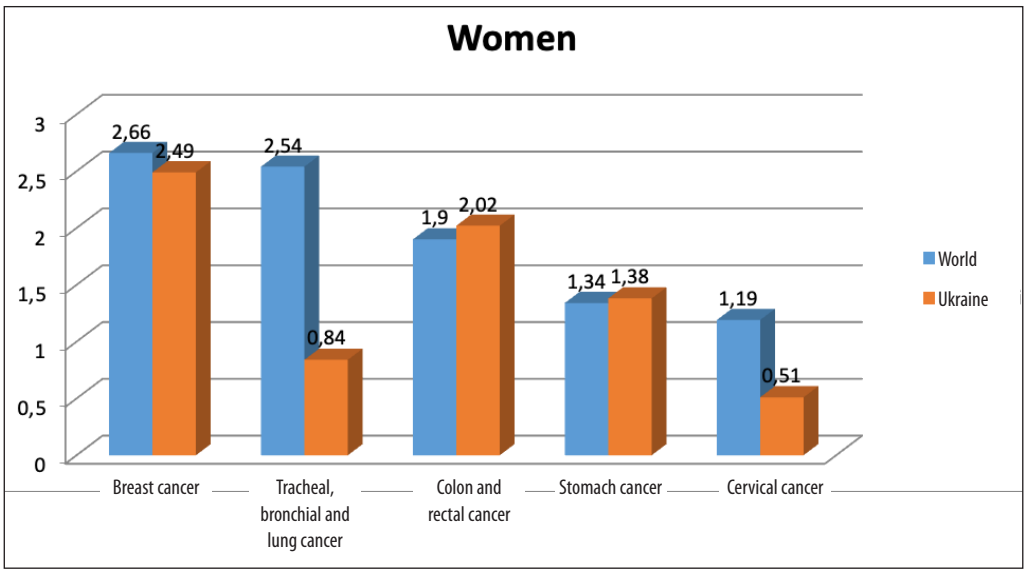

Fig. 2. Share of female mortality from certain types of cancer in the total number of deaths.

geal cancer, 18.0% – cancer of the lower lip (Figure 3).

An important factor associated with the mortality of people with cancer is alcohol consumption. Like tobacco smoking, alcohol consumption also is more strongly associated with mortality of people suffering from various nosological forms of cancer (Figure 4).

he second large group of factors associated with mortality from malignant tumors are environmental and occupational risk factors. Such environmental factors include: contaminated water, poor sanitary conditions, air pollution, environmental pollution, abnormal temperatures, toxic effects of lead. Among occupational risks GBD researchers consider occupational carcinogens, industrial emissions of solid particles, gases and vapors, occupational noise, occupational ergonomic factors.

The data of comparative analysis of the attributable risk of environmental and occupational factors in cancer mortality are presented in Table II.

Overweight, high serum glucose, low-density lipoprotein, high blood pressure, low bone mineral density belongs to metabolic factors, i.e., the third group, and are known risk factors for various chronic diseases and mortality. In most cases, all types of metabolic disorders are combined with each other and their development is based on an increase in the amount of abdominal fat, overweight or obesity. In recent decades, the prevalence of overweight and obesity has been increasing globally, raising concerns about their impact on health. Data of GBD studies on the impact of metabolic factors is presented in Table III.

In general, compared to the global data, metabolic factors in Ukraine are higher among the mortality risks of patients with liver cancer by 6.8%, esophageal cancer – 12.6%, uterine cancer – 15.1%, kidney cancer – 5.6%.

DISCUSSION

The study has observed a significant impact of behavioral factors on the development of cancer pathology. Moreover, in the population of Ukraine, behavioral factors are characterized by higher rates of attributable risk of death

