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Lung cancer incidence and mortality trends in the Republic of Belarus (1990–2019)

Relevance: Lung cancer is one of the most frequent and unfavorable malignant diseases globally. The Republic of Belarus ranks third (8.2%) in cancer incidence and first (21.5%) in cancer mortality.

The object of the study was the lung cancer incidence and mortality trends in the Republic of Kazakhstan in 1990-2019.

Results: In the study period, the standardized incidence rate decreased from 27.5 to 25.6 per 100 000 population (- 7.1%, $p < 0.01$). In males, it decreased from 62.1 to 54.6 per 100 000 males (- 12.1%, $p < 0.001$); in females, it increased from 5.3 to 6.4 per 100 000 females (+20.7%, $p < 0.05$).

The standardized lung cancer mortality rate has decreased over the study period from 23.0 to 18.3 per 100 000 population (- 20.4%, $p < 0.001$). In males, it went down from 53.6 to 40.7 (- 24.1%, $p < 0.001$), and in women it changed slightly from 3.6 to 3.7 (+ 2.8%, $p > 0.05$) per 100 000 of the relevant sex. The average annual increase in standardized mortality decreased eight times faster than the growth in standardized incidence.

Conclusion: In the Republic of Belarus, lung cancer incidence is increasing in males and decreasing in females. At that, lung cancer mortality is decreasing. Quality specialized cancer care creates conditions for quicker negative growth of lung cancer standardized mortality vs. incidence.

Keywords: lung cancer, crude intensity rates, standardized rates.

Introduction:

Lung cancer (LC) is one of the most common and adverse malignant diseases. In 2020, GLOBOCAN reports 2,206,771 LC cases worldwide and 1,796,144 deaths from LC. LC ranks second (11.4%) after breast cancer (11.7%) in the global cancer incidence structure. LC ranks first in the mortality structure accounting for 18% of all cancer deaths. In males, LC is the leading cause of death from malignancies. In women, it ranks third after breast cancer and colorectal cancer (when colorectal cancer and cancer of the colon are considered together). In 2020, the standardized incidence and mortality rates (World) for LC amounted to 22.4 and 18.0 per 100,000 population [1].

LC incidence and mortality are significantly higher in developed countries compared to countries with a lower sociodemographic index [2]. These differences will fade with the growing tobacco consumption in less developed countries, as smoking is the primary etiologic factor responsible for LC development [3]. More than 80% of LC cases and deaths from LC in the USA are associated with tobacco smoking [4].

Males develop LC twice more often than females, although this ratio varies widely from country to country – from 1.2 in North America to 5.6 in North Africa [5].

In the most developed countries (USA, UK), LC incidence has declined in males since the mid-1990s and increased in females [6]. This has been attributed to an earlier onset of peak tobacco use in men and a subsequent decline in the proportion of smokers as tobacco control programs have spread [7]. The tobacco epidemic gen-

der characteristics lead to a convergence in LC incidence. Moreover, in the USA, LC incidence in young females has exceeded that in young males [8]. Females may be more susceptible to tobacco smoke due to reduced DNA repair capacity and thus more prone to develop LC [9].

National cancer registries play a critical role in assessing the current status of medical cancer care in the countries. Belarus Cancer Registry contains personalized data on cancer incidence, mortality, and survival since 1990. Annually published collections contain data on current incidence and mortality from malignancies compared to previous years [10].

The object of the study was the lung cancer incidence and mortality trends in the Republic of Kazakhstan in 1990-2019.

Material and Methods: The study included all Belarusian patients diagnosed with LC (ICD-10: C33-C34) and registered at the national cancer registry between 1990 and 2019.

The Cancer Registry contains demographic data, stage of disease, histological type of tumor, treatment modalities, and countrywide survival data. Demographic variables included sex, age, and residence locality (urban or rural).

The number of LC cases is presented in absolute values and crude intensive rates per 100,000 population. Standardized incidence and mortality rates were calculated using the World standard and reported per 100,000 population [10].

MS Excel 2016 was used for a graphical display of calculated rates.