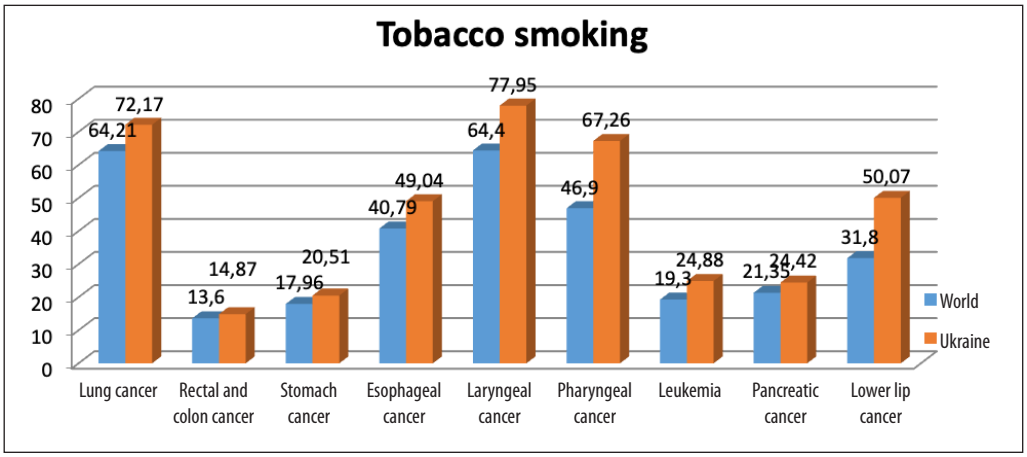

Fig. 3. Indicators of tobacco smoking attributable risk in mortality from certain types of cancer

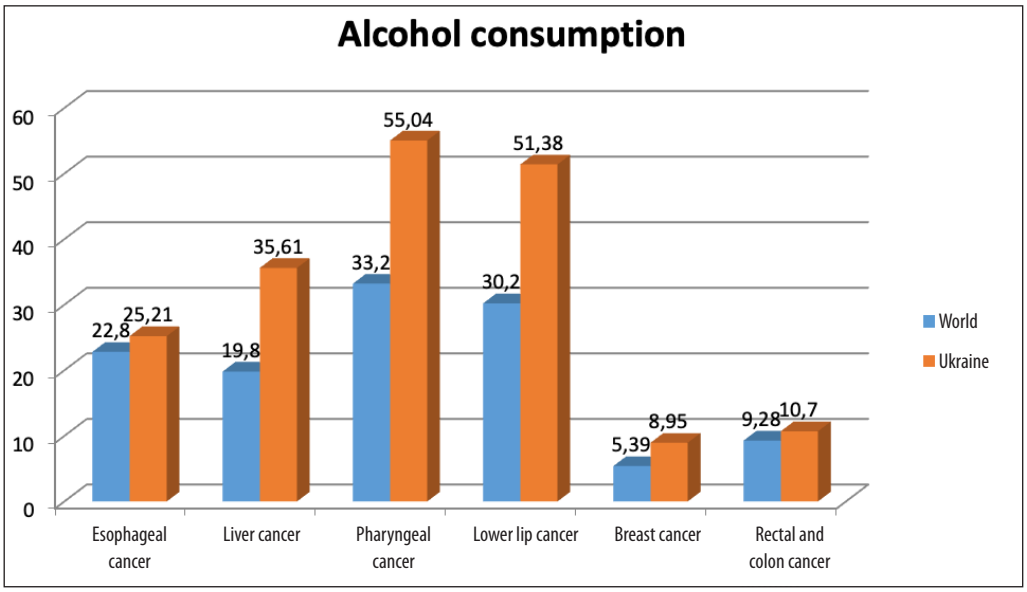

Fig. 4. Indicators of alcohol consumption attributable risk in mortality from certain types of cancer

in most nosological forms of cancer (namely, bronchial, tracheal and lung cancer, laryngeal, pharyngeal, lip and esophageal cancer).

Tobacco smoking has a significant impact on the development of oncological pathology. Thus, recent studies confirm the negative impact of tobacco smoking on public health and indicate an increased risk of developing not only lung cancer but also other cancers in smokers [11]. The age of patients who started smoking, the number of cigarettes and the duration of smoking are important [12]. Reducing smoking may reduce the risk of lung cancer, but the risk remains high [13]. Even when lung cancer is detected, smoking cessation improves the course of the disease, but not all patients want to give up this bad habit. Older people, people diagnosed with smoking-related cancer, people with higher education, and obese people are more likely to quit, while people living below the poverty level are less likely to quit [14].

Combined use of alcohol and tobacco increases the risk of colorectal and prostate cancer. A U-shaped multiplicative association was observed for breast cancer when both alcohol and tobacco were consumed together [15].