Results: According to the Belarusian Cancer Registry, 4,438 cases of LC were registered in 2019. Therefore, LC ranked third (8.2%) in the cancer incidence structure. In males, 3,742 LC cases were registered. In the mortality structure, LC ranked first, accounting for 21.5%. Standardized LC incidence and mortality (World rates)

amounted to 25.6 and 18.3 per 100,000 population of both sexes; 54.6 and 40.7 in males and 6.4 and 3.7 in females per 100,000 population of the respective sex.

Between 1990 and 2019, the absolute number of newly diagnosed cases of LC in the male and female populations increased (Figure 1).

Figure 1 – Trends in the absolute number of diagnosed LC cases in Belarus, 1990-2019

From 1990 to 1996, there was an increase in diseased males from 3,315 to 4,121 (24.3%). Subsequently, the number of cases decreased to 3,674 by 2002. Up to 2013, the annual absolute values ranged from 5.1% to -3.6%, with a further increase to 3,742 in 2019. In women, there was a slow but steady increase in the number of cases from 3,799 to 4,498 (+18.4%).

The dynamics of LC incidence in urban and rural areas had opposite tendencies. In urban areas, there was a steady increase in cases from 2,047 to 3,054 (49.2%). In rural areas, the incidence over the entire period decreased by -21.1%. That could be due to the increasing migration of the rural population to urban areas.

The number of deaths from 1990 to 2002 paralleled the number of cases (Figure 2).

Figure 2 – Trends in the absolute number of LC cases and deaths in Belarus, 1990-2019

By 2013, the number of cases and deaths diverged up to a 3.2-fold increase in the difference between cases and deaths (from 483 to 1,526).

Crude intensive incidence increased from 37.3 in 1990 to 46.9 in 2019 (+25.7%, $p < 0.001$). Before 1996, the increase

in incidence was more significant (+21.2%), followed by a slight negative tendency before 2002 and an increase in incidence after 2002, starting at 41.6 (Figure 3).

In males, LC incidence increased from 69.4 to 86.5 per 100,000 male population till 1996 (+ 24.6%), then there

was a downward trend up to 79.5 in 2002, followed by a slow increase in incidence up to 84.8 in 2019.

In females, the incidence remained relatively stable from 1990 to 2002 and started increasing from 8.2 in 2003 to 13.8 in 2019 (+68.3%, $p < 0.001$).

Rural and urban incidence rates were about the same. Still, there is a higher incidence in rural areas (68.2 vs. 41.1 in 2019, $p < 0.001$), mainly due to the migration of young people to urban areas and the aging of the rural population (Figure 4).

Figure 3 – Trends in LC crude intensive incidence (per 100 000) in Belarus, 1990-2019

Figure 4 – Trends in LC crude intensive incidence (per 100,000) among the urban and rural population of Belarus, 1990-2019

Figure 5 shows the crude LC mortality dynamics.

From 1990 to 1997, total mortality showed an increasing tendency – 31.5 to 39.4 (+25.1%, $p < 0.001$), less marked in males – 59.8 to 75.3 (+25.9%, $p < 0.001$). Further up to 2013, the mortality was decreasing. Total mortality decreased from 39.4 to 29.5 (-25.1%, $p < 0.001$), male mortality – from 75.3 to 56.0 (-25.6%, $p < 0.001$). Since 2013, the crude total mortality increased from 29.5 to 34.1 (+15.6%, $p < 0.001$), male mortality – from 56.0 to 63.4 (+13.2%, $p < 0.01$).

In women, the mortality from LC was relatively stable from 1990 to 2013 but increased since 2014 – from 6.6 to 8.4 in 2019 (+27.3%, $p < 0.01$), providing a higher increase in the crude intensive rate of total mortality than males.

The trends in crude intensive mortality among urban and rural populations were similar to those in men and women (Figure 6).

Since 2013, crude mortality from LC among the rural population increased from 39.8 to 51.8 in 2019 (+30.1%, $p < 0.001$), with an increased rate of 16.4% ($p < 0.001$) over the entire period. The crude urban mortality increased from 26.3 in 2013 to 29.2 in 2019 (+11.0%, $p < 0.001$). For the entire period since 1990, the mortality rate increased by 17.3% ($p < 0.001$). In 2019, the crude mortality among the rural population was 1.7 times ($p < 0.001$) higher than among the urban population.

Figure 5 – Trends in crude intensive mortality (per 100,000) from LC in Belarus, 1990-2019

Figure 6 – Trends in crude intensive mortality (per 100,000) from LC among urban and rural populations of Belarus, 1990-2019

The standardized total incidence (both sexes) (Figure 7) slightly increased (by 14.5%) in 1990-1996, then decreased till 2019 (by 18.7%). The overall increase over the period was 6.9%, $p < 0.01$

Figure 7 – Standardised lung cancer incidence rates (per 100,000) in Belarus, 1990-2019

The general tendency of changing from an upward to a downward trend in incidence was more evident among men, where the standardized incidence increased from 62.1 to 71.4 (+15.0%, $p < 0.001$) in 1990-1996, then decreased to 54.6 (-23.5%, $p < 0.001$) by 2019. Over the entire period of 1990 to 2019, the standardized incidence rate in men decreased by 12.1% ($p < 0.001$).

In women, from 1990 to 2002, the standardized incidence was decreasing by 4.3-5.3 a year per 100,000 (a

total decrease by -18.9%, $p < 0.05$). However, since 2003, the incidence has steadily increased to reach 6.4 per 100,000 ($p < 0.001$). In total, the standardized incidence increased from 5.3 to 6.4 (+20.7% ($p < 0.05$)). Thus, since 2003 we have observed a convergence of LC incidence trends in men and women.

The LC incidence picture in rural areas looks unfavorable (Figure 8).

Figure 8 – Trends in LC standardized incidence (per 100,000) among urban and rural populations of Belarus, 1990-2019

Standardized incidence among the rural population has been steadily increasing – from 26.4 to 32.1 (+21.6%, $p < 0.001$) over the whole period. Thus, in addition to the demographic aging of the rural population, other factors also influence the LC incidence. The incidence among the urban pop-

ulation has decreased from 29.5 to 23.7 (-19.7%, $p < 0.001$).

Standardized mortality from LC has increased from 23.0 to 26.5 (+15.2%) during 1990-1997. Since 1998, the mortality rate has been steadily decreasing to stabilize at 18.3 ($p < 0.001$) over the last four years (Figure 9).

Figure 9 – Trends in standardized mortality (per 100,000) from LC in Belarus, 1990-2019

Standardized mortality in both sexes has decreased by 20.4% ($p < 0.001$) over the whole period. In men, it increased by 14.2% (from 53.6 to 61.0, $p < 0.001$) from 1990 to 1997 and decreased to 40.7 (-33.3%, $p < 0.001$) from 1998 to 2019. The decrease over the entire period was 24.1% ($p < 0.001$). In women, standardized mortality has slightly

increased from 3.6 per 100,000 female population in 1990 to 3.7 in 2019 (+2.8%, $p > 0.05$).

In rural areas (Figure 10), standardized mortality did not change significantly statistically over the whole period (22.6 vs. 23.8, $p > 0.05$), while urban mortality decreased from 24.3 to 16.6 (-31.7%, $p < 0.001$).

Figure 10 – Trends in standardized mortality (per 100,000) from LC in urban and rural populations of Belarus, 1990-2019

Discussion: Epidemiological data on LC incidence in the Republic of Belarus from 1990 to 2019 evidence the demographic aging of the population, accompanied by an increase in the absolute number of LC cases and the crude intensive incidence rates. This effect was stronger manifested in women: over 30 years, the number of diseased has increased by 45.4%, the crude incidence rate added 53.3%, and the standardized index rate grew by 20.8%.

Since 2003, the trends in LC incidence in men and women diverged: by 2019, the standardized incidence has decreased by 13.4% in men and increased by 26.4% in women.