Compared to the global data, tobacco smoking in Ukraine is more associated with the risk of lung, esophageal, laryngeal, pharyngeal, and lower lip cancer. The association between alcohol consumption and mortality from liver, pharyngeal and lower lip cancer is especially pronounced in Ukraine.

The numerical data of the indicators show that environmental and occupational factors in Ukraine do not exceed the impact indicators at the global level, and for some nosologies – namely, bronchial, tracheal, lung and laryngeal cancer – cancer pathologies are estimated to be lower.

To date, researchers have confirmed the association between body mass index and the risk of developing adenocarcinoma of the esophagus, colon, rectum, kidney, pancreas, and gallbladder, as well as postmenopausal breast, ovarian and endometrial cancer. GBD researchers attribute about 4% of cancer deaths to high body mass index. Researchers point to strong evidence that being overweight is associated with an increased risk of cancer of at least 13 anatomical areas, including endometrial, esophageal, renal and pancreatic adenocarcinomas; hepatocellular carcinoma; gastric cardia cancer; meningioma; multiple myeloma;

Table I. Data on attributable risk of behavioral factors in cancer mortality

Cancer localization	Impact data at the global level, % (95% CI)	Impact data in Ukraine, % (95% CI)
Bronchial, tracheal and lung cancer	67.82 (65.53-69.95)	75.01 (71.98-77.76)
Laryngeal cancer	69.19 (62.98-74.52)	83.38 (78.67-88.89)
Pharyngeal cancer	61.87 (56.18-66.84)	84.57 (80.05-88.36)
Lip cancer	62.19 (57.50-66.51)	74.09 (68.21-79.06)
Rectal and colon cancer	50.41 (43.64-56.38)	47.52 (39.83-54.48)
Stomach cancer	24.24 (15.68-43.09)	24.51 (17.41-40.63)
Liver cancer	45.81 (39.74-51.30)	69.94 (65.75-73.89)
Esophageal cancer	61.09 (55.37-66.87)	71.43 (64.82-77.28)
Bladder cancer	33.89 (25.88-41.74)	40.79 (31.32-50.02)

Table II. Data of attributable risk of environmental/occupational factors in cancer mortality

Cancer localization	Impact data at the global level, % (95% CI)	Impact data in Ukraine, % (95% CI)
Bronchial, tracheal and lung cancer	33.91 (28.42-39.13)	23.79 (16.59-33.62)
Laryngeal cancer	6.19 (3.92-9.17)	3.75 (1.90-6.05)
Mesothelioma	91.68 (89.70-93.41)	92.45 (87.60-96.43)
Ovarian cancer	3.32 (1.52-5.40)	3.79 (1.18-8.63)

Table III. Data on metabolic factors attributable risk in cancer mortality

Cancer localization	Impact data at the global level, % (95% CI)	Impact data in Ukraine, % (95% CI)
Bronchial, tracheal and lung cancer	8.77 (2.03-19.06)	5.20 (0.99-12.25)
Rectal and colon cancer	16.13 (7.99-26.59)	16.37 (9.35-24.61)
Breast cancer	13.13 (5.91-22.89)	12.15 (5.09-20.69)
Liver cancer	13.47 (5.83-24.62)	20.34 (9.52-34.03)
Esophageal cancer	18.07 (5.78-35.19)	30.66 (8.83-53.82)
Cancer of the pancreas	14.54 (6.40-25.76)	13.25 (6.10-22.4)
Uterine cancer	39.81 (27.64-52.67)	54.87 (40.12-67.92)
Kidney cancer	19.05 (11.09-28.30)	24.77 (15.38-35.36)

colorectal, postmenopausal breast, ovarian, gallbladder and thyroid cancer [16].

It remains evident that at the moment this problem mainly concerns high-income regions, for example, 64% of all cancer cases globally associated with excessive body mass index were observed in North America and Europe. In Ukraine, metabolic factors prevail among the mortality risks in patients with liver, esophageal, uterine and kidney cancer.

CONCLUSIONS

Thus, behavioral, occupational, environmental and metabolic risk factors for cancer mortality have high attributable risk. Behavioral risk factors for cancer mortality have the most pronounced impact both globally and in Ukraine, and notably, for the majority of nosological forms of cancer in Ukraine mortality risks are higher compared to the global data.