The crude intensity LC incidence in rural areas is 1.6 times higher than in urban areas. The higher incidence rate in rural areas is due to the demographic aging of the population. At that, the standardized incidence among the rural population is still 1.3 times higher than among the urban population. This indicates the presence of additional etiological factors of LC development in rural areas, which have to be studied.

The quality of medical care for cancer patients is reflected in the mortality from LC. The annual number of LC deaths in the country has increased from 3,205 to 3,224 (+0.6%), while the annual number of cases has grown by 16.8% over the same period. The average yearly increase in crude intensive mortality was 3.1 times lower than the increase in crude intensive incidence. The average annual growth of standardized mortality rate decreased eight times faster than the growth in standardized incidence. This indicates a high quality of specialized medical care provided to cancer patients suffering from LC. At the same time, in rural areas, crude and standardized mortality remains higher than in urban areas, and the average annual increase in standardized mortality is positive (+0.2%).

Conclusions:

1. The LC incidence in the Republic of Belarus is decreasing in men and increasing in women.
2. The mortality from LC is decreasing.
3. A faster negative increase in standardized mortality compared to LC incidence is due to high-quality specialized cancer care.

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References:

1. Sung H., Ferlay J., Siegel R.L., Laversanne M., Soerjomataram I., Jemal A., Bray F. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries // *CA Cancer J. Clin.* – 2021. – T. 71, N 3. – P. 209-249. <https://doi.org/10.3322/caac.21660>;
2. Global Burden of Disease Cancer Collaboration. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study // *JAMA Oncology.* – 2017. – Vol. 3. – P. 524–548. <https://doi.org/10.1001/jamaoncol.2016.5688>;
3. WHO global report on trends in the prevalence of tobacco use 2000-2025, 3rd ed. – WHO, 2019. – 121 p. <https://escholarship.org/uc/item/0z43b5dv>;
4. Islami F., Goding Sauer A., Miller K.D., Siegel R.L., Fedewa S.A., Jacobs E.J., McCullough M.L., Patel A.V., Ma J., Soerjomataram I., Flanders W.D., Brawley O.W., Gapstur S.M., Jemal A. Proportion and number of cancer cases and deaths attributable to potentially modifiable risk factors in the United States // *CA Cancer J. Clin.* – 2018. – Vol. 68. – P. 31–54. <https://doi.org/10.3322/caac.21440>;
5. Cheng T.-Y.D., Cramb S.M., Baade P.D., Youlten D.R., Nwogoy C., Reid M.E. The international epidemiology of lung cancer: latest trends, disparities, and tumour characteristics // *J. Thor. Oncol.* – 2016. – Vol. 11, N 10. – P. 1653–1671. <https://doi.org/10.1016/j.jtho.2016.05.021>;
6. Jemal A., Center M.M., DeSantis C., Ward E.M. Global patterns of cancer incidence and mortality rates and trends // *Cancer Epidemiol. Biomarkers Prev.* – 2010. – Vol. 19, N 8. – P. 1893–1907. <https://doi.org/10.1158/1055-9965.EPI-10-0437>;
7. Jemal A., Miller K. D., Ma J., Siegel R.L., Fedewa S.A., Islami F., Devesa S.S., Thun M.J. Higher lung cancer incidence in young women than young men in the United States // *N. Engl. J. Med.* – 2018. – Vol. 378. – P. 1999–2009. <https://doi.org/10.1056/NEJMoa1715907>;

8. Kiyohara C., Ohno Y. Sex differences in lung cancer susceptibility: a review // *Gend. Med.* – 2010. – Vol. 7, N 5. – P. 381-401. <https://doi.org/10.1016/j.genm.2010.10.002>;

9. Travis W., Brambilla E., Noguchi M., Nicholson A.G., Geisinger K.R., Yatabe Y., Beer D.G., Powell C.A., Riley G.J., Van Schill P.E., Garg K., Austin J.H.M., Asamura H., Rusch V.W., Hirsch F.R., Scagliotti G., Mitsudomi T., Huber R.M., Ishikawa Y., Jett J., Sanchez-Cespedes M., Sculier J.-P., Takahashi T., Tsuboi M., Vansteenkiste J., Wistuba I., Yang P.-C., Aberle D., Brambilla C., Flieder D., Franklin W., Gazdar A., Gould M., Hazleton P., Henderson D., Johnson B., Johnson D., Kerr K., Kuriyama K., Lee J.S., Miller V.A., Petersen I., Roggli V., Rosell R., Saijo N., Thunnissen E., Tsao M., Yankelewitz D. International Association for the Study of Lung Cancer/ American Thoracic Society/European Respiratory Society international

multidisciplinary classification of lung adenocarcinoma // *J. Thorac. Oncol.* – 2011. – Vol. 6, N 2. – P. 244-285. <https://doi.org/10.1097/JTO.0b013e318206a221>;

10. Okeanov A.E., Moiseev P.I., Levin L.F. Rak v Belarusi: cifry i fakty. Analiz dannyh Belorusskogo kancer-registra za 2010-2019 gg. / A.E. Okeanov (i dr.) pod red. S.L. Polyakova. – Minsk: RNPС OMR im. N.N. Aleksandrova, 2020. – 298 s. [Okeanov A.E., Moiseev P.I., Levin L.F. Cancer in Belarus: facts and figures. Analysis of data from the Belarusian Cancer Registry for 2010-2019 / A.E. Okeanov (and others), ed. S.L. Polyakov. – Minsk: N. N. Alexandrov National Cancer Centre of Belarus, 2020. – 298 p. (in Russian)]. <https://omr.by/news/news-main/novyy-vypusk-rak-v-belarusi-tsifry-i-fakty-analiz-dannykh-belorusskogo-kantser-registra-za-2010-2019-gg>.

ТҰЖЫРЫМ

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Беларусь Республикасында өкпе обырымен сықаттанушылық пен өлім динамикасы (1990-2019 жж.)

Өзектілігі: өкпе обыры – әлемдегі ең көп таралған және қолайсыз қатерлі ісіктердің бірі. Беларусь Республикасында өкпе обыры қатерлі ісіктермен сықаттанушылық құрылымында 3-орынды (8,2%) және олардан болатын өлім құрылымында бірінші орынды (21,5%) алады.

Зерттеудің мақсаты – 1990 жылдан 2019 жылға дейінгі кезеңде Беларусь Республикасында өкпе обырынан сықаттанушылық пен өлім-жітімнің динамикасын зерттеу болды.

Әдістері: Қазіргі зерттеуге 1990 жылдан 2019 жылға дейін өкпе қатерлі ісігі диагнозымен ұлттық канцер-регистрде тіркелген барлық Беларусь тұрғындары кірді (ICD-10 коды: C33-C34). Демографиялық айнымалыларға жынысы, жасы және тұрғылықты жері (қалалық немесе ауылдық) кірді. Өкпе қатерлі ісігінің саны 100 000 адамға шаққанда абсолютті мәндер және өрескел қарқынды көрсеткіштер түрінде ұсынылған. Сықаттанушылық пен өлім-жітімнің стандартталған көрсеткіштері әлемдік стандартты (World) қолдана отырып есептелген және 100 000 тұрғынға көрсетілген.

Нәтижелері: зерттелетін кезеңде популяция аурушаңдығының стандартталған көрсеткішінің мәні 100 000 тұрғынға шаққанда 27,5-тен 25,6-ға дейін төмендеді (өсім – 7,1%, $p < 0,01$). Ерлер арасындағы көрсеткіш мәні 100 000 еркек халыққа шаққанда 62,1-ден 54,6-ға дейін төмендеді (өсу қарқыны – 12,1%, $p < 0,001$), ал әйелдер арасында 100 000 әйелге халыққа шаққанда 5,3-тен 6,4-ке дейін өсті (өсу қарқыны – 20,7%, $p < 0,05$).