REFERENCES

1. Rak v Ukrayini, 2020-2021. Zakhvoryuvanist', smertnist', pokaznyky diyal'nosti [Cancer in Ukraine, 2020-2021. Morbidity, mortality, performance indicators]. Bulletin of the National Chancery Register of Ukraine 2022; 23. Kyiv URL: http://www.ncru.inf.ua/publications/BULL_23/index.htm (UA)
2. Global Burden of Disease (GBD). URL: https://vizhub.healthdata.org/gbd-compare/
3. Kocarnik JM, Compton K, Dean FE et al. Cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life years for 29 cancer groups from 2010 to 2019: a systematic analysis for the Global Burden of Disease Study. 2019. JAMA Oncol. 2022; 8: 420-444.
4. Hecht SS Cigarette smoking and lung cancer: chemical mechanisms and approaches to prevention. Lancet Oncol. 2002; 3: 461-469.
5. Evans J, van Donkelaar A, Martin RV et al. Estimates of global mortality attributable to particulate air pollution using satellite imagery. Environ Res. 2013; 120: 33-42.

6. Bianchini F, Kaaks R, Vainio H Overweight, obesity, and cancer risk. Lancet Oncol. 2002; 3: 565-574.
7. Pukkala E, Martinsen JI, Lynge E et al. Occupation and cancer—follow-up of 15 million people in five Nordic countries. Acta Oncol. 2009; 48: 646-790.
8. Takala J Eliminating occupational cancer. Ind Health. 2015; 53: 307-309.
9. Islami F, Goding Sauer A, Miller KD et al. Proportion and number of cancer cases and deaths attributable to potentially modifiable risk factors in the United States. CA Cancer J Clin. 2018; 68: 31-54.
10. Poirier AE, Ruan Y, Volesky KD et al. The current and future burden of cancer attributable to modifiable risk factors in Canada: summary of results. Prev Med. 2019; 122: 140-147.
11. Sugawara Y, Tsuji I, Mizoue T et al. Cigarette smoking and cervical cancer risk: an evaluation based on a systematic review and meta-analysis among Japanese women. Japanese journal of clinical oncology. 2019;49(1);77-86.
12. Pierce JP, Shi Y, McMenamin SB et al. Trends in Lung Cancer and Cigarette Smoking: California Compared to the Rest of the United States. Cancer Prev. Res. (Phila). 2019;12(1);3–12.
13. Chang JT, Anic GM, Rostron BL et al. Cigarette smoking reduction and health risks: a systematic review and meta-analysis. Nicotine and Tobacco Research. 2021;23(4);635-642.
14. Talluri R, Domgue JF, Gritz ER, Shete S Assessment of trends in cigarette smoking cessation after cancer diagnosis among US adults, 2000 to 2017. JAMA network open. 2020;3(8);e2012164-e2012164.
15. Viner B, Barberio AM, Haig TR, et al. The individual and combined effects of alcohol consumption and cigarette smoking on site-specific cancer risk in a prospective cohort of 26,607 adults: results from Alberta's Tomorrow Project. Cancer Causes & Control. 2019;30(12);1313-1326.
16. Avgerinos KI, Spyrou N, Mantzoros CS, Dalamaga M Obesity and cancer risk: Emerging biological mechanisms and perspectives. Metabolism. 2019;92;121-135.

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ORCID and contributionship:
Arkadii H. Shulhai: 0000-0002-2145-5851 [B, C, F]
Nataliia O. Terenda: 0000-0001-5655-4326 [B, C, D]
Larysa Ya. Fedoniuk: 0000-0003-4910-6888 [A, C, E, F]
Yurii M. Petrashyk: 0000-0003-1286-110X [B, D, F]
Nataliia Ya. Panchyshyn: 0000-0001-5786-3083 [A, E, F]
Lesia M. Sas: 0000-0002-5718-2912 [C]
Viktoriia V. Piliponova: 0000-0002-5465-5809 [F]

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CORRESPONDING AUTHOR

Larysa Ya. Fedoniuk
Medical Biology Department
I. Horbachevsky Ternopil National Medical University
Valova street, 9, Ternopil, 46000, Ukraine
tel: +380673999143
e-mail: Fedonyuk22Larisa@gmail.com

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