Өкпе обырынан популяция өлімінің стандартталған көрсеткіші барлық кезеңде 100 000 тұрғынға шаққанда 23,0-ден 18,3-ке дейін төмендеді (өсу қарқыны – 20,4%, $p < 0,001$). Ерлерде өлім көрсеткіші тиісті жыныстағы 100 000 тұрғынға шаққанда 53,6-дан 40,7-ге дейін (өсу қарқыны – 24,1%, $p < 0,001$) төмендеді, ал әйелдерде 3,6-дан 3,7-ге дейін (өсу қарқыны – 2,8%, $p > 0,05$) аздап өзгерді. Стандартталған өлім-жітім көрсеткіші мәнінің орташа жылдық өсу қарқыны стандартталған сықаттанушылық көрсеткіші мәнінің өсу қарқынынан 8 есе тез төмендеді.

Қорытынды: Беларусь Республикасында өкпе обырымен сықаттанушылық ер адамдар арасында төмендеп, әйелдер арасында қарқынды өсіп келеді. Өкпе обырынан болатын өлім-жітім көрсеткіші төмендеу үрдісімен сипатталады. Сапалы мамандандырылған онкологиялық көмек өкпе обырымен сықаттанушылық көрсеткішімен алыстырғанда өлім-жітімнің стандартталған көрсеткішінің теріс өсу қарқынының неғұрлым жылдам қарқынын негіздейді.

Түйінді сөздер: өкпенің қатерлі ісігі, өрескел қарқынды көрсеткіштер, стандартталған көрсеткіштер.

АННОТАЦИЯ

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Динамика заболеваемости и смертности при раке легкого в Республике Беларусь (1990-2019 гг.)

Актуальность: Рак легкого (РЛ) – одно из наиболее распространенных и неблагоприятно протекающих злокачественных новообразований в мире. В Республике Беларусь РЛ занимает 3-е место (8,2%) в структуре заболеваемости злокачественными новообразованиями и первое место (21,5%) в структуре смертности от них.

Целью исследования явилось изучение динамики заболеваемости и смертности от рака легкого в Республике Беларусь за период с 1990 по 2019 гг.

Методы: В настоящее исследование были включены все пациенты – жители Беларуси, зарегистрированные в национальном канцер-регистре с 1990 по 2019 гг. с диагнозом РЛ (код ICD-10: C33-C34). Демографические переменные включали пол, возраст и место проживания (городская или сельская). Количество случаев РЛ представлено в виде абсолютных значений и грубых интенсивных показателей на 100 000 населения. Стандартизованные показатели заболеваемости и смертности рассчитаны с применением мирового стандарта (World) и указаны на 100 000 населения.

Результаты: За исследуемый период значение стандартизованного показателя заболеваемости популяции снизилось с 27,5 до 25,6 на 100 000 населения (прирост – 7,1%, $p < 0,01$). У мужчин значение показателя снизилось с 62,1 до 54,6 на 100 000 мужского населения (темпы прироста – 12,1%, $p < 0,001$), а у женщин – увеличилось с 5,3 до 6,4 на 100 000 женского населения (темпы прироста 20,7%, $p < 0,05$).

Стандартизованный показатель смертности популяции от РЛ за весь период снизился с 23,0 до 18,3 на 100 000 населения (темпы прироста – 20,4%, $p < 0,001$). У мужчин показатель смертности снизился с 53,6 до 40,7 (темпы прироста – 24,1%, $p < 0,001$), а у женщин незначительно изменился с 3,6 до 3,7 (темпы прироста 2,8%, $p > 0,05$) на 100 000 населения соответствующего пола. Среднегодовой темпы прироста значения стандартизованного показателя смертности снижались в 8 раз быстрее темпы прироста значения стандартизованного показателя заболеваемости.

Заключение: Заболеваемость РЛ в Республике Беларусь снижается у мужчин и растет у женщин. Смертность от РЛ характеризуется нисходящим трендом. Качественная специализированная онкологическая помощь обуславливает более быстрый темп отрицательного пророста стандартизованного показателя смертности по сравнению с показателем заболеваемости РЛ.

Ключевые слова: рак легкого, грубые интенсивные показатели, стандартизованные показатели.

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